Ministry for the Environment
Manatū Mō Te Taiao

ENERGY SUPPLY AND DEMAND

Environmental Report Card
July 2009

Summary

Energy is an essential part of everyday life. Virtually all of our everyday activities and productive processes involve energy in one form or another. Fuels and electricity power our transport systems, heat our buildings and produce the goods and services that underpin New Zealand's economic and social well-being.

Because energy is such an essential part of almost all our activities, a secure, sustainable and affordable supply is vital to ensuring New Zealand's continued economic and social well-being.

We meet our energy needs through a wide range of sources, both renewable (hydro, geothermal, wood, wind, biogas and solar) and non-renewable (fossil fuels such as oil, gas and coal). Around two-thirds of our energy supply is non-renewable, and a growing proportion of our electricity is generated from non-renewable sources.

All forms of energy production and use have an impact on the environment. For example, our use of non-renewable fossil fuel energy contributes to greenhouse gas and particulate emissions, which have negative impacts on the environment and human health. On the other hand, the installation of wind farms contributes to localised ecosystem and aesthetic impacts, and geothermal extractions can have environmental impacts on local land and water.

As a nation, our energy use is growing; particularly transport energy. While much of this growth can be attributed to population growth, we are also using more energy on a per person basis. In recent years, however, New Zealand's economic growth has exceeded growth in energy demand, indicating that our economy is relying less on energy to generate wealth than in the past.

This report card examines energy from an environmental perspective. It seeks to capture the key environmental implications associated with trends in energy production (supply) and use (demand) in New Zealand.

Recognising the specific environmental impacts associated with each type of energy production and use, and tracking how New Zealand's energy profile is changing over time is important when developing energy policy. It gives decision-makers the information they need to set the environmental and health impacts of energy options alongside economic and other considerations.

This report card provides information on four energy indicators.

Total consumer energy demand

CURRENT SITUATION: In 2007, 508 petajoules of energy was used in New Zealand. This equates to 120 gigajoules per person.

Getting worse

TREND: Between 2005 and 2007, the total amount of energy used in New Zealand increased by 3 per cent, to 508 petajoules. While population growth accounts for some of this increase, it does not account for all of it: per person energy use increased by 0.8 per cent over the same period. This continues the long-term trend, where energy use in New Zealand increased 20 per cent between 1998 and 2007, with an 8 per cent increase per person over the same period. With fossil fuels accounting for 63 per cent of New Zealand's energy use in 2007, its associated environmental impacts continue to dominate.

INTERNATIONAL COMPARISON: The comparison of New Zealand's energy use to other Organisation for Economic Co-operation and Development (OECD) countries delivers mixed results. At the national level, our total energy use ranks well – we have the fourth lowest total energy use in the OECD (as might be expected from a small country with a small population). However, New Zealand is average on a per person basis, using more energy per person than 17 of our OECD peers (30 countries are members of the OECD).

Consumer energy demand compared to gross domestic product

CURRENT SITUATION: In 2006, 4 gigajoules of energy was required to add $1000 in value to New Zealand's economy.

Getting better

TREND: Between 2004 and 2006 the amount of energy required to add $1000 in value to New Zealand's economy fell (improved) by 4.8 per cent. This continues a long-term trend. Between 1990 and 2006, the energy required to add $1000 in value to New Zealand's economy improved by almost 15 per cent. Although this does represent, at least to some degree, an increase in how efficiently our economy makes use of energy, it also reflects a continued shift towards less energy-intensive economic activity.

INTERNATIONAL COMPARISON: The energy intensity of New Zealand's economy compares poorly with our OECD peers. We use more energy to add $1000 in value to our economy than 20 other OECD countries.

Total primary energy supply

CURRENT SITUATION: In 2007, 752 petajoules of primary energy was supplied for energy production in New Zealand. This equates to 178 gigajoules per person. (Primary energy is that found in natural resources, such as coal, oil and lakes, before it is converted or transformed.)

Little or no change

TREND: Between 2005 and 2007, the amount of primary energy supplied for energy production in New Zealand increased by 1 per cent, to 752 petajoules. This short-term growth in the supply of primary energy for energy production is consistent with the long-term trend – a 4.3 per cent increase in total primary energy supply between 1998 and 2007. While the supply of renewable energy grew by 4 per cent between 2005 and 2007, this goes against the long-term trend – between 1998 and 2007, the share of primary energy derived from renewable energy sources decreased. Given the environmental impacts in producing non-renewable sources of energy, their continued dominance of New Zealand's total primary energy supply is of environmental concern.

INTERNATIONAL COMPARISON: New Zealand has the fifth lowest level of primary energy supply in the OECD (as might be expected from a small country with a small population), and has the third highest percentage of total primary energy supply produced from renewable resources in the OECD.

Electricity generation

CURRENT SITUATION: In 2007, 153 petajoules of electricity was generated in New Zealand. This equates to 36 gigajoules per person.

Mixed

TREND: Between 2005 and 2007, the total amount of electricity generated in New Zealand grew by 1.7 per cent, to 153 petajoules. However, electricity generation on a per person basis dropped by 0.5 per cent over this period. The short-term growth in electricity generation is consistent with the long-term trend – a 15 per cent increase in electricity generation between 1998 and 2007. However, the short-term drop in per person electricity generation runs counter to the overall 3.8 per cent increase in per person electricity generation between 1998 and 2007. While the recent drop may signal an

improvement in electricity use on an individual basis, the 47 per cent increase in the use of coal and natural gas for electricity generation between 1998 and 2007 has contributed to a 68 per cent increase in electricity-related greenhouse gas emissions over the same period.

INTERNATIONAL COMPARISON: While New Zealand's total electricity generation is the seventh lowest amongst the 30 OECD countries, we have the eighth highest per person electricity generation in the OECD.

Future watch

Population size and economic activity will continue to be the major drivers in energy production and use in New Zealand. While the projected growth of New Zealand's population is likely to increase total demand for energy, increasing awareness and the use of energy-efficient technologies could result in future reductions of energy use per person. In the short term, however, the economic recession is likely to significantly affect the production and use of energy. With a slowdown in economic activity, energy use by industrial and commercial sectors is likely to fall. The depth and length of this recession, as well as associated changes in the composition of the economy, are likely to be key factors in determining any changes in short-term energy demand in New Zealand.

Introduction

Energy is an essential part of everyday life. Virtually all of our everyday activities and productive processes involve energy in one form or another. Fuels and electricity power our transport systems, heat our buildings and produce the goods and services that underpin New Zealand's economic and social well-being.

Because energy is such an essential part of almost all our activities, a secure, sustainable and affordable supply is vital to ensuring New Zealand's continued economic and social well-being.

We meet our energy needs through a wide range of sources, both renewable (hydro, geothermal, wood, wind, biogas and solar) and non-renewable (fossil fuels such as oil, gas and coal). Around two-thirds of our energy supply is non-renewable, and a growing proportion of our electricity is generated from non-renewable sources.

All forms of energy production and use have an impact on the environment. For example, our use of non-renewable fossil fuel energy contributes to greenhouse gas and particulate emissions, which have negative impacts on the environment and human health. On the other hand, the installation of wind farms contributes to localised ecosystem and aesthetic impacts, and geothermal extractions can have environmental impacts on local land and water.

As a nation, our energy use is growing; particularly transport energy. While much of this growth can be attributed to population growth, we are also using more energy on a per person basis. On the positive side, in recent years New Zealand's economic growth has exceeded growth in energy demand, indicating that our economy is relying less on energy to generate wealth than in the past.

Text box 1: What are environmental report cards?

Environment New Zealand 2007, the country's second national state of the environment report, provided information from around 115 national-scale environmental data sets. Its primary focus was to report on the 66 national data sets that constitute New Zealand's core set of 22 environmental indicators. These indicators cover 10 domains: four 'pressures' on the environment (consumption, transport, energy and waste), and six 'states' of the environment (air, atmosphere, land, fresh water, oceans and biodiversity).

A key focus of the Ministry for the Environment's national environmental reporting programme is to produce a series of 'report cards' to provide updated information on the indicators reported in *Environment New Zealand 2007*. This is one such report card.

About this report card

All analysis in this report card is conducted from an environmental perspective. As such, it captures some of the key environmental effects associated with trends in energy production (supply) and use (demand).

To that end, this report card reports and analyses short-term and long-term trends associated with the following four indicators:

- total consumer energy demand
- consumer energy demand compared to gross domestic product
- total primary energy supply
- electricity generation.

Data is further analysed to provide better insight into important underlying trends, for example, by considering per person trends and making international comparisons.

The energy indicators were last reported in *Environment New Zealand 2007*, using data up to 2005. This report card updates that information and expands on some areas not previously discussed.

Text box 2: Units of measurement

The joule (J) is commonly used as the standard unit of measurement in energy statistics. It is the derived unit of energy in the International System of Units. One joule is the amount of energy required to heat 1 cubic centimetre of water by 0.239 of a degree Celsius (Ministry of Economic Development, 2008a).

In reality, a joule is a very small unit of energy. This report card therefore uses gigajoules (GJ) and petajoules (PJ) in its reporting. A gigajoule (10^9 or 1,000,000,000 joules) is comparable to the amount of energy in 33 litres of petrol. A petajoule (1,000,000,000,000,000 or 10^{15} joules) is comparable to the load of a coastal oil tanker (approximately 20,000 tonnes of oil or 40,000 tonnes of coal), or the amount of electricity consumed by 36,000 average New Zealand homes annually (Electricity Networks Association, no date).

Converting all types of energy into joules simplifies comparisons between a range of energy types (coal, gas, electricity, etc), and allows for easier international comparisons of energy statistics.

Key findings

Total consumer energy demand

This indicator measures the total amount of energy used by consumers in New Zealand. It is measured by specific energy type, and by consumer type. Because it is a measure of the end-use of energy, it excludes:

- any energy used for non-energy purposes (eg, coal used as a raw material in steel manufacturing)
- any energy loss resulting from the transformation of energy from its initial state (primary energy) into a more convenient useable state (consumer energy) (eg, converting geothermal heat into electricity)
- any energy used to bring useable energy to the final consumer (eg, electricity transmission losses).

It is important to measure energy use because it can have both direct and indirect impacts on the environment:

- Direct impacts include those resulting from the use of the energy itself, such as greenhouse gas and particulate emissions from the combustion of fossil fuels (Ministry for the Environment, 2007).
- Indirect environmental impacts of energy use are those that arise from demand. For example, how electricity is used may not necessarily have a direct impact on the environment, but the demand for electricity influences the supply of electricity – and there are environmental impacts associated with its production (see page 18).

As New Zealand's population grows and lifestyles change, so do our energy needs. Because the environment has a finite capacity to absorb wastes, and some types of energy use have impacts on human health, it is important to minimise those impacts. We therefore need to develop a clearer perspective of:

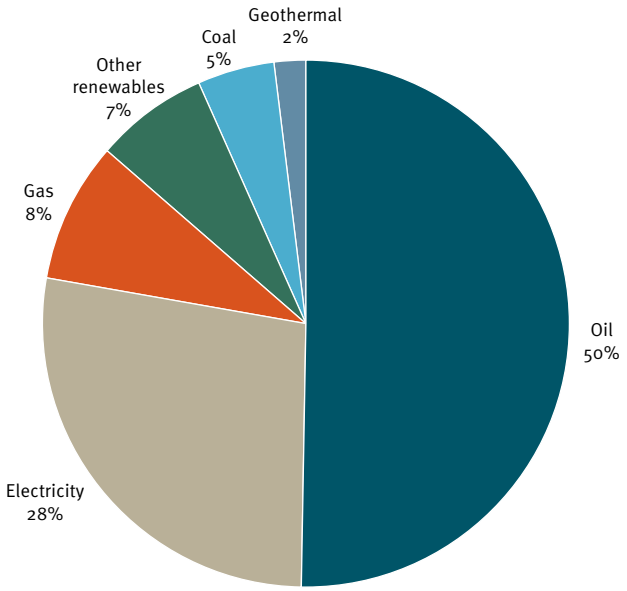
- what types of energy are used by which sectors
- the environmental impacts associated with specific uses
- what drives the demand for specific energy types.

Current situation

In 2007, the total consumer energy demand in New Zealand was 508 petajoules, or approximately 120 gigajoules per person. This is equivalent to approximately 3400 litres of petrol per person (Ministry of Economic Development, 2008a).

As shown in figure 1, in 2007, nearly two-thirds (63 per cent) of New Zealand's consumer energy demand was met by fossil fuels (oil, gas and coal). Petrol and diesel dominated, respectively accounting for 44 per cent and 42 per cent of total oil use (Ministry of Economic Development, 2008a). Electricity accounted for 28 per cent of our energy use, while geothermal accounted for 2 per cent, and other renewable energy sources made up 7 per cent (biogas, wind, wood and solar).

+ FIGURE 1
CONSUMER ENERGY DEMAND IN NEW ZEALAND BY FUEL TYPE, 2007



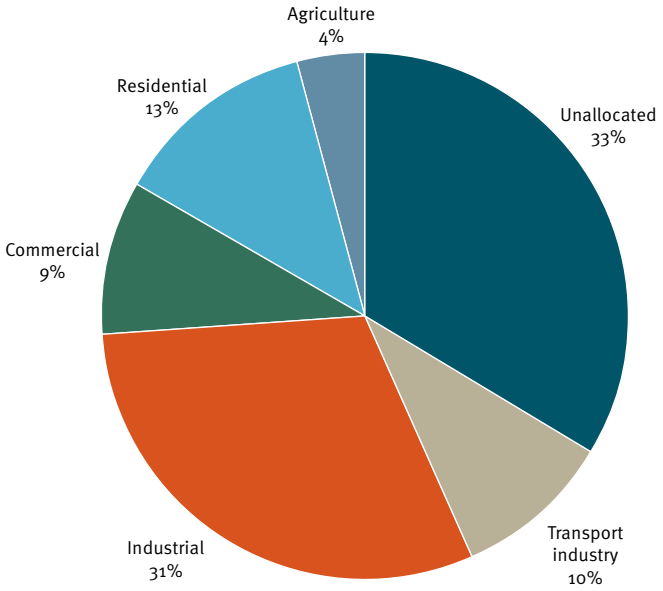
Note: 'Other renewables' include solar water heating and electricity generation from wind, biogas and wood.
Data source: Ministry of Economic Development, 2008a.

Figure 2 shows different sectors' demand for energy in 2007. Industry used the largest share of energy (31 per cent), followed by the residential sector (13 per cent), transport industry (10 per cent), commercial sector (9 per cent), and agricultural sector (4 per cent). Thirty-three per cent of energy demand was 'unallocated'.

'Unallocated' energy demand is fuel sold through all service stations and other independent delivery services, eg, marina refuelling facilities and farm delivery services (Ministry of Economic Development, 2008a). Traditionally it was assumed that this fuel was for 'on'-road use and was therefore included under transport. However, a recent review of liquid fuel use in New Zealand has indicated that a large percentage of this 'unallocated' energy demand was being used by farmers, earth moving contractors, and forestry and fishing operators, whose primary activity is 'off'-road (Ministry of Economic Development, 2008b). As a result, the current method of data collection used to inform this report card was found to over-allocate liquid fuel use to transport, with a corresponding under-allocation of fuel use to the agriculture, forestry and mining and industrial sectors (Ministry of Economic Development, 2008b).

+ FIGURE 2

CONSUMER ENERGY DEMAND IN NEW ZEALAND BY SECTOR, 2007



Notes: (1) The 'Industrial' sector includes primary industry not accounted for in the other sectors – food processing; textiles; wood, pulp, paper, and printing; chemicals; non-metallic minerals; basic metals; mechanical/electrical equipment; and building and construction.

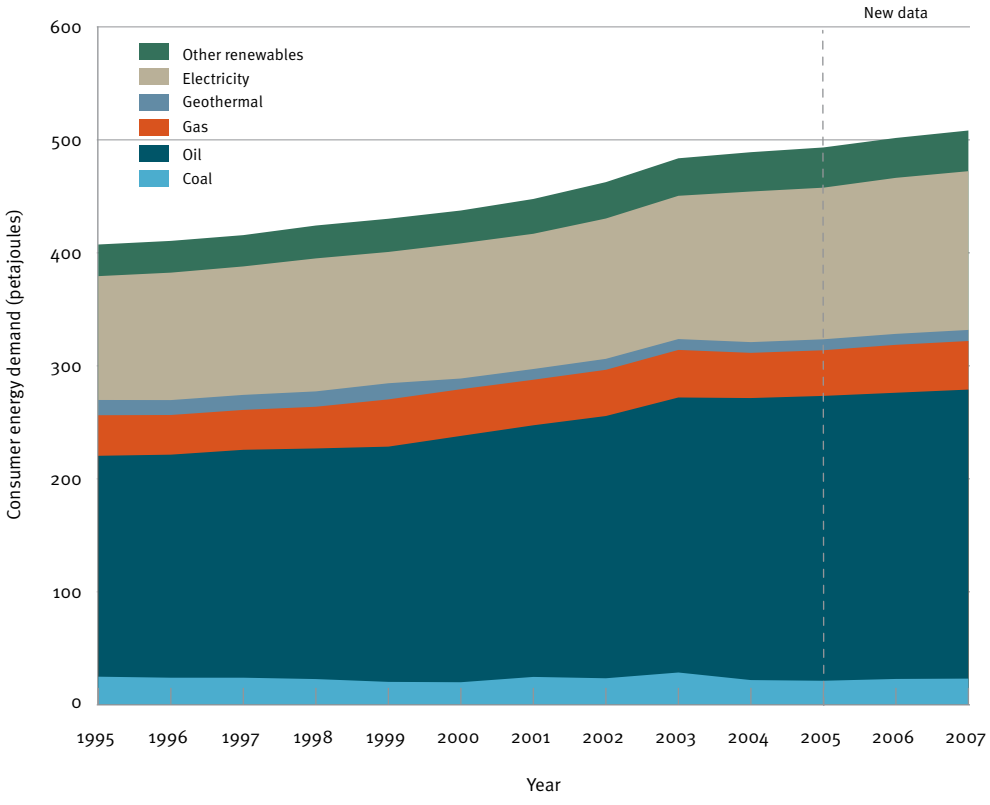
(2) 'Transport industry' refers to fuel sold to freight and transportation companies.

(3) 'Unallocated' refers to fuel sold through all service stations and other independent delivery services, eg, marina refuelling facilities and farm delivery services.

Data source: Ministry of Economic Development, 2008a.

+ FIGURE 3

TOTAL CONSUMER ENERGY DEMAND IN NEW ZEALAND BY FUEL TYPE, 1995–2007



Note: 'Other renewables' includes solar water heating and electricity generation from wind, biogas and wood.

Data source: Ministry of Economic Development, 2008a.

Long-term trend

Total consumer energy demand in New Zealand increased by 20 per cent between 1998 and 2007. As seen in figure 3, apart from a slight surge between 2000 and 2003, growth in energy use was relatively steady between 1998 and 2007.

Total consumer energy demand met by renewable energy, including solar, wind, biogas and wood, grew by 24 per cent between 1998 and 2007.

More significant was the growth in the use of non-renewable energy – between 1998 and 2007 the use of fossil fuels increased by 22 per cent. Oil saw the greatest increase, up 25 per cent, with gas and coal also increasing, by 17 and 2 per cent respectively.

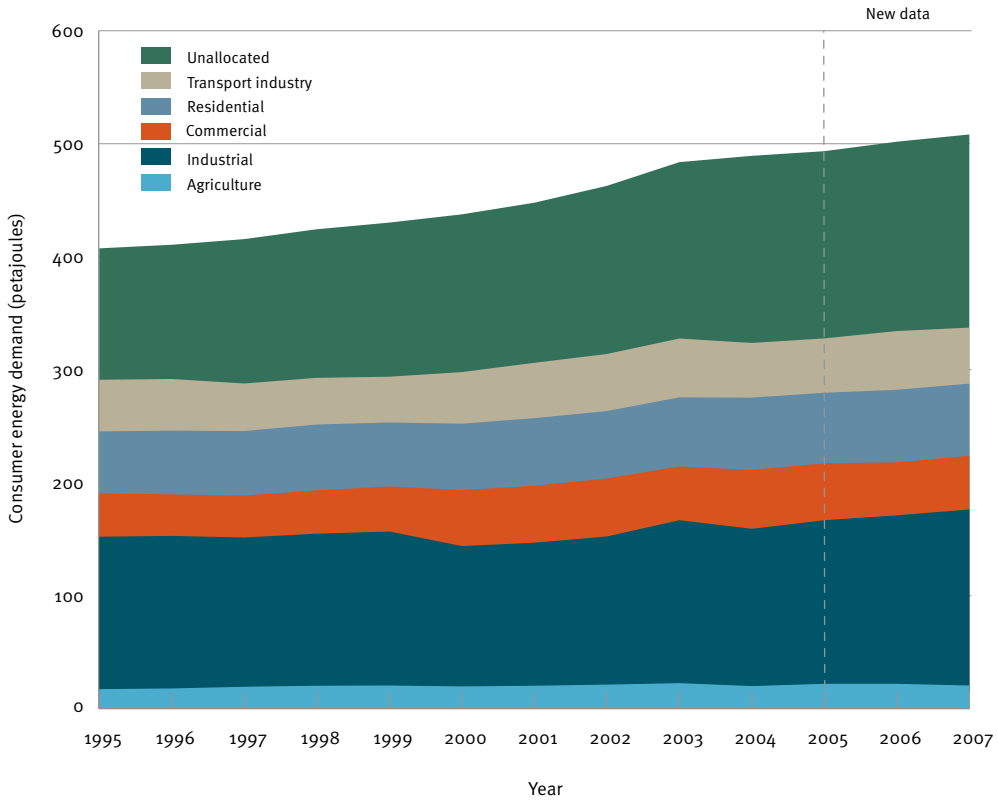
A key factor contributing to this increased use of oil is the 20 per cent increase in the use of energy by the transport industry between 1998 and 2007. The 17 per cent increase in gas consumption over this period is due to its increased use in electricity generation and methanol production (Ministry of Economic Development, 2008a).

An important environmental impact associated with the increasing use of energy for transport is an increase in greenhouse gas emissions. Between 1998 and 2007, transport-related greenhouse gas emissions increased in New Zealand by 28 per cent, accounting for 46 per cent of all of our energy-related greenhouse gas emissions in 2007 (Ministry of Economic Development, 2008c).

The largest growth of allocated energy use between 1998 and 2007 was found in the commercial sector (24 per cent), followed by the transport sector (20 per cent), industrial sector (16 per cent), residential sector (9 per cent), and agricultural sector (1 per cent) (see figure 4).

+ FIGURE 4

TOTAL CONSUMER ENERGY DEMAND IN NEW ZEALAND BY SECTOR, 1995–2007



Notes: (1) The 'Industrial' sector includes primary industry not accounted for in the other sectors; food processing; textiles; wood, pulp, paper, and printing; chemicals; non-metallic minerals; basic metals; mechanical/electrical equipment; and building and construction.

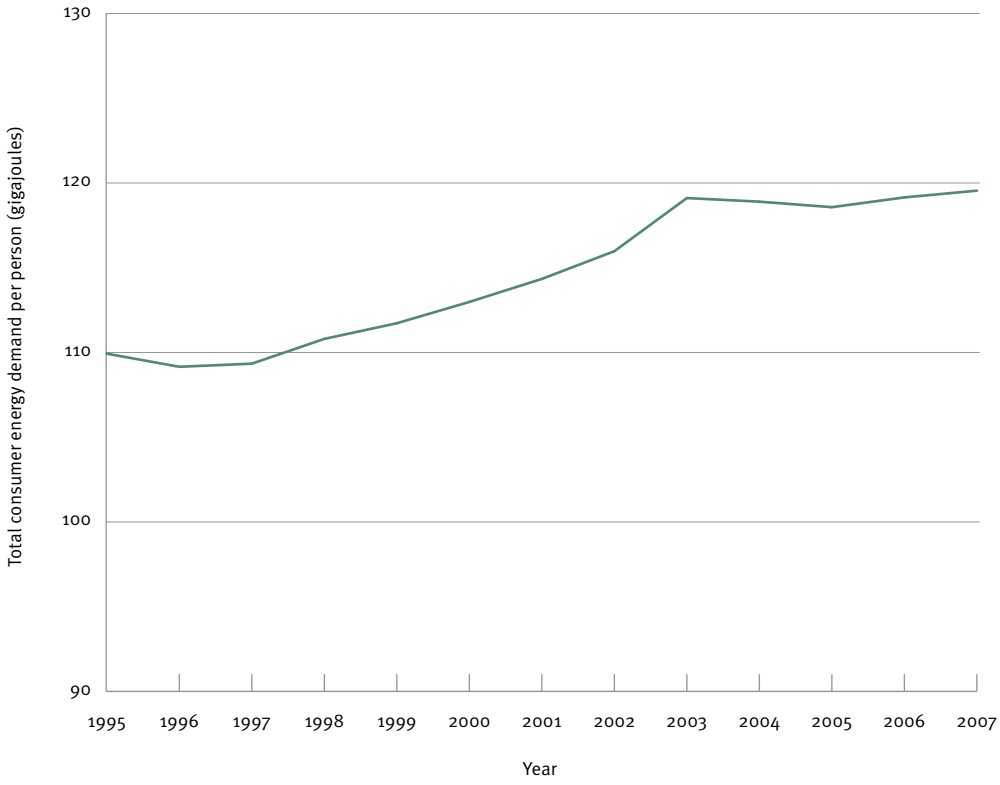
(2) 'Transport industry' refers to fuel sold to freight and transportation companies.

(3) 'Unallocated' refers to fuel sold through all service stations and other independent delivery services, eg, marina refuelling facilities and farm delivery services.

Data source: Ministry of Economic Development, 2008a.

While an increase in population accounts for some of the increase in energy use seen in figures 3 and 4, it does not account for all of it. Figure 5 shows the change in per person energy demand between 1995 and 2007. The long-term trend is one of growth: per person energy use increased by 8 per cent between 1998 and 2007.

+FIGURE 5
TOTAL CONSUMER ENERGY DEMAND PER PERSON IN NEW ZEALAND, 1995–2007



Data source: Ministry of Economic Development, 2008a; Statistics New Zealand, 2008a.

Getting worse

New Zealand's energy use per person continues to increase.

Recent trend

Between 2005 and 2007, total consumer energy demand increased by 3 per cent, while demand per person increased by 0.8 per cent. This pattern of growth is consistent with trends observed between 2003 and 2005.

There was an increase in the use of every energy type between 2005 and 2007. A 5 per cent increase in the use of electricity led this growth, followed by a 3 per cent increase in the use of fossil fuels and a 1 per cent increase in the use of other renewables. Although the rates of growth for each energy type differed over the two-year period, the proportion of each type used remained relatively unchanged.

Similar patterns of growth were found in the industrial sector (8 per cent), residential sector (2 per cent), transport industry sector (3 per cent), and unallocated (3 per cent). Commercial and agricultural sector use of energy fell by 6 and 7 per cent respectively.

While New Zealand ranks well in the OECD for total primary energy demand, it is only average when this demand is allocated per person.

International comparison

According to the latest OECD comparative data, New Zealand's total energy demand is comparatively low among OECD countries, with only Luxembourg, Iceland and the Slovak Republic using less energy (Organisation for Economic Co-operation and Development, 2008). However, when demand is allocated on a per person basis, New Zealand is only average, using more energy per person than 17 of our OECD peers (Organisation for Economic Co-operation and Development, 2008). This high per person ranking is due largely to our heavy reliance on private motor vehicles. And, while New Zealand's per person energy use still falls below the OECD average, the rate at which it increased between 1996 and 2006 was greater than that of the OECD average (Organisation for Economic Co-operation and Development, 2008).

Text box 3: Energy and greenhouse gases

Greenhouse gases are atmospheric gases that absorb infrared radiation from the Earth's surface. By absorbing heat that would otherwise be lost, greenhouse gases contribute to increasing the Earth's temperature (Ministry of Economic Development, 2008c). Such gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), carbon monoxide (CO), other oxides of nitrogen (NO_x), non-methane volatile organic compounds (NMVOCs), and water vapour (H_2O). While these gases are naturally occurring, human behaviour is increasing their abundance in our atmosphere (Intergovernmental Panel on Climate Change, 2007).

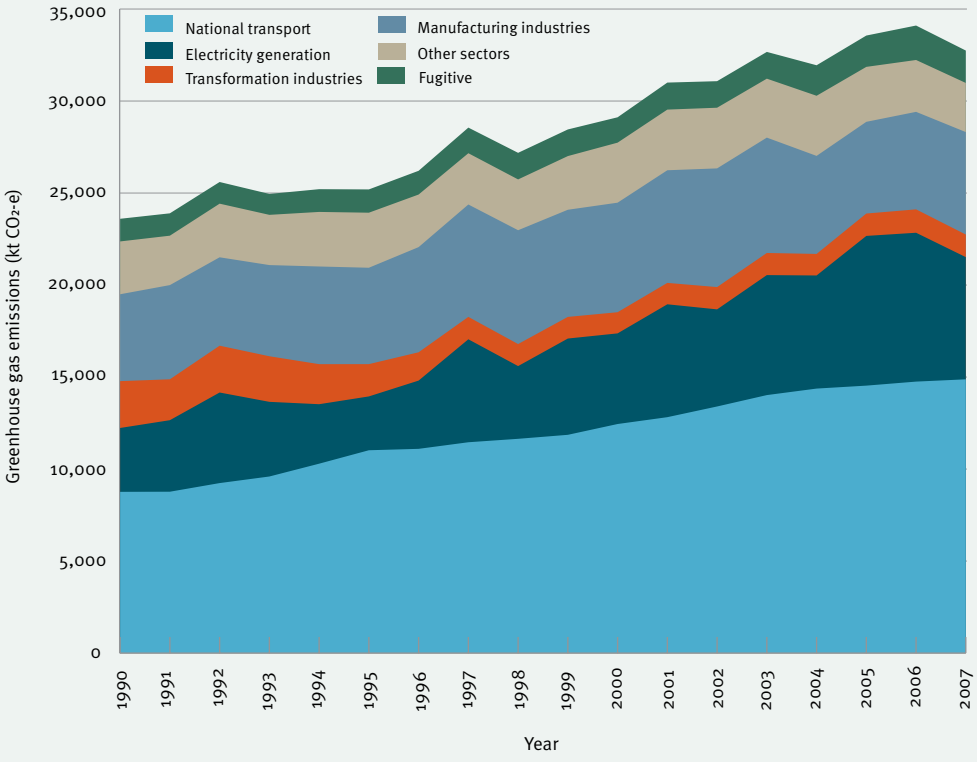
The production and use of energy accounts for 44 per cent of New Zealand's greenhouse gas emissions. New Zealand's energy sector produces two types of greenhouse gas emissions – combustion and fugitive. Combustion emissions come from burning fuel to produce energy. Examples are burning oil for transport and burning coal for thermal electricity generation. In 2005, our CO_2 emissions from fuel combustion were 8.5 tonnes per person (Ministry of Economic Development, 2008c).

Fugitive emissions are much smaller in quantity. They arise from processing or transforming fuels. Examples include the venting of CO_2 in the process of gas extraction and emissions from geothermal fields in the process of electricity generation.

Greenhouse gas emissions attributed to New Zealand's energy sector have increased by 39 per cent since 1990. This represents the second largest increase in greenhouse gas emissions from the energy sector of any OECD country (Ministry of Economic Development, 2008c). Figure 6 shows the trends in energy-related greenhouse gas emissions in New Zealand by sector between 1990 and 2007.

+FIGURE 6

ENERGY-RELATED GREENHOUSE GAS EMISSIONS IN NEW ZEALAND BY SECTOR, 1990–2007



Notes: (1) Emissions are a measure of the combined climate changing potential of multiple greenhouse gases. Emissions of each gas are converted to an amount of CO_2 that would cause the same climate change impact and summed to produce kilotonnes (kt) CO_2 equivalent (-e).

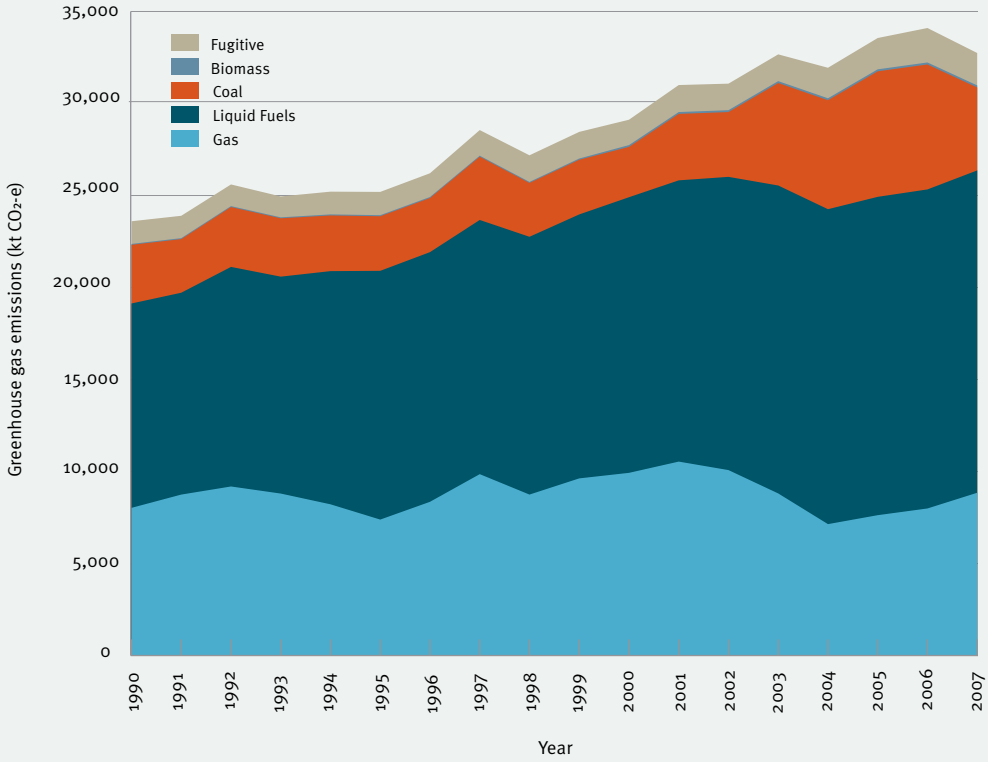
(2) The sources of transformation emissions in New Zealand include petroleum refining; synthetic petrol production; and oil and gas extraction and processing.

Data source: Ministry of Economic Development, 2008c.

National transport continues to contribute the greatest proportion of energy-related greenhouse gas emissions, making up 45 per cent of the total. This is followed by electricity (20 per cent), manufacturing (17 per cent), and transformation (4 per cent), with other sectors and fugitive emissions rounding it off (8 per cent and 5 per cent respectively). This dominance of national transport is consistent with the trend visible in energy-related greenhouse gas emissions from different fuels, highlighted in figure 7. However, as discussed previously, because of new understanding regarding the 'off-road use of liquid fuels, the above figures are likely to over-allocate greenhouse gas emissions to national transport, and under-allocate greenhouse gas emissions to the agriculture, forestry and mining and industrial sectors (Ministry of Economic Development, 2008b).

+FIGURE 7

ENERGY-RELATED GREENHOUSE GAS EMISSIONS IN NEW ZEALAND BY FUEL, 1990–2007



Note: Emissions are a measure of kilotonnes of CO_2 equivalent greenhouse gas emissions (kt CO_2 –e).

Data source: Ministry of Economic Development, 2008c.

Key findings

Consumer energy demand compared to gross domestic product

This indicator measures the energy intensity of the economy. It does this by comparing economic growth as measured by gross domestic product (GDP) with consumer energy demand. It is represented as the amount of energy required (in gigajoules (GJ)) to contribute $1000 towards New Zealand's economy. This is represented as GJ/$000.

While energy is integral to New Zealand's economy, the environmental impacts associated with its production and use means long-term sustainability will depend, in part, on becoming more efficient in the amount of energy we use to add value to the economy (International Atomic Energy Agency, 2005).

With the New Zealand Energy Strategy under review, it is important that we understand how various sectors of the economy use energy to create value, as well as the relative composition of these sectors within the economy.

Current situation

In 2006, New Zealand's economy used 4 gigajoules of energy for every $1000 of value it created (4 GJ/$000) (Statistics New Zealand, 2008b).

As a whole, in 2006, the goods-producing sector was the most energy intensive sector in the New Zealand, using 4.7 GJ/$000. This is followed by the primary sector, which used 4.5 GJ/$000, and finally the service sector, which used 2.3 GJ/1000 (Statistics New Zealand, 2008b).

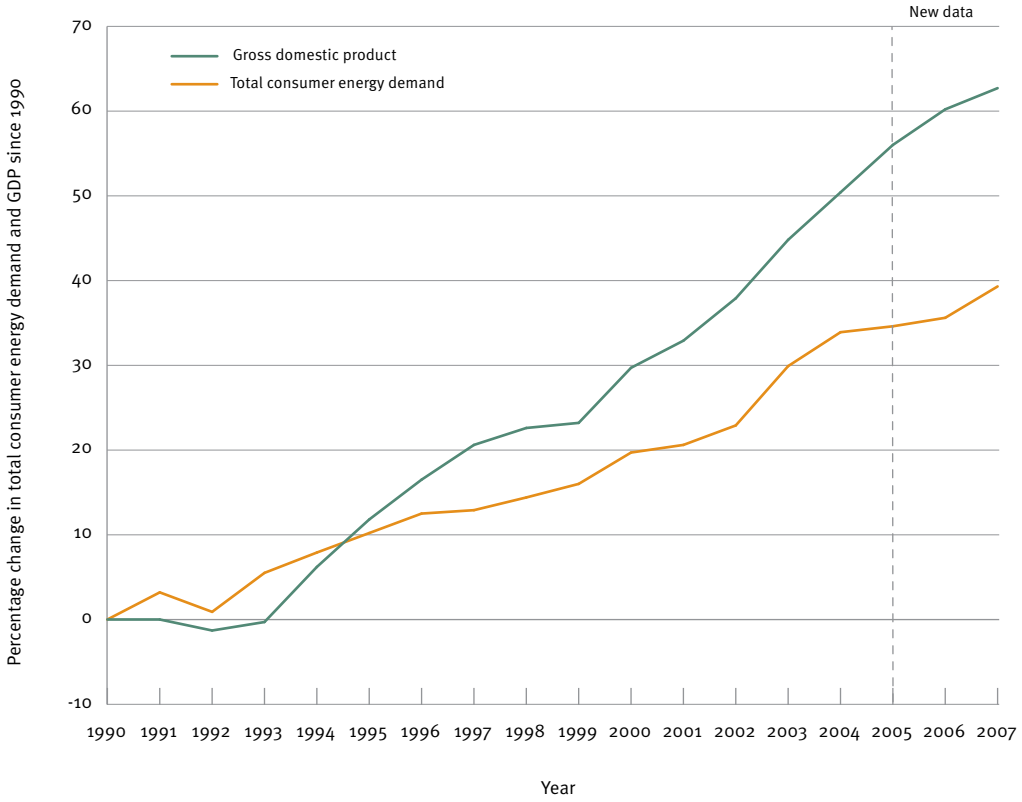
Among New Zealand's industries, in 2006, fishing was the most energy intensive in New Zealand, using 32.7 GJ/$000. Transport and storage followed as the second most energy intensive industry, using 21.5 GJ/$000. This is because both require large quantities of liquid fuels to operate vessels and vehicles. Non-metallic mineral production and petroleum, chemical, plastic and rubber product manufacturing are also relatively energy intensive, requiring large amounts of energy to operate heavy machinery and run heat-intensive processes (Statistics New Zealand, 2008b).

Long-term trend

Between 1990 and 2007, New Zealand's total consumer energy demand increased by 39 per cent (see figure 8). Over the same period, New Zealand's gross domestic product increased by 63 per cent. The difference between these two rates of growth represents the economy's reduced energy intensity – almost 15 per cent (Ministry of Economic Development, 2008a). As shown in figure 8, while the relationship between energy demand and economic growth has varied during this period, in the long term there exists a trend of 'relative decoupling'.

+FIGURE 8

CONSUMER ENERGY DEMAND COMPARED TO GDP IN NEW ZEALAND, 1990–2007 (PERCENTAGE CHANGE SINCE 1990)



Data source: Ministry of Economic Development, 2008a.

Text box 4: Decoupling New Zealand's economy from its environment

Decoupling refers to a disassociation of economic benefits from environmental pressures. With respect to energy and the economy, decoupling can be said to occur when, over a given period, the growth in energy demand (the environmental pressure) is less than that of GDP (the economic benefit). This can occur in either absolute or relative terms.

'Absolute decoupling' occurs when energy demand remains stable or decreases while GDP grows. Decoupling is said to be 'relative' when the growth rate of energy demand is positive, but less than the GDP growth rate (Statistics New Zealand, 2008b). The trend observed in the New Zealand economy, as well as much of the OECD, is that of relative decoupling. While reducing reliance of our economy on energy is an improving trend, any overall increase in energy demand will still have environmental impacts.

Recent trend

Getting better

New Zealand continues its long-term trend of using less energy intensive means to add value to the economy.

Between 2004 and 2006, New Zealand's economy reduced the amount of energy required to add $1000 of value to GDP by 4.8 per cent.

The most significant reductions in energy intensity were found in the service industries, which in 2006 required 4.6 per cent less energy to add $1000 of value to the GDP than they did in 2004. Goods-producing industries also showed improved energy use, with a 3.7 per cent reduction in energy intensity over the same time period. Following a fall in energy intensity in 2004, by 2006 primary industries had increased their energy intensity by 3.8 per cent.

Figure 9 graphs the amount of energy the service, primary and goods-producing industries used to add $1000 of value to New Zealand's economy between 1997 and 2006. It highlights not only the changes in energy intensity of each individual sector, but also relative changes in energy intensity between the sectors.

The energy intensity of the economy as a whole is not only affected by technical improvements in energy efficiency, but also by the relative composition of the sectors within it. The service sector is the largest and fastest growing sector of New Zealand's economy (Figure 10). It also happens to be the least energy intensive. As this sector grows, its low energy intensity will have an increasingly large impact on the energy intensity of the economy as a whole. Thus, decreased energy intensity at the economy-wide level is not necessarily the result of the decreased energy intensity of any given sector, but could be attributed to sector shifts in the economy's composition, and it is important to recognise the impact of both.

Figure 10 shows the change in GDP by sector, since 1997. While all sectors grew, they did so at different rates. It is these different rates of growth between the individual sectors that lead to changes in composition of the economy as a whole.

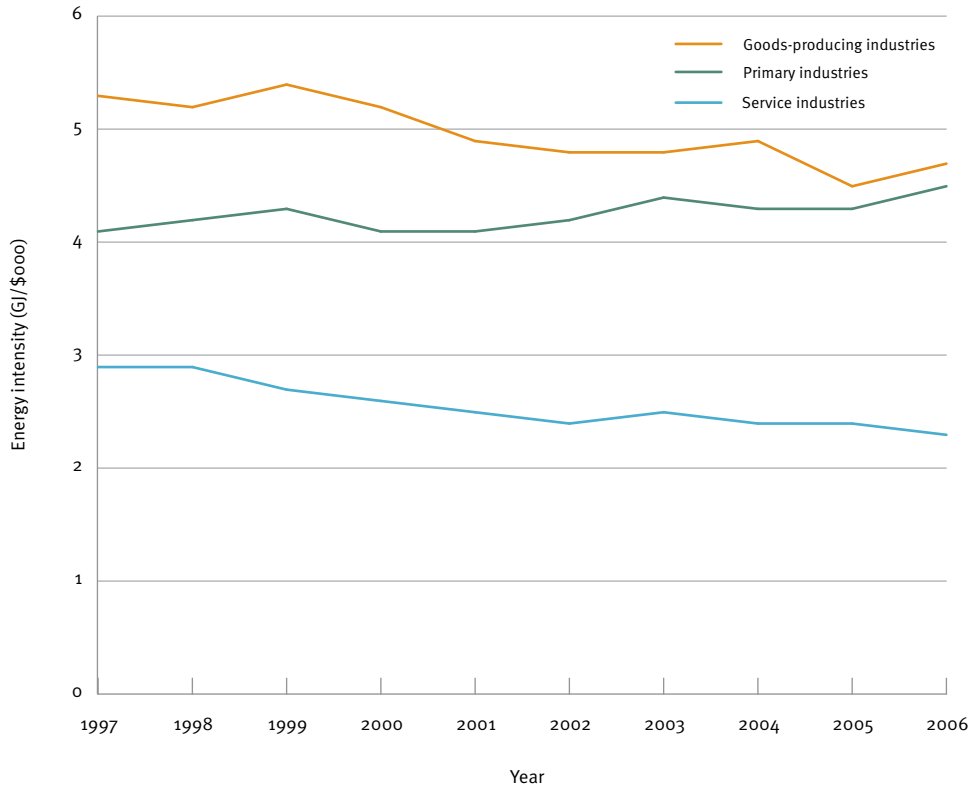
International comparison

The energy intensity of New Zealand's economy compares poorly with our OECD peers.

According to the most recent data, New Zealand ranks poorly amongst the OECD countries, with a more energy intensive economy than 20 of our peers (Energy Information Administration, 2008). Figure 11 shows the changes in the energy intensity of New Zealand's economy between 1994 and 2006, as well as the OECD and world averages. While, as highlighted previously, New Zealand's economy is depending less on energy to add value to GDP over time, it remains more energy intensive than both the OECD and world averages.

+FIGURE 9

ENERGY INTENSITY BY SECTOR IN NEW ZEALAND, 1997–2006

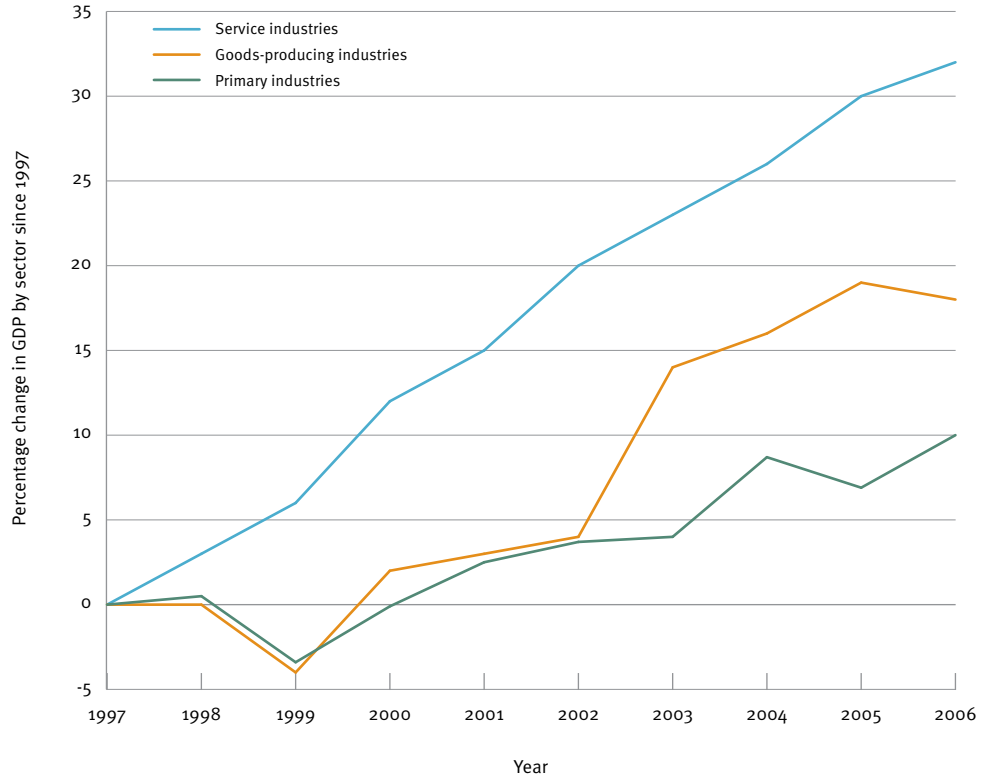


Notes: (1) Industry groups are combined to form the following broad groupings, based on the Australian and New Zealand Standard Industrial Classification (ANZSIC 96): primary industries (agriculture, fishing, forestry, mining), goods-producing industries (manufacturing; electricity, gas and water; construction), service industries (wholesale trade; retail, accommodation and restaurants; transport and communications; finance, insurance and business services; government administration and defence; personal and community services).

Data source: Adapted from Statistics New Zealand, 2008b, and Statistics New Zealand, 2008c.

+FIGURE 10

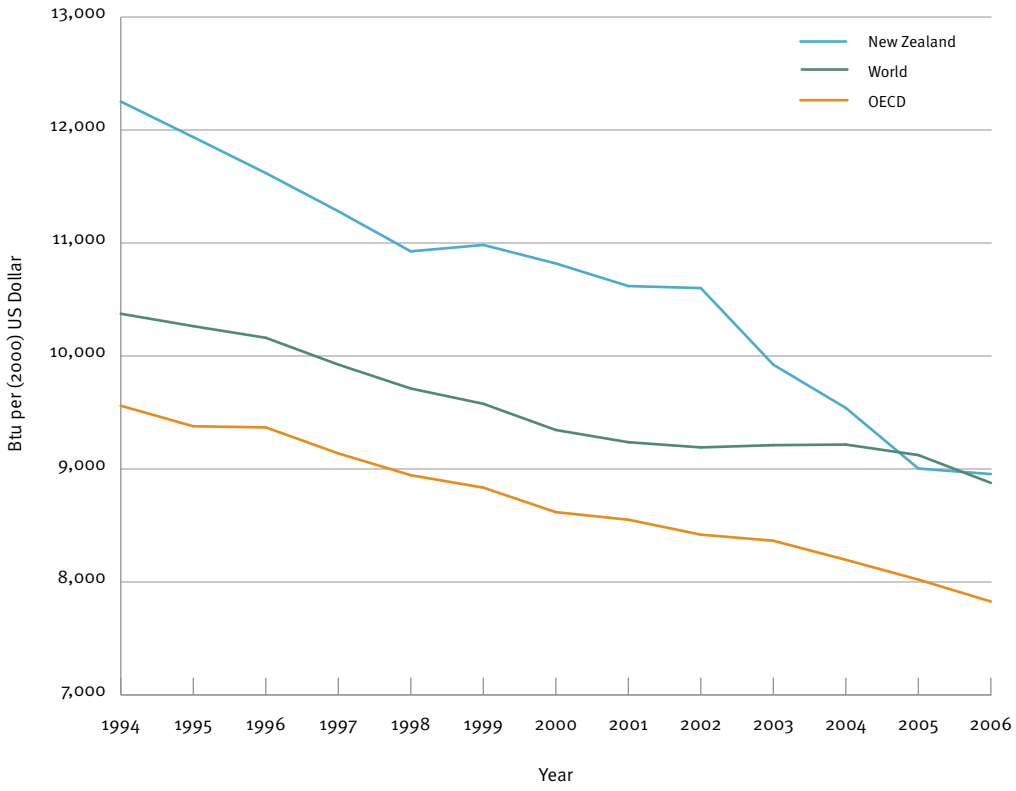
ECONOMIC OUTPUT BY SECTOR IN NEW ZEALAND, 1997–2006 ((PERCENTAGE CHANGE SINCE 1997)



Data source: Statistics New Zealand, 2008c.

+FIGURE 11

TOTAL PRIMARY ENERGY CONSUMPTION PER DOLLAR OF GDP, USING PURCHASING POWER PARITIES, 1994–2006



Data source: Energy Information Administration, 2008.

Key findings

Total primary energy supply

This indicator measures the total amount of primary energy available for energy production in New Zealand. We account for coal; domestic oil and gas extracted from wells; imported oil and oil products; and hydro, geothermal and other renewable energy sources used for electricity generation and heat production.

The supply of primary energy for energy production is shaped by a complex interaction of variables, including:

- demand for specific energy types (eg, oil for transport)
- relative cost of making specific forms of energy available (eg, cost of gas extraction versus the cost of wind generation)
- geopolitical accessibility to specific energy types (eg, political and social unrest in oil exporting countries) (International Energy Agency, 2007).

All forms of primary energy supply have impacts on our environment through their extraction, distribution and conversion (Ministry for the Environment, 2007). Examples are:

- greenhouse gas emissions associated with the extraction of fossil fuel
- risks of environmental contamination from the extraction and transportation of fossil fuels
- ecological impacts arising from geothermal, hydro and wind energy developments.

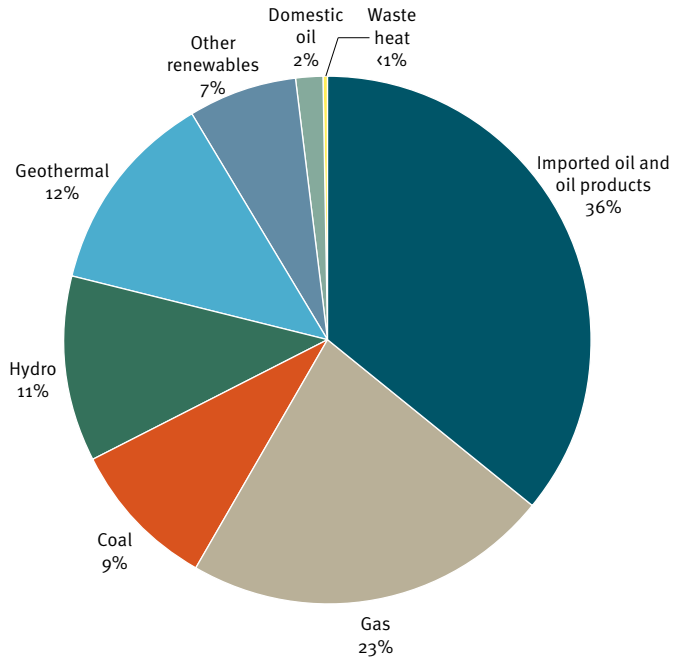
Because of the range of environmental impacts associated with extracting, distributing and converting each type of primary energy, understanding which are made available in New Zealand (and in what proportions) is important in understanding how to minimise the specific environmental impacts they may cause.

Current situation

In 2007, New Zealand's total primary energy supply was 752 petajoules, or approximately 178 gigajoules per person (Ministry of Economic Development, 2008a). This equates to about 5000 litres of petrol per person. About two-thirds of this (508 petajoules), was used as consumer energy. The remaining third was used or lost during energy transformation and distribution to consumers (for example, converting geothermal steam into electricity and conducting it to consumers) or diverted into non-energy products (for example, the production of urea fertiliser and methanol from natural gas).

As shown in figure 12, in 2007, more than two-thirds (70 per cent) of the primary energy available for energy production in New Zealand was derived from non-renewable resources, such as oil (38 per cent), gas (23 per cent), and coal (9 per cent). The remaining supply was derived from renewable resources, such as hydro-electricity (11 per cent), geothermal (12 per cent), and other renewables (biogas, wind, wood and solar water heating) (7 per cent).

+FIGURE 12
TOTAL PRIMARY ENERGY SUPPLY IN NEW ZEALAND, 2007



Note: 'Other renewables' includes solar water heating and electricity generation from wind, biogas and wood.
Data source: Ministry of Economic Development, 2008a.

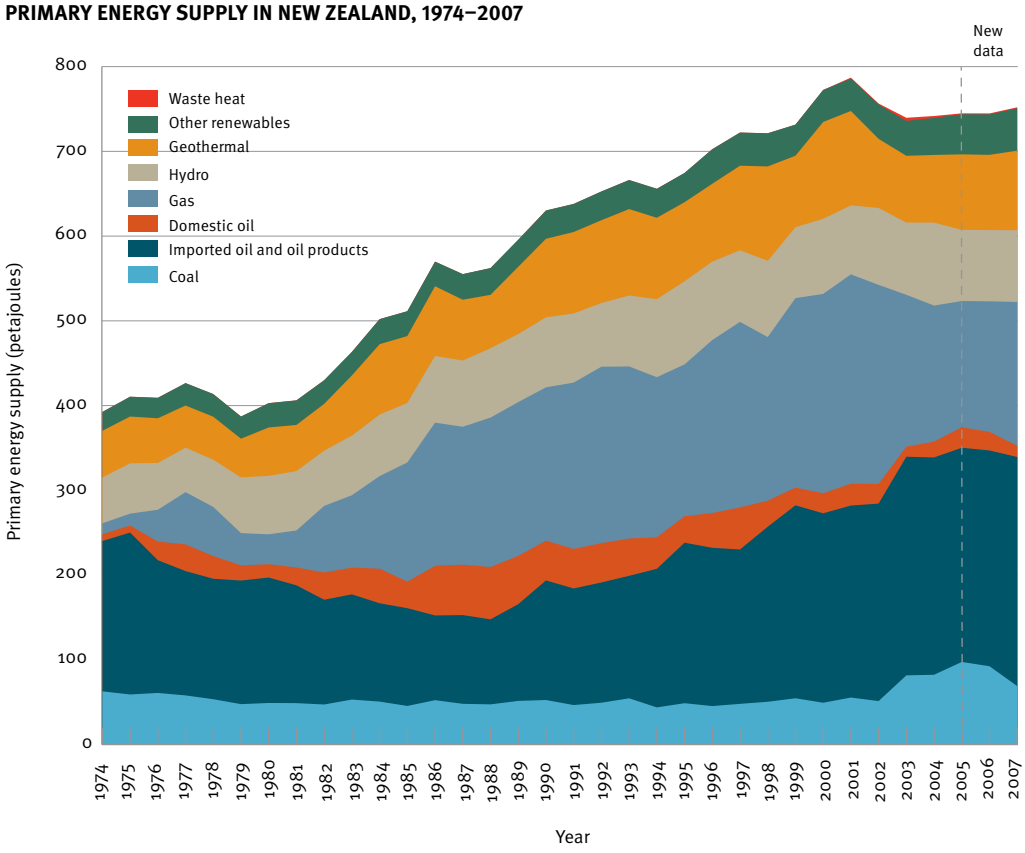
Long-term trend

Total primary energy supply in New Zealand increased by 4 per cent between 1998 and 2007. While the long-term trend is upwards, as shown in figure 13, it is a trend marked by volatility. The most recent example of volatility was the 6 per cent fall in energy production between 2001 and 2003.

A fall in the recorded amount of geothermal energy supply was one contributing factor. This, however, was largely the result of a change in the way in which geothermal energy supply is measured. In fact, geothermal energy is expected to increase in the long run, with a number of large-scale projects coming on line in the near future (Ministry of Economic Development, 2008a). The supply of geothermal energy has impacts on the environment, through harmful discharges into waterways and land subsidence (Kristmannsdottir and Armannsson, 2003), and through the release of fugitive greenhouse gas emissions, albeit on a small scale – in 2007 these emissions accounted for only 1 per cent of New Zealand's energy-related greenhouse gas emissions (Ministry of Economic Development, 2008c).

+FIGURE 13

PRIMARY ENERGY SUPPLY IN NEW ZEALAND, 1974–2007



Note: 'Other renewables' includes solar water heating and electricity generation from wind, biogas and wood.

Data source: Ministry of Economic Development, 2008a.

A second contributing factor to this fall was a 27 per cent reduction in the availability of natural gas for energy production over the same period, the result of a reduction in the estimated economically recoverable reserves in New Zealand's largest natural gas field (Statistics New Zealand, 2008c). While this fall in the availability of natural gas has led to a fall in environmental impacts associated with its use, such as greenhouse gas emissions, the net environmental impacts have been mitigated by two main factors:

- First, despite the lower availability of natural gas for energy production, a 47 per cent increase in the availability of coal led to an increase in the percentage of total primary energy supply derived from fossil fuels between 2001 and 2003.
- Second, this increased scarcity of natural gas led to a reduction in methanol production. As a result, carbon previously sequestered during the methanol manufacturing process is now being released as fugitive emissions through the venting process in natural gas manufacturing (Ministry for the Environment, 2008a). Therefore, while the supply of natural gas fell by 12 per cent between 1998 and 2007, greenhouse gas emissions related to its supply have actually increased.

Ultimately, energy-related greenhouse gas emissions increased by 20 per cent between 1998 and 2007 (Ministry of Economic Development, 2008c).

Little or no change

Since 2005, there has been little change in total primary energy supply.

Recent trend

Between 2005 and 2007, total primary energy supply increased by 1 per cent. This small increase is consistent with the trend for the previous two years. There were, however, significant changes in the supply of specific primary energy types over this period. Coal supply fell, while gas and renewable sources increased.

Coal supply fell by 29 per cent between 2005 and 2007. This fall in supply is partly attributable to reduced availability resulting from a 14-month $25 million redevelopment of the Spring Creek mine, as well as delays in accessing resources in the Stockton mine (Ministry of Economic

Development, 2008a). It is also because of a large decrease in the use of coal for electricity generation, as a result of the commissioning of the new gas-fired electricity generation station at the Huntly site in 2007. Between 2005 and 2007, this fall in supply contributed to a 34 per cent decrease in greenhouse gas emissions related to the extraction, distribution and conversion of coal (Ministry of Economic Development, 2008c).

Gas supply increased by 14 per cent between 2005 and 2007. The increase was because the Pohokura natural gas field came on line, accounting for 36 per cent of the gas supplied in 2007, as well as a 26 per cent increase in the use of gas for electricity generation between 2005 and 2007. Gas-related greenhouse gas emissions increased 16 per cent between 2005 and 2007.

There was also an increase in renewable sources of primary energy between 2005 and 2007, with geothermal supply increasing by 5 per cent, and other renewables increasing by 6 per cent.

In total, non-renewable energy supply decreased by 0.2 per cent, while the supply of renewable sources of energy increased by 4 per cent between 2005 and 2007.

International comparison

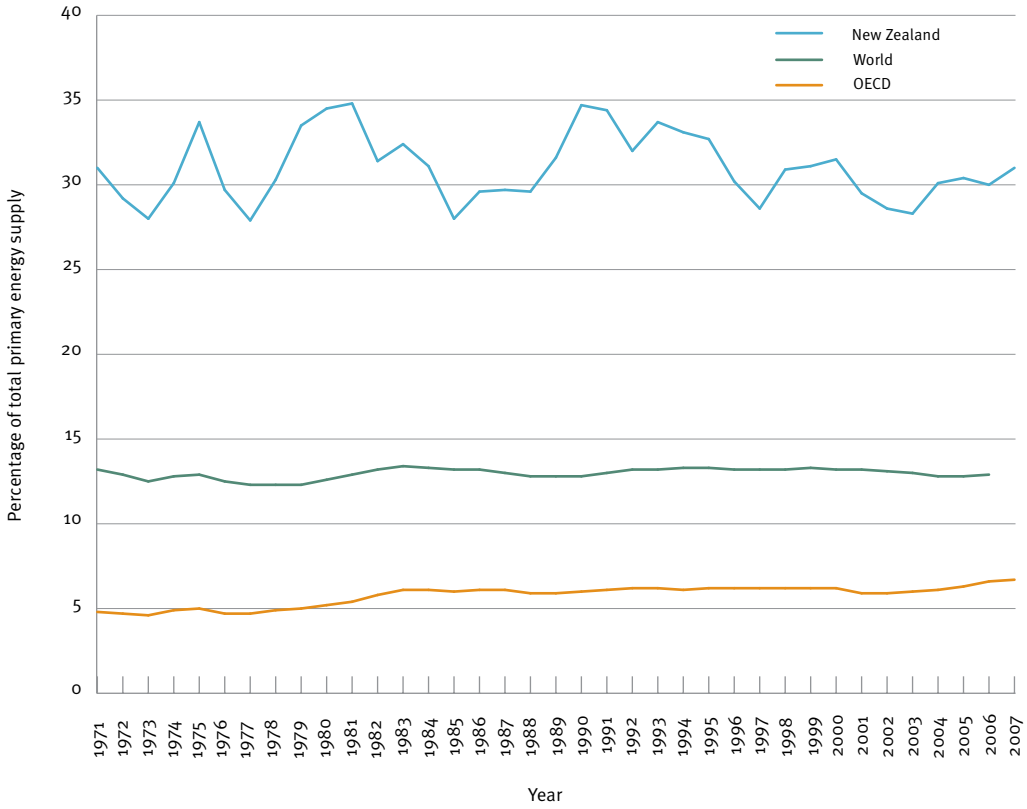
New Zealand performs well amongst the OECD in both total primary energy supply, and the percentage of this being met from renewable sources.

According to the latest OECD comparison, New Zealand has the fifth lowest level of primary energy supply in the OECD (Organisation for Economic Co-operation and Development, 2009). Given that the environmental impacts of primary energy supply depend largely on the specific types of energy being supplied, this measurement provides only a rough estimate of their national environmental impacts.

Because non-renewable primary energy sources have higher environmental impacts, ranking nations according to the proportion of their total primary energy supply being met from renewable sources provides a better perspective of the environmental impacts associated with primary energy supply. Under this measurement, New Zealand ranks very well, trailing only Norway and Iceland among the OECD countries. As shown in figure 14, this is well above both the OECD and world averages.

+FIGURE 14

INTERNATIONAL COMPARISON OF THE PROPORTION OF TOTAL PRIMARY ENERGY MET FROM RENEWABLE SOURCES, 1971–2007



Data source: Organisation of Economic Co-operation and Development, 2009.

Key findings

Electricity generation

This indicator measures the amount of electricity generated from each fuel type in New Zealand. Non-renewable fuel types (coal and gas) are accounted for as they are used in New Zealand's six thermal electricity generators. Renewable sources such as wind, hydro, geothermal, biogas, solar, wood and marine are also accounted as they generate electricity from various locations throughout the country.

All forms of electricity generation have impacts on the environment. The development of dams required for hydro-electricity alters natural flows of water and submerges land, while the installation of wind turbines alters visual landscapes. Greenhouse gas emissions result from fugitive emissions in the use of geothermal heat in electricity generation, as well as from fugitive and combustion emissions resulting from the use of fossil fuels in thermal electricity generators.

Because electricity accounts for 28 per cent of total consumer energy demand, and many of the environmental issues associated with electricity generation depend on the specific method of generation, understanding the composition of energy sources is important in developing a clear perspective of associated environmental impacts associated with meeting New Zealand's electricity needs.

Text box 5: Harnessing New Zealand winds

According to the New Zealand Wind Energy Association (www.windenergy.org.nz), there were eight wind farms operating in New Zealand in 2008. These wind farms vary in size from 1 turbine, such as the Gebbies Pass test site, to 134 turbines, such as the Tararua wind farm 10 kilometres from Palmerston North. With a combined capacity of 321 megawatts from 248 turbines, these wind farms supplied about 2.5 per cent of New Zealand's electricity, about the same amount of electricity as 145,000 New Zealand homes use in a year.

As of January 2009, 11 additional wind farms had received resource consents, with 9 additional farms under consideration. In total, this represents a potential for more than 3000 additional turbines, with a combined capacity to produce 3225 megawatts. This represents a potential to supply more than 25 per cent of New Zealand's electricity from wind.

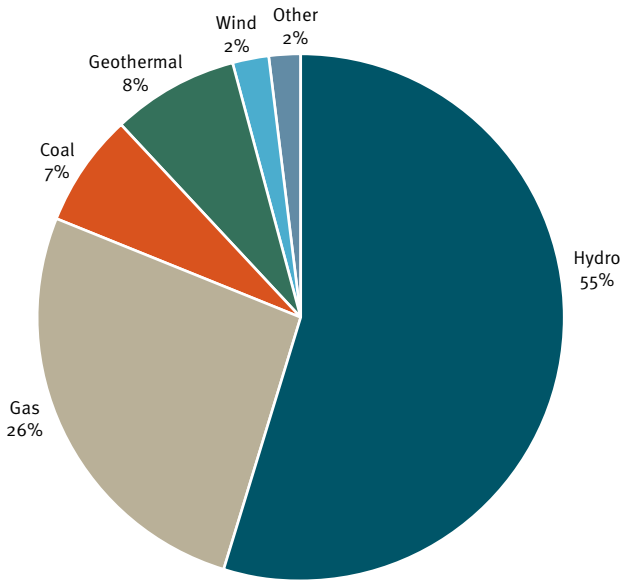
While wind is a renewable source of energy, the harnessing of it with turbines is not without its potential environmental impacts. First, the construction and installation of turbines requires energy, and this may not come from sources with zero greenhouse gas emissions. Second, the use of heavy machinery in the installation of wind farms has the potential to impact plants and animals in ecologically sensitive areas. Third, wind farms have the potential to detract from the recreational and aesthetic value of a landscape (Energy Efficiency and Conservation Authority, 2004).

While all of the above factors can cause some environmental impact, they can be mitigated through sound planning. Furthermore, given the alternatives to meeting New Zealand's growing demand for electricity, wind power is increasingly seen as an environmentally-friendly and economically-viable answer for large-scale generation (Energy Efficiency and Conservation Authority, 2005).

Current situation

In 2007, 153 petajoules of electricity was generated in New Zealand, equating to 36 gigajoules per person (Ministry of Economic Development, 2008a). New Zealand generates a high proportion of electricity from renewable sources. As shown in figure 15, in 2007, renewable sources accounted for 67 per cent of New Zealand's electricity generation, with hydro-electricity providing 55 per cent, geothermal 8 per cent, wind 2 per cent, and others (biogas and wood) 2 per cent.

+FIGURE 15
ELECTRICITY GENERATION IN NEW ZEALAND BY FUEL TYPE, 2007



Note: 'Other' includes electricity generation from biogas and wood.
Data source: Ministry of Economic Development, 2008a.

Long-term trend

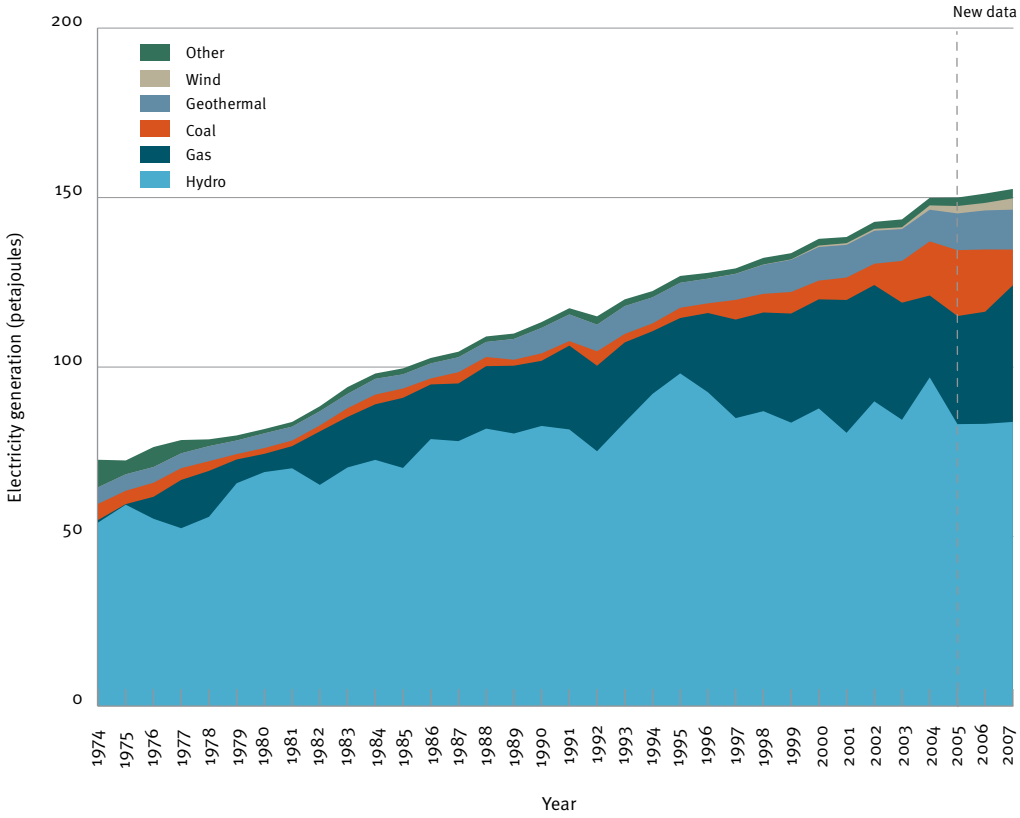
As highlighted in figure 16, New Zealand's total electricity generation has seen a steady long-term upward trend, amounting to a 15 per cent increase between 1998 and 2007. The use of non-renewable energy sources has also grown, accounting for 37 per cent of electricity generation in 2007 – up from 26 per cent in 1998.

Hydro-electricity generation is traditionally the largest source of electricity in New Zealand. While hydro continues to dominate, the availability of cheap gas from the Maui field, and the limited opportunities for further hydro development, has meant that the growing demand for electricity has largely been met by non-renewable developments. This has resulted in hydro's share of total electricity generation falling 11 per cent between 1998 and 2007. While there has been rapid growth in electricity generation from other renewable electricity sources – especially wind, which has increased by 2.5 petajoules (over 4000 per cent) between 1998 and 2007 – the share of total electricity generation from non-hydro renewables remains too small to meet the growing gap between electricity demand and hydro's static generation. Instead, fossil fuels have been increasingly relied upon.

Between 1998 and 2007, the use of coal and gas to generate heat in thermal electricity generators increased by 47 per cent. This increase has contributed to a 68 per cent increase in greenhouse gas emissions from electricity generation over the same period.

+FIGURE 16

ELECTRICITY GENERATION IN NEW ZEALAND BY FUEL TYPE, 1974–2007



Note: 'Others' includes electricity generation from biogas and wood.

Data source: Ministry of Economic Development, 2008a.

Recent trend

Mixed

Since 2005, electricity demand continued to grow, with a growing proportion met through the combustion of fossil fuels. However, electricity generation per person fell by half a per cent.

Between 2005 and 2007, electricity generation increased by 1.7 per cent in New Zealand. As a result of population growth, electricity generation per person fell by half a per cent over the same period.

Coal-fired electricity generators accounted for 21 per cent of New Zealand's non-renewable generation in 2007, down considerably from 36 per cent the previous year. This 46 per cent fall in coal generation is the result of the development of a new natural gas-fired thermal electricity generator, which came on line in 2007, fuelled by increased production from Pohokura natural gas field (Ministry of Economic Development, 2008d).

Geothermal energy represents a significant and growing component of electricity supply in New Zealand, accounting for 7 per cent of the total in 2007. The geothermal power sector will continue to grow, with a number of new projects planned or under construction.

There has also been a considerable rise in electricity production from other forms of renewable sources. Electricity generation from wind increased by 53 per cent between 2005 and 2007, while production from other renewables, including biogas, solar and marine, increased by 11 per cent over the same period. While these sources only accounted for 4 per cent of New Zealand's total electricity generation in 2007, continued investment in developing these technologies could lead to their increased role in electricity generation in the future.

While New Zealand has the seventh lowest total electricity generation in the OECD, it has the eighth highest electricity generation per person.

International comparison

According to the latest data, while New Zealand has the seventh lowest level of total electricity generation in the OECD, it has the eighth highest level of electricity generation per person (Organisation for Economic Co-operation and Development, 2009). Furthermore, as highlighted earlier, not only is New Zealand's electricity generation showing a long-term growth trend, between 1998 and 2007 it grew more quickly than the OECD average (Organisation for Economic Co-operation and Development, 2009).

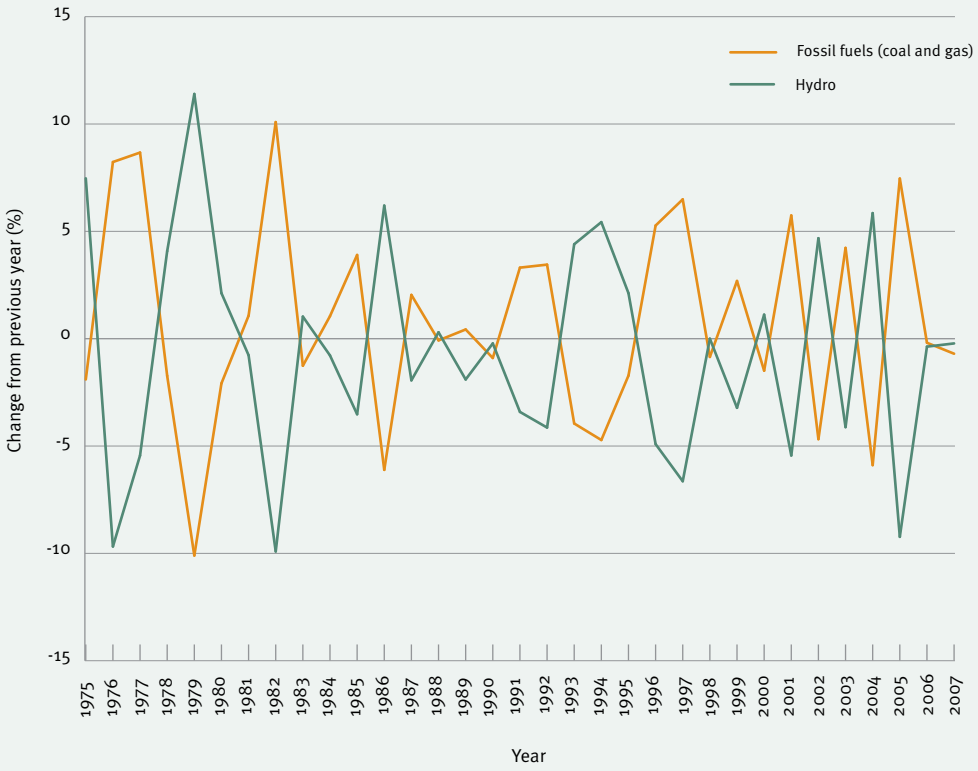
Text box 6: Water and renewable electricity

New Zealand uses several renewable sources to supply its electricity needs. Despite recent growth in less traditional forms of electricity generation, including wind, tidal and wave, the bulk of our renewable electricity continues to be generated by hydro-electric power stations in the South Island.

While hydro-electricity has provided New Zealand with a long history of renewable electricity supply, its generation is critically dependent on water supply to storage lakes, which can be highly variable. In dry years (such as 2008, when storage lake levels were low), fossil fuel-fired electricity generators (coal and gas) are relied on to make up the shortfall. Figure 17 graphs the annual percentage change of electricity generation from hydro, as well as fossil fuels. This graph highlights the close inverse relationship between the two electricity sources.

+FIGURE 17

ANNUAL CHANGE IN ELECTRICITY GENERATION FROM FUEL SOURCE IN NEW ZEALAND, 1975–2007



Data source: Adapted from Ministry of Economic Development, 2008a.

As a result of a high percentage of New Zealand's electricity being generated from hydro, our greenhouse gas emissions from electricity generation are very low by international standards (Ministry of Economic Development, 2008d). However, as highlighted in figure 17, due to the seasonal patterns in the amount of water available for hydro generation, these emissions can vary greatly from year-to-year. The most recent drought of 2008 coincided with a 25 per cent increase in the energy sector's greenhouse gas emissions (Ministry of Economic Development, 2008d).

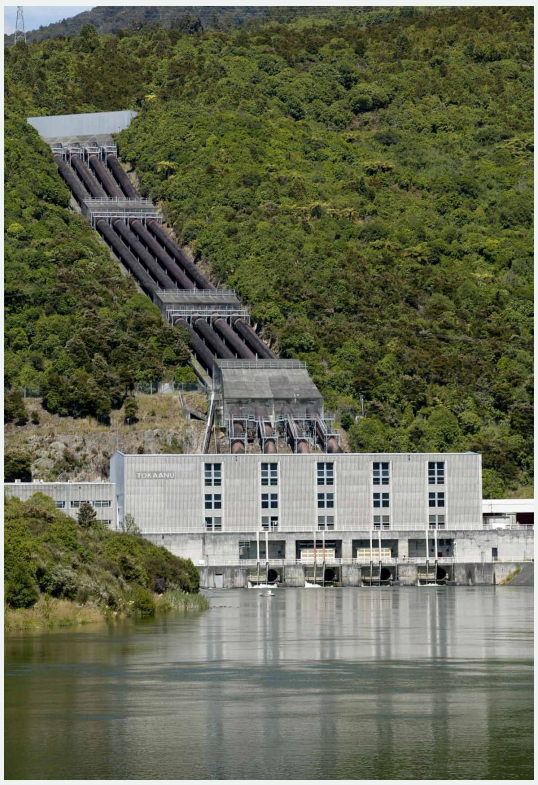
Case study

Responding to drought

As highlighted earlier, New Zealand relies on water to generate more than half our electricity supply. The amount of water in hydro lakes is critically dependent on rainfall and snow melt. Low water inflows during the winter drought of 2008 is the most recent reminder of this – record lows in hydro lakes led to a fall in hydro generation of 11 per cent from the same quarter in 2007 (Ministry of Economic Development, 2008d).

When hydro-electricity supply drops like this, it is largely compensated for by an increase in electricity production from fossil fuels. As an example, the drought of 2008 led to a 26 per cent increase in fossil fuel-generated electricity.

TOKAANU POWER STATION



But increasing generation from fossil fuels is not the only way to compensate for the reduced supply from hydro. Efforts can also be made to reduce demand. As an example, the launch of the industry-backed *Powersavers* campaign on 15 June 2008 encouraged residential and commercial consumers to reduce electricity consumption (Transpower, 2008). The aim was to conserve hydro-electric reserves and mitigate the high environmental and economic costs associated with increased generation from fossil fuels. Planned and paid for by the five largest electricity retailers in New Zealand, this conservation campaign provided practical and simple ideas for consumers to voluntarily reduce their electricity use, including switching off lights or appliances when not needed, choosing alternative, less electricity-intensive activities, and taking shorter showers.

A week into the campaign, every New Zealand region had achieved electricity savings of between 1.3 and 3.3 per cent. Electricity savings from industrial use raised that figure to more than 5 per cent. In fact, according to a Research New Zealand poll, New Zealanders were cutting back on power even before the *Powersavers* campaign began. When taken in mid-May, the poll showed 64 per cent of respondents were consciously reducing their power use (Ministry for the Environment, 2008b).

The reductions in energy demand arising from these conservation efforts were significant in avoiding the need for more drastic measures, such as induced black outs. They were also significant in showing the difference that individual electricity consumption decisions can make to the national power consumption totals.

Future watch

Population size and economic activity will continue to be the major drivers in energy generation and use in New Zealand. Projected growth of New Zealand's population is likely to result in an increase in total demand for energy. However, any growth in demand stemming from an increasing population size is likely to be mitigated, at least somewhat, by the current economic recession. With the slowdown in economic activity currently under way, energy use by industrial and commercial sectors is likely to fall. The depth and length of this recession are likely to be key factors in determining New Zealand's short-term energy demand.

Despite the current economic recession, our long-term economic outlook remains positive (NZIER, 2009). As such, any reduced demand in energy in the short term is not likely to result in any long-term trend. The efficiency of energy use and the renewability of its generation are likely to remain the key long-term challenges associated with energy use and generation in New Zealand.

Further information

While the use of energy is essential to our daily lives, there are a number of ways we can reduce its environmental impacts.

For information on how to reduce household energy use, visit the following websites:

- www.sustainability.govt.nz
- www.energywise.govt.nz
- www.eeca.govt.nz
- www.rightlight.govt.nz.

For more information on how to reduce transport-related energy use, visit the following websites:

- www.fuelsaver.govt.nz
- www.transport.govt.nz/news/media/Choke-the-Smoke-Campaign-Details.

Technical notes

Limitations of this indicator

Energy supply and demand are widely used international proxies for the pressures of energy production and use on the environment. By understanding the total amount of energy supply and demand, the intensity at which it is being used in the economy, and the types of fuels being used, we can learn more about the scale and types of pressures energy production and use are placing on our environment.

However, there are limitations to the use of these measures. For one, these indicators are only proxies to the environmental impacts associated with energy supply and demand. They have the ability to highlight likely trends in environmental impacts but do not comprehensively cover the specific environmental impacts associated with the specific forms of energy production and use.

Secondly, while these indicators highlight the environmental impacts associated with energy production and use, they do not provide an evaluation between these various environmental impacts. For example, the localised environmental impacts of geothermal energy are not evaluated against the global impacts of greenhouse gas emissions from fossil fuel combustion.

Finally, recent work conducted by the Ministry of Economic Development has highlighted a limitation in the data regarding the use of liquid fuels in the economy. Because of assumptions regarding the 'on'-road use of unallocated fuels, the data used in this report card is likely to over-allocate liquid fuel use to transport, with a corresponding under-allocation of liquid fuel use to the agriculture, forestry and mining and industrial sectors. This also has flow on effects to the calculations of both industry specific greenhouse gas emissions and energy intensity. Changes made by the Ministry of Economic Development to the collection of liquid fuel data will likely lead to a correction of these figures in the future (Ministry of Economic Development, 2008b).

References

Electricity Networks Association. (no date). *Energy Conversion Factors*. Retrieved from http://www.electricity.org.nz/?page=download&type=public&file=Energy_conversion_factors.doc (5 March 2009).

Energy Efficiency and Conservation Authority. 2004. *Winds Up: Planning for the Future Now*. Retrieved from http://www.eeca.govt.nz/eeca-library/renewable-energy/wind/report/winds-up-planning-the-future-now-report-04.pdf (15 February 2009).

Energy Efficiency and Conservation Authority. 2005. *Wind Fact Sheet*. Retrieved from http://www.eeca.govt.nz/eeca-library/renewable-energy/wind/fact-sheet/wind-fact-sheet-05.pdf (15 February 2009).

Energy Information Administration. 2008. *International Energy Annual 2006*. Retrieved from http://www.eia.doe.gov/pub/international/iealf/tablee1p.xls (10 February 2009).

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt, K, Tignor MB, and Miller H L. (eds) Cambridge, United Kingdom and New York, United States: Cambridge University Press.

International Atomic Energy Agency. 2005. Energy Indicators for Sustainable Development: Guidelines and Methodologies. Vienna: IAEA.

International Energy Agency. 2007. *World Energy Outlook 2007*. Paris: IEA.

Kristmannsdottir H, Armannsson H. 2003. Environmental aspects of geothermal energy utilization. *Geothermics* 32: 451–461.

Ministry for the Environment. 2007. *Environment New Zealand 2007*. Wellington: Ministry for the Environment.

Ministry for the Environment. 2008a. *New Zealand's Greenhouse Gas Inventory 1990–2006*. Wellington: Ministry for the Environment.

Ministry for the Environment. 2008b. *Talk Sustainability: Issue 11*. Retrieved from http://www.mfe.govt.nz/publications/sus-dev/talk-sustainability/talk-sustainability-issue11.html (1 February 2009).

Ministry of Economic Development. 2008a. *New Zealand Energy Data File: June 2008*. Wellington: Ministry of Economic Development.

Ministry of Economic Development. 2008b. *Liquid Fuel Use in New Zealand*. Wellington: Ministry of Economic Development.

Ministry of Economic Development. 2008c. *New Zealand Energy Greenhouse Gas Emissions 1990–2007*. Wellington: Ministry of Economic Development.

Ministry of Economic Development. 2008d. *New Zealand Energy Quarterly: June 2008*. Wellington: Ministry of Economic Development.

NZIER (New Zealand Institute of Economic Research). 2009. *Quarterly Predictions March 2009*. Media release, Monday 2 March 2009. Retrieved from www.nzier.org.nz/includes/download.aspx?ID=100666 (12 June 2009).

Organisation for Economic Cooperation and Development. 2008. *OECD in Figures 2008*. Paris: OECD Publishing.

Organisation for Economic Cooperation and Development. 2009. *OECD Factbook 2009: Economic, Environmental and Social Statistics*. Retrieved from http://oberon.sourceoecd.org/vl=3289435/cl=15/nw=1/rpsv/factbook2009/index.htm (4 May 2009).

Statistics New Zealand. 2008a. *Demographic Trends: 2007*. Wellington: Statistics New Zealand.

Statistics New Zealand. 2008b. *Energy and the Economy: 1997–2006*. Wellington: Statistics New Zealand.

Statistics New Zealand. 2008c. *Gross Domestic Product: September 2008 Quarter*. Wellington: Statistics New Zealand.

Transpower. 2008. *'Powersavers' Advertisements to run this Sunday*. Retrieved from http://www.transpower.co.nz/n1690.html (1 February 2009).

FOR MORE INFORMATION about energy supply and demand see *Environment New Zealand 2007* at www.mfe.govt.nz

New Zealand Government

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