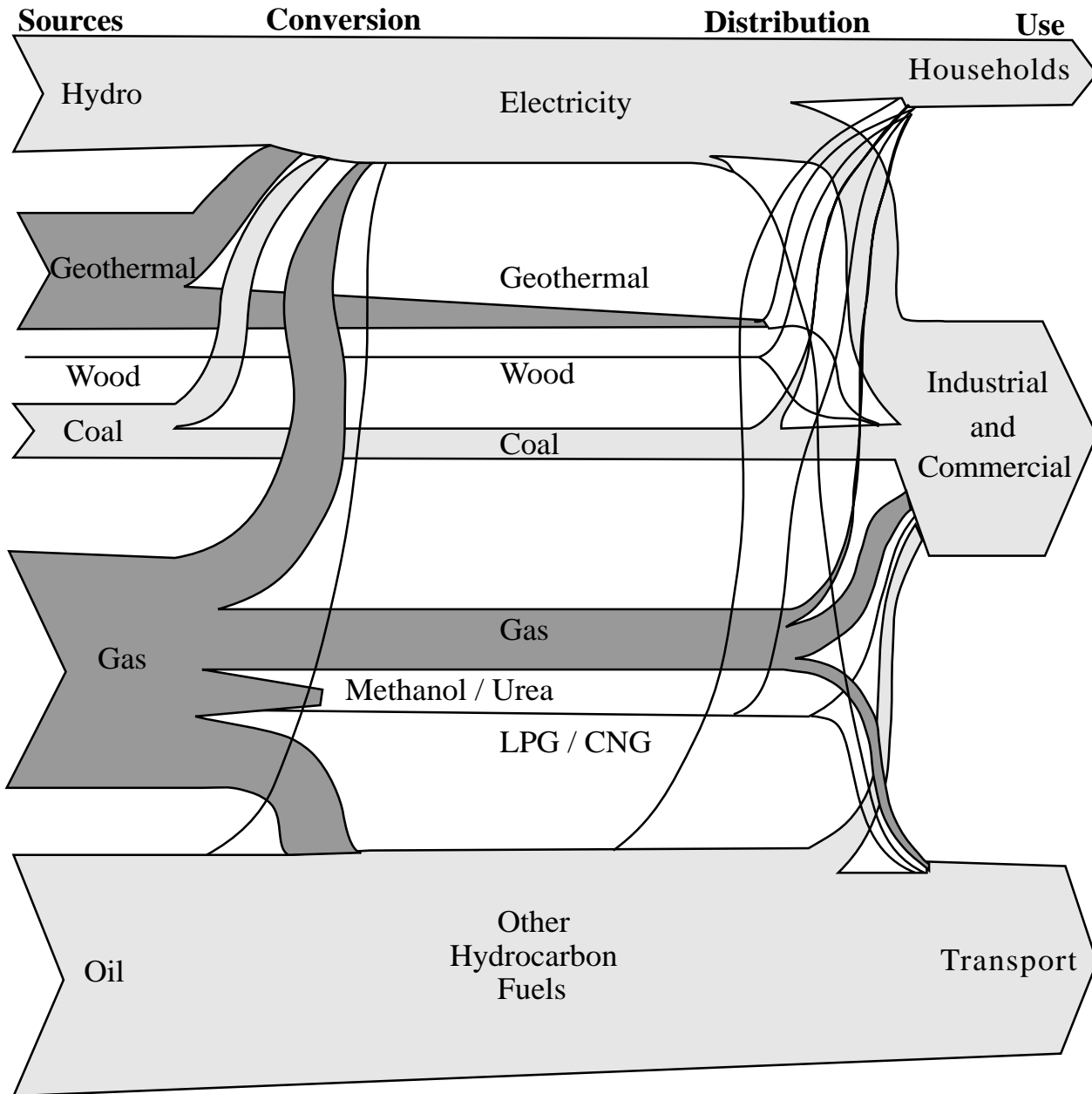


A. Energy Overview

Figure A.1: Energy Flows



This energy flow diagram summarises New Zealand's energy use. Primary energy sources are at the left. The flow of these through conversion processes to consumers is pictured, with final end use classified by consumer type. The width of the bands is approximately to scale.

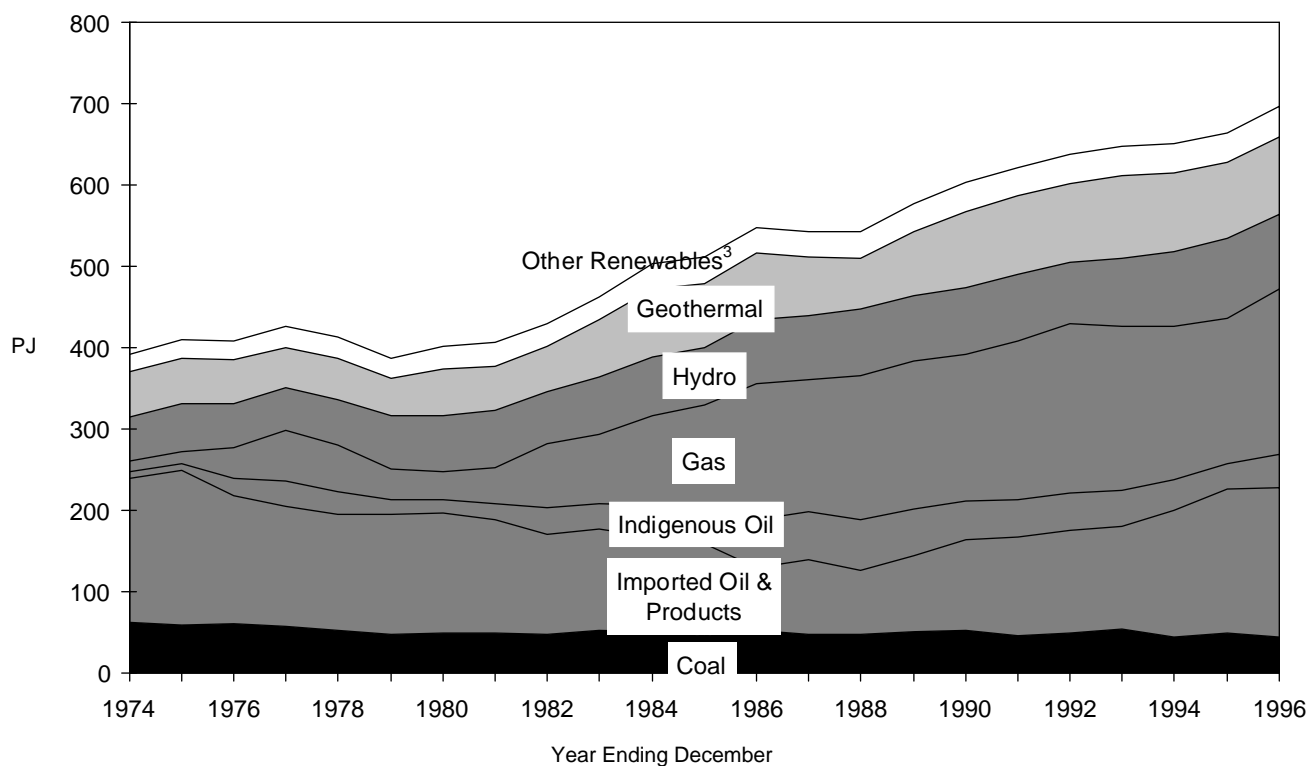
Statistics in this Overview are for the calendar year (December year) 1996 unless otherwise specified, for which they assume the following basic national statistics: population of 3.680 million, GDP of \$93.8 billion New Zealand, and a NZ\$/US\$ exchange rate of 0.65.

A.2 Primary Energy Supply¹(PJ)

Table A.2a: Petajoules of Primary Energy

Calendar Year	Coal	Imported Oil and Products	Indigenous Oil (Net)	Gas	Hydro ²	Geothermal ²	Other Renewables ³	Total ⁴
1974	62.80	177.54	7.98	12.92	54.13	55.07	21.69	392.14
1975	59.10	191.25	8.28	14.03	59.39	55.21	23.01	410.27
1976	60.90	156.84	21.96	37.54	55.24	52.74	23.78	409.00
1977	58.00	146.83	31.50	61.68	52.46	49.76	26.08	426.31
1978	53.50	142.31	26.81	57.91	55.81	50.65	26.38	413.38
1979	47.70	146.98	17.90	38.06	65.73	45.68	25.78	387.84
1980	49.06	148.16	15.71	35.31	69.02	57.06	28.50	402.82
1981	48.88	139.17	21.04	43.63	70.14	54.42	28.97	406.24
1982	47.27	123.69	32.13	78.56	65.24	55.19	27.96	430.03
1983	53.09	124.19	31.55	85.25	70.39	70.94	27.90	463.31
1984	50.68	116.07	40.86	108.58	72.62	83.05	31.15	503.02
1985	45.57	114.17	31.48	139.39	70.24	78.93	31.38	511.15
1986	52.37	77.47	58.70	167.86	78.76	82.26	31.13	548.55
1987	48.06	91.64	59.56	162.20	78.15	71.70	32.34	543.66
1988	47.42	79.78	62.09	176.03	81.84	63.06	33.64	543.86
1989	51.51	93.61	57.63	180.77	80.40	79.26	34.08	577.26
1990	52.55	112.35	47.31	179.85	82.63	92.65	35.52	602.87
1991	46.61	120.30	46.79	195.41	81.60	96.16	35.27	622.13
1992	49.37	126.57	46.32	207.51	75.17	97.70	36.07	638.72
1993	54.57	126.39	44.05	201.77	83.73	101.99	36.42	648.92
1994	43.84	157.00	37.22	188.20	92.08	96.05	36.34	650.73
1995	48.79	178.45	31.22	177.77	98.13	93.30	36.73	664.40
1996	45.41	182.62	40.83	203.00	92.70	94.46	37.47	696.49

Chart A.2a: Annual Primary Energy Supply (PJ)



Notes: ¹ See Glossary Section K for definitions of terms used.

² Hydro and geothermal generation in this table includes estimates of the generation by electricity companies and private plants. Geothermal is calculated as electricity generation from geothermal x 10 (assumes 10% efficiency) + direct use of geothermal heat (13 PJ) and losses (6 PJ).

³ Other Renewables include electricity generation from biogas, industrial waste, wood and wind.

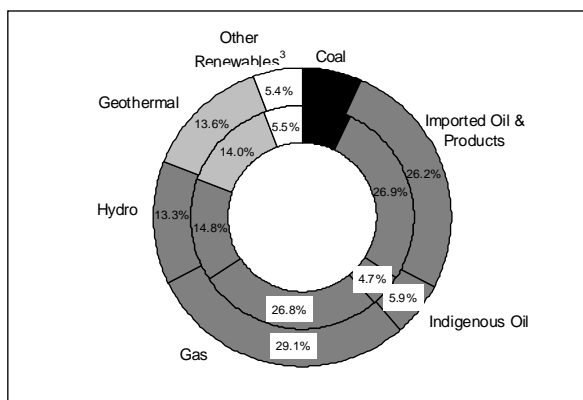
⁴ Totals may not match with tables B.2a, B.2e & B.2i (pp 29, 33 & 37) energy supply and demand balances due to rounding.

Table A.2b: Total Primary Energy Supply (%)

Calendar Year	Coal	Imported Oil and Products	Indigenous Oil (Net)	Gas	Hydro ²	Geothermal ²	Other Renewables ³	Total ⁴
1974	16.0%	45.3%	2.0%	3.3%	13.8%	14.0%	5.5%	100%
1975	14.4%	46.6%	2.0%	3.4%	14.5%	13.5%	5.6%	100%
1976	14.9%	38.3%	5.4%	9.2%	13.5%	12.9%	5.8%	100%
1977	13.6%	34.4%	7.4%	14.5%	12.3%	11.7%	6.1%	100%
1978	12.9%	34.4%	6.5%	14.0%	13.5%	12.3%	6.4%	100%
1979	12.3%	37.9%	4.6%	9.8%	16.9%	11.8%	6.6%	100%
1980	12.2%	36.8%	3.9%	8.8%	17.1%	14.2%	7.1%	100%
1981	12.0%	34.3%	5.2%	10.7%	17.3%	13.4%	7.1%	100%
1982	11.0%	28.8%	7.5%	18.3%	15.2%	12.8%	6.5%	100%
1983	11.5%	26.8%	6.8%	18.4%	15.2%	15.3%	6.0%	100%
1984	10.1%	23.1%	8.1%	21.6%	14.4%	16.5%	6.2%	100%
1985	8.9%	22.3%	6.2%	27.3%	13.7%	15.4%	6.1%	100%
1986	9.5%	14.1%	10.7%	30.6%	14.4%	15.0%	5.7%	100%
1987	8.8%	16.9%	11.0%	29.8%	14.4%	13.2%	5.9%	100%
1988	8.7%	14.7%	11.4%	32.4%	15.0%	11.6%	6.2%	100%
1989	8.9%	16.2%	10.0%	31.3%	13.9%	13.7%	5.9%	100%
1990	8.7%	18.6%	7.8%	29.8%	13.7%	15.4%	5.9%	100%
1991	7.5%	19.3%	7.5%	31.4%	13.1%	15.5%	5.7%	100%
1992	7.7%	19.8%	7.3%	32.5%	11.8%	15.3%	5.6%	100%
1993	8.4%	19.5%	6.8%	31.1%	12.9%	15.7%	5.6%	100%
1994	6.7%	24.1%	5.7%	28.9%	14.2%	14.8%	5.6%	100%
1995	7.3%	26.9%	4.7%	26.8%	14.8%	14.0%	5.5%	100%
1996	6.5%	26.2%	5.9%	29.1%	13.3%	13.6%	5.4%	100%

Notes: ^{2,3} See notes on page 7 for more details.

⁴Totals may not add to 100% due to rounding.

Chart A.2b: Total Primary Energy Supply (%)

Tables A.2a and A.2b show primary energy supply (PES) trends in New Zealand by fuel type. Primary energy refers to energy as it is first obtained from natural resources.

Total primary energy is the amount of energy available for use in New Zealand and therefore includes imports but excludes exports and international transport.

The proportion of total PES dependent on oil imports decreased during the 1980s, falling from 37%

of the total in 1980 to 19% in 1990, but has gradually risen since, with oil imports 26% of total energy supply in 1996. In the year ended December 1996, total PES was approximately 696.5 petajoules (PJ), an increase in supply of 5.0% over the previous year.

Total coal production increased from 91.5 PJ in 1995 to 96.2 PJ in 1996. Similarly, exports of high quality coal increased by 19% during the same period. Oil imports in 1996 increased by around 2.3% to 182.6 PJ compared with 178.5 PJ imported in 1995. Natural gas production rose from 178.0 PJ in 1995 to 203.4 PJ in 1996, an increase of around 14.2%.

Primary electricity is electricity generated from hydro, geothermal and other renewable sources. Hydro generation decreased 5.5% to 92.7 PJ; the production of geothermal (including 10% efficiency, direct use and losses) rose by 1.2% to 94.5 PJ. Other renewables increased 1.9% to 37.5 PJ.

A.3 Energy Demand by Sector and Fuel Type

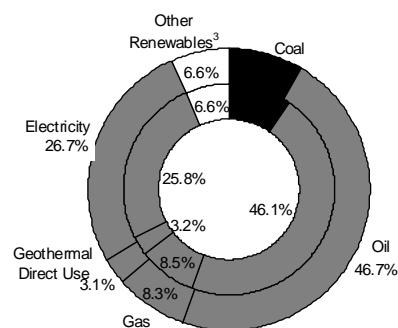
Table A.3a: Total Consumer Energy by Fuel (PJ)

Calendar Year	Coal	Oil	Gas	Geothermal Direct Use	Electricity	Other Renewables ³	Total
1995	41.7	195.6	35.9	13.5	109.6	27.9	424.3
1996	36.1	197.5	34.9	13.2	112.9	28.0	422.6

Total Consumer Energy by Fuel

Calendar Year	Coal	Oil	Gas	Geothermal Direct Use	Electricity	Other Renewables ³	Total
1995	9.8%	46.1%	8.5%	3.2%	25.8%	6.6%	100%
1996	8.6%	46.7%	8.3%	3.1%	26.7%	6.6%	100%

Chart A.3a: Total Consumer Energy by Fuel



Inside circle: Year 1995
Outside circle: Year 1996

New Zealand's energy consumer (observed) decreased slightly from 424.3 PJ in 1995 to 422.6 PJ in 1996, a decline of 0.4% (see Table A.3a). The decline was not evenly spread over the different energy fuel types. Compared with the year before,

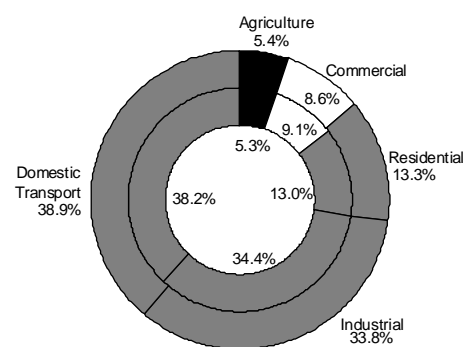
the relative share of energy used for electricity (26.7%), oil (46.7%) and other renewables (6.6%) in 1996 increased by 3.0%, 1.0% and 0.3% respectively, while geothermal (3.1%), gas (8.3%) and coal (8.6%) fell by 2.7%, 2.9% and 13.4% respectively.

Calendar Year	Agriculture	Commercial	Residential	Industrial	Domestic Transport	Total
1995	22.3	38.6	55.1	146.2	162.0	424.3
1996	22.7	36.3	56.3	142.8	164.5	422.5

Total Consumer Energy by Sector

Calendar Year	Agriculture	Commercial	Residential	Industrial	Domestic Transport	Total
1995	5.3%	9.1%	13.0%	34.4%	38.2%	100%
1996	5.4%	8.6%	13.3%	33.8%	38.9%	100%

Chart A.3b: Total Consumer Energy by Sector



Inside circle: Year 1995
Outside circle: Year 1996

Table A.3b and Chart A.3b show energy use by sector for the years ending December 1995 and 1996. The residential, agriculture and transport (excluding international transport) sectors increased

their shares of total consumer energy by 2.2%, 1.7%, and 1.5% respectively, while the shares of commercial and industrial sectors fell by 6.1% and 2.3% between 1995 and 1996.

³ See notes on page 7 for more details.

A.4 Energy Sector Key Facts

Total energy consumption (observed) was 423 petajoules (PJ) for the year ended December 1996. This is about 115 gigajoules (GJ) per capita, or the equivalent of about 3250 litres of regular petrol.

Energy contributed about 3% to New Zealand's gross domestic product (GDP), and directly employs about 8,000 - 9,000 people, or about 0.5% of the work force.

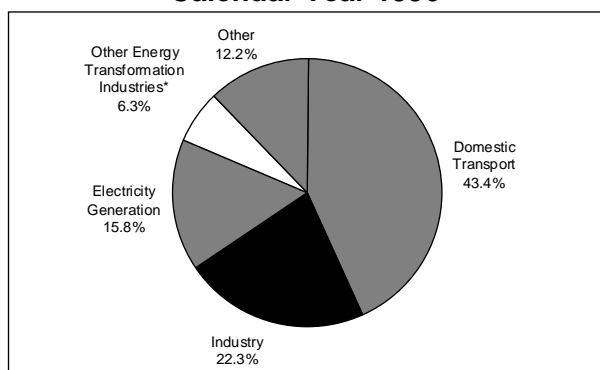
New Zealand is self-sufficient in electricity and all major fuel types except oil (in which New Zealand can be over 50 % self-sufficient), with a total self-sufficiency in energy of nearly 90% (see charts A.2b, A.3a, and A.3b on pages 8 and 9).

Although the population rose by only 18% between 1974 and 1996, energy consumption increased by 60% in the same period. In part, this was caused by the development and expansion of a number of energy-intensive industries, such as aluminium smelting and the Taranaki-based petrochemical industries, since 1974. New Zealand's energy intensity is amongst the highest in the Organization for Economic Cooperation and Development (OECD), but its sustained increase from 1982 to about 1992 has reversed in the last few years.

A.5 Energy Greenhouse Gas Emissions Key Facts

**Chart A.5a:
Energy CO₂ Emissions' Sectoral Share**

Calendar Year 1996



* Petroleum refining, synthetic petrol production, and oil and gas extraction and processing.

For more information see "Energy Greenhouse Gas Emissions 1990-1996", details on page 152.

Carbon dioxide (CO₂) emissions from energy sources were about 26 million tonnes in 1996. The energy sector contributes around 90% of New Zealand's national gross human-made CO₂ emissions with the remainder from industrial processes. Chart A.5a shows New Zealand energy CO₂ emissions by source, excluding international transport, in 1996.

New Zealand's per capita emissions of 7.6 tonnes of CO₂ compare favourably with those of many other developed countries.

Other greenhouse gases emitted from energy sources include nitrous oxide (N₂O) and methane (CH₄). The amount of these gases emitted is small compared with CO₂, and agriculture rather than the energy sector is the main contributor for both gases.

A.6 Energy Outlook

The Ministry of Commerce's Energy Modelling and Statistics Unit publishes a periodic *Energy Outlook* (see page 152 for details). This publication presents energy supply and demand scenarios for New Zealand to 2020. The scenarios are developed using the Ministry's SADEM long-range energy model, which estimates the market clearing pattern of energy supply and demand, reaching equilibrium through prices.

The latest *Energy Outlook* presents a baseline scenario that assumes 3% per annum (pa) GDP growth, sufficient gas discoveries to sustain reticulated demand, and oil prices rising to US\$25 per barrel by 2005 and stable thereafter.

This scenario projects consumer energy demand to grow by 1.5% pa to 2020. This includes 2.1% pa in the transport sector, 0.8% pa in the industrial and commercial sector, and 1.7% pa in the residential

sector. Oil and electricity are projected to increase their fuel shares with a slight decline in fuel share for coal. A significant decline for gas's share is projected as the Maui field depletes.

Some 2,600 MW of electricity generation capacity is projected to be economic by 2020, with the Stratford gas combined cycle station as the single biggest addition to capacity prior to 2000.

Electricity prices are projected to rise the fastest as the cost of providing additional generation rises. Petrol and diesel prices would rise with the assumed increase in crude oil prices. The price of natural gas is also projected to rise in real terms with the price of coal projected to remain stable over the period to 2020.

Alternative scenarios involving low and high GDP growth paths are also considered.

A.7 International Energy Price Comparisons

This section compares New Zealand's end user energy prices with those of major trading partners for which reliable information is available: Australia, Canada, Germany, Japan, Taiwan, the UK and the USA.

Data are based on "Energy Prices and Taxes Fourth Quarter 1996", IEA, OECD, 1997 and have been rounded. As data do not always relate to the same year, care is needed in interpreting them. Moreover, product specifications and statistical methodology vary across the different countries. Exact ratios between different prices should only be calculated from the original IEA data.

If no data has been available for five or more years, then no comparison is made. Domestic electricity,

domestic gas, and petrol prices for New Zealand include Goods and Services Tax (GST) at 12.5%. Note that Taxation forms a large component of some energy prices, notably for petrol (around 50% or more for most countries, except for the USA for which the share is 30%). A comparison of international electricity prices (excluding taxes) is given for a wider range of countries in Section G.

Of the countries shown in Table A.7a, Canada and the USA generally have the cheapest energy prices, whilst Germany and Japan generally have the most expensive. New Zealand has the second lowest industrial electricity price.

Table A.7a: International Energy Prices (NZ\$/GJ)

		Australia	Canada	Germany	Japan	NEW ZEALAND	UK	USA	Taiwan ⁵
Gas	Domestic	11.6 ³	5.8	17.4 ³	51.3 ³	15.1	11.2	8.9	14.2
	Industrial	4.8 ³	2.3	7.4 ¹	17.9 ³	7.6	3.0	4.5	9.8
Electricity	Domestic	34.2 ⁴	25.2 ⁴	68.9	118.1 ⁴	31.5	50.6	32.3	36.8
	Industrial	18.6 ⁴	16.4 ⁴	32.6	83.9 ⁴	16.7 ²	29.1	16.5	29.3
Coal ⁶		1.9	1.6	11.4 ⁴	3.0	3.7	3.0	1.9	4.7
Petrol ⁷	Premium ⁸	30.0	25.0	52.5	na	31.7	52.1	18.8	28.7
	Regular ⁹	28.1	21.6	49.6	46.0	30.0	45.9	16.4	26.9
Fuel Oil	Domestic Light	na	11.2	12.9	15.6	na	10.9	10.9	na
	Industrial Light	na	7.5	11.2	10.5	9.0	7.8	6.9	7.8
	Industrial Heavy	na	4.8	5.6	6.0	7.4	6.0	5.1	5.5
Weighted average price ¹⁰		20	16	38	53	21	32	15	23

cheapest 2 countries

most expensive 2 countries

The weighted average price¹⁰ is based on New Zealand's relative consumption patterns of these fuels¹⁰, and therefore does not represent the overall end-user energy price from these fuels for each country (since each country has different consumption patterns). It is nevertheless indicative of the relative overall price for each country - it shows, for the countries surveyed, New Zealand to be a close fourth behind Australia, Canada and the USA, with Germany and Japan having much higher average energy prices.

¹1994 data.

²1996 second quarter data.

³1995 data.

⁴1995 third quarter data.

⁵1996 data.

⁶Based on steam coal data; FOB export price for Australia and Canada.

⁷Unleaded.

⁸98 RON except Australia 95 RON, New Zealand 96 RON, USA 95 RON, Taiwan 95 RON.

⁹91 RON except Australia 91/93 RON, Canada and Taiwan 92 RON, UK 95 RON.

¹⁰Weighted by New Zealand consumption for the year ended March 1995, excluding fuel oil and other fuels not shown here, eg, diesel, wood, and direct use of geothermal.

Table A.7b: Real Energy Prices for Industry (1990 = 100)

	1990	1991	1992	1993	1994	1995	1996	% change 1990 -1996
Australia	100	109.6	109.5	109.2	104.6	100.6	105.0	5.0%
Canada	100	104.8	106.6	102.9	102.9	85.0	88.3	-11.7%
Germany	100	102.5	97.2	97.0	97.3	93.4	93.2	-6.8%
Japan	100	97.6	93.4	89.4	85.9	80.7	88.9	-11.1%
New Zealand	100	96.4	93.4	90.4	86.8	85.7	90.0	-10.0%
UK	100	96.8	95.0	94.9	93.8	90.2	84.6	-15.4%
USA	100	93.1	93.4	94.8	92.9	87.0	95.1	-4.9%
OECD	100	98.2	96.6	97.4	96.0	91.6	98.1	-1.9%

Table A.7c: Real Energy Prices for Households (1990 = 100)

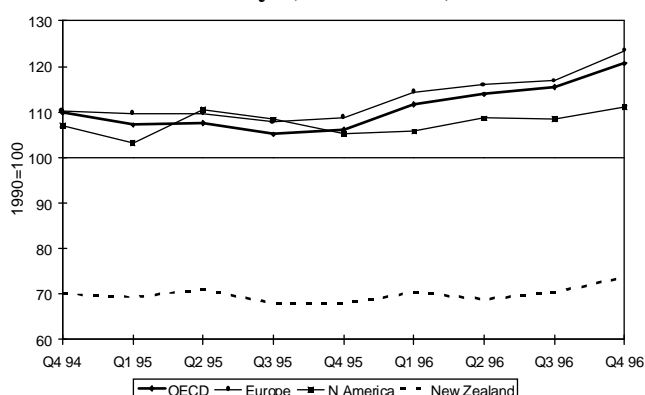
	1990	1991	1992	1993	1994	1995	1996	% change 1990 -1996
Australia	100	99.5	101.4	100.5	100.2	99.0	97.8	-2.2%
Canada	100	98.2	96.9	95.6	95.6	93.9	91.2	-8.8%
Germany	100	104.9	99.8	95.7	96.5	93.4	95.2	-4.8%
Japan	100	99.2	96.2	94.0	92.3	86.2	86.0	-14.0%
New Zealand	100	102.2	103.3	103.0	100.3	99.0	97.3	-2.7%
UK	100	101.2	99.6	99.7	102.2	102.5	101.9	1.9%
USA	100	95.3	91.2	88.7	87.4	85.5	88.1	-11.9%
OECD	100	99.1	97.1	95.6	95.0	93.5	96.1	-3.9%

Between 1990 and 1996 real energy prices have fallen for both industry and households in most OECD countries; the sharply higher crude oil prices of 1996 contributed to increases between 1995 and 1996 in a number of countries, and in the OECD as a whole.

Although Japan still has some of the highest energy prices, it has made some of the best progress in reducing real energy prices - between 1990 and 1996 reducing prices for industry by 11% and for households by 14%.

At the same time the USA reduced its industrial and household energy prices by 4.9% and 12%, while New Zealand's industrial and household prices fell by 10% and 2.7% respectively.

Product focus: diesel

Chart A.7a: Real Diesel Prices for Industry (1990 = 100)

Real diesel prices for industrial are higher than in 1990 OECD as a whole, North America and Europe, but lower in New Zealand¹¹.

After falls in 1995, real diesel prices for industrial rose in 1996 OECD as a whole, and in Europe, North America, and New Zealand, reflecting the higher crude oil prices in 1996.

The index for industrial diesel in the OECD rose by 4.5% in the fourth quarter of 1996, compared with the previous quarter: the North American index rose by 2.4%; the Europe index rose by 5.7% (with rises of 8.1% and 7.1% in France and the UK); the New Zealand index rose by 4.8%.

¹¹ This is partly due to the removal of excise duty on diesel from 1 January 1991.