3 New Zealand domestic context

3.1 New Zealand's emissions profile and the economy

Summary

This section:

- describes the composition of New Zealand's emissions and compares this with other countries' profiles
- explores the growth in New Zealand's emissions since 1990
- given the growing role of carbon dioxide in New Zealand's emission profile, explores the link between energy and economic growth
- considers the relationship between economic growth and emissions, comparing New Zealand's experience with that of other key Annex I countries.

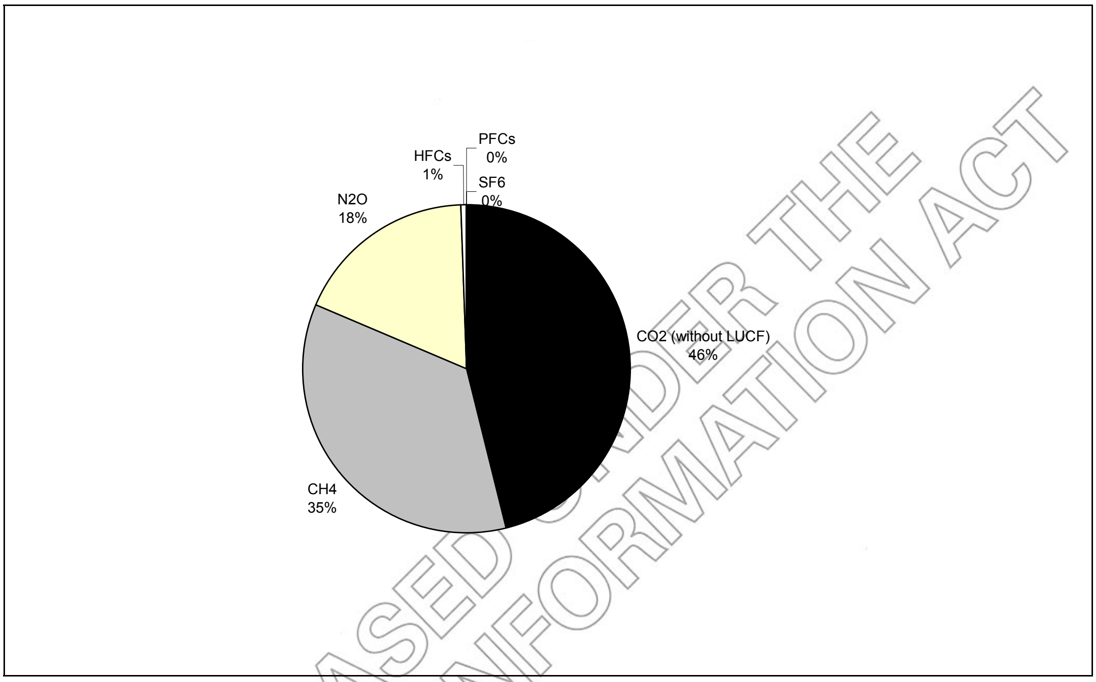
It concludes that:

- New Zealand's relatively high proportion of methane and nitrous oxide and low share of carbon dioxide is unique by international standards, reflecting the importance of our pastoral-land activities and the relatively large contribution of renewable energy sources to our electricity generation
- emissions growth since 1990 has been strongest for CO_2 emissions, which increased by 2.5% per annum, largely driven by road-transport emissions
- strong growth in methane emissions from dairy cattle was partly offset by reductions in other sources of enteric fermentation and in methane emissions from waste
- energy use is closely related to the level of economic activity
- a country's scope for decoupling emissions and GDP growth depend on the nature of its comparative economic advantages, the contribution of technology and the impact of external events (such as outbreaks of bovine foot and mouth disease)
- these avenues for decoupling are not necessarily applicable to the New Zealand context.

3.1.1 New Zealand's unique emissions profile

In 2003, the most recent year for which full data is available, New Zealand's total greenhouse gas emissions were 75,345 Gg CO_2e. This measurement is not used outside of this section, so it is anomalous. Usually tonnes and Mt are used Figure 15 shows the composition of emissions by gas. In 2003, carbon dioxide (CO_2) comprised 46.0% of New Zealand's gross emissions, methane (CH_4) 35.4% and nitrous oxide (N_2O) 17.9%. Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) accounted for some 0.5% of gross emissions.

Figure 15 - New Zealand's Greenhouse Gas Emissions by Gas 2003



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

Table 1 compares New Zealand's profile with that of other selected countries, highlighting its uniqueness among Annex I countries. New Zealand's profile is more closely aligned with that of Argentina, a Non-Annex I country. For the majority of Annex I countries, CO_2 accounts for more than 75% of gross emissions, with methane and nitrous oxide playing a correspondingly less important role. Among Annex I countries, Ireland most closely matches New Zealand, but CO_2 emissions still account for nearly 67% of its total emissions.

Table 1 - Emissions Profiles for Selected Countries 2002

Country	CO_2	CH_4	N_2O
	% of Total Gross Emissions		
Argentina	46.8	31.6	21.7
Australia	68.6	23.8	6.8
Canada	79.0	12.9	7.3
European Union	82.0	8.5	7.9
Finland	84.8	6.2	8.3
Germany	85.4	8.2	5.5
Ireland	66.6	18.6	14.2
Japan	94.1	1.5	2.7
New Zealand	**46.0**	**34.5**	**17.9**
Russian Federation	80.4	15.5	1.9
United Kingdom	84.9	7.0	6.5
United States	83.6	8.6	6.0

Sources: UNFCCC Greenhouse Inventory Database (see <www.wri.org>) and New Zealand's Greenhouse Gas Inventory 1990-2003. Data for Argentina is for 1997 and for New Zealand, 2003

Underpinning the uniqueness of New Zealand's profile is the importance of methane emissions from enteric fermentation and nitrogen emissions from agriculture soils. In 2003, these two sources accounted for 48.5% of New Zealand's total gross emissions. Table 2 shows that while Ireland is most closely aligned with New Zealand, emissions from these two sources accounted for only some 24% of its total emissions in 2002, half the proportion for New Zealand. For the European Community, emissions from these sources accounted for some 12% of total emissions and for Australia, some 16% of total emissions.

Table 2 - Importance of Methane Emissions from Enteric Fermentation and Nitrous Oxide Emissions from Agriculture Soils for Selected Countries 2002[11]

Country	CH_4 Emissions from Enteric Fermentation	N_20 Emissions from Agriculture Soils	Total of two sources
	% of Total Gross Emissions		
Argentina	19.3	20.5	39.8
Australia	12.3	3.7	16.0
Canada	2.6	4.1	6.7
European Union	4.1	8.4	12.5
Germany	2.6	3.1	5.7
Ireland	13.8	10.4	24.2
Japan	0.5	0.6	1.1
New Zealand	**31.3**	**17.2**	**48.5**
United Kingdom	2.7	4.2	6.9
United States	1.7	4.2	5.9

Sources: UNFCC Greenhouse Gas Inventory Database (<www.wri.org>) and New Zealand's Greenhouse Gas Inventory 1990-2003. Data for Argentina is for 1997 and for New Zealand, 2003

The other particularly notable feature of New Zealand's profile is the relatively low share of emissions accounted for by carbon dioxide from energy industries (including electricity generation), which reflects the very significant role of hydroelectricity in New Zealand's energy supply. In 2003, carbon dioxide emissions from energy industries accounted for some 10% of New Zealand's total emissions. As shown in Table 3, this contrasts markedly with Australia, where these accounted for 38% of total emissions in 2002. In the European Union, they accounted for 27.3% of total emissions, but the situation varies among member countries. For example, in Norway, hydroelectricity is important in explaining the lesser role of carbon dioxide emissions from energy industries in its emissions profile.

[11] Data for other selected countries can be supplied.

***Table 3 - Importance of CO_2 Emissions from Transport and Energy Industries for Selected Countries 2002*[12]**

Country	CO_2 Emissions from Transport	CO_2 Emissions from Energy Industries
	% of Total Gross Emissions	
Argentina	14.1	12.8
Australia	14.2	38.1
Canada	24.8	27.3
European Union	20.4	27.8
Germany	17.4	35.2
Ireland	16.3	23.5
Japan	19.2	28.6
New Zealand	**18.3**	**10.1**
Norway	24.2	19.7
United Kingdom	19.4	30.7
United States	25.5	32.4

Sources: UNFCC Greenhouse Gas Inventory Database (<www.wri.org>) and New Zealand's Greenhouse Gas Inventory 1990-2003. Data for Argentina is for 1997 and for New Zealand, 2003.

Table 3 shows that the significance for New Zealand of CO_2 emissions from transport is within the range of other Annex I countries. These emissions account for some 18% of New Zealand's emissions, which is somewhat lower than in the United States, Canada and Norway, where CO_2 emissions from transport account for between 24% and 29% of total emissions. In the United Kingdom, CO_2 emissions from transport account for some 19% of total emissions and in Australia, 14%.

New Zealand's unique emissions profile has implications for the range of emission mitigation options currently available to New Zealand and the likely cost of domestic mitigation relative to some other countries. Effective and low-cost mitigation options have not yet been identified to address either methane from enteric fermentation or nitrous oxide from soils.

A further significant source of emissions is transport. As with other countries, the increasing trend in transport emissions will not be easily addressed in the short term. Because future developments in transport technologies will largely occur overseas, New Zealand's potential for mitigation in this respect will depend largely on the availability and uptake (as opposed to development) of any cost-effective new technologies. Overseas experience can also assist in scoping policy options and effectiveness.

[12] Data for other selected countries can be supplied.

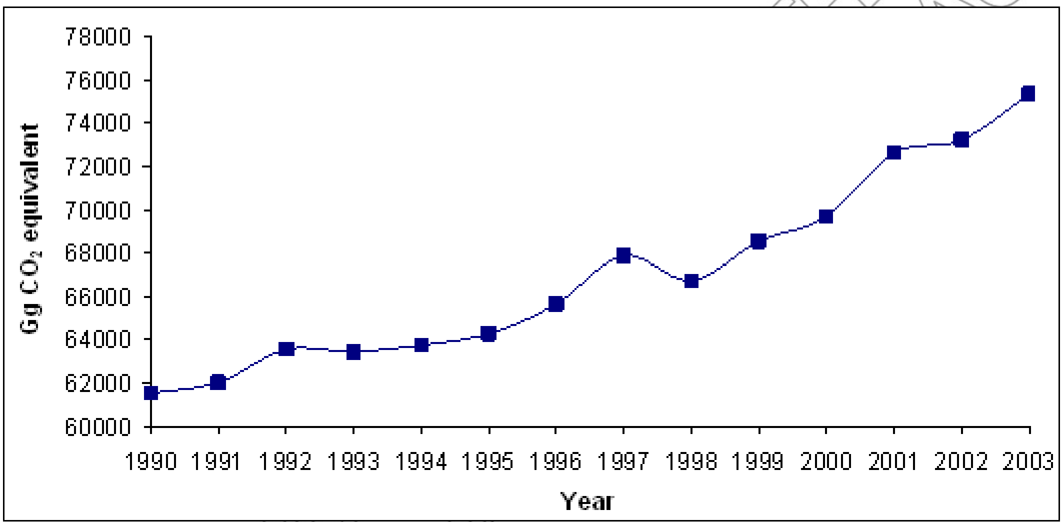
Overall, the particular profile and the high degree of concentration of New Zealand's emissions means that we face a limited range of viable mitigation options in the short term.

3.1.2 Emissions trends since 1990

In 2003, total gross emissions were 22.5% above the 1990 base level of 61,525.43 Gg CO_2 equivalent, representing an annual average growth rate of 1.6% per year.

This rate of growth is likely, however, to overstate the underlying growth trend. An important feature of New Zealand's emissions is significant year-to-year fluctuations arising from the importance of hydro in electricity generation. In dry years, it is necessary to use thermal stations, which use gas and coal, to supplement hydro- electric generation. The rise in emissions in 2003, apparent in Figure 16, was attributable, in part, to this dry-year factor.

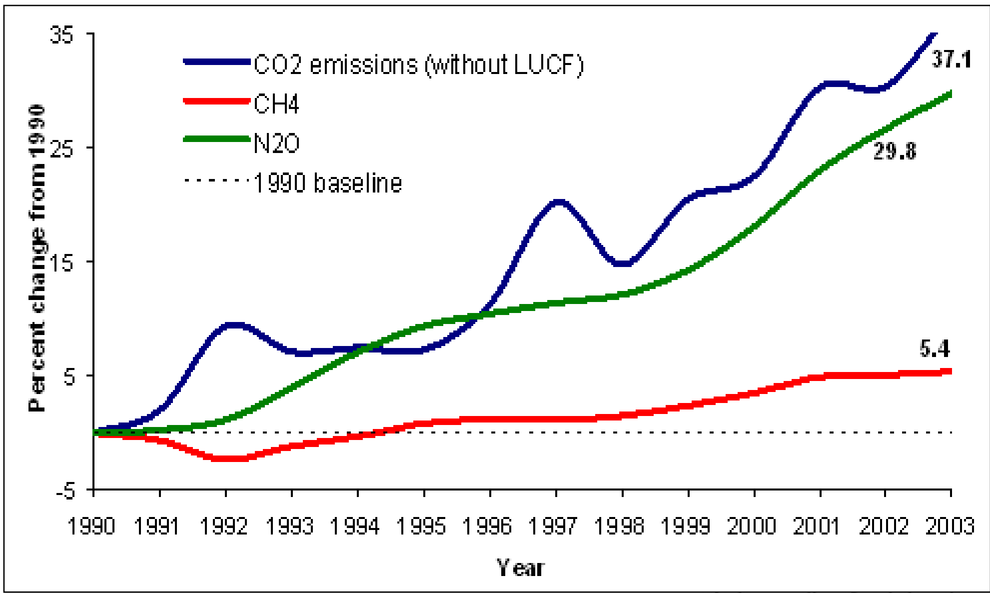
Figure 16 – New Zealand's Total Greenhouse Gas Emissions 1990-2003



Source: New Zealand's Greenhouse Gas Inventory 1990-2003

Figure 17 shows the trend in emissions by gas type. Over the 1990 to 2003 period, carbon dioxide emissions have grown most rapidly and were 37.1% higher than in 1990. This is equivalent to an average growth rate of 2.5% per year. As indicated above, this is likely to overstate the underlying trend, given the dry-year factor in CO_2 emissions from public electricity generation. Nitrous oxide emissions grew on average by 2.0% per year and methane emissions by 0.4% per year.

Figure 17 – Change in New Zealand's Emissions of CO_2, CH_4 and N_2O 1990-2003



Source: New Zealand's Greenhouse Gas Inventory 1990-2003

Carbon dioxide

A major driver in the growth of carbon dioxide emissions is the growth in transport emissions. These increased, on average, by 3.7% per year. Data for 2004 indicates a somewhat slower level of growth in 2004, marginally pulling down the average annual growth rate to 3.6% per year. It is, however, too early to say whether the lessening in transport emission in 2004 is the start of a trend.

The most important driver of transport emissions has been increased emissions from road transport, with this source accounting for some 89% of the increase in emissions. In terms of fuel source, diesel accounted for some 67.3% of the increase in transport emissions, and petrol some 28.2%. This suggests that increased road freight, together with the growing share of diesel vehicles in the passenger transport fleet, have been important contributing factors.

CO_2 emissions from energy industries have increased, on average, by 1.8% per year between 1990 and 2003. Emissions from thermal electricity generation increased, on average, by 4% per year. Contributing factors are increased demand for electricity, and the substitution since 2001 of coal for gas in thermal generation because of the sharp decline in the Maui gas field and the 2003 dry-year factor.[13] The strong growth in emissions from thermal electricity generation has been offset to some extent by the closure of synthetic petrol production facilities in 1996, with these having accounted for 1,488 Gg of CO_2 emissions in 1990.

[13] Recently released data for 2004 indicates that emissions from thermal energy generation fell sharply in 2004, decreasing by 4.6%.

Manufacturing and construction accounted for an increase of 1,302 Gg in CO_2 emissions from 1990 to 2003, or a growth rate of 2% per year. The major source of growth has been emissions from natural gas consumption in the manufacture of methanol. Emissions from this source increased from 367 Gg CO_2 in 1990 to 2,013 Gg in 2002, and then fell by more than 50% in 2003 because of the decline in the availability of low-price natural gas. Recent MED data suggests a further marginal decline in 2004.

Carbon dioxide emissions from industrial processes increased from 2662 Gg in 1990 to 3470 Gg in 2003, or some 2.1% per year. This has reflected a general trend of growth in iron and steel production, aluminium, cement and urea. There was, however, a particular increase in emissions from iron and steel production in 2003.

Methane

The 0.4% average annual increase in methane emissions results from the offsetting effects of divergent trends in emissions from enteric fermentation and from waste. Emissions from enteric fermentation grew, on average, by 0.7% per year, with this offset in part by the 2.9% per year reduction in waste emissions.

The increase in emissions from enteric fermentation reflects the changing pattern and intensification of the agriculture sector, particularly as a result of the shift in land use towards dairying. Emissions from dairy cattle increased by 52.3% over the period as a result of increased dairy cattle numbers and increased emissions per animals (related to the increased productivity of herds). Emissions from sheep fell by 18.9% in total, reflecting a reduction in the sheep population (down 31.95%), offset in part by increased emissions per animal (up 19.4%). Emissions from non-dairy cattle and deer have also increased as a result of population growth and increased emissions per animal.

Nitrous oxide

Nitrous oxide emissions grew on average by 2.0% per year, accounting for an increase of 3,000 Gg CO_2 equivalent. Over half of the growth in these emissions is attributable to increased use of synthetic nitrogen fertiliser, from 51.786 tonnes in 1990 to 298,380 tonnes in 2003. The remainder is attributable to increased animal production of nitrogen, which in turn is a result of the increased intensity of agriculture and associated changes in the population structure (increased dairy cattle) and the increased nitrogen production per animal.

3.1.3 Energy and economic growth in New Zealand

Historical context

New Zealand's economic history and associated policy background has shaped its structural composition and energy use. Our natural resources (in particular, abundant hydro and coal resources) have meant that the economy has historically enjoyed relatively low energy costs. This has, in turn, attracted energy-intensive industries. The supplementation of tariffs with import licences in the 1930s assisted New Zealand's growing manufacturing sector. Through the mid-twentieth century, the economy witnessed the resulting industrial developments in sawmilling, pulp and paper making, steel, oil refining and aluminium smelting (Briggs, 2003).

Historically, Britain's free trade policy, combined with New Zealand's temperate climate, meant that from the nineteenth century, primary products from New Zealand could be sold to the prospering British economy at competitive prices despite the associated transport costs. Our current economic structure still reflects these historical roots, with our comparative advantage lying in producing commodities that require high energy intensity either in processing or in transportation.

Dairy, forestry and meat products all require extensive movement of bulky, heavy goods around the country, and when processed further in New Zealand, require considerable further inputs of energy. In 2001, the New Zealand Institute of Economic Research (NZIER) reported that New Zealand agriculture requires 4,500 kJ of energy per dollar of GDP. The transport and storage sector uses around 20,000 kJ per dollar, and primary food manufacturing (dominated by dairy and meat processing), 7,000 kJ.

Drivers of energy-demand growth

There are a number of key determinants of growth in energy use:

- **economic growth**. As an input into production, energy use is closely related to the level of economic activity. Evidence for New Zealand suggests that there is a one-way causal relationship from GDP to energy consumption (Fatai *et al*)[14]

- the **economic structure of industry**. The relative energy intensities of industries and their contribution to economic growth will impact on the growth in energy demand. Structural composition is important to bear in mind when interpreting cross-country comparisons of energy intensity

- the **price** of energy, in terms of different energy sources and types and also relative to other production inputs. The effect that price changes will have on demand depends on own- and cross-price elasticities, and hence the extent to which energy can be substituted with other inputs (capital, labour)

- **technological change**. Generally speaking, we may expect new capital equipment (eg, plant, machinery, vehicles) to be more energy efficient than old stock. In this respect, energy demand is influenced by the turnover of capital stock (and appliance stock in the residential sector). New investment growth is correlated with the economic cycle

- **Population growth** and **demographic change**. Population growth is itself a driver of economic growth and hence energy use. But changes in the demographic composition of the population, as well as societal changes, can also influence energy demand. For example, in developed countries, there is a trend towards larger houses and fewer people per household. Both these trends serve to provide upward pressure on residential energy-demand growth. Societal change can influence consumption patterns and lifestyles, which can impact on energy use in terms of the types of end use (eg, use of particular appliances)

- **Climate**. Climate impacts on energy use, such as for heating and air conditioning. Space heating represents the most significant residential energy end use in almost all International Energy Agency (IEA) countries (typically accounting for around 40% of total energy use), with climate being a key driver of this component. Other

[14] However, this analysis did not adjust for energy quality, which is thought to be crucial in correctly establishing the relationship.

geographical factors (such as topography) are also likely to impact on total energy consumption (including transport fuel use).

Energy use is also affected by a variety of **intermediaries** in the production and consumption processes. Intermediaries include designers of new plant and machinery that will use energy, and architects of buildings whose occupants will use energy.

These intermediaries, acting in the broader context of a country's economic and policy history, contribute to the characteristics of **existing infrastructure**. Because infrastructure and large capital investments such as roading have a long life span, their impact on energy use can be apparent for many decades. Changes in major infrastructure are likely to be incremental and at the margin. These factors, as well as potentially long payback periods, can lead to inertia surrounding the energy use associated with existing infrastructure.

Historical trends in New Zealand's energy intensity

New Zealand's total energy intensity (measured by the ratio of energy to GDP) is relatively high by OECD standards, as shown by Table 4. However, it is important to note that this does not translate directly into a high carbon intensity. This is due to the contribution of hydro (and other low-emissions renewables) to our electricity generation.

Table 4 - Energy and CO_2 Intensity of GDP for Selected Countries 2002

	Energy Intensity[15]	Carbon Dioxide Intensity[16]
Argentina	9,875	0.48
Australia	11,936	0.88
Canada	17,341	0.79
Chile	11,498	0.59
China	35,764	2.75
Denmark	3,920	0.26
France	5,998	0.22
Germany	5,269	0.31
Ireland	5,273	0.38
Italy	6,186	0.36
Japan	3,876	0.21
New Zealand	11,871	0.51
Norway	10,968	0.25
Poland	20,004	1.60
United Kingdom	7,039	0.41
United States	10,575	0.62

Source: Energy Information Administration 2004, *International Energy Annual*

New Zealand's energy intensity increased between 1987 and 1993, and has since been declining. To gain a better understanding of changes in energy intensity within an economy, it is useful to separately identify the contribution from:

- structural change; ie, change in the composition of economic activity within an economy
- technical changes resulting from replacing or retrofitting old technology with more energy-efficient equipment (and management processes)
- energy-quality changes in both a thermodynamic[17] and an economic sense.[18]

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[15] BTU per 1995 US dollars at market exchange rates (BTU = British thermal units, the quantity of heat required to raise the temperature of one pound of water from 60 to 61 degrees Fahrenheit at a constant pressure of one atmosphere).

[16] Metric tons of carbon dioxide per 1000 1995 US dollars at market exchange rates. Relates exclusively to CO_2 from the consumption and flaring of fossil fuels.

Research undertaken by Lermit and Jollands (commissioned by Energy Efficiency and Conservation Authority (EECA) (EECA, 2001)) quantified the relative contribution of these three factors for the 1987 to 2000 period (excluding for the residential sector). Their analysis suggests that the increase in energy intensity between 1987 and 1993 was primarily attributable to declining technical efficiency. Between 1993 and 2000, the improvement in energy efficiency was attributable to improvements in technical efficiency, a shift in the structural composition of the economy away from energy-intensive activities and, to a lesser extent, improvements in energy quality, mainly due to improvements in the quality of liquid fuels.

There has been debate about the underlying drivers of the observed decline in technical efficiency between 1993 and 2000. Lermit and Jollands suggested this was attributable to the slow growth in investment. The period was characterised by economic recession and major restructuring, and concurrent weak performance in the manufacturing sector. Subsequent analysis by NZIER queries this explanation. (NZIER, 2003b). It points to two reasons why intensity is unlikely to increase as a result of low investment growth:

- the proportion of capital stock replaced in any year, even in a year when economic growth is high, is relatively low
- even in years when investment growth is low, the level of investment is still positive and has been more than enough to offset depreciation, thereby lifting the total capital stock.

The Lermit and Jollands analysis does, nonetheless, highlight the significance of the general macroeconomic cycle for short-run energy-efficiency change. During periods of poor economic performance, investment growth will slow, limiting the improvements in energy efficiency from new, more energy-efficient capital. Capacity utilisation appears to be a likely driver of changes in the technical effect. When capacity utilisation drops (especially when economic growth is sluggish), any fixed energy requirements will represent a higher proportion of total inputs, serving to increase energy intensity. The converse is true for high capacity utilisation, which itself may spur new capital investment (to expand capacity). Other contributing factors are likely to include the relative prices of other substitutable inputs (including labour), the cost of capital (and hence of new investment) and energy prices themselves.

NZIER analysis confirms this short-run relationship between energy efficiency and capacity utilisation, finding that capacity utilisation (measured by the capital/output ratio) tends to account for most of the changes in the technical effect. In the long run, they find that energy use is related to the capital stock, and that as New Zealand's capital stock has grown over time, it has become more energy efficient. However, because new investment represents a very small proportion of the total capital stock, these improvements have been very gradual.

Lermit and Jollands' decomposition analysis was updated in 2003 (EECA, 2003) to explore changes in energy intensity between 2001 and 2002. The revised methodology used is documented in a report to the Energy Efficiency and Conservation Authority (EECA) (Lermit, 2001). In this update, they decompose growth in energy use into the following components:

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[17] The scientific/engineering definition relating to the physical relationship between energy inputs and outputs.

[18] Derivation of quality co-efficient for New Zealand shows electricity to be the consistently highest-quality energy input over time, followed by geothermal, liquid fuel (including petroleum), gas and finally solid fuel (coal).

- structural effect (as previously)
- activity effect, capturing changes in sectoral-level economic activity levels
- underlying energy-efficiency effect (effectively, the technical effect, with the activity and wealth effects stripped out)
- wealth effect, isolating changes due to GDP growth (ie, the value of output).

The residential sector is also modelled and decomposition here includes isolation of the impact of climate (a weather effect).

This analysis shows that between 2001 and 2002, economy-wide energy use grew 1.4%. GDP growth over this period was 3.4%. Energy-efficiency improvements are calculated as being 1.85% for the year, which is above the National Energy Efficiency and Conservation Strategy target for this period (1.67% on a compound growth basis). Efficiency gains came largely from the transport sector; gains were also recorded in the commercial and industrial sectors. Efficiency in the residential sector appears to have declined, and the primary sector also registered a deterioration (located in the agriculture, mining and fishing industries).[19]

In regard to the residential sector, between 1991 and 1998, residential energy use declined *per capita* by 5%, and per m^2 of floor area by 9%. EECA attributes this trend to a range of factors, including the northward population drift (hence warmer climate), increased turnover of the domestic appliance stock, higher domestic electricity prices and a higher proportion of new homes (which are better insulated and fitted out with more efficient heating equipment). They also point to trends towards more energy-efficient domestic practices such as washing laundry in cold water and increased use of microwaves for cooking.

[19] Transport includes both freight and passenger (private) transport.

New Zealand's energy intensity *per capita* is low compared with other developed countries. New Zealand has the lowest residential energy use *per capita* in the OECD, despite having larger-than-average houses (by floor area). EECA suggest that this is largely due to New Zealand's temperate climate, resulting in relatively low amounts of energy used for space heating. Moreover, New Zealand households tend not to heat (or air condition) their entire house. This latter factor could suggest a trade-off in terms of comfort or welfare, which is perhaps mitigated by the moderate climate. It may also be, in part, an income-related effect (with New Zealand having relatively modest income *per capita* compared with its OECD counterparts). Given the possible combination of factors at play, it is difficult to predict likely future trends in this sector.

3.1.4 Greenhouse gas emissions and economic growth

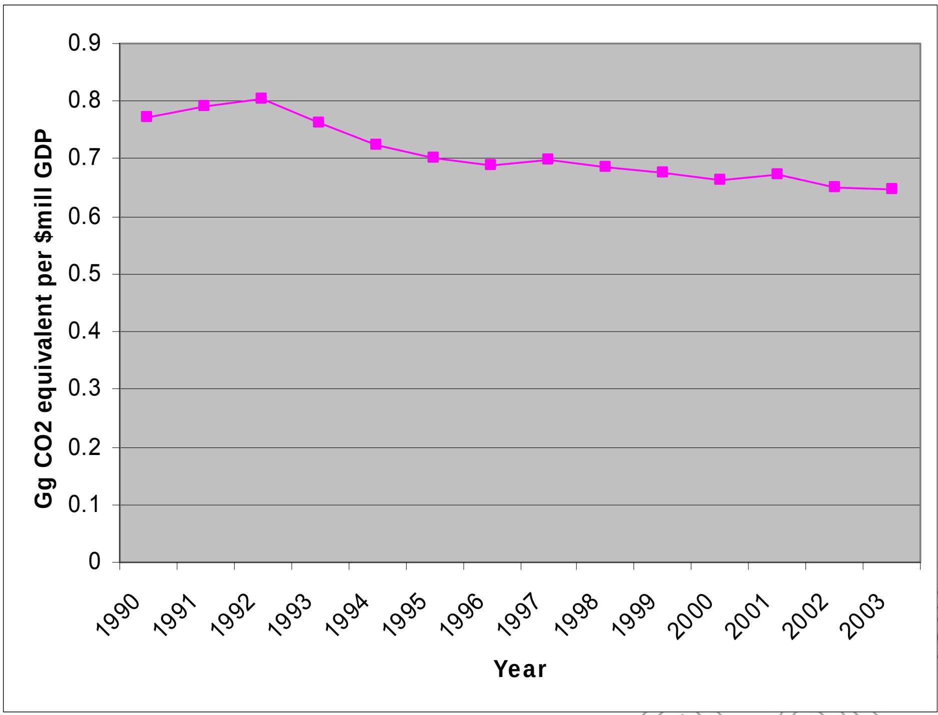
New Zealand experience since 1990

A major driver of the rising trend in New Zealand's emissions has been the growth in the economy since 1990. New Zealand's economic performance improved significantly over the 1990s, following a period of major economic restructuring and deregulation. From mid-1991, the economy grew strongly, with particularly buoyant output growth between 1993 and 1996. While the latter half of 1997 and early 1998 saw the economy slip briefly into recession, the following year saw a recovery in broad-based growth, with the economy growing 4.4% in calendar year 1999 and 3.5% in 2000. Overall, the New Zealand economy averaged 3% annual average growth over the 1990 to 2003 period.

Although the New Zealand economy diversified over this period, New Zealand's economic growth remained reliant on exports of commodity-based products as a main source of export receipts, and on imports of raw materials and capital equipment for industry. Key merchandise exports include dairy products, meat, wool, aluminium, iron and steel, and wood products.

While the greenhouse gas intensity in GDP fell at an average rate of 1.4% per year over this period (see Figure 18), this was outstripped by economic growth, leading to a significant increase in the absolute level of emissions. In effect, New Zealand achieved only limited decoupling of emissions and economic growth.

Figure 18 – New Zealand's Greenhouse Gas Intensity of GDP 1990-2003



Source: Statistics New Zealand; Greenhouse Gas Emissions New Zealand's Greenhouse Gas Inventory 1990-2003

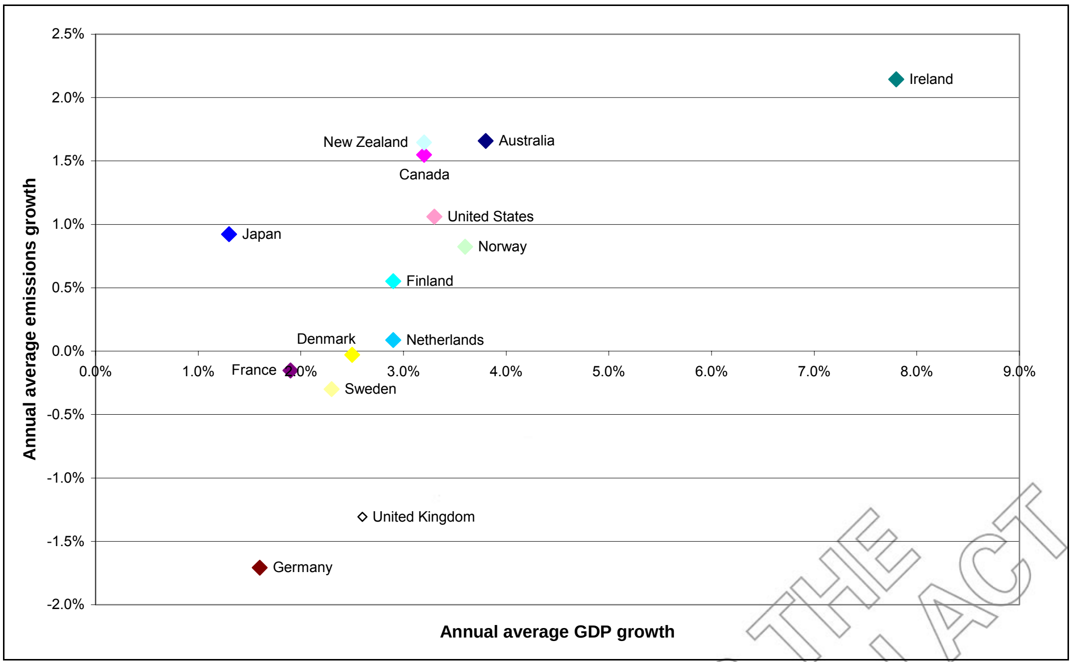
International experience

There is no unequivocal relationship between emissions and GDP growth, either across countries or over time. The chart below plots annual average growth in greenhouse gas emissions and GDP over the 1990 to 2002 period for a selection of Annex I countries.

Ireland is a clear outlier, with its strong GDP growth over the period (averaging 7.8% per annum) likely to have been a significant driver of its relatively high growth in emissions (2.1% per annum). New Zealand sits at the high end for both variables, alongside Australia and Canada.

However, a number of Annex I countries appear to have achieved some success in decoupling emissions growth from economic growth. The United Kingdom, Germany, France and Sweden have all reduced their greenhouse gas emissions at the same time as their economies have continued to expand (albeit more slowly than New Zealand's).

Figure 19 - Growth in Emissions and GDP for Selected Countries 1990-2002



Sources: Emissions data from UNFCCC Greenhouse Inventory Database (www.wri.org); GDP data from World Development Indicators 2004

How have they achieved this? Perhaps the best way of investigating this is by sector, or source of emissions.

Germany and the United Kingdom have both achieved reductions in CO_2 emissions and (due to the composition of their total greenhouse gas emissions) this has driven their overall improvement in emissions. In the United Kingdom, a major contributing factor has been the switch from coal to natural gas and nuclear in electricity production. In Germany, this has been assisted by efficiency improvements in its coal-fired power stations.

More broadly, structural change is likely to have assisted reductions in energy intensity (and hence in CO_2 emissions) in many countries. The shift in developed countries towards a more services-oriented economy is generally assumed to aid decoupling of economic and emissions growth, to the extent that service sector industries are less energy (including transport) intensive. For instance, the OECD (2004) sees the relative decoupling of transport sector and emissions growth in the United States resulting from the structural shift from low-value raw-material production (such as fossil fuels, basic chemicals and cereals) towards more high-value-added industries (such as electronics and textiles) as having reduced economy-wide transport intensity.

In the United Kingdom, the services sector has expanded rapidly over the last decade or so, while the agriculture sector has contracted. Germany has also seen strong service-sector growth, coupled with a declining industrial sector. This is likely to have contributed to their decline in emissions.

However, the relationship between structural change and emissions growth is far from clear. For instance, Mulder and de Groot (2004) examined energy use in 14 OECD countries over a 27-year period. They found that structural change in the economy has a significant positive effect on energy intensity in some countries and a negative effect in others.

Mitigation from structural change depends crucially on, among other things, the composition of service-sector industries (such as their transport intensity) and the sources of fuel (including indigenous energy resources). The nature of a country's comparative economic advantage will directly impact on the scope for emissions mitigation through structural change.

A number of European countries, including the United Kingdom, Germany and the Netherlands, have achieved reductions in methane emissions from reductions in stock numbers. In the European Union, dairy cattle numbers were, on average, 26% lower in 2003 than they were in 1990, and sheep numbers 12% lower[20]. Underlying these trends have been changes in the European Union common agriculture policies and nitrate directives, as well as the outbreak of foot and mouth disease resulting in stock reductions in the United Kingdom.

Even more significant has been the reductions in methane emissions from waste and fugitive emissions in these countries. For example, the United Kingdom has achieved reductions from the implementation of methane recovery systems at landfills and reduced emissions from coal mines.

Reduced stock numbers in European countries have also contributed to declines in nitrous oxide emissions. In recent years, use of synthetic fertilisers there has reduced, partly as farmers have readjusted their operations in response to changes in European Union farm policies. An additional factor has been the European Union nitrate directive, which has involved controls and restrictions on the use of fertiliser and application of manure.

In summary, international trends between emissions and GDP growth have varied over time and across countries, according to circumstances and opportunities. A country's scope for decoupling emissions from economic growth depends on a range of factors, including the nature of its economic comparative advantages, its energy resources, the policy context, the contribution of technology and the impact of external events (such as outbreaks of foot and mouth disease). New Zealand's prospects for decoupling emissions and economic growth are explored in Section 4.1.1.

3.2 New Zealand's current climate change policy settings – background

[20] European Environment Agency (2005) *Annual European Community Greenhouse Gas Inventory 1990-2003 and Inventory Report 2005* <http://reports.eea.eu.int/technical_report_2005_4/en>

3.2.1 Current New Zealand climate change policy objectives and expected outcomes

The context for the development of the current climate change goal and policy

The Kyoto Protocol was the first stage of what was expected to be an ongoing process with uneven coverage of nations with targets. In 2002, there was uncertainty about whether the Protocol would enter into force; eventual Russian ratification meant it entered into force on 16 February 2005. Another uncertainty was around the international price of emissions. It was anticipated that the European Emissions Trading Scheme would generate an emission price and other markets might evolve and progressively link.

These uncertainties meant that it was important to take a long-term view, and that policy design needed to reflect a prudent risk-management approach incorporating a phased transition and emphasising positioning for future commitment periods. It was expected that an international cost of carbon would not emerge until close to or in CP1, affecting consideration of a transition to emissions trading. The Protocol does not restrict domestic policy options, and it was considered that the expected availability of forest sink credits would facilitate flexibility in the domestic response. It was recognised that there are competing interests and objectives in domestic policy.

The New Zealand Government (2002d)[21] noted that the Kyoto Protocol was the first binding step in controlling greenhouse gases and that it signalled a long-term change in how the world thinks about key resources. The Government concluded that collective action was required and that the Government needed to show it was serious about aiming for real reductions in emissions. In addition, it noted that consultation and modelling indicated that policies that imposed high costs on emissions could significantly affect some sections of the economy and, at the same time, increase overall global emissions. It was anticipated that by CP1, all sectors of the economy would (in one way or another) contribute to reducing New Zealand's greenhouse gas emissions.

The goal behind the current policy and its expected outcomes

The current climate change goal is that:

> "New Zealand should have made significant greenhouse gas reductions on business as usual and be set towards a permanent downward path for total gross emissions by 2012."

At the time that it was set, the Government stated that the expected outcomes of the goal were that[22]:

- New Zealand will be on a path to reshaping its energy use
- there will be an increased rate of technology uptake of renewable energy, energy efficiency, and lower emissions production
- all sectors will be addressing emissions and positioning themselves greenhouse-wise on world markets
- research findings to date will have been transferred to agricultural practice

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[21] Paragraphs 2 and 3.
[22] New Zealand Government (2002d), Annex 1.

- new buildings, dwellings, plant, vehicles and machinery will be at the optimal edge of efficiency
- there will be a population knowledgeable about greenhouse gases and taking responsibility for them.

Subsidiary principles to be met by policies introduced to achieve the goal

Policies to achieve the climate change goal had to meet four principles[23] based around the need for:

- environmental integrity
- flexibility (because of future uncertainties)
- consistency with a growing and sustainable economy
- avoiding disadvantaging the vulnerable in society.

1 **Policies must result in permanent reductions in emissions over the long term (environmental integrity)**. This principle was driven by the need to achieve real and sustainable emissions reductions across all commitment periods, for both international credibility reasons and as preparation for the longer term. Avoidance of emissions leakage and achieving permanent changes in behaviour were also objectives underlying this principle.

2 **Policies need to be responsive to the changing international context and enable emitters to have time to adjust (flexibility)**. This principle reflected the uncertainty (in 2002) of the international framework, technological development and New Zealand's changing emissions profile. Policies were to be globally focused in anticipation of wider acceptance of targets. Policy was to accommodate a shift over time from the situation where all sectors of the New Zealand economy could not be exposed to the full cost of emissions (because many countries would not have binding targets) to a situation where progressively more of the economy would be exposed to the full emissions price as it became clear that countries currently without targets would take on targets and gradually expose their economies to the international price of carbon.

3 **Policies need to be consistent with a growing and sustainable economy.** It was recognised that competitiveness of industries (including new entrants) over time remained important. The policies were expected to move progressively to a full cost on emissions when global competitiveness issues had been addressed. Also, policies were to avoid inappropriate distortional effects on investment and were to promote economic opportunities from climate change.

4 **Policies will not disadvantage the vulnerable in our society.** The final policy principle was that lower socioeconomic (or vulnerable) groups should not have to bear the burden of change arising from implementing Kyoto Protocol commitments or climate change policies.

[23] The most detail about the rationale behind the four principles is in New Zealand Government (2002d), Annex 1.

Price measures

While the foundation policies (ie, policies that are relevant to climate change but that were either already in place or undertaken for other reasons – see Section 3.2.7) were considered to be a sound base upon which to build, it was recognised that they would be insufficient to enable New Zealand to meet its obligations. Because introducing a price is pivotal to the Protocol, the introduction of a domestic price instrument was central to the new policies.

Key issues considered when developing the price measures included:

- the importance of providing incentives and signals in the pre-2008 period that longer-term adjustment was necessary
- the extent that the economy should be exposed to the world price in CP1 and the timing of the introduction of any price measures
- what sectors of the economy should be covered by the price instruments
- issues around retention of sink credits and associated liabilities by the Crown versus their devolution to the private sector.

Polices to reflect the nature of the domestic economy

It was recognised that climate change policy had to reflect the specific characteristics of the New Zealand economy. This analysis resulted in the economy being separated into four groups based on: competitiveness, ability to respond to a price signal, any specific sector characteristics, and impacts upon the ability to recycle revenue.

The economy was grouped into four categories as follows:

- a **competitiveness-at-risk group** comprising energy-intensive industries that would find adjustment difficult if they were to face a cost of emissions in CP1. These export (and some import substitution) industries face a choice of closing (or reducing output) and changing location to a country with no controls on greenhouse gas emissions, often called carbon leakage
- a **general energy-users group** including less energy-intensive industries, institutions and households for which energy is not a major cost. Hence, this group is not at risk. The group represents about one-quarter of total greenhouse gas emissions but about two-thirds of CO_2 emissions and is expected to respond to the carbon tax
- **on-farm agriculture**, a major economic sector that contributes just over half of New Zealand's greenhouse gas emissions through methane and nitrous oxide emissions. Agriculture shares many characteristics of the competitiveness-at-risk group, along with some differences. Farmers have no clear way to reduce methane and nitrous oxide emissions other than by reducing stock numbers and measurement of these emissions on the farm is technically very difficult
- an **"others" group** of sectors where cost-effective abatement opportunities (synthetic gases) are lacking or emission measurement is difficult (waste), affecting the ability to adapt to an emission cost in the short term.

Current policy package

The policy package approved in 2002 comprises Foundation Policies and New Policies, as set out below.

Figure 20 – Policy Package Components

New Policies

Pre-commitment period	First commitment period
	• Introduction of an emissions charge from 2007. The charge will approximate the international price of emissions but will be capped at \$NZ25 per tonne of CO_2e (inflation-adjusted).
	• The charge will apply to emissions from energy supply and use, process emissions and fugitive energy emissions, unless exempted or rebated through a NGA.
	• Further work is required to determine whether the emissions charge will be applied to emissions from domestic bunker fuels used in shipping and aviation.
	• Retain option to introduce emissions trading if conditions permit (ie, there is a stable international market, and the price is reliably under \$NZ25 per tonne of CO_2e).
	• Redistribute all revenue from climate change policies back into the economy; eg, through the tax system and climate change projects/programmes.
	• Retain sink credit assets and liabilities.
	• Cap deforestation liabilities at 21Mt CO_2e.
	• Mechanisms to encourage forest sinks, including a mechanism to encourage permanent protection of forest sinks.
• Investigate possible additional policy for SMEs.	
• NGAs for competitiveness-at-risk firms.	• NGAs for competitiveness-at-risk firms.
• Projects to incentivise emissions reductions.	• Projects to incentivise emissions reductions.
• Industry-funded research for the on-farm agriculture group. Retain option to apply research levy.	• Industry-funded research for the on-farm agriculture group. Retain option to apply research levy.

• Voluntary handling programmes for HFCs and PFCs, linked with the Montreal Protocol programmes (except for HFCs in aerosols). • Industry agreement to work together and share information to limit leakage of SF_6. • Rely on New Zealand Waste Strategy for methane emissions from waste. Review in 2005. • Amend RMA to remove regional council ability to directly control greenhouse gas discharges through consents and plans	• Policy for synthetic gases and methane emissions from waste, dependent on outcome of review in 2005.

Foundation Policies

- National Energy Efficiency and Conservation Strategy (NEECS), including renewable energy target.
- The New Zealand Waste Strategy.
- The New Zealand Transport Strategy.
- Public Awareness Programme.
- Partnership between local and central government.
- Research.
- Business Opportunities Programme.
- Growth and Innovation Framework.
- Adaptation to the effects of climate change.

Expected impact on emissions

In 2002, when the climate change policy package was approved, it was estimated that achieving the NEECS targets would reduce emissions during CP1 by about 20Mt CO_2e. This estimate included the effect of the carbon tax and PREs, as they were two of the most important measures that were to be used to achieve the NEECS targets. It was also estimated that the waste strategy would reduce emissions during CP1 by about 5Mt CO_2e.

3.2.2 *Price-based instruments – carbon tax and NGAs*

The central policies in New Zealand's climate change policy 2002 package are a carbon tax and NGAs.

Carbon tax

In 2002, the Government decided that the climate change policy package would include a greenhouse gas emissions charge (carbon tax). In April 2005, the implementation details of the carbon tax were confirmed. Under current government policy, from April 2007, the carbon tax will apply to New Zealand's emissions from fossil fuel-based energy supply and use and industrial processes, and fugitive energy emissions of carbon dioxide, methane and nitrous oxide.

The rationale for the carbon tax is stated as: to require all sectors of the economy to begin to factor the cost of emissions into their decisions in order to assist New Zealand to fulfil its Kyoto obligations and to prepare the New Zealand economy for a smooth transition to more challenging commitments after 2012. It was considered that this would best be achieved by introducing a carbon tax on as broad a base of greenhouse gases as possible, and doing so earlier rather than later.

As announced, the carbon tax is set at $15 per tonne of CO_2e for CP1 unless the international price of carbon deviates substantially and on a sustained basis from this level, although the tax will be capped at $25 per tonne of CO_2e for this period.

The tax aims to provide a price signal motivating the adoption of least-cost options for reducing emissions. With the tax applied to fossil fuels, activities that draw on carbon-intensive energy sources will be relatively more expensive than those that draw on cleaner energy sources. Responses to the tax are expected to take a wide variety of forms, including investment in more fuel-efficient technology, improved logistical planning, and the substitution of renewable energy sources for fossil fuels.

The intention is to apply the tax as high in the supply chain as possible, as this will result in the smallest number of liable parties, ensure comprehensive coverage and minimise the administration and compliance costs of the tax. In general, this will mean taxing liable products when first sold by a producer or when imported.

At $15 per tonne of CO_2e, the carbon tax is estimated to increase prices by approximately 3.5 cents for a litre of petrol, 4 cents for a litre of diesel, $1.33 for one gigajoule of sub-bituminous coal, 79 cents for one gigajoule of natural gas and between 0.7 and 1.1 cents per kilowatt hour for residential electricity.[24]

Estimates of the macroeconomic impact vary according to the modelling technique and assumptions, but a small but negative impact on economic activity (measured by GDP) is expected. The Consumers Price Index is likely to increase when the tax comes into force, mainly through retail petrol and electricity prices (about 0.1% from the petrol price rise and 0.1% to 0.2% from the electricity price rise).

A carbon tax of $15 per tonne of CO_2e is expected to raise approximately $600 million (GST inclusive) per annum (plus or minus $50 million) while approximately $240 million (GST inclusive) per annum (plus or minus $50 million) will be needed to give firms with NGAs relief from the tax. Revenue from the charge will be recycled through a package of changes to the business tax regime.

[24] "Implementing the Carbon Tax: A Government Consultation Paper" (2005).

When the decision to proceed with a carbon tax was made, it was noted that emissions trading would almost certainly be more efficient than a tax if there was a functioning international emissions market that New Zealand could link into. Officials undertook to continue monitoring the situation with a view to considering a move to a domestic emissions trading regime once the international emissions market was more developed.

NGAs

Under NGAs, New Zealand firms whose international competitiveness will be affected by the carbon tax can apply to negotiate an agreement with the Crown whereby they receive a full or partial exemption from the tax in exchange for agreeing to move towards the world's best practice in emissions management.

The objective of the NGA policy is to mitigate the risk of economic production moving (or "leaking") from New Zealand without any corresponding global reduction in greenhouse gas emissions. At the same time, NGAs seek to reduce emissions or the intensity performance of applicant firms to assist New Zealand in meeting its Kyoto obligations in CP1.

To be eligible to enter NGA negotiations, a firm has to demonstrate to the Crown that its output is internationally traded and the climate change policies of competitor countries are less stringent. If the firm meets this criterion, the final eligibility decision is based on consideration of whether:

- a \$25 CO_2e carbon tax will have a significant impact on the firm's competitiveness (through meeting a threshold in relation to the firm's costs, profits, or weighted average cost of capital)
- there is expected to be a net national benefit in an NGA being negotiated with the firm.

The final decision on a firm's eligibility is the responsibility of the Minister of Finance and the Convenor of the Ministerial Group on Climate Change. If a firm has satisfied the test for eligibility, the Crown will make an offer to enter negotiations to agree an NGA.

Under the original policy agreed in 2002, key issues for negotiation were the level of exemption from the tax, the applicable world's-best-practice emissions target, penalties for non-compliance, flexibility provisions for meeting targets, and monitoring and enforcement.

In early 2005, a review of the NGA policy was carried out, as experience to date had shown that NGAs had taken longer to complete and the negotiations had been more complex and costly than originally envisaged. Key issues decided in this review included:

- a standard end date for all NGAs of 2012
- the increased use of standardised text for an NGA
- the development of a streamlined process to determine the "world's-best-practice" level of emissions for the firm
- the use of an automated procedure to calculate a firm's emissions target pathway, rather than this being a matter for negotiation between the Crown and the firm
- removing the principle that NGA firms should expect to be "held harmless" from all material and reasonably quantifiable impacts of the carbon tax.

Officials are estimating the level of pass-through of the carbon charge in the electricity, coal, gas, petroleum and LPG markets. This work will feed into the calculations to determine the refund each NGA firm will receive.

As of mid-August 2005, two NGAs had been concluded (with the New Zealand Refining Company and OceanaGold), eight firms had been found eligible to negotiate and applications from 12 firms were under assessment. The first 14 firms that applied for NGAs cover a range of major New Zealand energy users and represent approximately 55% of electricity used by New Zealand's industry. In addition, 15 expressions of interest had been submitted, four of which were from industry groups or associations.

The cost of carbon tax relief under the NGA policy is estimated at $240 million (GST inclusive) per annum, with a range of plus or minus $50 million per annum. Estimating the cost of the relief to be provided to NGA participants is complex, with a major uncertainty relating to the extent of the pass-through of the carbon tax for electricity.

3.2.3 *Energy policy*

Key policy instruments in the energy sector include the announced carbon tax and the use of NGAs. Both these measures were discussed in Section 3.2.2. In addition to these policies, a number of complementary energy sector measures are in place that impact on energy emissions, as discussed below.

PREs

The Government has developed the PRE programme to support initiatives that will reduce emissions of greenhouse gases over CP1. As well as aiming to reduce New Zealand's greenhouse gas emissions, the programme contributes to capacity building in renewable energy and improving energy efficiency.

Emission units are awarded to projects that produce emissions additional to business-as-usual. These units help bring forward projects that would not otherwise be economic. Successful projects are identified based on the request ratio – ie, the number of units requested relative to the CP1 abatement delivered. Firms awarded units are able to sell them on the international market.

In theory, the allocation of units is costless as they are awarded only to projects that are additional to business-as-usual and delivered only after the actual emissions reductions have been verified. The Crown is simply awarding units that it would have otherwise had to use towards compliance with Kyoto obligations.

The current project portfolio comprises 42 projects selected through two tender rounds held in 2003 and 2004 and an early projects process. Projects awarded emission units to date have been predominantly energy-related and include wind farms, small-scale hydroelectricity generation, geothermal-electricity generation, bioenergy and landfill gas projects. The first tender round gave priority to projects that contributed to the near-term security of New Zealand's electricity supply, although this criterion was removed for the second tender round. A third tender round is currently under consideration.

Energy-intensive businesses

For energy-intensive New Zealand businesses that do not meet NGA international competitiveness criteria or that may not have adequate resources to enter into an NGA application and negotiation, an "energy-intensive businesses" policy has been developed to assist them in adapting to the carbon tax. Energy-intensive businesses are defined as those that spend more than 8% of costs on energy.

The energy-intensive businesses policy aims to meet the following objectives:

- greenhouse gas emissions resulting from energy use by small and medium enterprises are reduced on a cost-effective basis
- the competitiveness of small and medium enterprises is not diminished by a carbon tax
- firms that are adversely affected by the charge are able to adjust to the new policy environment.

The policy also aims to contribute to other government objectives, including energy efficiency, electricity security, sustainable development, and growth and innovation. It involves four measures:

- financial grants to assist capital investment in technologies to improve energy efficiency
- demonstrations of energy-efficient technologies to provide support for innovation and technology uptake
- training for company directors to influence a conservation culture in corporate governance
- education for company managers and staff about a carbon tax and energy efficiency.

Implementation will proceed in two stages, depending on funding. A pilot scheme was established on 1 July 2005 to test the effectiveness of the grant scheme and demonstration projects, and to provide information that could support establishment of a fully fledged scheme. Training and education programmes will begin in 2006.

Nine industries have been identified as being energy intensive: wood processing, food processing, basic metals, non-metallic industries, paper and paper products, glasshouse crops, fishing, irrigated dairying, and irrigated arable crops. Technologies will be selected that are capable of delivering significant energy savings and have the potential to be widely used in these industries. Firms that are willing and able to host projects in some or all of these industries will then be selected to demonstrate the application of these technologies.

Energy Efficiency and Conservation Authority programmes

The Government established the Energy Efficiency and Conservation Authority (EECA) in 2000 to encourage energy efficiency and the development of renewable energy. EECA developed the National Energy Efficiency and Conservation Strategy (NEECS) in 2001, which establishes two high-level national targets:

- a 20% improvement in economy-wide energy efficiency by 2012
- an increase in renewable energy supply to provide a further 30 petajoules (PJ) of consumer energy in the year 2012.

Guided by the NEECS, EECA undertook a range of programmes to encourage the uptake of energy-efficiency and conservation measures.

EECA programmes include:

- Emprove - which provides grants for energy audits to high-energy-use businesses, as well as general information on how businesses can improve energy efficiency
- building regulations – which facilitate the efficient use of energy and the use of renewable energy in buildings through changes to the Building Code

- residential housing – which includes a grants scheme focused on fitting insulation in low-income households and an audit scheme for higher-income households
- renewable energy to the grid – which promotes the use of renewable energy to potential and existing electricity generators
- market development renewable energy – which encourages the uptake of small-scale renewable energy technology through grants, information provision and education, and supporting market research
- energy efficiency of products – which regulates standards for energy performance of appliances and includes mandatory and voluntary energy performance labelling regimes
- EnergyWise Councils – a partnership aimed at improving energy efficiency and the uptake of renewable energy in local government and their communities. EnergyWise Councils works alongside the Communities for Climate Protection programme, a global programme that allows councils to benefit from international best practice and experience in reducing emissions.

The first review of the NEECS was initiated in early 2005 and is being led by EECA. The review will provide an opportunity to evaluate New Zealand's progress and consider additional steps to address energy demand and supply options, including long-term behavioural change and technology development. It is anticipated a replacement NEECS strategy will follow the review.

Electricity Commission programmes

The Electricity Commission, established in 2003 to regulate the operation of the electricity industry and markets, is also tasked with promoting and facilitating the efficient use of electricity. The Commission has initiated a number of pilot programmes to deliver electricity efficiency:

- a trial of practical strategies to improve the efficiency of electric motor systems in New Zealand industry
- a study of opportunities to improve the functioning of compressed air systems to enhance industrial energy efficiency
- a project seeking to replace the use of incandescent lamps with energy-efficient lamps in Canterbury
- a project installing energy-efficiency measures in Auckland households and undertaking energy audits to demonstrate achievable savings
- a project testing an incentive to remove old, inefficient fridges in Waikato and replace them with new, efficient models.

The lifespan of these pilots ranges from three months to eighteen months. They will be reviewed on completion.

Resource Management Act 1991

Consideration of climate change has been incorporated in resource management law. The Resource Management Act 1991 (RMA) requires particular regard to be given to the national benefits derived from the use and development of renewable energy and the efficient use of energy, and the impacts of climate change. The Act was also amended to remove any obligation on councils to regulate the emission of greenhouse gases in resource management decisions, as this is expected to be dealt with through national-level policies such as the carbon tax.

Electricity-market regulations

Two sets of electricity-market regulations may impact on climate change outcomes. Regulations to require electricity retailers to offer low-fixed-charge tariff options to domestic consumers were introduced in 2004. While primarily aimed at improving the affordability of electricity for low-electricity users, these regulations will also allow users to benefit financially from low electricity use, thereby creating incentives for electricity (and consequently emissions) savings. The regulations require:

- electricity retailers to make available a tariff option that includes a fixed charge of not more than 30 cents plus GST per day
- electricity distributors to charge for lines services to domestic consumers on low-fixed-charge tariff options at not more than 15 cents plus GST per day
- domestic consumers on a low-fixed-charge tariff option to pay less than on other tariff options if electricity consumption is less than 8,000kWh per year.

Distributed generation is expected to play an increasingly important role in meeting electricity demand as the cost of smaller-scale and new renewable technologies continues to decline. Distributed generation is often, although not exclusively, based on renewable sources of energy such as solar and wind. Facilitation of distributed generation, where based on renewable energy, will therefore reduce the overall emissions intensity of the energy sector.

Electricity distribution companies (which operate the lines to which distributed generation needs to connect) appear to have weak incentives to effectively facilitate distributed generation. Industry self-governance arrangements have made insufficient progress in addressing this issue. The Government therefore intends to draft, consult on and introduce regulations that will provide for:

- a formal inquiry process, in order to obtain information on connection possibilities or constraints for particular locations
- application forms to be available and application decision timeframes
- access to compulsory dispute resolution when agreement on connection cannot be reached or an application is declined
- rules for network charges for various sizes of distributed generation.

3.2.4 *Forestry and land-use change*

Forestry scene-setting

Commercial planted forests

New Zealand has a forest resource that is a crop rather than a product of a natural ecosystem. This provides flexibility to manipulate and manage the resource. Productivity and quality gains have resulted from New Zealand's strong forestry research and development capability. New Zealand recognises the important role that forests can play as sinks and reservoirs of greenhouse gases. As at 1 April 2004, there were 1.82 million ha of sustainably managed planted forest in New Zealand. The predominant species is *Pinus radiata*.

More recently, there has been a decline in commercial forestry plantings, which has been driven by a combination of factors. These include: a relatively strong New Zealand dollar; substantial increases in shipping costs; tough international market conditions; and competition for land from alternative uses (which has pushed up land prices). There are no indications that the level of new planting will increase under current market conditions.

Indigenous forests

New Zealand indigenous forests represent a considerable reservoir of carbon. It is not known whether this reservoir is expanding or shrinking; ie, whether it is a sink or a source, but work is under way through the Carbon Monitoring System to monitor changes in indigenous forests.

Indigenous forests occupy 6.256 million ha, of which 5.187 million ha are owned by the Crown. A further 1.069 million ha of natural forest is privately owned; half by Maori. Of this, 124,000ha is considered commercially viable for wood production under current market conditions. Less than 0.005% of New Zealand's total commercial wood production is from indigenous forests.

"Kyoto" and "non-Kyoto" forests

Under the Kyoto Protocol, a clear distinction is made between forests established before 1990 (termed "non-Kyoto forests") and forests established from 1 January 1990 (termed "Kyoto forests").

A system to manage Kyoto forest sinks would provide the means for:

- New Zealand to receive additional emission units ("sink credits"), based on the increase in carbon stored in Kyoto forests over CP1 (2008 to 2012)

- obligations to be placed on "responsible parties" to hold sufficient emission units to offset CO_2 released into the atmosphere through harvesting or deforestation of Kyoto forests.

A system to manage non-Kyoto forests would provide the means for:

- obligations to be placed on responsible parties to hold sufficient emission units to offset emissions of CO_2 into the atmosphere over 2008 to 2012 from deforestation since 1990, where the land is not replanted but converted to some other land use

- credits to be gained (potentially) under Article 3.4 for management of non-Kyoto forests.

Current government policy for sink credits and deforestation

When the preferred policy package was announced in April 2002, it was assumed New Zealand would be a net seller of emission units in CP1. Although sink credits would cover all excess emissions, it was considered that sinks were a temporary offset and not a permanent solution.

Deforestation liabilities occur when forest land is changed to another land-use type. Initially, these were to be capped nationally at 5% of the area of forest expected to be harvested over CP1. Individual forest owners would not face a deforestation liability provided the total liabilities to the Crown stayed within a cap of 5% of each year's harvest. If it became apparent that the cap might be breached during CP1, the Government would have the option of lifting the cap or developing policy to allocate deforestation activity within the proposed cap.

The consultation process in 2002 on the preferred policy package raised concerns about the adequacy of the quantitative limit (or cap). Stakeholders thought that this cap was insufficient.

It was therefore decided that the cap would be increased to approximately 10% of the forests expected to be harvested during CP1 (21Mt CO_2e). Officials considered a cap of this magnitude would exceed all reasonable expectations of deforestation rates during the commitment period, and would therefore alleviate the risk of a cap creating a perverse incentive to deforest early.

If deforestation exceeds expectations, the Government has indicated that it will consider its policy options to manage emissions within the cap, including addressing issues such as: how deforestation rights within the cap will be allocated, how to monitor and enforce the deforestation cap, and what actions it will take if the cap is exceeded.

Permanent Forest Sinks Initiative

The Government also instigated a mechanism to create incentives for creating permanent forest sinks. The Permanent Forests Sinks Initiative is a mechanism that would involve landowners receiving sink credits in proportion to the carbon sequestered in their forests. The forest land would be covenanted and managed to create a permanent protection forest.

The Initiative is a contract (registered against land titles) between the Crown and a landowner in perpetuity, and binding on future landowners. Under the contract, the Crown agrees to provide an amount of tradable carbon emission units equal to the amount of carbon sequestered by new forests on a given block of land over CP1. Landowners receive returns only after the amount of carbon sequestered has been measured and verified. All costs and risks associated with the release of the carbon from a stand are borne by the landowner. Landowners are also liable for ongoing monitoring, verification and administrative costs.

Limited harvesting is permitted under the Initiative. Legislation to enact the Permanent Forests Sinks Initiative is currently before the House of Representatives.

The Initiative has wide-ranging benefits beyond climate change, including retiring marginal land, biodiversity enhancement, soil and water conservation, and improved flood protection.

Monitoring carbon stocks

A significant commitment has been made in the collection of data on the stocks of carbon sequestered in forests. Although principally designed for carbon accounting and reporting for climate change purposes, the data gathered by the New Zealand Carbon Accounting System and the Carbon Monitoring System will also help meet some of the Government's other international reporting obligations (eg, the Montreal Process and the Convention on Biological Diversity).

The information is also a prerequisite for New Zealand's ability to claim and trade sink credits.

New Zealand Carbon Accounting System

A carbon accounting and reporting system is being developed for New Zealand's managed forests. The New Zealand Carbon Accounting System comprises five modules: natural forests (indigenous forest and scrublands); planted forests (both pre- and post-1990 plantings); the soil carbon-monitoring system; land-use monitoring; and a database to store all point and spatial data and provide an accounting and reporting function.

Carbon Monitoring System

The Carbon Monitoring System is for indigenous forest and scrublands and will be fully in place by May 2007. It comprises 1,400 grid point locations to identify permanent plots.

Other policies

Forest-industry initiatives

The Government noted (POL Min (03) 26/10 refers) that without measures additional to the above policy package, the decision to retain sink credits and liabilities, including capped deforestation liabilities, would have the following consequences:

- New Zealand generally under-investing in new forest planting, leading to forgone economic benefit from additional carbon sequestration

- higher agricultural emissions than would otherwise be the case, as new forests tend to displace agriculture

- fewer sink credits being generated in the future, perhaps limiting the Government's ability to utilise forest sinks to manage future risks and liabilities and protect New Zealand's competitive position
- increasing emission liabilities as a result of relatively higher rates of deforestation during CP1.

To address these issues, the Government agreed to assign a proportion of the credits, or an equivalent value, to provide incentives, including generic incentives, to retain and enhance forest sinks. These incentives formed the Forest Industry Framework Agreement (FIFA). Initiatives under this package included market access, bio-energy, labour and skills, and market development.

The forest industry has had difficulty in accepting the FIFA, because of issues around deforestation and the Government's retention of sink credits. Towards the end of 2004, the Forest Industries Council, the Forest Owners Association and the Farm Forestry Association put forward a new, amended proposal that suggested the Government address industry development and carbon policy issues separately.

The Forest Industry Development Agenda (FIDA) is the result of that proposal. It includes the majority of the development initiatives included in the FIFA agreement. The FIDA is not concerned with carbon policy issues. The Government has announced that $18 million will be invested to develop the industry.

Non-climate policies with climate co-benefits

In addition to the above policies, there is a range of other policies and programmes that can contribute positive climate change outcomes from forestry. These include: the East Coast Forestry Project; implementation of the Biosecurity Act 1993; and sustainable development frameworks (such as the RMA and soil conservation/land management work undertaken by regional councils).

Many other non-climate policies and programmes contribute to climate change outcomes, including: implementation of Part IIIA of the Forests Act 1949; work by the Queen Elizabeth the Second National Trust; and forestry research by Crown Research Institutes and universities. The Sustainable Farming Fund investigates such issues as biosecurity, conservation biology, forest ecology, forest soils and silviculture of indigenous forests.

Current policy package for LULUCF

In 2002 and 2004, the Government made decisions on climate change and forestry. These included:

- retaining all the sink credits from Kyoto forests and their associated liabilities, at least for CP1

- protecting Kyoto forest owners from any deforestation or harvesting liabilities at any stage where the Crown has retained the forest sink-credit asset

- should the Government decide to devolve forest sink credits in future, devolvng associated deforestation and harvesting liabilities only in proportion to the credits received by the Kyoto forest owner

- assigning a proportion of the credits (or an equivalent value) to provide incentives for establishing and enhancing sinks deforestation liabilities of the non-Kyoto forests, provided these remain within a cap equal to 21 million tonnes of CO_2 equivalent. This is the carbon that would be released by the deforestation of approximately 10% (originally set at 5%) of the area of forest reaching maturity during CP1. In relation to non-Kyoto forests, the Government will:

    - consider its policy options (in the unlikely event that deforestation may exceed expectations) to manage emissions within the cap. This includes addressing issues such as:
        - how deforestation rights within the cap will be allocated
        - how to monitor and enforce the deforestation cap
        - what actions the Government will take if the cap is exceeded

    - consider the deforestation policies for non-Kyoto forests for he scheduled review of climate change policies national rules on forests in the Kyoto Protocol are further clarified

- establishing a mechanism to encourage the establishment of permanent protection sinks (the Permanent Forest Sinks Initiative). The Initiative has been proposed to encourage permanently converting land to forest. Legislation is currently before the House to implement the Initiative

- considering further whether it should elect any additional sink activities under Article 3.4 of the Kyoto Protocol (eg, forest management, revegetation, crop and grazing land management) before 2007 (dependent on availability of carbon accounting data).

3.2.5 Agricultural non-CO_2 emissions

Policy in this area consists of:

- exempting agriculture from emission charges
- co-funding research into mitigation options
- improving inventory.

Exempting agriculture from emission charges

Under the current policy package, agricultural non-CO_2 emissions are exempt from any emissions charges or other compulsory mitigation measures until 2012, for three key reasons (New Zealand Government 2002c):

- the risk to the international competitiveness of the sector and risk of carbon leakage if domestic output reduces (being similar criteria to those for exemptions under NGAs)
- the apparent absence of significant mitigation options (which means that the likely effect of a price measure would be structural adjustment in the sector rather than stimulation of more efficient means of production)
- the difficulty of measuring emissions at farm level (which means that a price measure would not effectively stimulate increased efficiency at that level).

Co-funding research

At the same time, the sector agreed to invest in research to develop cost-effective mitigation options. Following negotiations with industry and further consultation with the farming sector about funding arrangements, a memorandum of understanding on funding arrangements and research responsibilities based on the pastoral greenhouse gas research strategy was signed between the Government and an industry consortium, the Pastoral Greenhouse Gas Research Consortium (PGGRC).[25]

The goals of the research strategy underpinning the memorandum are:

- to identify, establish and develop on-farm technologies to improve production efficiency for ruminants
- to identify, establish and develop on-farm technologies for sheep, dairy and beef cattle and deer that lower methane emissions from New Zealand ruminants and nitrous oxide from grazing animal systems
- to exploit commercial opportunities arising from the science and technologies in a global market.

The target of the research strategy is to have safe, cost-effective greenhouse gas abatement technologies that will lower total New Zealand ruminant methane and nitrous oxide emissions by at least 20% compared with the business-as-usual emissions level by the end of the Kyoto Protocol's CP1; ie, 2012 (Leslie and O'Hara, 2003).

Reductions in inventory uncertainties and improving verification

[25] https://www.pggrc.co.nz/pggrc.asp?type=mou

The Government also funded agricultural inventory research, spending $2.75 million between June 2001 and June 2005. The research programme identified areas of deficiency and undertook work to move the agricultural inventory to a "Tier 2" reporting format, as required under IPCC Good Practice Guidance for key sources. This objective has been achieved.

Despite improvements to the inventory, the estimated uncertainty of absolute non-CO_2 emissions for any given year remains high. Based on a Monte Carlo estimation of uncertainties undertaken for emissions in the year 2002, the uncertainty of total methane emissions was estimated at about ±50%, while the uncertainty for nitrous oxide was estimated at about +73/-50% (Ministry for the Environment, 2005b).

However, the uncertainty surrounding the change in emissions since 1990 is much smaller, since many of the uncertainties are systematic errors that partially cancel when projected emissions during CP1 are compared with 1990 levels. The uncertainty as calculated from the inventory reporting guidelines (UNFCCC, 2004) and Good Practice (IPCC, 2000a) shows overall uncertainty in the trend of emissions to be ±4.9%. The uncertainty introduced into the trend of total emissions by nitrous oxide from agricultural soils is ±1.3%, and the uncertainty for methane from enteric fermentation is ±2.6%.

Based on the current understanding of the non-CO_2 inventory and projections in animal numbers and efficiencies, emissions from the agricultural sector are projected to range from 38.5Mt to 42.0Mt CO_2e per annum over the commitment period, with a mean of 40.4Mt per annum.

The main issues for future development of the agricultural non-CO_2 inventory are:

- to ensure it remains up to date with evolving international best practice and requirements imposed by the UNFCCC process
- to ensure the inventory and related tools for monitoring and verification are able to accurately capture and represent any mitigation activities that may be undertaken within the sector regarding non-CO_2 emissions.

The relevance of these inventory requirements, and work that may be required to achieve these objectives, are discussed in more detail in Section 4.7

3.2.6 Transport

Transport policy framework – introduction

Institutional arrangements for transport in New Zealand are divided between central government and local government. Central government provides the framework for policy and rule-making, transport investment and funding, and the regime for transport-user charging. The Crown is also involved as an owner of transport infrastructure and assets. Local government owns infrastructure and assets (eg, roads, port assets), is responsible for funding and maintaining infrastructure and administering public transport, and is also responsible for developing, maintaining and implementing strategic transport plans.

The following sections provide detail on the way in which climate change policies have overlaid, and impacted on, the existing transport framework.

The Climate Change Policy Package and Foundation Policies

The New Zealand Climate Change Policy Package and accompanying "Foundation Policies" were released in stages during 2001 and 2002. The Foundation Policies were the National Energy Efficiency and Conservation Strategy (NEECS), released in two parts in 2001 and 2002, and the New Zealand Transport Strategy (NZTS) released in 2002. The NEECS and the NZTS were developed independently, but designed to be complementary to the Climate Change Policy Package.

For the transport sector, the most significant measure announced to date is the $15 per tonne of carbon tax from 2007, which would apply to the use (within New Zealand) of all petroleum-based transport fuels: diesel, fuel oil, jet fuel, aviation gas, LPG, CNG and petrol. Petroleum fuels used for international transport would be excluded.

In addition, the implementation of NGAs and the Energy-Intensive Business Policy has some implications for transport. For example, NGAs can cover transport that is directly part of the industry's operation (eg, use of mining trucks). In the Energy Intensive Business Policy, some transport – particularly road haulage and transportation of tourists – is covered. This policy provides enterprises with financial assistance available through energy audits and demonstration pilots.

National Energy Efficiency and Conservation Strategy

The NEECS is enshrined in legislation, in the Energy Efficiency and Conservation Act 2000. It sets out objectives, policies, targets and associated measures to improve energy efficiency and the uptake of renewable energy. One of the six objectives of the strategy is to reduce CO_2 emissions, and transport is one of five areas in which an Action Plan was developed.

The NEECS established economy-wide targets for energy efficiency and the use of renewable energy sources by 2012. These targets are not mandated; rather, they are regarded as aspirational.

Nevertheless, it was expected that these targets would increasingly be incorporated into, and be supported by, other government policy areas, and that all sectors would contribute to them according to the opportunities available within those sectors; eg:

- the target of 20% improvement in economy-wide energy efficiency by 2012. With transport responsible for over 40% of consumer energy, achievement of the target would require a significant improvement in the efficiency of transport energy use
- the target of 30 PJ of renewable energy, with an indicative target of 2 PJ established for transport. The target of 2 PJ is equivalent to about 1% of New Zealand's total domestic transport energy use for 2004.[26]

Responsibilities for implementing the NEECS are spread between a number of government departments and agencies.[27] The main measures for transport are listed below, with lead agencies in brackets:

- investigate road pricing policy (MOT)

[26] Total energy consumed by transport in 2004 was 210 PJ. New Zealand, Ministry of Economic Development (2005)

[27] Note that since 2001, some of the lead agencies have changed: the Ministry of Transport has taken over work on fuel consumption information and Land Transport New Zealand was previously known as Transfund.

- improve the effectiveness of funding alternatives to roading (MOT, Land Transport New Zealand)
- facilitate and promote travel demand initiatives (EECA, Land Transport New Zealand, local government)
- investigate vehicle efficiency standards (MOT)
- investigate and deploy vehicle fuel consumption information (EECA)
- facilitate eco-efficient vehicles into public and private fleet (EECA)
- develop a renewable energy transport fuels programme (EECA and MOT).

The Ministry for the Environment and the oil and motor industries provide support.

Although the Action Plan for transport identified some timelines for report-backs and the development of proposals, many of the measures were described as “ongoing”. The programmes identified were not prioritised and there were no specific targets for the different activities within them.

The NZTS

The NZTS was released in 2002. It takes a sustainable-development approach to transport policy, addressing modal roles and different users’ needs. The strategy vision is that “by 2010 New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system”. Recognised within the strategy is the need to integrate and manage multiple objectives.

The NZTS has five objectives:

- assisting economic development
- assisting safety and personal security
- improving access and mobility
- protecting and promoting public health
- ensuring environmental sustainability.

The environmental-sustainability objective encompasses the need for more energy-efficient modes of transport and the need to reduce greenhouse gas emissions from the transport sector. There is also a potential synergy, where some actions to address access and mobility and public-health objectives can also result in CO_2 emissions reductions.

Before the NZTS, transport funding and operational agencies had a focus on “safety and efficiency at reasonable cost”. The subsequent enactment of the Land Transport Management Act 2003 has helped to embed the concepts of the strategy into the development of national and regional work programmes. Transport agencies must reflect the shift to the new "sustainable transport" paradigm within their policy and operational outputs. The Act provides for long-term planning of transport networks, integrated transport infrastructure, a multi-modal approach to the sector, and new mechanisms for funding roads. This has particularly flowed through to the funding regime administered by Land Transport New Zealand, and the further development of integrated Regional Land Transport Strategies prepared by local government.

Key to the NZTS (supported by the Land Transport Management Act 2003) is that it is a way of working rather than an action plan. The focus is on meeting environmental, social and economic objectives and all five objectives must be considered. The strategy does not identify specific short- and long-term work programmes, although it does identify some initiatives under each of the objectives as examples.

Complementary and other transport strategies

More recent developments that build on the principles of the NZTS are found in the Government's "Sustainable Energy" Discussion Document, released in October 2004. It included objectives for energy policy and "ways forward" for transport. It did not, however, confirm or develop any policies specifically for transport.

Other government strategies include:

- "Getting there – on foot, by cycle", released in February 2005, which supports active modes of transport

- the National Rail Strategy, released in May 2005. Following the national rail network being brought back into public ownership in 2004, and the subsequent commitment of $200 million in asset investment and maintenance, the strategy sets out the Government's rail policy objectives and priorities for action over the next 10 years.

CO2 emissions reductions as a co-benefit of other policy objectives

Reducing use of petroleum-based transport fuels, as well as reducing CO_2 emissions, also assists in achieving other government objectives.

There are also other government objectives where actions taken to achieve the objectives increase CO_2 emissions. This is because increased transport is integral to achieving those objectives (eg, where the emphasis is on improved access and mobility). National policy documents that affect transport include: Growing an Innovative New Zealand, the New Zealand Tourism Strategy, the New Zealand Health and Disability Strategies, and the New Zealand Waste Strategy. These are noted in the NZTS and highlight the multiple objectives in managing transport.

In summary, although there are tensions between government objectives for transport, there are also significant co-benefits for other environmental and social objectives.

Table 5: Summary of Other Policy Objectives' Positive and Negative Effects on Transport CO_2 Emissions

Policy Area	Positive Effects (reinforces CO_2 emissions reduction)	Negative Effects (indirectly leads to increased CO_2 emissions)
Road safety	Speed-control policies will reduce aerodynamic drag losses on vehicles and improve fuel efficiency Safety of vulnerable road users (eg, walkers, cyclists, motorcyclists) will improve	Meeting vehicle-safety concerns may result in increased weight and reduced fuel efficiency
Growth and innovation	An emphasis on high value-added production will lead to lower CO_2	In itself, economic growth translates to higher consumer spending on transport services and fuels Strong pattern of increased discretionary expenditure on transport services is created
Urban area design	People-friendly urban areas will emphasise low CO_2 travel modes	Large investments in transit systems/ facilities may not give net CO_2 benefits over the short term
Health and welfare	Physical exercise message reinforces low CO_2 forms of travel (for short distances) Vehicle-emissions controls that target inefficient vehicles will have small CO_2 emissions benefit	Providing access and mobility for the transport-disadvantaged may increase fuel use
Urban air quality	NES[28] for air generally supports more efficient engine combustion and lower CO_2 emissions Biodiesel use reduces particulate emissions	Some technologies to reduce toxic emissions can increase fuel use
Energy security	Fuel savings/conservation will give commensurate reductions in CO_2	Incentives for oil exploration will tend to reinforce status quo regarding CO_2

[28] NES = National Environmental Standard developed under the Resource Management Act 1991. The air NES sets ambient air standards for toxic emissions.

3.2.7 Foundation and other non-price policies

Foundation policies

These policies were already in existence in 2002 and had been established primarily for reasons other than climate change. However, they were expected to contribute to climate change outcomes.

The Government's **Growth and Innovation Framework** is designed to focus the Government and New Zealand business on an innovative, knowledge-driven approach to business development. This is to prepare New Zealand businesses to operate in a global market where greenhouse gas emissions increasingly have a cost and innovations and new technologies are required. This process is expected to create significant business opportunities in parts of the economy (and increased costs in others). "Climate-friendly" processes could also become an element of competitive advantage.

The **National Energy Efficiency and Conservation Strategy (NEECS)** was released in 2001. The NEECS has two high-level targets:

- a 20% improvement in economy-wide energy efficiency by 2012
- an additional 30 PJ of renewable energy above 2000 levels by 2012.

When the strategy was developed, it was estimated that achieving these targets would contribute emissions reductions of about 20Mt CO_2e during CP1, but it was noted that their achievement would depend on relevant programmes and actions being adequately funded and carried out. NEECS programmes and policies have been outlined in Section 4.4.

The **NZTS** includes an aim of environmental sustainability. Relevant transport policies have been outlined in Section 3.2.6.

At the time of the confirmed policy package, officials were aware that although synthetic greenhouse gases accounted for less than 1% of total emissions, imports (and hence emissions risk) were increasing rapidly. It was considered that appropriate policy interventions could yield significant reduction in emissions risk. Both of the policies set down for the pre-commitment period (voluntary handling programmes for HFCs and PFCs and an industry agreement to limit leakage of SF_6) have been implemented. Officials will soon advise the Government on whether these gases should now be regulated or be the subject of further non-regulatory policy initiatives.

In the confirmed policy package, the **New Zealand Waste Strategy** was relied on to create the incentives needed to reduce emissions and to reduce the variability across the country's waste facilities. A review of the success of the Waste Strategy was undertaken in 2004 and another is planned for 2006. Use of a waste levy was considered in 2003, but it was decided at that time to focus on developing a framework product stewardship approach to key waste streams instead. In addition, a National Environmental Standard for landfill methane was developed and came into force in 2005 to help manage greenhouse gas emissions. The Waste Strategy, along with current trends in the sector, was expected to reduce methane emissions from waste by 5Mt CO_2e during CP1 (this is 36% below 1990 levels).

Public awareness programmes have been developed and implemented to increase awareness of climate change and to assist New Zealanders in taking actions to reduce greenhouse gas emissions and make a difference. The 4 Million Careful Owners programme has included two outreach campaigns and a website linked from the Government's climate change website (www.climatechange.govt.nz). It generated increased awareness, as measured in surveys. Other elements of the programme include advertising, promotion, community education and partnership programmes with key groups.

Local government and the **RMA** are also important foundation policies. Local government in New Zealand is a large sector and undertakes a wide range of activities related to infrastructure and service provision (eg, roading, water and waste). It also has important regulatory and planning powers and plays a community leadership role. The Ministry for the Environment has partnered with Local Government New Zealand and EECA to promote the international Cities for Climate Protection model to councils.

There were many requests to clarify the role of the RMA in mitigating greenhouse gas emissions at a regional or local level. In March 2004, the RMA was amended by the Resource Management (Energy and Climate Change) Amendment Act to remove regional councils' ability to directly control greenhouse gas emissions through resource consents and regional plans. This put into law the Government's preference that industrial emissions be dealt with through national policies (as described above). This in no way limits councils' ability to reduce greenhouse gas emissions in the community through other means (eg, voluntary programmes and measures) and in their own operations.

The same Amendment Act made other amendments designed to:

- encourage energy efficiency
- ensure that renewable energy is given due weight in consent decisions
- direct local authorities to consider the effects of climate change in their day-to-day activities.

Policies to assist New Zealand in **adapting to climate change impacts** are also considered part of the foundation policies. They are not considered in this Review, as adaptation is not within its scope.