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The rising energy intensity of the New Zealand economy

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The Rising Energy Intensity of the New Zealand Economy

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ABSTRACT

Recently-published figures from the International Energy Agency indicate that in a world economy characterised by rising efficiency of energy use, New Zealand has been an anomaly. Between 1973 and 1988 the energy intensity (energy required per unit of Gross Domestic Product) fell 24% for the OECD countries on average, 31% in Japan, and 10% in Australia, whereas in New Zealand it rose 31%.

The working paper explores the New Zealand data in detail to identify the source of this behaviour and its possible causes. It is shown that the rising energy intensity of the New Zealand economy cannot be fully accounted for by reference merely to structural changes (the rise of energy-intensive petrochemicals industries, for example). Previous findings by Patterson (1989) of falling energy productivity in some sectors of the economy receive some support. Transport deregulation (including the removal of tariff protection for the local motor-vehicle and oil sectors, and the ending of regulatory restrictions on competition with Railways Corporation and Air New Zealand) clearly contributed also. Relative-price trends are shown to have provided no clear incentives to conserve energy, though other countries with strong energy-conservation records appear to have quite similar prices, suggesting that government non-price policies may have had an important effect on intensity in those countries.

The very low rate of adoption of energy-saving technology in the New Zealand economy to date, coupled with clear evidence that there exist major opportunities to improve the efficiency of energy use, suggest that the time is ripe for a sharp reversal of the rising trend in New Zealand's energy intensity.

Keywords: Energy intensity, energy prices, sectoral data, energy conservation, New Zealand.

The Rising Energy Intensity of the New Zealand Economy

CONTENTS

LIST OF TABLES

LIST OF FIGURES

The Rising Energy Intensity of the New Zealand Economy

Geoff Bertram

I. Introduction: The Aggregate Picture in International Context

One of the key statistics in modern energy planning is the energy intensity of GDP. This paper assembles International Energy Agency data for the New Zealand economy over the past two decades, and compares New Zealand's performance with that of other OECD economies. The evidence suggests a strong rising trend in New Zealand's energy use which runs counter to the usual international picture, which seems to have been largely unaffected by the two oil shocks, and which goes beyond what can be explained simply by reference to the changing structure of the New Zealand economy (for example, the impact of Think Big projects). This situation presents an important agenda for further research, as well as obvious opportunities for policy initiatives.

Energy intensity at the macroeconomic level is conventionally calculated by converting a country's primary energy requirements into some standard unit of account (tonnes of oil equivalents, in the International Energy Agency tables), and dividing this by the country's real Gross Domestic Product to obtain an estimate of the quantity of primary energy required per dollar of output. This exercise enables us to observe trends in the energy-intensity of output in each country through time, and to compare countries with each other to establish which are most energy-intensive. For both these purposes the standard oil-equivalent unit of account used by the International Energy Agency enables us to grasp the essential picture, without detracting at all from criticisms of that measurement approach by, e.g., Patterson (1989 pp.5-6).

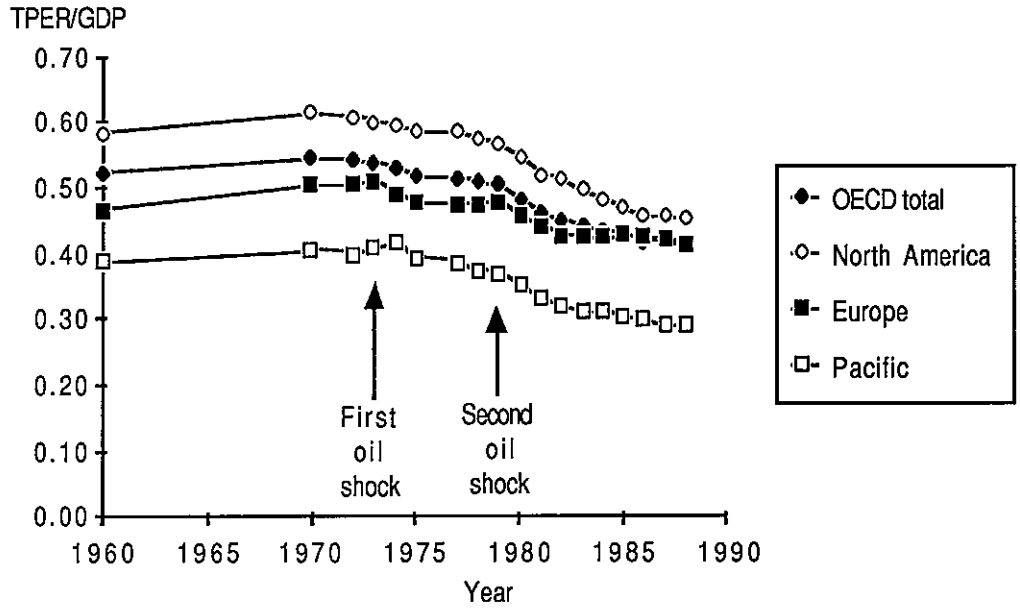
The time series for individual countries are likely to be more reliable than the cross-country comparisons, for two reasons. First, there are well-known problems in comparing GDP amongst countries, although such comparisons continue to be standard practice among policy economists. Converting national GDP figures into real terms involves the use of locally-specific deflators, while the conversion of each country's data to a standard unit (generally US dollars) requires the application of exchange rates. The conventional way of doing this, using nominal US dollar exchange rates, understates the GDP of poor countries relative to rich ones (Kravis, Heston and Summers 1982), and probably underestimates their growth rates as well, giving an upward bias to the energy-intensity estimates for such countries. In looking at the data which follows, we should therefore place most emphasis on differences in trends amongst countries, and should anticipate that poorer countries are more likely than New Zealand to have their energy intensities artificially inflated by statistical problems of GDP conversion.

Figure 1 (based on the data in Table 1 which, together with all other data tables, is presented at the end of the text of the paper) shows the trend of energy intensity for the OECD, and for three regional groupings of OECD countries - North America, Europe, and the Pacific (which includes New Zealand but is dominated by Japan). The general pattern is clear. Up to the first oil shock of 1973,

the general trend was towards rising energy intensity. The first oil shock reversed this trend, setting the OECD as a whole onto a downward path. This steepened markedly after the second oil shock of 1979, which confirmed in the minds of business and governments around most of the world the case for aiming at long-run efficiency gains in energy use. From 1973 to 1988 the energy intensity of GDP fell 24% for the OECD as a whole, 25% in North America, 20% in OECD Europe, and 29% in OECD Pacific.

Figure 1

Primary-Energy Intensity of Gross Domestic Product, 1960-1988:
OECD Trends

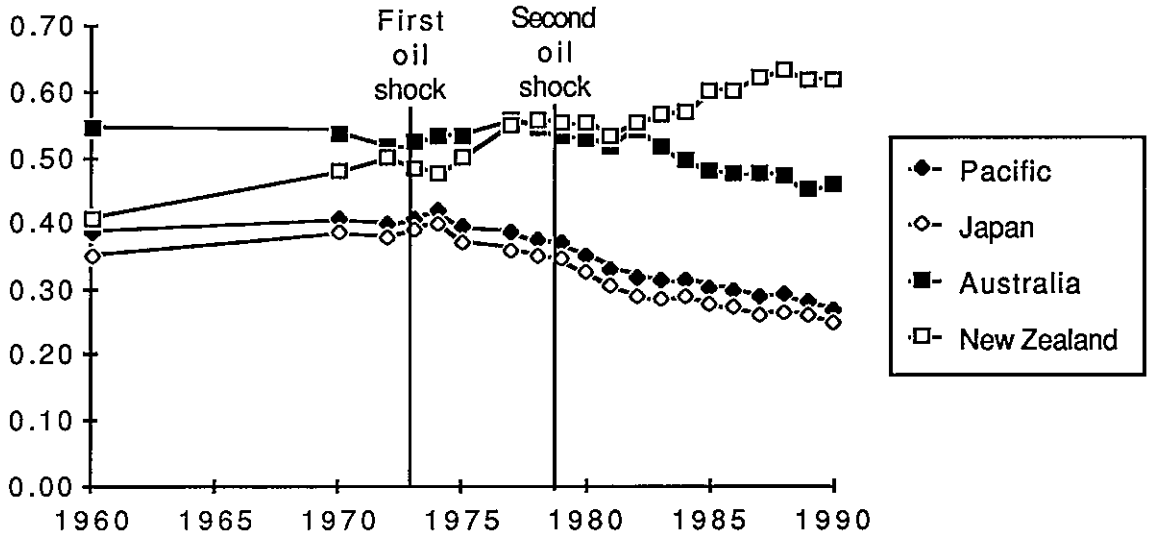


OECD Pacific comprises three countries: Japan, Australia, and New Zealand. Figure 2 (based on Table 2 in the appendix) shows the data for these countries since 1960. The extent to which Japan dominates the "OECD Pacific" totals is immediately obvious, with a very low, and falling, energy intensity in Japan contrasting sharply with the higher energy intensity of Australia and New Zealand. Equally dramatic, however, is the contrast in trends between Australia and New Zealand.

Australia exhibits a trend which is roughly consistent with the OECD-wide pattern, though lagging behind. The definite downturn in Australian energy intensity did not occur until the early 1980s, and during the period between the two oil shocks the Australian and New Zealand economies exhibited very similar levels and trends of energy intensity. In a longer term perspective, however, the differences of trend show up clearly. Through the 1960s and early 1970s New Zealand exhibited a steadily rising trend in energy intensity while Australia was on a high plateau, so that in effect New Zealand was "catching up". After 1980 Australia joined the worldwide downward trend, while New Zealand stayed firmly on its upward path. Thus in 1960 New Zealand's energy intensity was 25% below Australia's; in the late 1970s the two were equal; and by 1988 New Zealand's energy intensity was 34% above Australia's.

Figure 2

Primary-Energy Intensity of Gross Domestic Product, 1960-1990:
Pacific OECD Countries



Source: International Energy Agency, *Energy Balances of OECD Countries 1987-1988* pp.82, 94, 142,154; 1989 and 1990 calculated from International Energy Agency, *Quarterly Oil Statistics and Energy Balances* data on primary energy requirement, and real GDP growth rates from OECD *Economic Outlook* December 1990.

Figure 3 reproduces the New Zealand and Australian trends from Figure 2, superimposed on the OECD average from Figure 1, which makes clear the extent to which Australia, albeit with a lag, has followed the general OECD path towards increased efficiency.

Figure 3

Primary-Energy Intensity of Gross Domestic Product, 1960-1990:
Australia, New Zealand, OECD

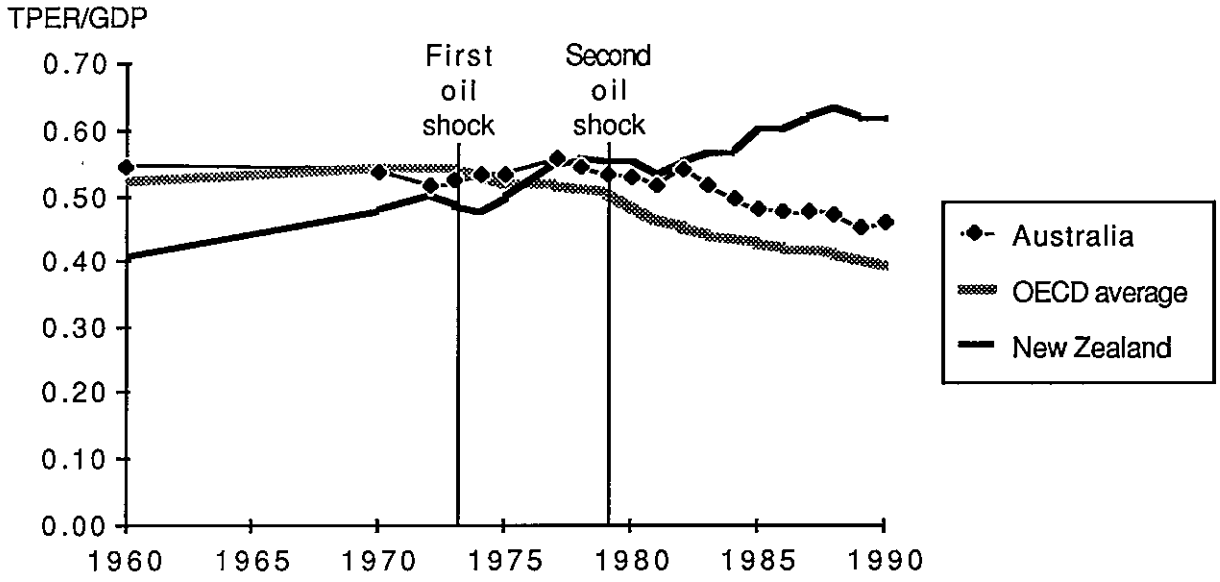


Figure 4

Six Countries with Rising Energy Intensity, 1960-1988

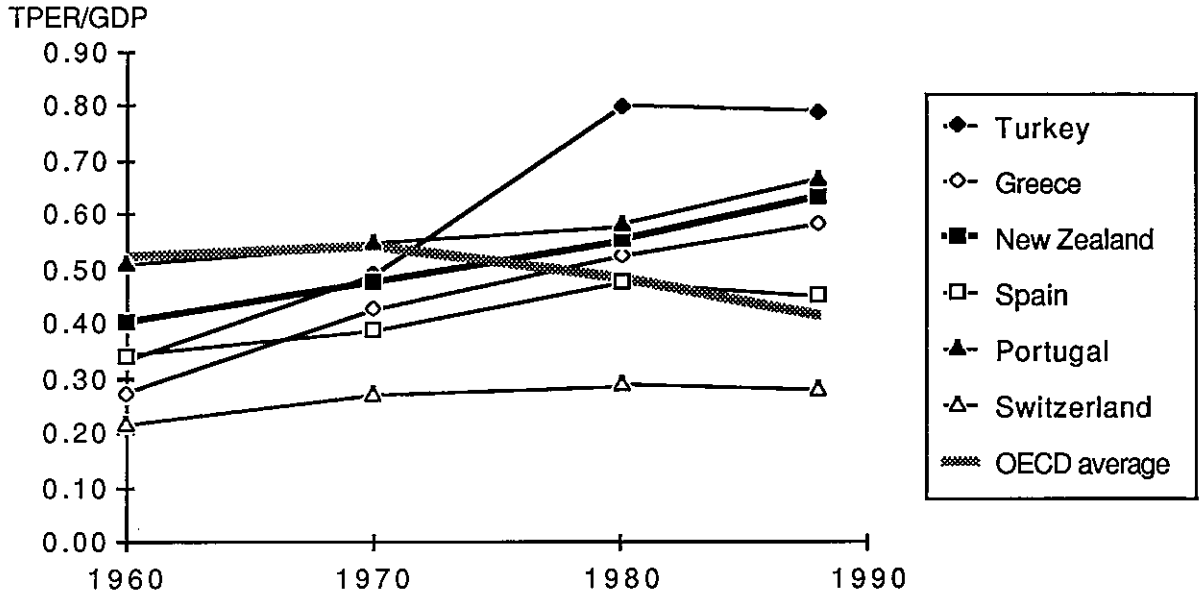
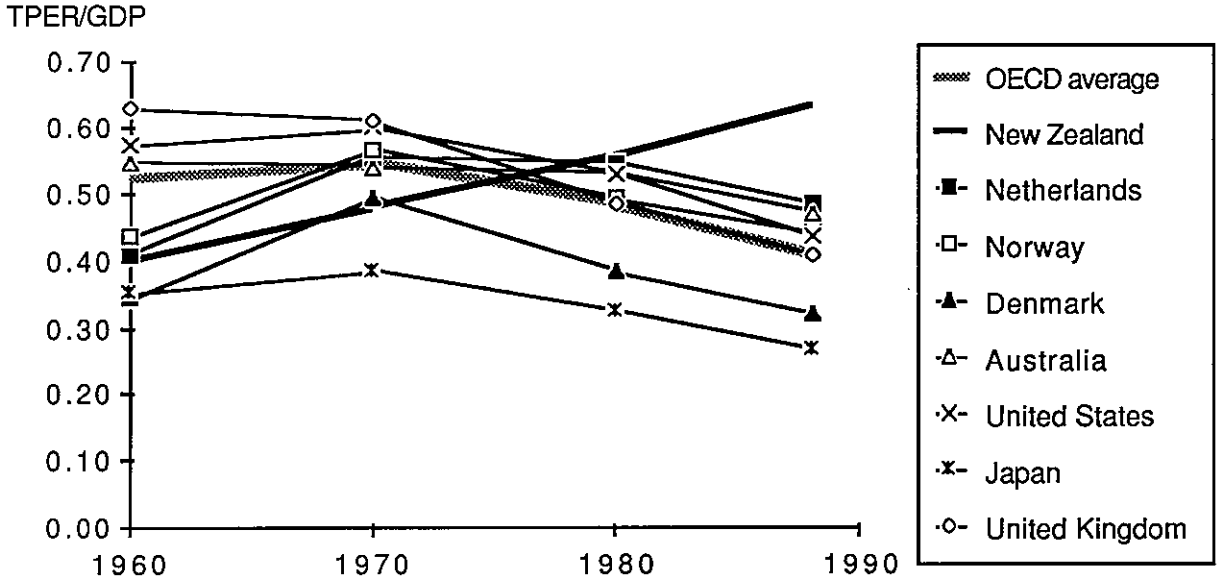


Figure 5

Seven OECD Countries with Falling Energy Intensity vs New Zealand, 1960-1988



Wider comparisons between New Zealand and other countries are made in Figures 4 and 5, which take four benchmark years (1960, 1970, 1980 and 1988) and compare the overall trends firstly for the group of OECD countries which shared New Zealand's experience of rising energy intensity over the period (Figure 4) and then for New Zealand against a selection of countries with falling trends (Figure 5).

Figure 4 indicates that New Zealand has not been altogether alone. Greece and Portugal exhibit time paths very similar to New Zealand's, and Turkey emerges as the only OECD economy to exhibit a dramatically steeper rise than New Zealand over the period 1960-1988, though Turkey's energy intensity (in common with Spain and Switzerland) has begun to fall in the 1980s.

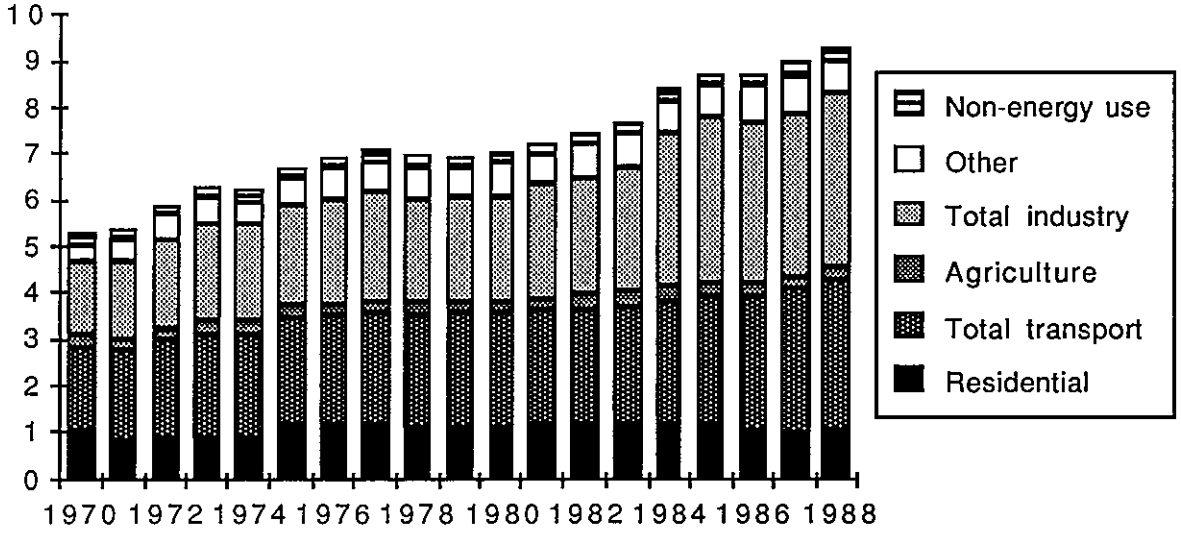
II. Anatomy of the New Zealand Experience: Sectoral Analysis

The simple energy-intensity data discussed in the preceding section provide a quick indication of the overall picture, but they leave many questions unanswered. How can we account for the rising energy intensity of the New Zealand economy over the past three decades? Is the increase concentrated in one or a few sectors? Do the same trends apply across the board to all energy forms? Can we find any evidence that relative-price trends in New Zealand have been particularly unfavourable to conservation? How much of the rising energy intensity of the 1980s is directly attributable to Think Big?

To begin with, Figures 6 and 7 show the orders of magnitude, and trends through time, of New Zealand's energy use by major sector. Figure 6 breaks down total final consumption (TFC) of energy among six categories: residential, transport, agriculture, industry, other, and non-energy use (such as lubricants and road-sealing materials). The data are presented first as a stacked bar graph (Figure 6A), and then as plots for the individual items (Figure 6B). Figure 7 repeats the exercise with the addition of energy lost in conversion and distribution, to show the allocation of the total primary energy requirement (TPER).

Figure 6A

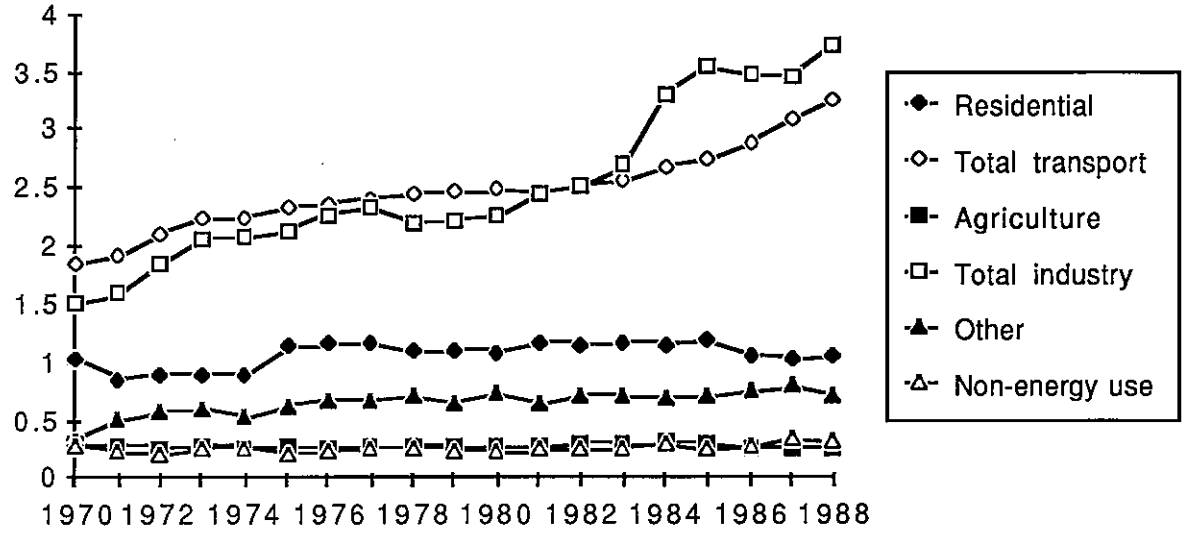
New Zealand Final Energy Consumption by Sector, 1970-1988
Million tonnes of oil equivalents



Source: Appendix Table 3.

Figure 6B

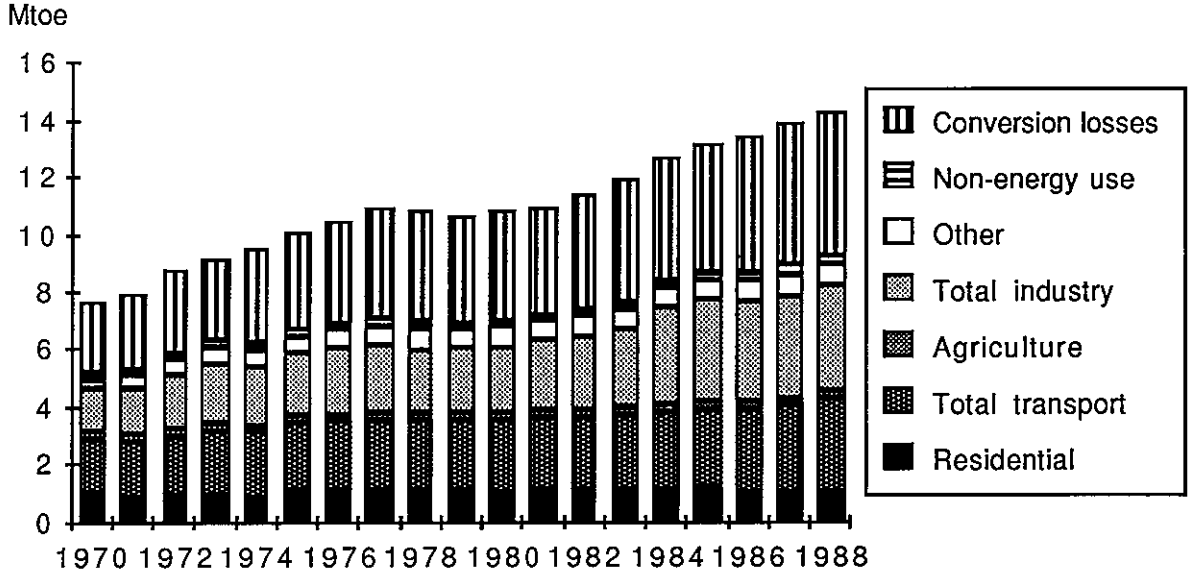
New Zealand Final Energy Consumption by Sector, 1970-1988
Million tonnes of oil equivalents



Source: Appendix Table 3.

Figure 7A

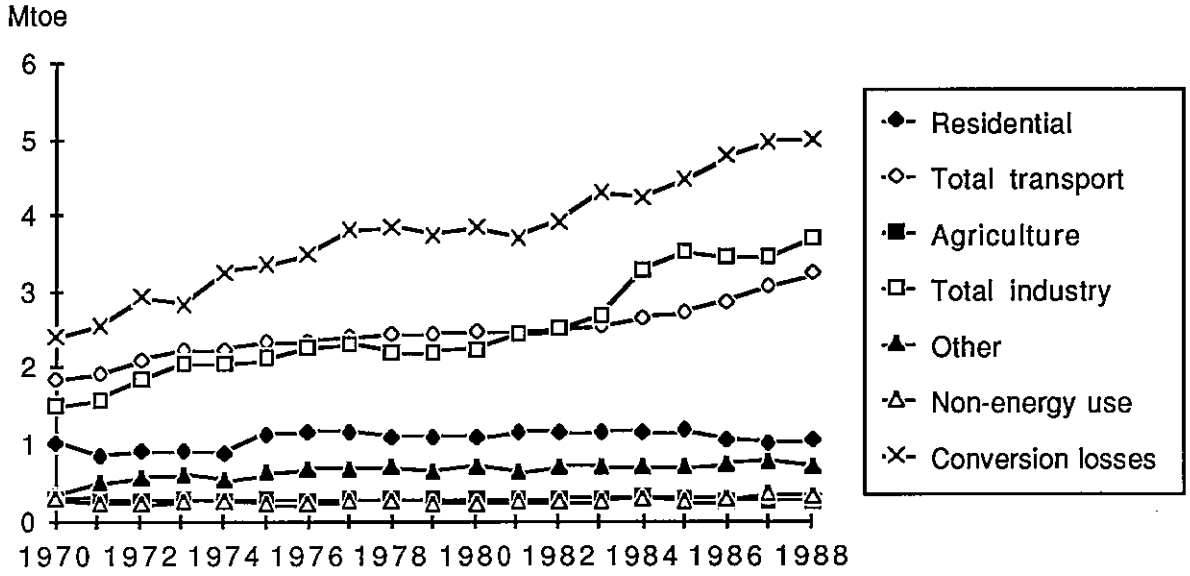
New Zealand: Allocation of Total Primary Energy Requirement to Demand Categories, 1970-1988



Source: Appendix Table 3.

Figure 7B

New Zealand: Allocation of Total Primary Energy Requirement to Demand Categories, 1970-1988

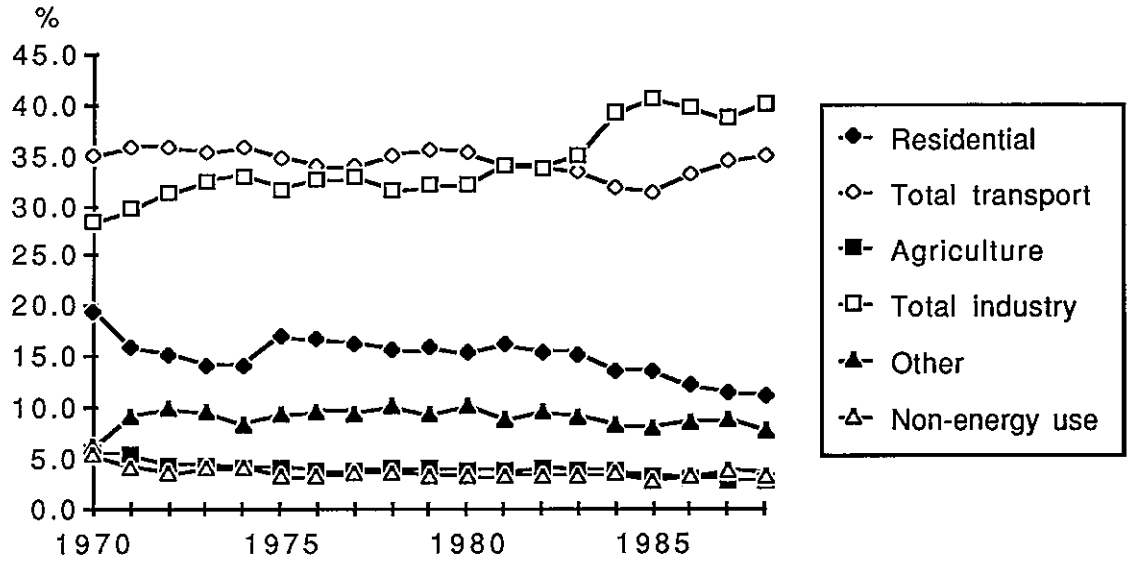


Source: Appendix Table 3.

Figure 8 graphs the data for sectoral consumption as percentages of TFC, and for the system's energy losses (the difference between TPER and TFC) as a percentage of TPER, to identify areas whose shares of the energy pie have been rising. Figure 9 relates the sectoral data back to the rising overall energy-intensity, by showing the contribution of each demand component to the change in the primary energy/GDP ratio.

Figure 8

New Zealand: Percentage Sectoral Shares of Total Final Consumption of Energy, 1970-1988



Source: Appendix Table 4.

The following conclusions emerge:

1) The main upward pressure on final energy consumption has come from industry and transport. Residential, agricultural, and non-energy consumption have remained fairly stationary over the past two decades in absolute terms, and their shares have fallen. Service-sector consumption ("other") jumped in the early 1970s but has since remained fairly static.

2) Relative to 1973 (the last year before the first oil shock) the New Zealand economy's total final consumption of energy in 1988 was 47% higher. Residential consumption was up 16%, transport up 45%, agriculture down 8%, industry up 81%, and non-energy use up 18%.

3) While total energy consumption increased by 2.95 million tonnes of oil equivalent between 1973 and 1988, total primary energy requirements soared by 5.13 million tonnes of oil equivalent. The proportion of total primary energy actually delivered for consumption thus fell from 69% in 1973 to 65% in 1988, with conversion and distribution losses rising from 31% to 35%. The low thermal efficiency of synthetic petrol production and fossil-fuel-fired electricity generation account for much of this deterioration.

4) Turning to the rise in the energy/GDP ratio, this is attributable to developments in industry, transport, and conversion/distribution. The timing of changes in these differs considerably. The industrial surge of energy-intensity clearly coincides with the years of Think Big in the first half of the 1980s. The transport sector provided the driving force in the second half of the decade, as road haulage displaced more energy-efficient rail transport and airways deregulation increased commercial flights. The rising level of conversion/distribution losses was a steady trend throughout the period, with a jump in 1983 attributable to the starting-up of the Huntly thermal power station. (Energy losses associated with electricity generation and transmission rose from 3.44 million tonnes of oil equivalent in 1982 to 3.85 mtoe in 1983.)

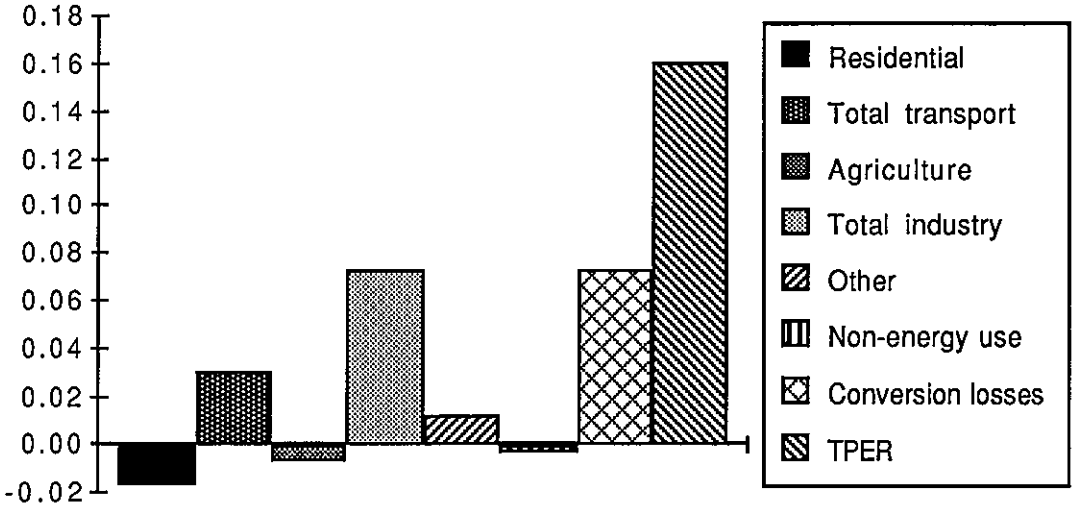
Table 5 shows sectoral contributions to the rising intensity of Total Primary Energy Requirement over three periods: 1970-1988, 1973-1988, and 1980-1988. Figure 9 provides a chart of the data for the period 1970-1988, in metric tonnes of oil equivalents. It can be seen that the dominant contributors to the increase in the energy intensity ratio were conversion losses and industry, with transport in third place. Residential energy use, agriculture, other and non-energy uses had negligible or negative impacts on the ratio during the period. Reference back to Figure 8 shows that in the first half of the 1980s the driving force behind rising energy intensity was industry, but from 1985 on the transport sector set the pace.

Table 5

Sector	----------Contribution to change in TPER/GDP Ratio----------					
	(1) 1970-88	(2) % of overall 1970-88	(3) 1973-88	(4) % of overall 1973-88	(5) 1980-88	(6) % of overall 1980-88
Residential	-0.017	-11	-0.001	0	-0.009	-13
Total transport	0.030	19	0.027	17	0.016	22
Agriculture	-0.007	-4	-0.004	-3	-0.003	-5
Total industry	0.073	46	0.058	37	0.049	68
Other	0.012	7	0.000	0	-0.006	-8
Non-energy use	-0.003	-2	0.001	0	0.002	3
Conversion losses	0.073	46	0.074	48	0.023	33
TPER	0.160	100	0.154	100	0.071	100

Figure 9

Sectoral breakdown of the 1970-1988 change in the TPER/GDP Ratio for New Zealand



Source: Table 5.

More Detailed Sectoral Data: Industry

We turn now to a more detailed disaggregation of energy consumption by industrial sub-sector, on the IEA classification. The IEA database lists under "Industry" a number of manufacturing sectors plus construction and mining and quarrying. Table 6 (in the appendix) gives the annual data from the IEA energy balances, and Figure 10 graphs the data as a stacked bar chart.

Inspection of this chart indicates that the classification procedures used by the New Zealand Government to compile the detailed data have been erratic. The data for 1987 and 1988 reflect a sharp

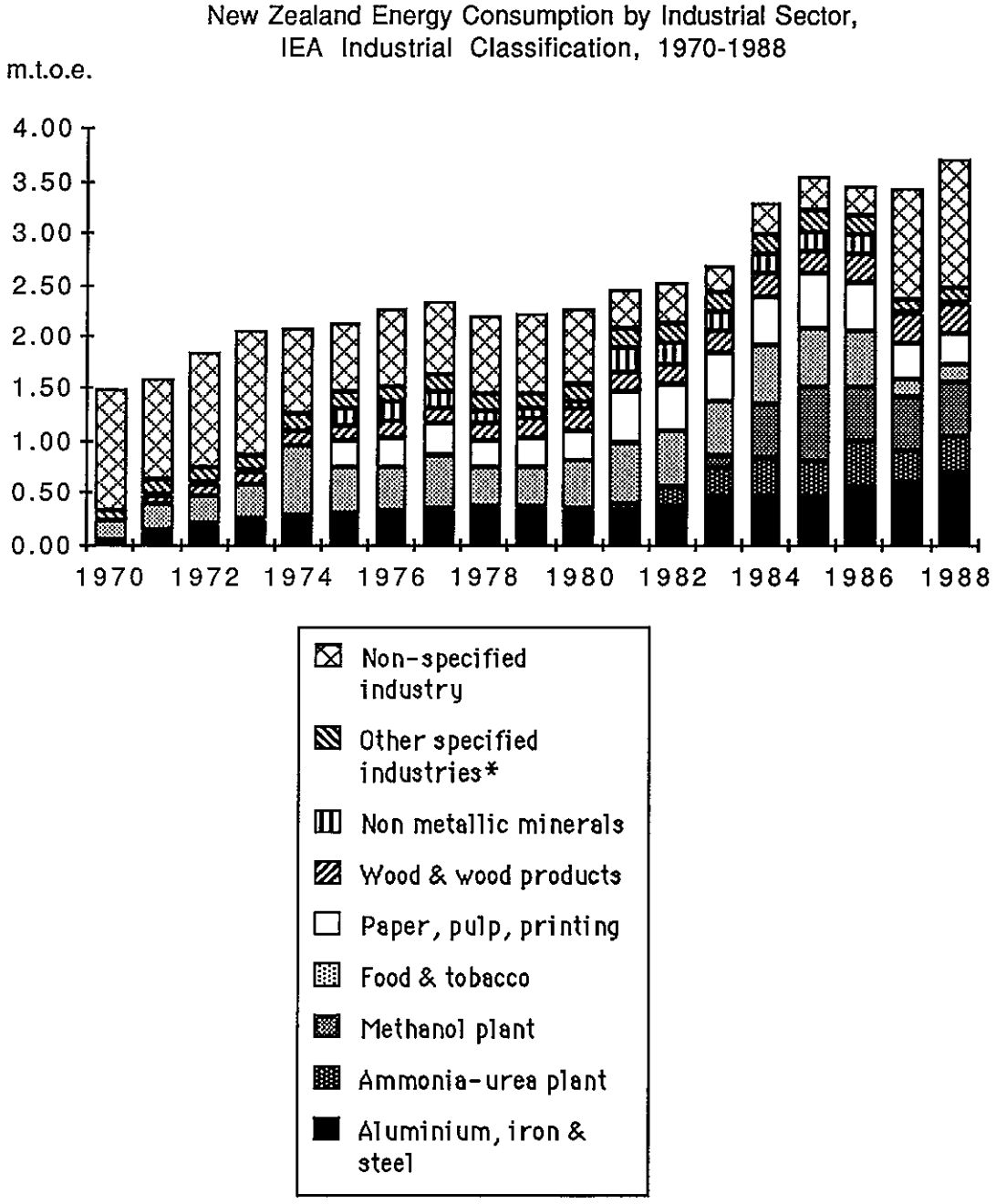
drop in accuracy as large parts of the industrial sector's consumption disappeared into the "non-specified" category, reflecting the Labour Government's dismantling of the energy planning machinery and its associated statistical capability.

The impression is that apparent trends in the first half of the 1970s are likely to be due to improvements in the accuracy of the classification of data rather than to genuine changes in individual industrial sectors. Virtually the only fully-reliable evidence to be drawn from the chart is the effects of the start-up of the ammonia-urea plant ("chemical non-feedstock") and methanol plant ("chemical feedstock") in the early 1980s. (The Motunui synthetic petrol plant does not appear here, being treated as part of the energy transformation stage rather than as a final energy-using industry.)

[The Tiwai Point aluminium smelter poses a problem. Column (4) of Table 6 shows only insignificant energy consumption by the non-ferrous metals sector, which evidently includes only relatively minor activities such as aluminium fabricating. By the late 1980s the smelter was consuming over 4,000 GWh of electricity annually, which at a conversion factor of 12,000 GWh per million tonnes of oil equivalent (BP 1990 p.36) would come to 0.33 m.t.o.e. or about 9% of total industrial energy consumption. The only industrial sector with electricity consumption of this magnitude is "iron and steel", which is shown as consuming 0.45 m.t.o.e. (IEA 1990 p. 157), or 5,400 GWh, in 1988, and 0.43 (5,150 GWh) in 1987. The March-year 1988 electricity statistics show 4,977 GWh consumed by "iron and steel basic; non-ferrous metals", so this is clearly the classification used in the IEA database too, notwithstanding their separate column for non-ferrous metals.]

The industrial consumption data as a whole show clear evidence of a slowdown in the growth of energy consumption as the late-1980s recession overtook manufacturing and construction activity. There is no evidence that New Zealand industry has yet begun to achieve major gains in the productivity with which energy is used; on the contrary, Patterson (1989) offers some evidence that energy intensity in industry has been raised both by the substitution of energy for labour, and by negative technological progress, reflected in a falling residual in his production-function-based growth accounting exercise. Closer inspection of Patterson's data suggests that even his pessimistic assessment of technological change may have been too favourable.

Figure 10



* "Other specified industries" comprises Textiles and Leather, Construction, Mining and Quarrying, Machinery, Transport Equipment, and Non-Ferrous Metals (excluding aluminium smelting).

Patterson (1989 p.47) estimated that two petrochemical plants (methanol and ammonia-urea) consumed 29% of New Zealand's total energy in 1984 to generate 0.73% of GDP. He deduces that the impact of these two plants on the energy/GDP ratio can be obtained simply by subtracting their energy use from the numerator, and their contribution to GDP from the denominator. On this basis, their establishment accounted for 8.39% of the 18.89% increase in the energy/GDP ratio 1971-1984

(Patterson 1989 p.54). This, however, is not altogether satisfactory, because the production of the natural gas purchased by the two plants also contributes to the GDP figure for those years, and in the absence of the plants, gas production would have been lower, and GDP correspondingly lower also. (The original rationale for building the plants, after all, was to accelerate depletion of the Maui gasfield in order to minimise the losses to the Government from its take-or-pay contract to purchase the gas.) "Mining and quarrying" accounts for roughly 1% of GDP, so the magnitude of the consequent adjustment is not so great as to eliminate the observation that Think Big was a major contributor to raising the energy/GDP ratio. But the implication is that Patterson overstated the petrochemical contribution to rising energy intensity in his Table 4.3 (p.56) and thereby understated the extent of deterioration in the technological "residual".

More Detailed Sectoral Data: Transport

The IEA energy balances break the transport sector down into air, road, rail, internal navigation, and unspecified. Features of the data (Figures 11A and 11B) are the steep rise in energy use in transport since 1982, and the extent to which this has been due to the air and road transport sectors, both of which continued to increase their energy use rapidly in the second half of the 1980s.

Figure 11A

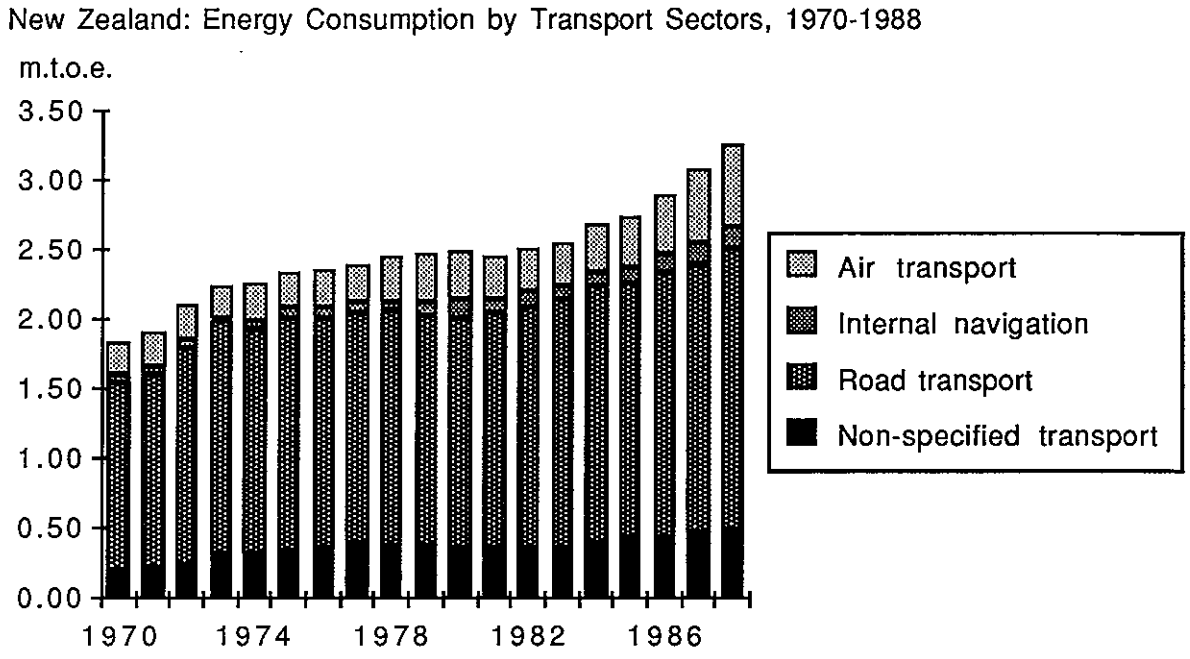
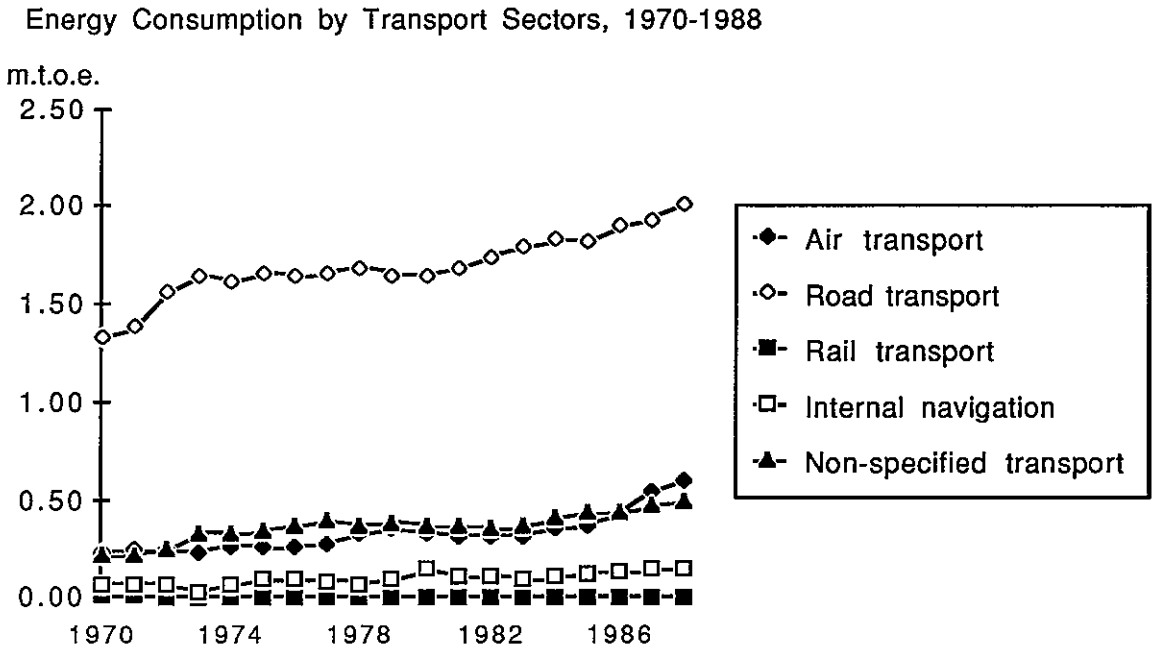


Figure 11B



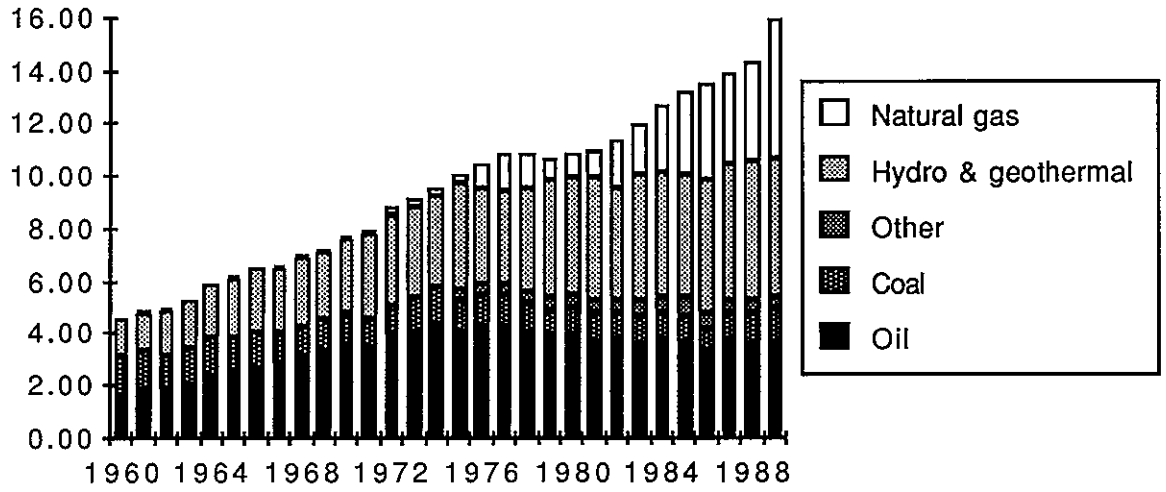
III. Energy Consumption by Energy Form

The IEA data provides a breakdown of total primary energy requirement (TPER) among oil, gas, coal, hydro and geothermal, and other sources of energy. Total final consumption (TFC) is similarly decomposed among oil products, gas, coal, electricity, other fuels, and non-energy uses. The difference between TPER and TFC is accounted for by losses of net calorific value in the processes of converting one energy form to another (e.g. coal to electricity, gas to synthetic petrol) and distribution (e.g. transmission losses on the electricity grid).

Figure 12 shows the data for New Zealand's TPER from 1960 to 1989. Figure 13 gives the data for TFC. There is an apparent increase in the coverage of the statistics in 1975, when the "other" category makes its first appearance in both TPER and TFC, but any resulting upward bias to the post-1974 period relative to the pre-1975 period is too small to affect the overall picture significantly.

Figure 12A

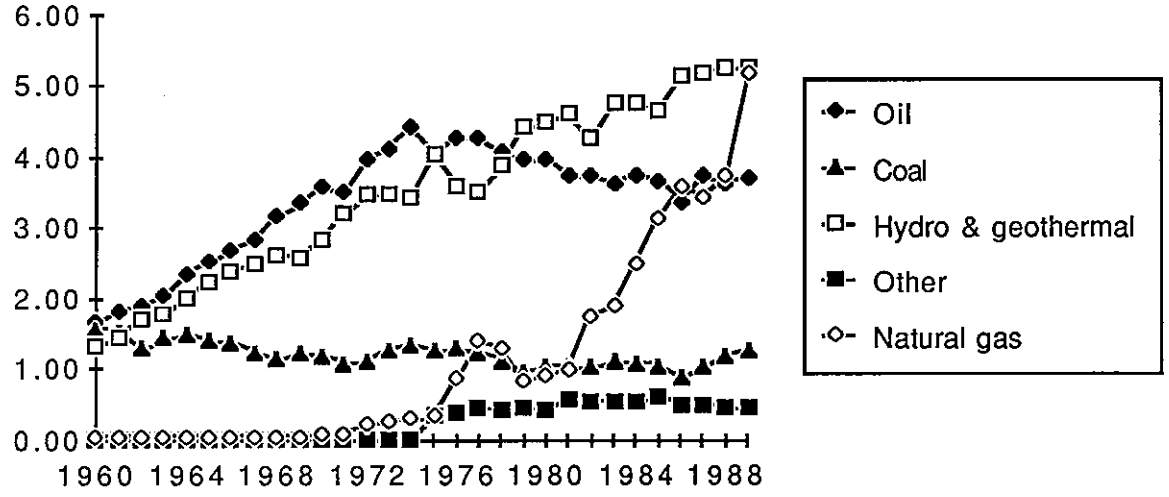
New Zealand Primary Energy Requirement by Energy Form, 1960-1989
Million tonnes of oil equivalents



Source Appendix Table 8.

Figure 12B

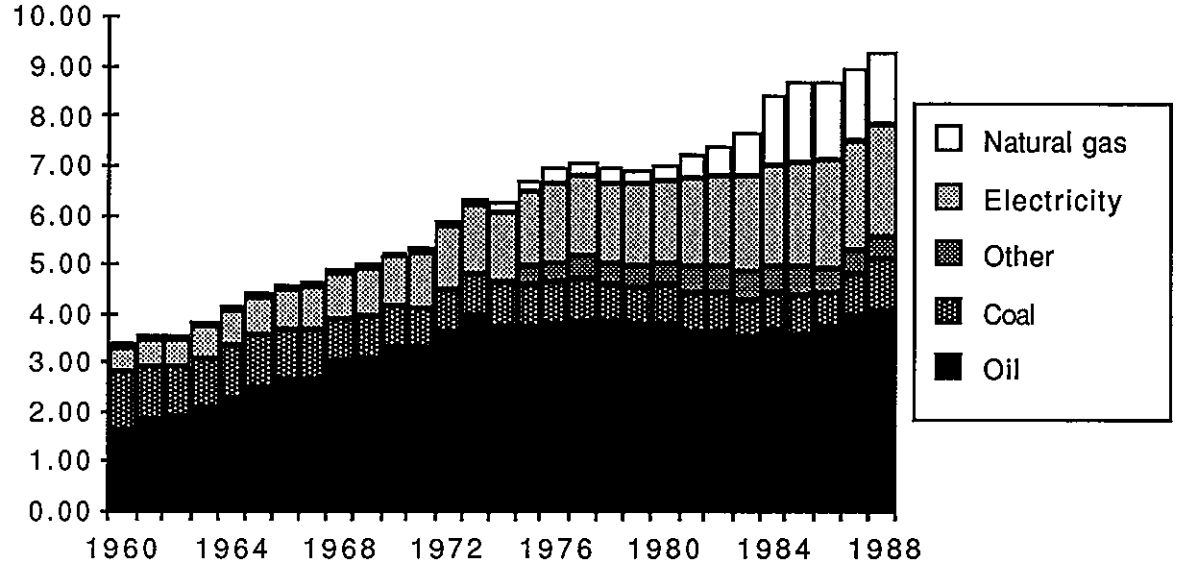
New Zealand Primary Requirement for Main Energy Forms 1960-1989
Million tonnes of oil equivalents



Source Appendix Table 8.

Figure 13A

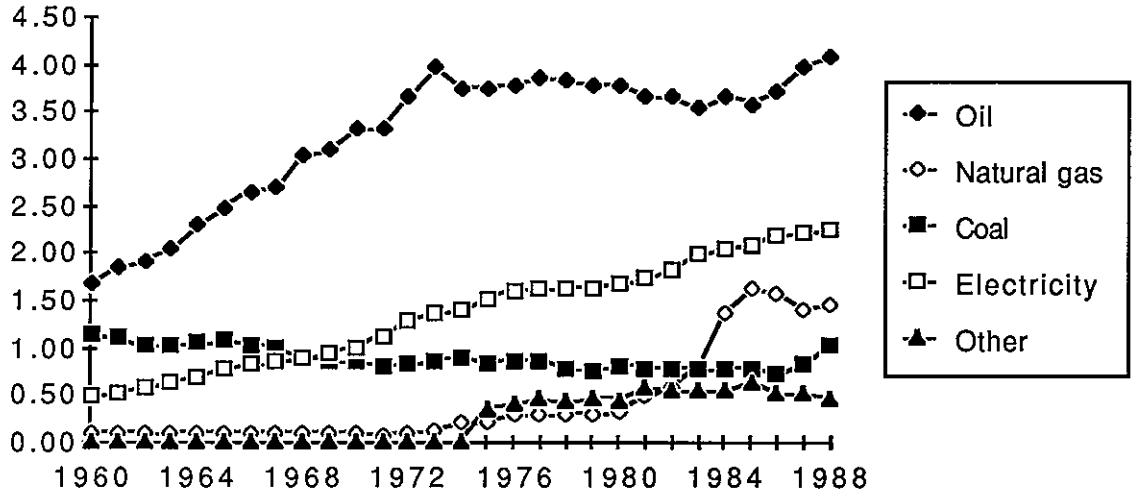
New Zealand Total Final Consumption by Energy Form, 1960-1988
Million tonnes of oil equivalent



Source Appendix Table 9.

Figure 13B

New Zealand Final Consumption of Main Forms of Energy, 1960-1988
Million tonnes of oil equivalents



Source Appendix Table 9.

IV. Energy Intensity by Form of Energy

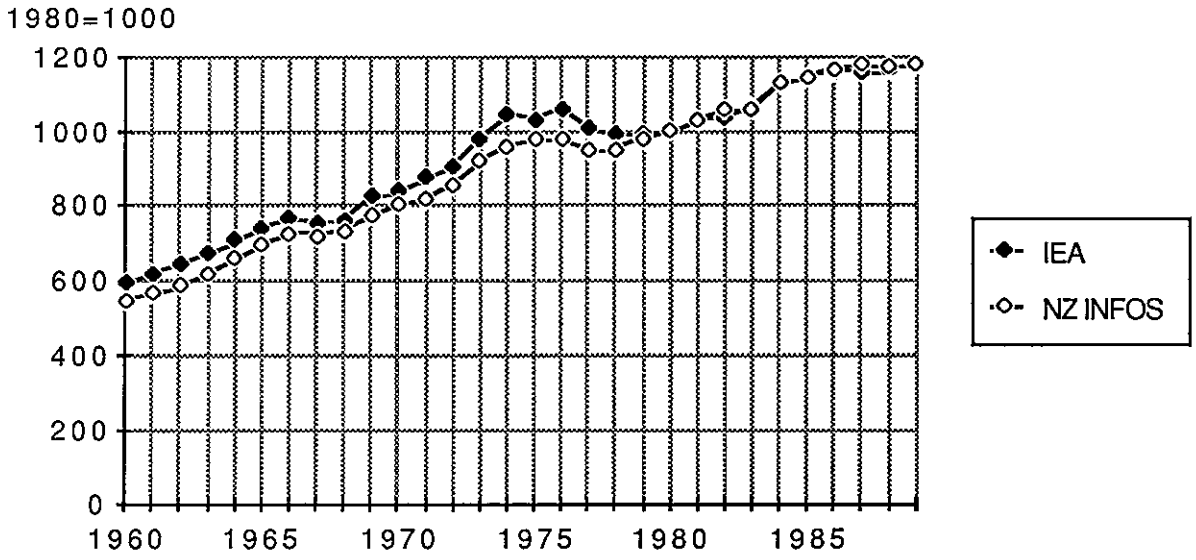
To convert the data in section III above from million tonnes of oil equivalents into energy-intensity ratios involves simply dividing through by a real GDP series. Up to the 1987 edition of *Energy Balances of OECD Countries* this was expressed in US dollars at 1980 prices. In the 1988 edition a new series appeared using 1985 prices. The series are constructed by taking each country's GDP data in constant prices and converting to US dollars using nominal exchange rates.

Comparison of the IEA series with the official New Zealand SNA real GDP series from INFOS makes it seem likely that the IEA obtained its pre-1978 calendar-year GDP series by simply backdating the March-year New Zealand series for years prior to 1978. Figure 14 shows the fit of the IEA and INFOS series when this backdating is applied to the New Zealand SNA figures up to 1977, and actual calendar-year SNA data are used from 1978 on.

It can be seen that 1977 and 1978 show a stronger drop in the IEA data than in the INFOS data, so that over a period such as 1973-1988 the IEA series exhibits slightly lower growth than the INFOS series. The significance of this is the possibility that the IEA estimates of energy intensity may be slightly biased upwards. Table 10 (in the appendix) sets out the IEA series for GDP in 1980 US dollars and in 1985 US dollars, and the INFOS index series.

Figure 14

New Zealand Real GDP Series "backdated" by one year and compared with International Energy Agency data.



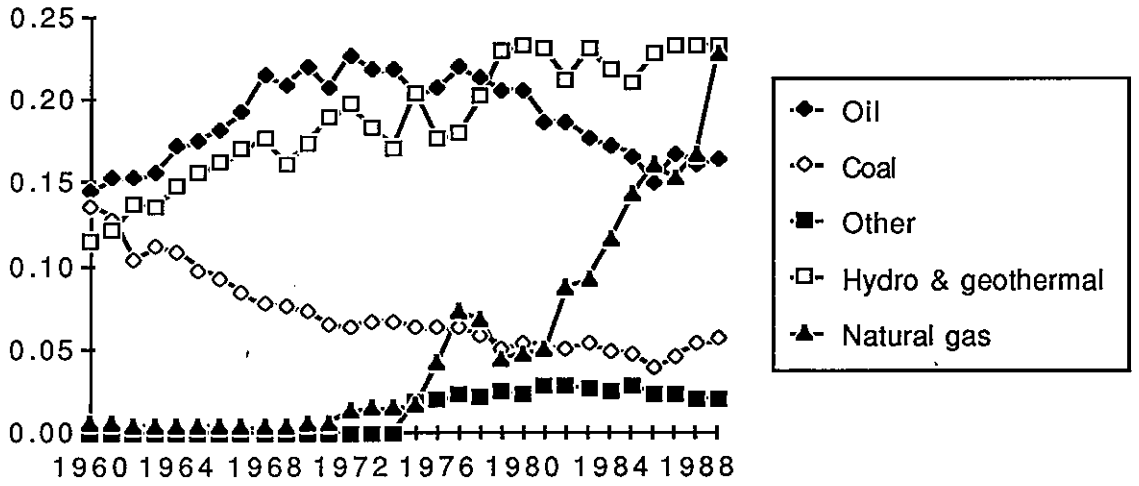
Source: Table 10 below.

Figure 15 shows the primary energy intensity series by energy form. Figure 16 shows final energy consumption on the same basis. A striking contrast between the two data sets is seen in the role of natural gas, which rose extremely rapidly in primary use but showed a much more muted increase in

total final consumption. The explanation is that a large part of the primary use of natural gas has been accounted for by synthetic petrol (which appears under "oil products" in Table 12 and Figure 16) and electricity generation. This accounts equally for the appearance of falling oil intensity in the primary-energy data, but no secular downward trend in the final-consumption intensity of oil use.

Figure 15

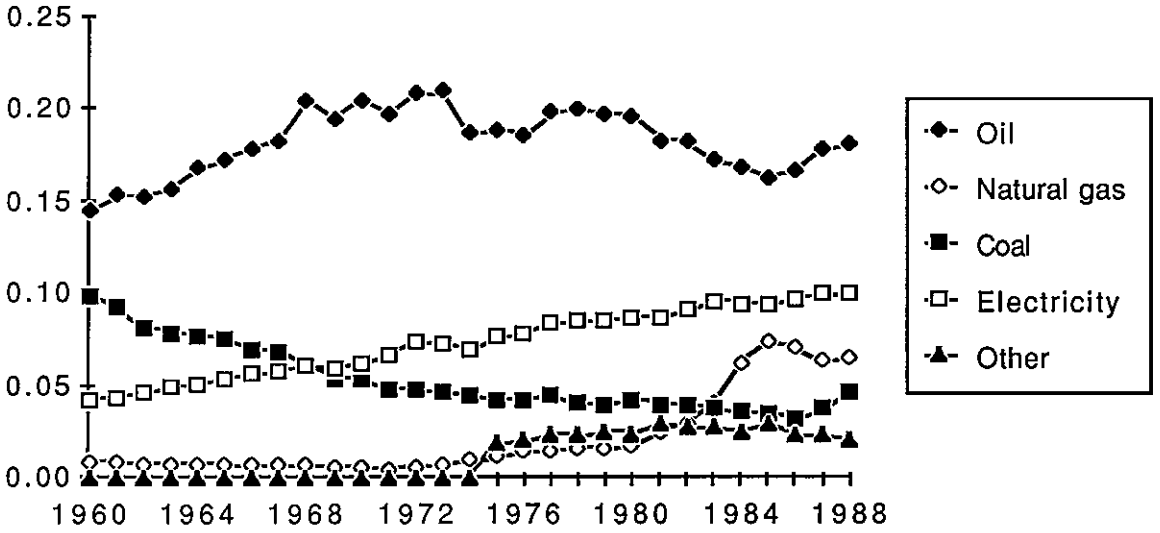
New Zealand Primary Energy Intensity by Energy Form, 1960-1989
(Tonnes of oil equivalent per US$000 at 1985 prices)



Source: Table 11

Figure 16

New Zealand Intensity of Final Energy Consumption, by Energy Form
(Tonnes of oil equivalent per US$000 at 1985 prices)



Source: Appendix Table 12.

V. Energy Prices.

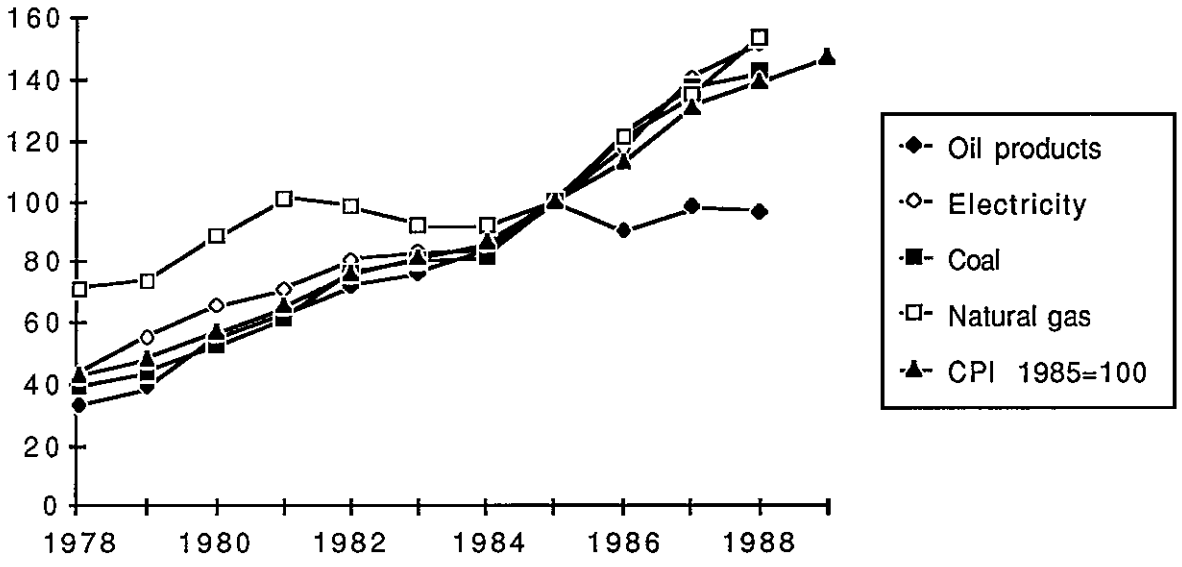
One of the important potential stimuli to the adoption of energy-saving measures is the price of energy in general relative to (a) other goods and services within each country's economy, and (b) energy prices in other countries. The structure of energy use within a country can also be expected to respond to the relative prices of alternative energy forms. For New Zealand, the following generalisations appear broadly right.

Relative-Price Trends Within New Zealand

In the New Zealand economy, energy prices for end-users have not risen relative to other prices over time. Figures 17 and 18 below show the IEA's energy price indices for New Zealand (based on NZ dollar data) for the period 1978-1988, and the New Zealand Consumer Price Index for the same period. (The notes to the relevant table, in IEA 1990 p.190, indicate that the source data for the indices came from the Department of Statistics and appears to correspond to the Department's CPI database collection system, combining retail prices from 25 centres.) Figure 18 uses the CPI to deflate the energy price indices. The outstanding trends of the 1980s were a fall in the real natural gas price in the first half of the period, with this price becoming roughly indexed to the CPI from 1985 on; and a drop in real oil prices in the second half of the 1980s. No price signals favouring conservation are discernable in these series.

Figure 17

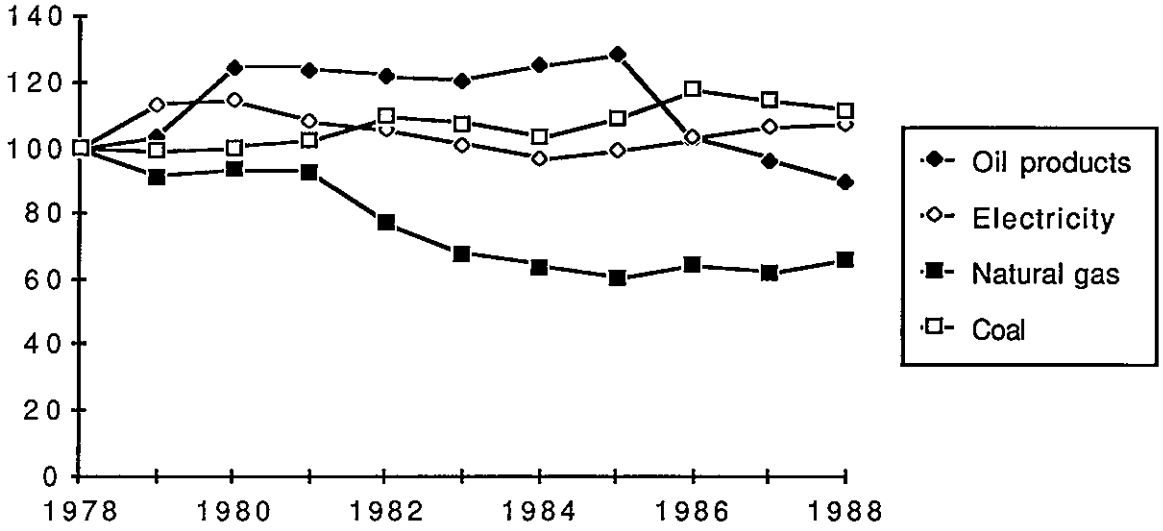
New Zealand Price Indices, 1985=100



Source: Appendix Table 13.

Figure 18

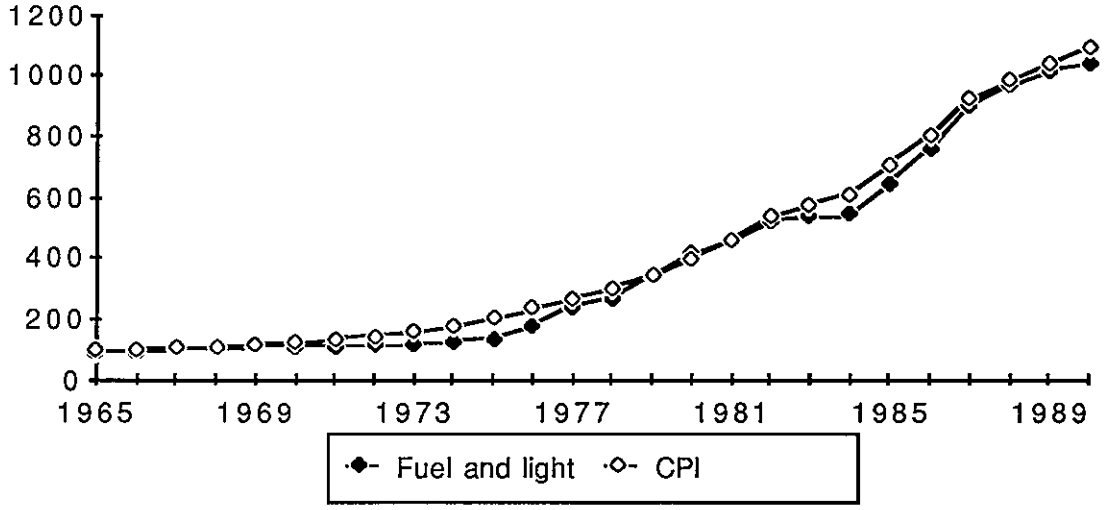
New Zealand Retail Energy Prices relative to Consumer Price Index, 1978=100.



Source: Appendix Table 14.

Figure 19

New Zealand Price Indices: Fuel and Light, and Consumer Price Index (All Groups)
Calendar years, December Quarter 1988=1000



Source: Appendix Table 15.

International Price Comparisons

Comparisons of the country data in the IEA's *Energy Prices and Taxes* show that relative to the OECD average New Zealand energy users face very high fuel oil prices, moderate natural gas prices (with a tendency towards becoming a cheap-gas country in the 1980s), average (but relatively-rising) diesel prices, and very cheap electricity. These comparisons are shown in the charts in Figures 20-27. Patterson (1989 p.16) describes the salient features of the energy price situation as follows:

> According to the IEA ... New Zealand had the second lowest price for industrial sector electricity ($US 0.029/kWh) and the lowest price for the household sector ($US 0.22/kWh) in 1985. Although energy prices of other energy forms (gasoline, natural gas, but not fuel oils) were also comparatively low in New Zealand, the cost relativity between these and electricity was much greater for the New Zealand case than for other OECD countries.

Reference to Figure 24B shows that by 1988 New Zealand's electricity price to industry had risen considerably relative to other countries, making it sixth cheapest rather than second as in 1985. It is notable that Australia's industrial electricity prices seem to have fallen behind New Zealand's during the 1980s without preventing Australia turning in a steady performance of falling energy intensity through the decade.

It is notable also that New Zealand fuel oil prices are high by international standards, and diesel prices are about average; yet oil intensity of final energy consumption in New Zealand has held up much more than in other countries with similar prices. Apart from electricity and gasoline, New Zealand does not obviously rank at the cheap-energy end of the spectrum internationally. The relatively high level of electrification of the New Zealand economy is thus explicable in terms of domestic relative prices, and there may also be some relative-price explanation for the low penetration of CNG into the automotive fuels market. But it is difficult to find any glaring price-based explanation for the divergent trend of New Zealand's energy intensity merely by inspection of the data. The issue clearly requires econometric work.

The relative roles of electricity and other energy forms have changes markedly world-wide. The stylised facts of energy use since the first oil shock have been that the amount of primary energy used to produce a dollar of final output has fallen by about half in fifteen years, with the exception of electricity which has more or less maintained its relationship to GDP. An important reason for this persistence of the electricity/GDP ratio has been a move towards electrification as a substitute for direct use of fossil fuels in industry. The pattern is shown clearly in the US figures for 1973-1987 in Kelly et al (1989, p.322). Their chart shows that over the fifteen years covered, US GNP rose by 40% while primary energy use remained virtually unchanged. If we set 1973 equal to 100, thus, the primary energy to GNP ratio had fallen to $^{100}/_{140} = 71$, a drop of around 30% in the energy-intensity of the world's most heavily industrialised country.

Electricity use, however, did not share the trend of other forms of energy; the ratio of electricity to US GNP was much the same in 1987 as it had been in 1973. This has led some commentators to suppose

that electricity demand is less vulnerable to conservation than is the demand for energy as a whole. The truth seems to be rather different. What has happened is that although the oil price shocks triggered a widespread adoption of energy-saving measures across a range of energy forms, the process was selective in two senses. Firstly, the biggest relative-price effects (not to mention worries about long-run security of supply) were felt by oil users, so the biggest immediate results accrued in the efficiency of oil use. Second, electrification of many industrial processes and services in domestic and commercial buildings was an important part of the quest for greater energy efficiency, with the result that the general efficiency gains in electricity use were swamped by the substitution effect from other energy forms into electricity (much of it from nuclear plants inherited from the 1970s and early 1980s).

Figure 20A

1978 Gasoline Prices

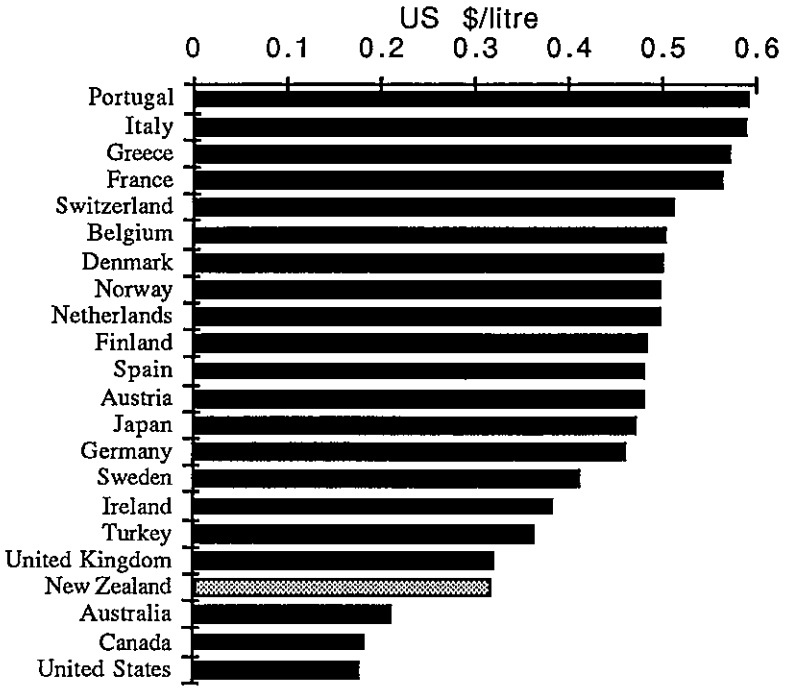


Figure 20B

1988 Gasoline Prices

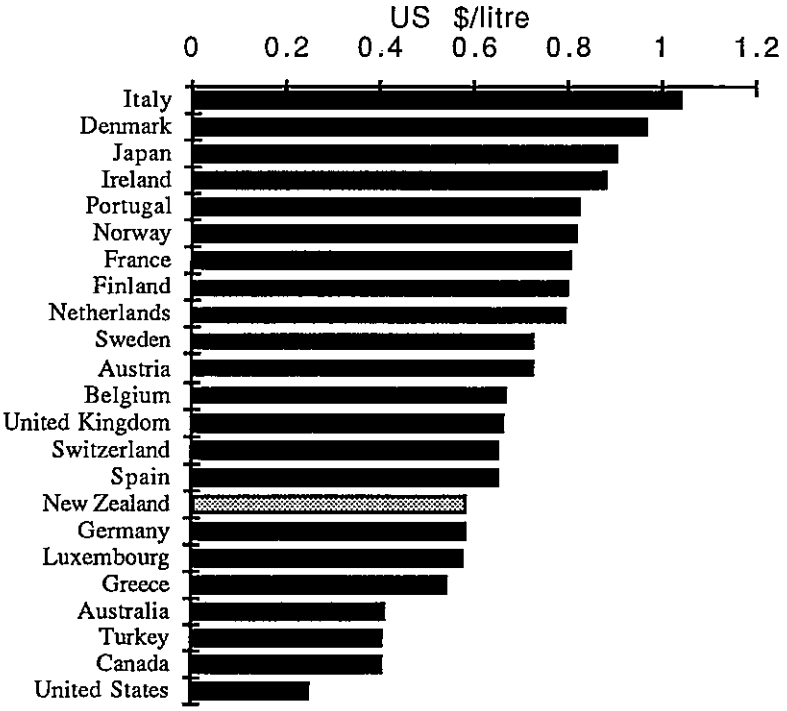


Figure 21A

Automotive Diesel Prices in 1978

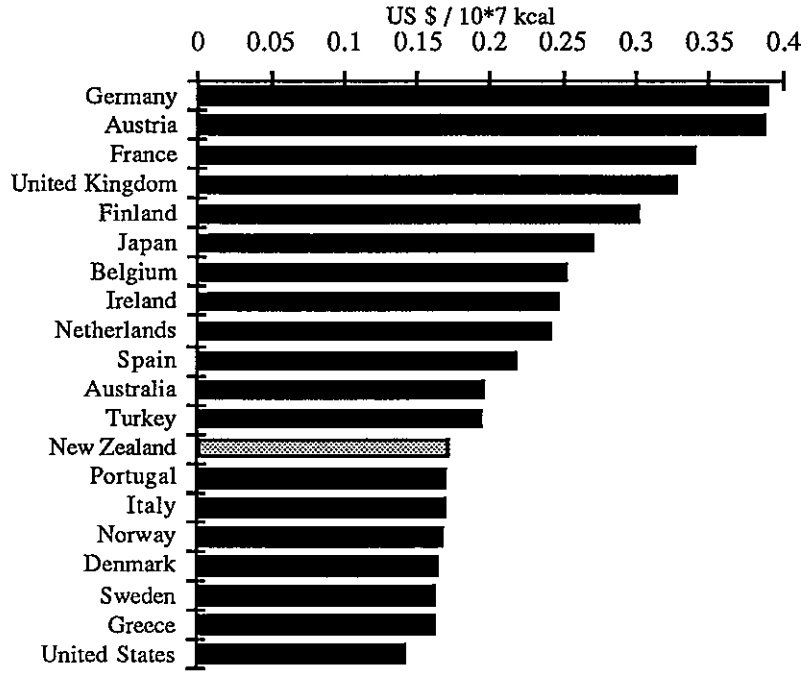


Figure 21B

Automotive Diesel Prices in 1988

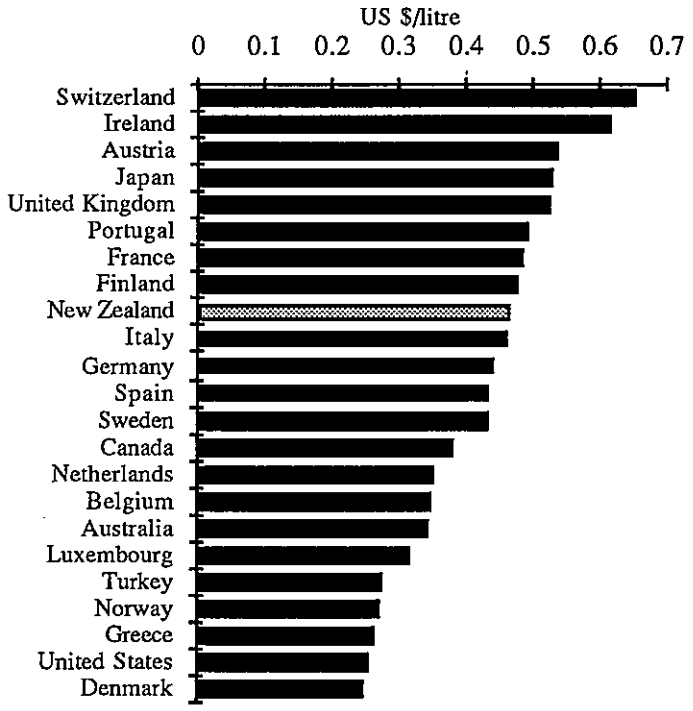


Figure 22A

Light Fuel Oil for Industry Prices in 1978

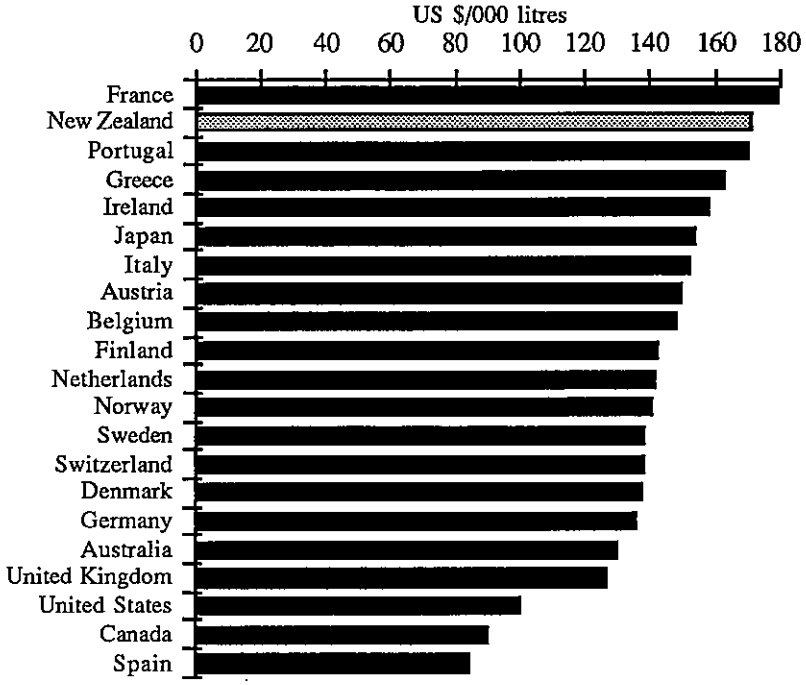


Figure 22B

Light Fuel Oil for Industry Prices in 1987

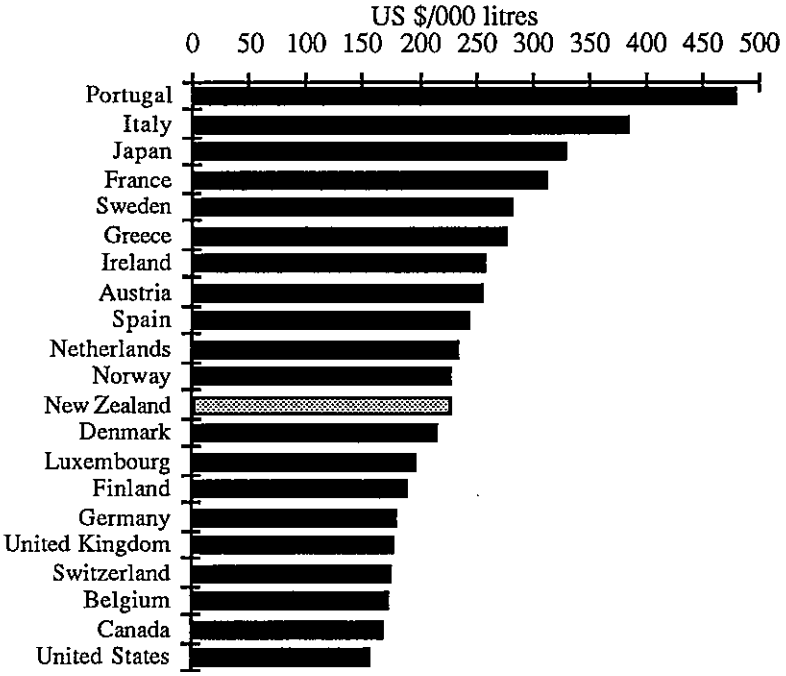


Figure 23A

Heavy Fuel Oil for Industry Prices 1978

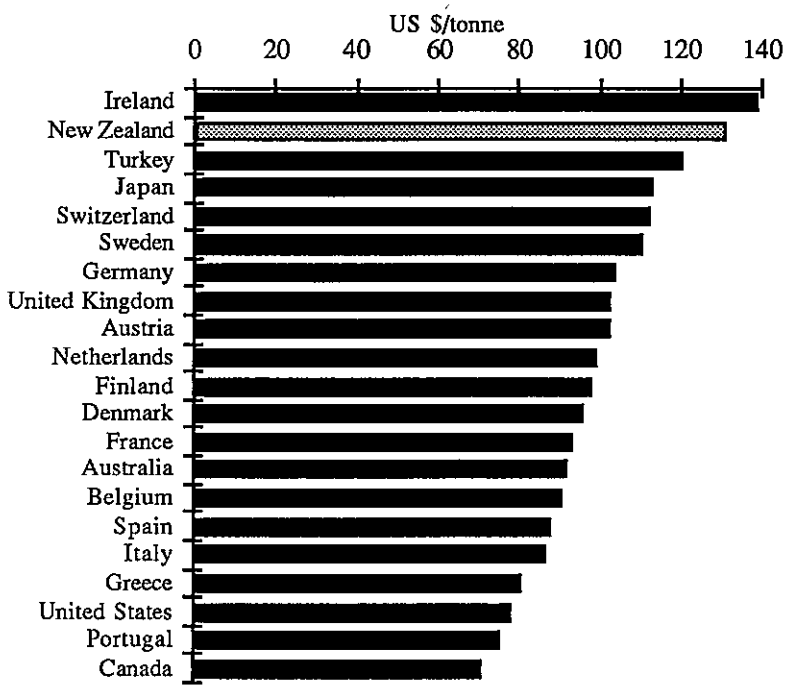


Figure 23B

Heavy Fuel Oil for Industry Prices 1987

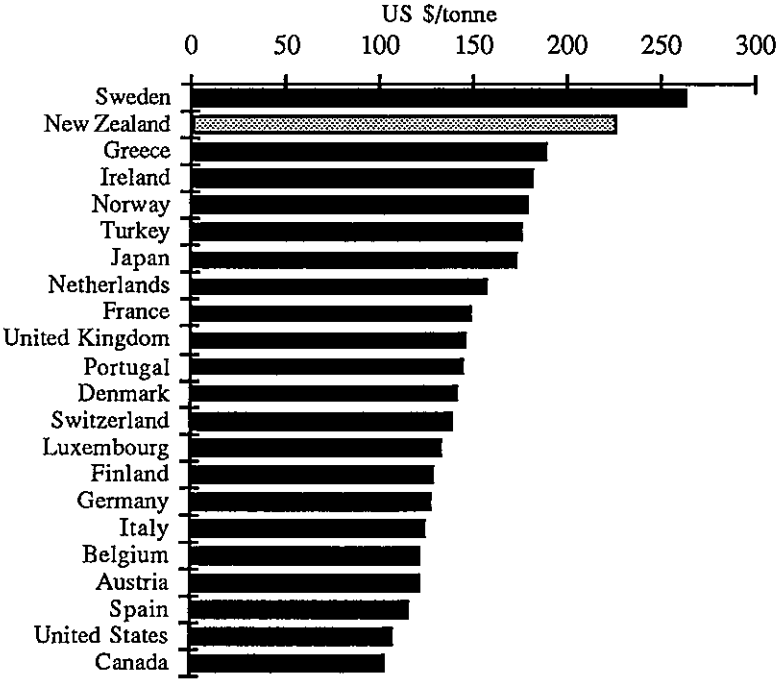


Figure 24A

Electricity Prices for Industry in 1980

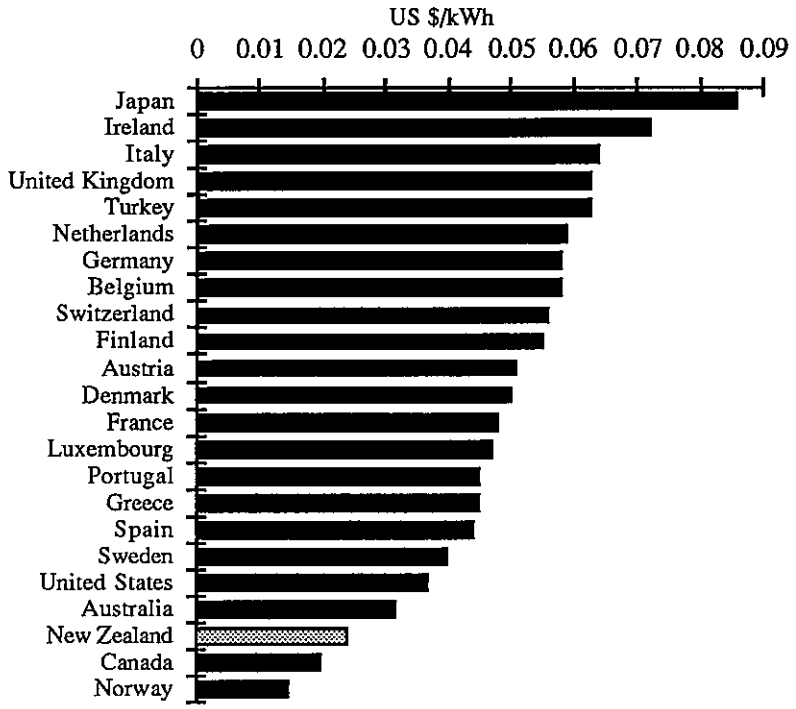


Figure 24B

Electricity Prices for Industry in 1987

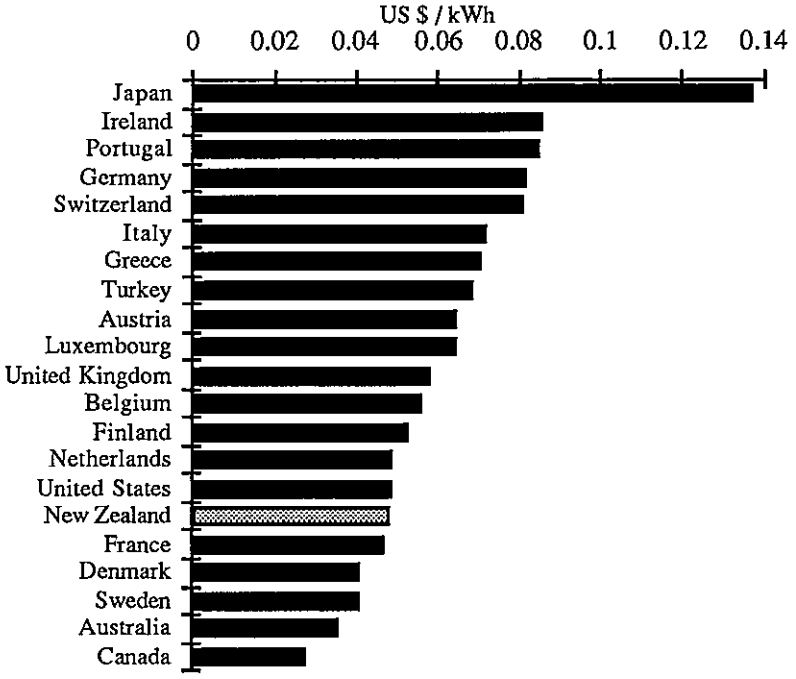


Figure 25A

Electricity Prices for Households in 1978

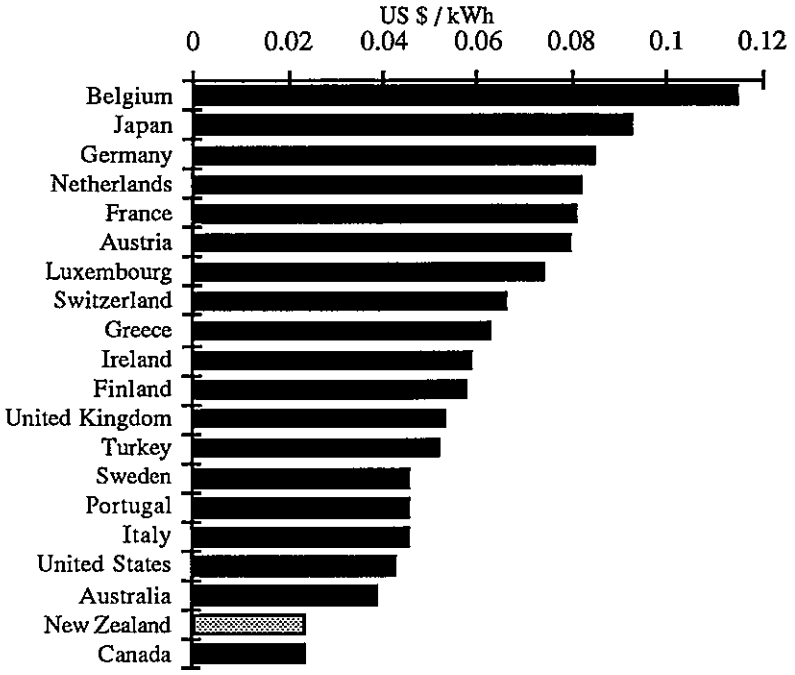


Figure 25B

Electricity Prices for Households in 1988

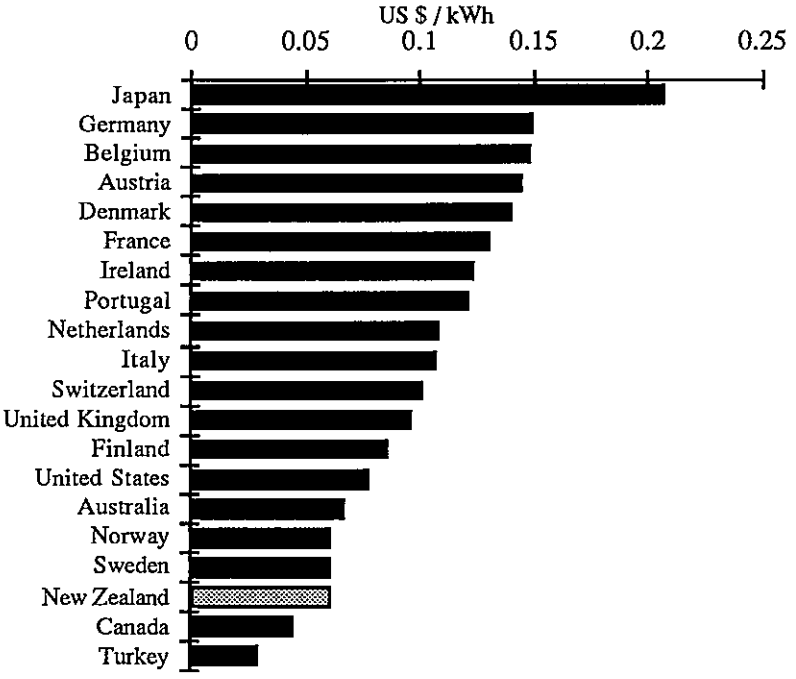


Figure 26A

Natural Gas Prices for Industry in 1978

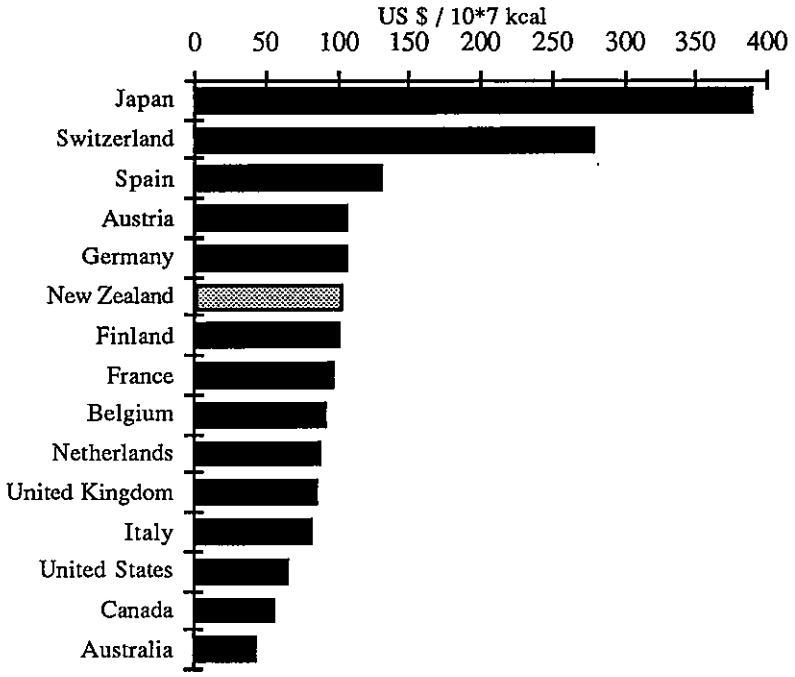


Figure 26B

Natural Gas Prices for Industry in 1988

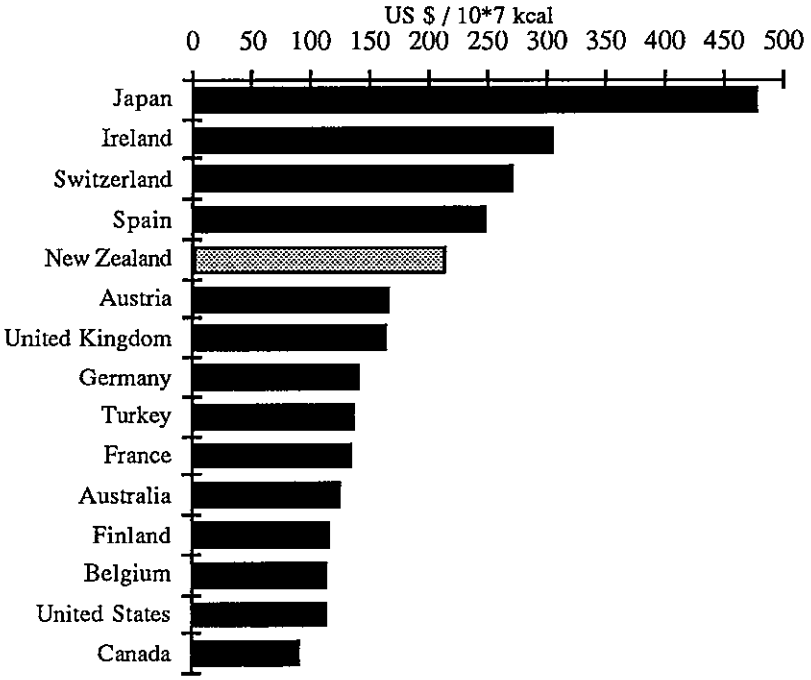


Figure 27A

Natural Gas Prices for Households in 1978

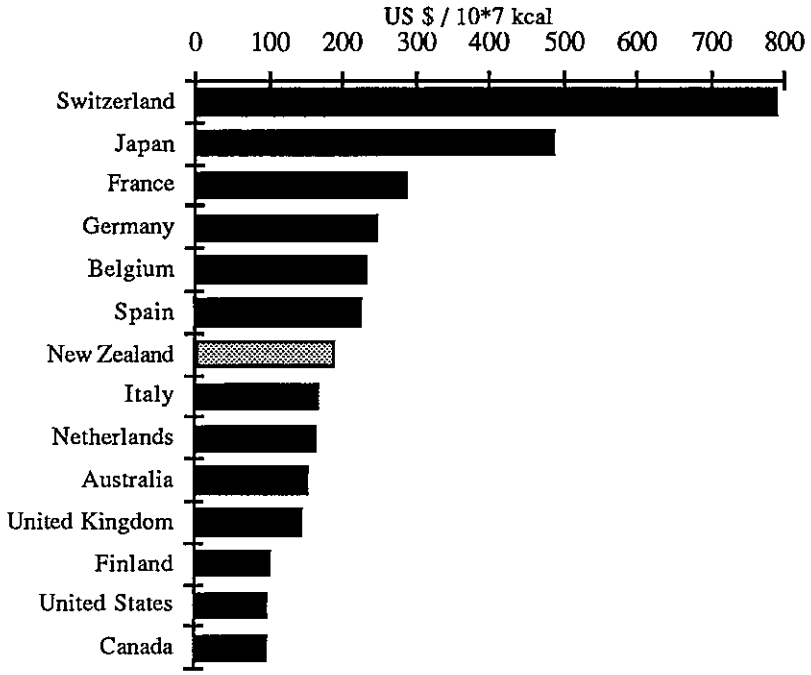
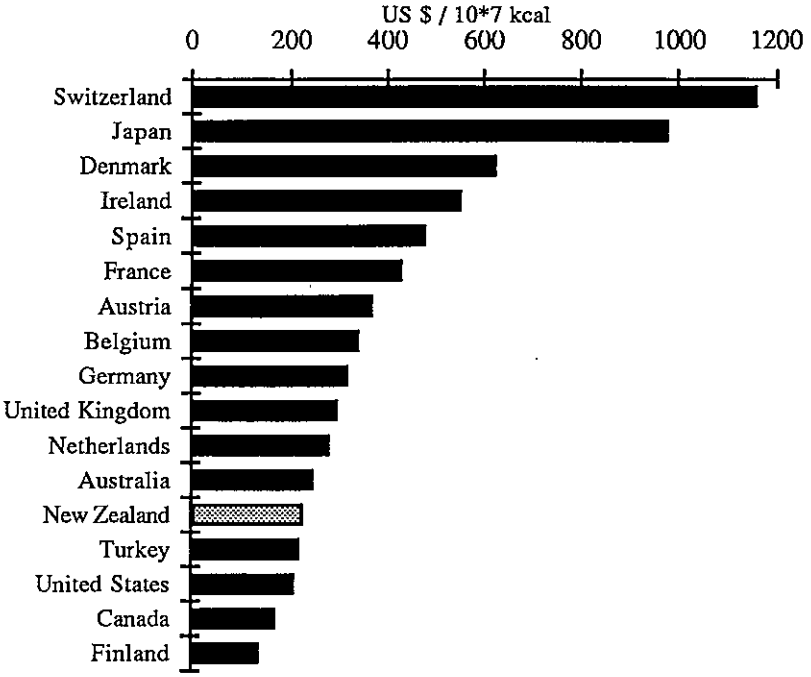


Figure 27B

Natural Gas Prices for Households in 1988



VI. Some Remarks on Energy Conservation in New Zealand

The macro-level data presented in this paper confirms anecdotal and micro evidence of a very low uptake of energy-saving and co-generation techniques by New Zealand industry and other sectors, relative to overseas trends. Survey results reported by Shula (1989), for example, indicate that in 1989 the New Zealand pulp and paper industry was only 43% self-sufficient in energy. Yet Miliander (1989 p.17) comments that on the basis of Swedish experience, "a modern kraft pulp mill is already today energy self-sufficient", and his Figure 15 anticipates that integrated pulp-and-paper production will also in the near future exhibit a net energy surplus.

Cameron (1989 Appendixes 1 and 5) estimated the existence of cost-effective, but non-adopted, electricity saving options for New Zealand Steel of 186.1 GWh, or 35% of its consumption of 538.6 GWh. For the major forestry companies Tasman, Panpac and Winstones she estimated savings opportunities of 870.9GWh out of consumption of 1,424.5 GWh, or 61%. For New Zealand Aluminium Smelters, savings of 1,393.1 GWh out of consumption of 4,287.5 GWh (32%) would have been cost-effective had the aluminium smelter been paying a market price for its electricity. Overall, Cameron's study concluded (1989, p.6) that 14,733 GWh (57%) of New Zealand's total 1988 electricity consumption of 25,804.6 GWh could technically be eliminated at a cost per kilowatt-hour well below the wholesale electricity price. Her findings are reproduced as Table 16 and Figure 28 below.

Table 16
Estimate of Electricity Conservation and Management Savings Available in the New Zealand Economy, by End-Use Category, 1988 March year

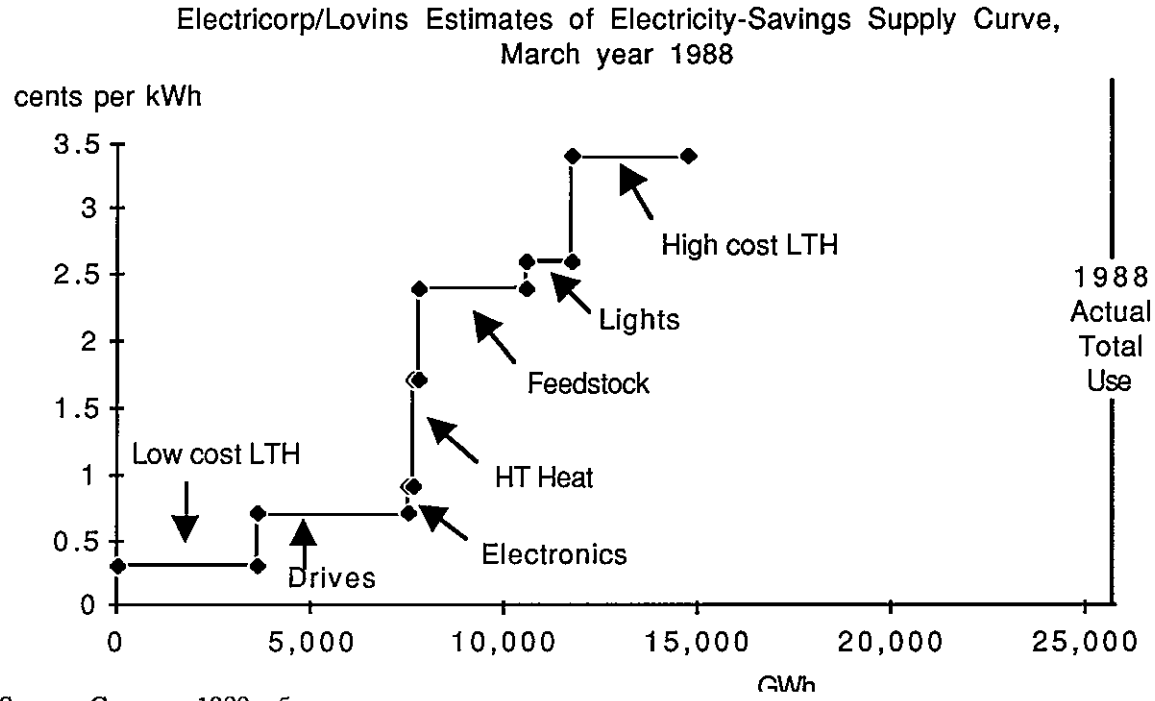
Category	Cost of reducing electricity use cents/kWh	GWh of electricity savings available at this cost	End-use in 1988 March year	% potential savings on 1988 use
LT Heat	0.3	3,634.0	9,318.0	39
Drive	0.7	3,869.1	7,738.2	50
Electronics	0.9	141.9	283.7	50
HT Heat	1.7	137.3	1,372.5	10
Lights	2.4	2,785.7	3,095.3	90
Feedstock	2.6	1,183.4	3,944.5	30
LT Heat	3.4	2,981.8	9,318.0	32
Motive	n.a	n.a	52.5	na
Total	1.6	14,733.1	25,804.7	57

Source: Cameron 1989 Appendix 2.

Cameron pointed out, however, that "because electricity generation is costly while efficiency in using it is relatively cheap, consumers in the United States are demanding less electricity and more efficiency. At present, a market in electrical efficiency has not been established in New Zealand"

(1989, p.1). She suggests also, echoing Patterson's (1989) conclusions, that "New Zealand was a relatively 'low-tech' country in relation to the United States in 1986" (1989 p.6). Terry (1991) echoes Cameron's comment that a market for efficiency has not yet been established in New Zealand, and canvasses some of the institutional barriers to emergence of such a market and possible policy responses.

Figure 28



Source: Cameron 1989 p.5.

Several other studies in the 1980s indicated the existence of apparently cost-effective but non-exploited energy-saving opportunities in various sectors of the New Zealand economy (for example Wright and Baines 1986; Downey 1986; Downey and Fleming 1988; Baird and Bruhns 1986; Process Developments Ltd 1987). The very slow adoption of energy-efficient technologies in New Zealand poses an interesting problem for further research. Relative-price trends have certainly provided no strong impetus towards efficiency, and the small size and isolation of the New Zealand market means that new equipment and processes may not have been promoted here by their makers. On the other hand, relative-price trends in several other efficiency-conscious economies have been not dissimilar to those in New Zealand; and seven years of deregulation and liberalisation have disposed of many of the possible barriers to market penetration by new techniques. The time may now be ripe for a sharp reversal of the rising trend in New Zealand's energy intensity.

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APPENDIX: DATA TABLES

Table 1

Energy Intensity Figures for Four Regional Groupings

Tonnes of Oil Equivalent Primary Energy per Thousand 1985 US Dollars of GDP:

Year	OECD Total	North America	OECD Europe	OECD Pacific
1960	0.52	0.58	0.47	0.39
1970	0.54	0.61	0.50	0.41
1972	0.54	0.61	0.51	0.40
1973	0.54	0.60	0.51	0.41
1974	0.53	0.59	0.49	0.42
1975	0.52	0.59	0.48	0.39
1977	0.52	0.59	0.47	0.39
1978	0.51	0.58	0.48	0.37
1979	0.50	0.57	0.48	0.37
1980	0.48	0.55	0.46	0.35
1981	0.46	0.52	0.44	0.33
1982	0.45	0.51	0.43	0.32
1983	0.44	0.50	0.42	0.31
1984	0.43	0.48	0.42	0.31
1985	0.43	0.47	0.43	0.30
1986	0.42	0.46	0.42	0.30
1987	0.42	0.46	0.42	0.29
1988	0.41	0.45	0.41	0.29
1989	0.40		0.41	
1990	0.39		0.39	

Source: International Energy Agency, *Energy Balances of OECD Countries 1987-1988* (Paris, 1990), pp.70,78, 82, 86; *Quarterly Oil Statistics and Energy Balances* for 1989-1990.

Table 2

Energy Intensity Figures for OECD Pacific

Tonnes of Oil Equivalent Primary Energy per Thousand 1985 US Dollars of GDP:

Year	OECD Pacific	Japan	Australia	New Zealand
1960	0.39	0.35	0.55	0.41
1970	0.41	0.39	0.54	0.48
1972	0.40	0.38	0.52	0.50
1973	0.41	0.39	0.52	0.48
1974	0.42	0.40	0.53	0.48
1975	0.39	0.37	0.53	0.50
1977	0.39	0.36	0.56	0.55
1978	0.37	0.35	0.54	0.56
1979	0.37	0.35	0.53	0.55
1980	0.35	0.32	0.53	0.56
1981	0.33	0.30	0.52	0.53
1982	0.32	0.29	0.54	0.55
1983	0.31	0.28	0.52	0.57
1984	0.31	0.29	0.49	0.57
1985	0.30	0.28	0.48	0.60
1986	0.30	0.27	0.48	0.60
1987	0.29	0.26	0.48	0.62
1988	0.29	0.27	0.47	0.63
1989	0.28	0.26	0.45	0.62
1990	0.27	0.25	0.46	0.62

Source: International Energy Agency, *Energy Balances of OECD Countries 1987-1988* pp.82, 94, 142,154; 1989 and 1990 calculated from International Energy Agency, *Quarterly Oil Statistics and Energy Balances* data on primary energy requirement, and real GDP growth rates from OECD *Economic Outlook* December 1990.

Table 3

Demand Side of the New Zealand Energy Balance, 1970-1988
(Million tonnes of oil equivalent)

	Resid-ential	Trans-port	Agric-ulture	Industry	Other	Non-energy uses	Total Final Cons-umption	Conv-ersion losses	Total Primary Energy Require-ment
1970	1.03	1.85	0.29	1.50	0.32	0.28	5.28	2.42	7.70
1971	0.85	1.92	0.28	1.59	0.49	0.22	5.35	2.56	7.91
1972	0.90	2.11	0.26	1.85	0.58	0.20	5.90	2.93	8.83
1973	0.90	2.24	0.28	2.06	0.60	0.25	6.34	2.83	9.17
1974	0.89	2.25	0.26	2.07	0.52	0.26	6.26	3.27	9.53
1975	1.14	2.34	0.27	2.13	0.62	0.21	6.71	3.36	10.07
1976	1.16	2.36	0.26	2.27	0.67	0.23	6.95	3.51	10.46
1977	1.16	2.41	0.27	2.33	0.67	0.25	7.09	3.81	10.90
1978	1.09	2.45	0.28	2.20	0.70	0.25	6.97	3.87	10.84
1979	1.10	2.47	0.27	2.22	0.64	0.23	6.93	3.76	10.69
1980	1.08	2.49	0.27	2.26	0.72	0.22	7.05	3.85	10.90
1981	1.17	2.46	0.27	2.45	0.63	0.24	7.22	3.72	10.94
1982	1.15	2.52	0.30	2.51	0.71	0.24	7.43	3.93	11.36
1983	1.17	2.56	0.29	2.69	0.70	0.25	7.67	4.30	11.97
1984	1.15	2.68	0.31	3.30	0.69	0.29	8.42	4.25	12.67
1985	1.18	2.74	0.29	3.54	0.70	0.24	8.71	4.48	13.19
1986	1.06	2.89	0.26	3.47	0.75	0.27	8.71	4.79	13.50
1987	1.02	3.08	0.25	3.46	0.79	0.34	8.94	4.99	13.93
1988	1.05	3.25	0.24	3.73	0.71	0.31	9.29	5.01	14.30

Sources: International Energy Agency, *Energy Balances of OECD Countries 1970-1985* pp.380-397; *Energy Balances of OECD Countries 1986-87* p.88; *Energy Balances of OECD Countries 1987-88* pp.156-157.

Table 4

Demand Side of the New Zealand Energy Balance, 1970-1988, by Sector
Percentage Breakdown

	Percentages of Total Final Consumption							Conversion losses % of
	Residential	Transport	Agriculture	Industry	Other	Non-energy uses	Total Final Cons-umption	TPER
1970	19.5	35.0	5.5	28.4	6.1	5.3	100.0	31.4
1971	15.9	35.9	5.2	29.7	9.2	4.1	100.0	32.4
1972	15.3	35.8	4.4	31.4	9.8	3.4	100.0	33.2
1973	14.2	35.3	4.4	32.5	9.5	3.9	100.0	30.9
1974	14.2	35.9	4.2	33.1	8.3	4.2	100.0	34.3
1975	17.0	34.9	4.0	31.7	9.2	3.1	100.0	33.4
1976	16.7	34.0	3.7	32.7	9.6	3.3	100.0	33.6
1977	16.4	34.0	3.8	32.9	9.4	3.5	100.0	35.0
1978	15.6	35.2	4.0	31.6	10.0	3.6	100.0	35.7
1979	15.9	35.6	3.9	32.0	9.2	3.3	100.0	35.2
1980	15.3	35.3	3.8	32.1	10.2	3.1	100.0	35.3
1981	16.2	34.1	3.7	33.9	8.7	3.3	100.0	34.0
1982	15.5	33.9	4.0	33.8	9.6	3.2	100.0	34.6
1983	15.3	33.4	3.8	35.1	9.1	3.3	100.0	35.9
1984	13.7	31.8	3.7	39.2	8.2	3.4	100.0	33.5
1985	13.5	31.5	3.3	40.6	8.0	2.8	100.0	34.0
1986	12.2	33.2	3.0	39.8	8.6	3.1	100.0	35.5
1987	11.4	34.5	2.8	38.7	8.8	3.8	100.0	35.8
1988	11.3	35.0	2.6	40.2	7.6	3.3	100.0	35.0

Source: Table 3.

Table 6

NZ Energy Consumption by Industrial Sector, 1960-1988

Year	(1) Iron & steel*	(2) Chemical except feedstock	(3) Chemical feedstock	(4) Non-ferrous metals*	(5) Non-metallic minerals	(6) Transport equipment	(7) Machinery
1970	0.04	0.00	0.00	0.00	0.00	0.00	0.00
1971	0.13	0.01	0.00	0.00	0.02	0.00	0.02
1972	0.20	0.02	0.00	0.00	0.02	0.00	0.02
1973	0.24	0.02	0.00	0.00	0.02	0.00	0.02
1974	0.27	0.02	0.00	0.00	0.02	0.00	0.03
1975	0.28	0.02	0.00	0.00	0.18	0.00	0.02
1976	0.31	0.01	0.00	0.00	0.18	0.00	0.03
1977	0.33	0.02	0.00	0.00	0.15	0.00	0.03
1978	0.36	0.01	0.00	0.00	0.10	0.00	0.03
1979	0.35	0.02	0.00	0.00	0.10	0.00	0.03
1980	0.33	0.02	0.00	0.00	0.09	0.01	0.04
1981	0.34	0.05	0.00	0.01	0.23	0.00	0.05
1982	0.38	0.19	0.00	0.01	0.20	0.00	0.05
1983	0.46	0.29	0.12	0.01	0.19	0.00	0.05
1984	0.48	0.36	0.52	0.01	0.20	0.00	0.05
1985	0.46	0.37	0.70	0.01	0.20	0.00	0.05
1986	0.56	0.45	0.51	0.01	0.17	0.00	0.05
1987	0.60	0.32	0.50	0.00	0.02	0.00	0.03
1988	0.70	0.36	0.50	0.00	0.02	0.00	0.03

* The Tiwai Point aluminium smelter is included in "iron and steel".

Table 6 continued:

Year	(8) Mining and quarrying	(9) Food and tobacco	(10) Paper, pulp & printing	(11) Wood & wood products	(12) Construc-tion	(13) Textiles and leather	(14) Non-specified industry	(15) TOTAL
1970	0.00	0.19	0.00	0.00	0.09	0.00	1.18	1.50
1971	0.01	0.25	0.00	0.09	0.09	0.02	0.95	1.59
1972	0.01	0.26	0.00	0.11	0.09	0.02	1.10	1.85
1973	0.01	0.32	0.00	0.13	0.09	0.02	1.18	2.06
1974	0.01	0.66	0.01	0.13	0.10	0.02	0.81	2.07
1975	0.01	0.45	0.26	0.13	0.10	0.02	0.66	2.13
1976	0.01	0.43	0.28	0.16	0.10	0.02	0.73	2.27
1977	0.01	0.52	0.29	0.16	0.10	0.02	0.70	2.33
1978	0.01	0.38	0.26	0.17	0.10	0.02	0.76	2.20
1979	0.01	0.37	0.29	0.18	0.08	0.02	0.77	2.22
1980	0.01	0.46	0.29	0.20	0.08	0.02	0.72	2.26
1981	0.01	0.60	0.48	0.20	0.08	0.03	0.37	2.45
1982	0.01	0.54	0.43	0.19	0.09	0.03	0.40	2.51
1983	0.01	0.51	0.47	0.20	0.08	0.03	0.27	2.69
1984	0.01	0.56	0.47	0.22	0.09	0.03	0.29	3.30
1985	0.01	0.56	0.52	0.21	0.09	0.04	0.32	3.54
1986	0.01	0.53	0.48	0.28	0.08	0.04	0.28	3.47
1987	0.01	0.18	0.34	0.28	0.07	0.02	1.07	3.46
1988	0.01	0.18	0.30	0.28	0.07	0.02	1.24	3.73

Source: International Energy Agency, *Energy Balances of OECD Countries 1970-1985* pp.380-397; *Energy Balances of OECD Countries 1986-87* p.88; *Energy Balances of OECD Countries 1987-88* pp.156-157.

Table 7

Energy Consumption in New Zealand Transport Sectors
Million tonnes of oil equivalents

Year	Air	Road	Rail*	Internal navigation	Non-specified*	Total
1970	0.23	1.33	0.01	0.07	0.21	1.85
1971	0.24	1.38	0.01	0.07	0.22	1.92
1972	0.24	1.56	0.00	0.06	0.24	2.11
1973	0.23	1.65	0.00	0.03	0.33	2.24
1974	0.26	1.61	0.00	0.06	0.32	2.25
1975	0.25	1.66	0.00	0.09	0.34	2.34
1976	0.26	1.64	0.00	0.09	0.36	2.36
1977	0.27	1.66	0.00	0.08	0.39	2.41
1978	0.32	1.69	0.00	0.07	0.37	2.45
1979	0.35	1.65	0.00	0.09	0.38	2.47
1980	0.33	1.65	0.00	0.14	0.36	2.49
1981	0.31	1.68	0.00	0.10	0.36	2.46
1982	0.31	1.74	0.00	0.11	0.35	2.52
1983	0.31	1.79	0.00	0.09	0.36	2.56
1984	0.35	1.83	0.00	0.10	0.40	2.68
1985	0.37	1.82	0.00	0.12	0.43	2.74
1986	0.42	1.90	0.00	0.13	0.43	2.89
1987	0.54	1.93	0.00	0.14	0.47	3.08
1988	0.60	2.01	0.00	0.15	0.49	3.25

Note totals may not add exactly due to rounding.
* Rail evidently included in "non-specified transport" for most of the period.

Source: International Energy Agency, *Energy Balances of OECD Countries 1970-1985* pp.380-397; *Energy Balances of OECD Countries 1986-87* p.88; *Energy Balances of OECD Countries 1987-88* pp.156-157.

Table 8

New Zealand Total Primary Energy Requirement by Energy Form
Million tonnes of oil equivalents

Year	Oil Total	Natural gas	Coal	Hydro & geothermal	Other fuels	
1960	1.67	0.06	1.57	1.33	0.00	4.63
1961	1.84	0.06	1.54	1.46	0.00	4.89
1962	1.91	0.06	1.30	1.71	0.00	4.96
1963	2.05	0.06	1.45	1.78	0.00	5.34
1964	2.36	0.06	1.49	2.03	0.00	5.94
1965	2.53	0.06	1.40	2.24	0.00	6.23
1966	2.71	0.06	1.38	2.41	0.00	6.57
1967	2.84	0.06	1.23	2.50	0.00	6.63
1968	3.18	0.06	1.14	2.63	0.00	7.00
1969	3.36	0.07	1.22	2.59	0.00	7.24
1970	3.59	0.09	1.19	2.83	0.00	7.70
1971	3.51	0.11	1.09	3.21	0.00	7.91
1972	3.99	0.24	1.12	3.47	0.00	8.83
1973	4.13	0.29	1.27	3.48	0.00	9.17
1974	4.42	0.31	1.35	3.46	0.00	9.53
1975	4.06	0.34	1.25	4.06	0.36	10.07
1976	4.27	0.88	1.29	3.62	0.40	10.46
1977	4.28	1.41	1.23	3.52	0.46	10.90
1978	4.09	1.30	1.13	3.89	0.43	10.84
1979	3.96	0.86	0.98	4.42	0.47	10.69
1980	3.99	0.93	1.04	4.49	0.45	10.90
1981	3.74	1.00	1.02	4.61	0.57	10.94
1982	3.75	1.77	1.02	4.27	0.55	11.36
1983	3.64	1.91	1.10	4.77	0.55	11.97
1984	3.76	2.52	1.08	4.77	0.54	12.67
1985	3.68	3.16	1.05	4.66	0.64	13.19
1986	3.38	3.61	0.87	5.13	0.51	13.50
1987	3.75	3.44	1.03	5.20	0.51	13.93
1988	3.64	3.75	1.20	5.26	0.46	14.30
1989	3.72	5.18	1.28	5.26	0.46	15.90

Table 9

New Zealand Final Consumption of Energy, by Energy Form
Million tonnes of oil equivalents

Year	Oil	Natural gas	Coal	Electricity	Other	Total
1960	1.67	0.10	1.14	0.49	0.00	3.39
1961	1.84	0.10	1.11	0.53	0.00	3.57
1962	1.91	0.09	1.02	0.57	0.00	3.60
1963	2.05	0.10	1.03	0.65	0.00	3.83
1964	2.30	0.10	1.06	0.70	0.00	4.16
1965	2.48	0.10	1.08	0.77	0.00	4.44
1966	2.65	0.10	1.04	0.83	0.00	4.63
1967	2.69	0.10	1.00	0.85	0.00	4.64
1968	3.03	0.10	0.90	0.89	0.00	4.93
1969	3.11	0.10	0.86	0.95	0.00	5.03
1970	3.32	0.09	0.86	1.01	0.00	5.28
1971	3.33	0.08	0.81	1.13	0.00	5.35
1972	3.66	0.11	0.83	1.29	0.00	5.90
1973	3.97	0.13	0.87	1.37	0.00	6.34
1974	3.76	0.20	0.90	1.40	0.00	6.26
1975	3.76	0.22	0.84	1.52	0.36	6.71
1976	3.79	0.29	0.87	1.61	0.40	6.95
1977	3.85	0.29	0.87	1.62	0.46	7.09
1978	3.83	0.31	0.77	1.63	0.43	6.97
1979	3.78	0.29	0.76	1.64	0.47	6.93
1980	3.78	0.33	0.81	1.68	0.45	7.05
1981	3.65	0.49	0.79	1.73	0.57	7.22
1982	3.66	0.59	0.79	1.83	0.55	7.43
1983	3.54	0.82	0.77	1.98	0.55	7.67
1984	3.67	1.37	0.78	2.06	0.54	8.42
1985	3.59	1.62	0.78	2.08	0.64	8.71
1986	3.73	1.58	0.71	2.18	0.51	8.71
1987	3.98	1.41	0.83	2.22	0.51	8.94
1988	4.08	1.46	1.04	2.25	0.46	9.29

Table 10

GDP Data from IEA and INFOS, Compared

Year on	(1) IEA data in 1980 US $ billions	(2) IEA data in 1985 US $ billions	(3) IEA data as an index, 1980=1000	(4) NZSNA index of GDP at 1977/78 prices: 1977=1000	(5) NZSNA index of GDP at 1982/83 prices: 1982=1000	(6) Linked NZSNA index base 1980
1960	13.41	11.52	599	581		552
1961	13.96		623	600		570
1962	14.51		648	619		588
1963	15.16		677	656		623
1964	15.92		711	697		662
1965	16.66		744	739		702
1966	17.20		768	767		729
1967	17.02		760	761		723
1968	17.15		766	777		738
1969	18.56		829	816		775
1970	18.84	16.24	841	846		804
1971	19.61		875	868		825
1972	20.35	17.81	908	906		861
1973	21.96	19.08	980	971		923
1974	23.40	20.21	1045	1011		961
1975	23.08	19.98	1030	1027		976
1976	23.76		1061	1028		977
1977	22.55	19.47	1007	1000		950
1978	22.21	19.13	992	1002	907	952
1979	22.21	19.04	992	1027	935	982
1980	22.40	19.36	1000	1033	952	1000
1981	23.56	20.00	1033	1081	983	1032
1982	23.53	20.12	1039	1086	1006	1057
1983	24.75	20.66	1067	1116	1008	1059
1984	26.02	21.82	1127	1183	1076	1130
1985	26.34	22.17	1145		1092	1147
1986		22.47	1161		1113	1169
1987		22.41	1158		1123	1180
1988		22.54	1164		1114	1170
1989					1121	1178

Sources: Column 1 from *Energy Balances of OECD Countries 1970-1985* p.381.
Column 2 from *Energy Balances of OECD Countries 1987-1988* p.154.
Column 3 is an index of Column 1 up to 1980 and of Column 2 thereafter.
Column 4 from INFOS series SNAA.SW9
Column 5 from INFOS series SNBQ.SX199, aggregated to calendar years.
Column 6 from Column 5 1978-1989, and from Column 4 1960-1977.

Table 11

New Zealand Primary Energy Intensity
Tonnes of oil equivalents per Thousand US Dollars of GDP at 1985 prices

Year	GDP at 1985 prices, US$B	Oil	Natural gas	Coal	Hydro & geothermal	Other fuels	Total Primary Energy Requirement
1960	11.60	0.14	0.01	0.14	0.11	0.00	0.40
1961	12.06	0.15	0.00	0.13	0.12	0.00	0.41
1962	12.55	0.15	0.00	0.10	0.14	0.00	0.40
1963	13.11	0.16	0.00	0.11	0.14	0.00	0.41
1964	13.77	0.17	0.00	0.11	0.15	0.00	0.43
1965	14.41	0.18	0.00	0.10	0.16	0.00	0.43
1966	14.87	0.18	0.00	0.09	0.16	0.00	0.44
1967	14.72	0.19	0.00	0.08	0.17	0.00	0.45
1968	14.83	0.21	0.00	0.08	0.18	0.00	0.47
1969	16.05	0.21	0.00	0.08	0.16	0.00	0.45
1970	16.28	0.22	0.01	0.07	0.17	0.00	0.47
1971	16.94	0.21	0.01	0.06	0.19	0.00	0.47
1972	17.58	0.23	0.01	0.06	0.20	0.00	0.50
1973	18.98	0.22	0.02	0.07	0.18	0.00	0.48
1974	20.23	0.22	0.02	0.07	0.17	0.00	0.47
1975	19.94	0.20	0.02	0.06	0.20	0.02	0.50
1976	20.54	0.21	0.04	0.06	0.18	0.02	0.51
1977	19.50	0.22	0.07	0.06	0.18	0.02	0.56
1978	19.21	0.21	0.07	0.06	0.20	0.02	0.56
1979	19.21	0.21	0.04	0.05	0.23	0.02	0.56
1980	19.36	0.21	0.05	0.05	0.23	0.02	0.56
1981	20.00	0.19	0.05	0.05	0.23	0.03	0.55
1982	20.12	0.19	0.09	0.05	0.21	0.03	0.56
1983	20.66	0.18	0.09	0.05	0.23	0.03	0.58
1984	21.82	0.17	0.12	0.05	0.22	0.02	0.58
1985	22.17	0.17	0.14	0.05	0.21	0.03	0.59
1986	22.48	0.15	0.16	0.04	0.23	0.02	0.60
1987	22.42	0.17	0.15	0.05	0.23	0.02	0.62
1988	22.54	0.16	0.17	0.05	0.23	0.02	0.63
1989	22.68	0.16	0.23	0.06	0.23	0.02	0.70

Sources: GDP series derived from data in Table 10 above. Other columns obtained by dividing data from Table 8 by this GDP series.

Table 12

NZ Intensity of Total Final Consumption of Energy
Tonnes of oil equivalent per thousand US dollars of GDP at 1985 prices

Year	Oil	Natural gas	Coal	Electricity	Other	Total
1960	0.14	0.01	0.10	0.04	0.00	0.29
1961	0.15	0.01	0.09	0.04	0.00	0.30
1962	0.15	0.01	0.08	0.05	0.00	0.29
1963	0.16	0.01	0.08	0.05	0.00	0.29
1964	0.17	0.01	0.08	0.05	0.00	0.30
1965	0.17	0.01	0.07	0.05	0.00	0.31
1966	0.18	0.01	0.07	0.06	0.00	0.31
1967	0.18	0.01	0.07	0.06	0.00	0.32
1968	0.20	0.01	0.06	0.06	0.00	0.33
1969	0.19	0.01	0.05	0.06	0.00	0.31
1970	0.20	0.01	0.05	0.06	0.00	0.32
1971	0.20	0.00	0.05	0.07	0.00	0.32
1972	0.21	0.01	0.05	0.07	0.00	0.34
1973	0.21	0.01	0.05	0.07	0.00	0.33
1974	0.19	0.01	0.04	0.07	0.00	0.31
1975	0.19	0.01	0.04	0.08	0.02	0.34
1976	0.18	0.01	0.04	0.08	0.02	0.34
1977	0.20	0.01	0.04	0.08	0.02	0.36
1978	0.20	0.02	0.04	0.08	0.02	0.36
1979	0.20	0.02	0.04	0.09	0.02	0.36
1980	0.20	0.02	0.04	0.09	0.02	0.36
1981	0.18	0.02	0.04	0.09	0.03	0.36
1982	0.18	0.03	0.04	0.09	0.03	0.37
1983	0.17	0.04	0.04	0.10	0.03	0.37
1984	0.17	0.06	0.04	0.09	0.02	0.39
1985	0.16	0.07	0.04	0.09	0.03	0.39
1986	0.17	0.07	0.03	0.10	0.02	0.39
1987	0.18	0.06	0.04	0.10	0.02	0.40
1988	0.18	0.06	0.05	0.10	0.02	0.41

Source: Tables 9 and 11.

Table 13

Price Indices 1985=100

Year	----------IEA indices of retail energy prices----------				NZ
	Oil products	Electricity	Natural gas	Coal	CPI
1978	33.1	43.0	71.1	39.1	42.6
1979	39.0	55.4	73.8	44.0	48.4
1980	54.9	65.5	88.3	52.2	56.7
1981	63.0	71.3	101.1	61.5	65.5
1982	72.1	80.9	98.1	76.5	76.0
1983	76.4	83.2	92.1	80.5	81.6
1984	84.2	84.5	92.0	81.9	86.6
1985	100.0	100.0	100.0	100.0	100.0
1986	90.3	117.7	121.2	122.4	113.2
1987	98.0	140.9	135.1	137.6	131.0
1988	96.9	151.7	153.9	142.8	139.4
1989					147.4

Sources: International Energy Agency, *Energy Prices and Taxes* ; NZ Department of Statistics for New Zealand CPI.

Table 14

Price Indices Relative to New Zealand CPI, 1978=100

Year	Oil products	Electricity	Natural gas	Coal
1978	100.0	100.0	100.0	100.0
1979	103.6	113.3	91.3	99.0
1980	124.5	114.4	93.2	100.2
1981	123.9	107.9	92.5	102.4
1982	122.0	105.4	77.3	109.6
1983	120.5	101.0	67.6	107.5
1984	125.1	96.6	63.6	103.0
1985	128.7	99.1	59.9	108.9
1986	102.6	103.0	64.1	117.8
1987	96.2	106.5	61.8	114.4
1988	89.4	107.8	66.1	111.6

Source: Calculated from Table 13.

Table 15

New Zealand Consumer Price Indices: Fuel and Light for Households, and All Groups CPI
Data for calendar years, December quarter 1988=1000

	Fuel and Light	All Groups CPI
1965	91.13	97.00
1966	92.95	100.00
1967	98.69	105.75
1968	105.71	110.50
1969	106.89	116.00
1970	107.44	123.75
1971	110.72	136.50
1972	114.00	145.75
1973	118.01	157.75
1974	125.84	175.50
1975	135.25	201.75
1976	177.50	234.75
1977	242.50	269.00
1978	268.75	301.00
1979	339.50	342.25
1980	412.50	400.75
1981	457.25	462.25
1982	522.25	537.00
1983	537.25	576.50
1984	545.50	612.25
1985	646.25	706.50
1986	757.75	799.75
1987	902.00	926.00
1988	968.00	985.00
1989	1015.50	1041.25
1990	1040.00	1098.33

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