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Energy and Sustainable Development in New Zealand

A report by

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New Zealand's main indigenous energy resources are hydroelectricity, natural gas, condensate, a small amount of oil, and coal. So-called "new renewable" electricity generation has increased substantially since 1990 (here above : landfill biogas generation).

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Introduction and Summary of Conclusions

New Zealand could achieve sustainablity in its energy sector more easily than any other IEA country. It has a temperate climate, high sunshine, rainfall and wind regimes. Trees and crops grow very quickly. Its population is small and educated. It is far from energy exporting countries. Energy suppliers that were owned and run by the state are now companies, which are more accountable at least in theory. Sustainability is an overall objective of several laws and regulations.

The factors above are favourable. But New Zealand's so-called "free-market" culture is working against sustainability. Privatisation and deregulation have been implemented passionately by both Government and business interests aligned with global markets. This allows energy companies to wield great market power. New Zealand has an unusually "lumpy" mix of supply facilities and demand centres, usually connected by long transmission facilities. This allows market power to be greatly increased. Many energy companies that were once publicly owned have been wholly or partly sold to foreign companies. When these companies abuse their market power, the excessive profits go overseas, adding to New Zealand's burden of debt.

This report follows the brief of HELIO International[1], by using eight indicators to monitor New Zealand's progress in relation to sustainable development. We compare the values of these in 2000 to the values in 1990. Because statistics are available for each year, and there are great variations in each year, we draw a trendline wherever possible[2].

- For the global environment, we find that New Zealand's average per capita CO2 emissions from fossil fuel combustion are 8% higher than those in 1990, and 80% higher than global emissions in 1990.

- For the local enivronment, emissions of particulate matter is the most significant indicator. These come mostly from domestic solid fuel burning in winter. The city of Christchurch has long monitored these emissions; they were 25% higher in 2000 than in 1990.

- For social sustainability, the indicator for access to electricity is simple: New Zealand households had 100% access in both 1990 and 2000. It is not access, but high prices for small consumers, rural consumers, and low-income households, that deprive some people of benefits of electricity.

- A second social indicator is the trend towards "clean energy", defined as small-scale renewable energy and energy efficiency investment. This indicator is very subjective, because we must define what counts as "small-scale". Our best estimates are that investment in small-scale renewable energy almost doubled between 1990 and 2000. Unfortunately the two significant wind farms that contributed to this have postponed their plans to expand.

- Economic indicators begin with "resilience", essentially the amount of self-sufficiency in fossil fuels. This is declining - we imported 29% more fossil fuels in 2000 than in 1990.

- The "burden of investment" indicator works differently in New Zealand's highly commercialised environment than in most countries. We define "burden" as the flow of profits overseas as New Zealand energy supply businesses are privatised. We

[1] home page: www.helio-international.org

[2] We use the third power"polynomial trendline" available in Excelthe simplest fit available that allows significant variations in either direction over the ten-year period of interest.

cannot quantify the flow of wealth overseas from capital gains and payments to related companies and to top managers and directors.

- For technological sustainability, we look at the amount of primary energy needed to produce a unit of gross domestic product. This indicator has declined (become more favourable) by 13% in the decade from 1990 to 2000.

- The final technological indicator is the percentage of energy supply coming from all renewable resources. This was 18% higher in 2000 than the 1990 figure. Plans for more thermal generation may reverse this trend.

The indicators above do not fully reflect the generally adverse effects of New Zealand's free market reforms of the 1980s and 1990s. Reporting requirements are too loose, and important data remain confidential. Independent studies confirm that the reforms have failed to achieve the promised economic or environmental gains, and have made the rich richer and the poor poorer.

The unregulated energy market allowed large companies to gain wealth at the expense of small consumers, rural consumers and small-scale energy businesses. New Zealand's energy efficiency and economic efficiency have both lagged behind gains made by other OECD countries. For years, governments have responded by making "sustainable development" a broad goal of energy law and policy. But they still allow the big energy companies to abuse their market power. Increasing foreign ownership is allowing profits to flow overseas, adding to New Zealand's burden of debt.

The restructuring of the 1980s and 1990s amounted to a cultural revolution, and the energy sector led those reforms. It would take a counter-revolution to bring social goals back into the energy free-market. Energy companies are constrained only by threat of regulation. Until real regulation is imposed on energy companies, we have little hope for sustainable energy development in New Zealand.

Geographic and economic setting

New Zealand comprises two main islands and several smaller ones, with a land area approximately equal to Great Britain or Japan.[3] Like Japan, some 40% of New Zealand's area is mountainous. The population of New Zealand was 3.8 million in 2000; of which 86% live in urban areas. As in other OECD countries, the "baby boom" has left a population bulge which will reach pension age during the two decades after the year 2000.

The New Zealand economy is very dependent on exports and imports. Many of our exports are very dependent on energy inputs, including agricultural products, forest products, fish, and tourism. Also New Zealand exports methanol and aluminium which are in effect nearly pure energy. Twenty years ago we exported most of our products to the U.K. Now Asia is our largest market. Many of our largest energy businesses, as well as almost all our banks and financial institutions, are now overseas-owned. As profits flow overseas, New Zealand's burden of debt increases. All these factors make New Zealand vulnerable to world economic cycles.

New Zealand was relatively wealthy following the second world war, but was hit hard by the OPEC oil crises of the 1970s. Between 1975 and 1985, New Zealand's public debt increased sevenfold, inflation mounted, growth slowed and overseas debt grew. This helped stimulate the free-market policies that were introduced by the Labour Government after 1984. Government removed subsidies and controls, and restructured its trading departments into corporations. This was supposed to allow the forces of enterprise, self-interest and competition to generate efficiency and economic growth.

New Zealand's economic performance became worse after the free-market policies began in 1985. It recovered briefly but the stock market crash in 1987 hit the economy hard. In 1992 New Zealand suffered its most prolonged recession since the Second World War. The rate of economic growth then increased and unemployment fell, and New Zealand began to run fiscal surpluses. However in 1997 New Zealand's Asian markets were hit again by their fiscal crisis. This, together with our balance of payments deficit, put our international credit rating at risk. The table next page shows New Zealand's main economic indicators during the last decade.

The country's net overseas debt continues to grow steadily "The corporate sector overseas debt has been driving the increase in total overseas debt since 1993".[4]

New Zealand statistics give little information on the increase of foreign ownership in New Zealand's energy sector. Figures are given for 1999 and 2000; earlier figures are not available and the 2001 figure is confidential. Our discussion under Indicator 5 is based on information on New Zealand's "top 200 companies", and captures most but not all the flow of energy profits overseas.

New Zealand's ranking on the UNDP Human Development Index (HDI) was 19th in 2001, compared to 9th place in 1994. No values for the HDI indicators on income inequality were recorded for New Zealand in 2001.[5] However the World Bank notes that of 49 countries with data on inequality over a long period, only China and New Zealand saw substantial increases in inequality.[6] A report to New Zealand's Treasury concludes that New Zealand now has one of the highest levels of income inequality in the OECD. It links this trend directly to the economic reforms of the late 1980s and the changes in employment legislation and social welfare cuts of the 1990s, rather than natural business

[3] Information from NZ Yearbook 2000 and Statistics NZ website, www.stats.govt.nz

[4] StatisticsNZ "Hot of the Press, NZs Total Overseas Debt as at 31 March 2000 Highlights".

[5] www.undp.org/hdr2001/indicator/cty_f_NZL.html

[6] www.worldbank.org/html/dec/annual/docs/growth1.htm

cycles.[7] A brief resurgence of economic growth in the mid 1990s did not diminish inequality.

Most New Zealanders did not support the revolutionary policies of restructuring and privatisation [8]. More recent independent analyses confirmed their judgement[9].

Principal aggregates: 1990-99(1)

	Gross domestic product (GDP)	Gross national income (GNI)	National income (NI)	National disposable income (NDI)	GDP at 1995/96 prices
Year ended March					
1990	71,441	68,143	58,359	58,647	79,442
1991	73,113	70,379	60,015	60,181	79,443
1992	72,918	68,142	57,181	57,343	78,416
1993	75,274	71,410	60,088	60,199	79,320
1994	81,502	76,980	65,453	65,743	84,447
1995	87,321	81,366	69,433	69,653	88,963
1996	92,679	86,680	74,273	74,413	92,679
1997	96,911	89,647	76,782	77,539	95,502
1998	99,631	93,231	79,748	80,226	97,256
1999	101,169	96,192	82,063	82,421	97,369
2000	105,641	99,545	85,283	85,283	102,251
2001	112,316	105,046	89,841	89,841	104,982

(1) Includes stock valuation adjustment. GNI = GDP plus net primary incomes from the rest of the world.

NI = GNI less consumption of fixed capital. NDI = NI plus net current transfers from the rest of the world.

[Source: Statistics NZ]

The drive to privatise essential services slowed, but did not stop, after the change in government in 1999. The effects of privatisation are still being discussed. One recent example is a series of papers by individual Treasury officials. One of these expressed disappointment at lack of ongoing productive and dynamic efficiency gains in the business sector, and poor growth rate considered likely to continue; the others criticised various aspects of the reforms. No Treasury supporters of the reforms contributed to the series.[10]

[7] www.treasury.govt.nz/workingpapers/2000/00-13.asp

[8] Royal Commission on Social Policy, 1988; can't find summary on any website

[9] Kelsey, Jane, "The New Zealand Experiment", Auckland University Press, 1995, 1997

[10] summarised in Easton "Of roast pork", Listener March 19 2002 p. 36; originals available at http://www.treasury.govt.nz/workingpapers/2001/

▸Energy Sector

New Zealand's main indigenous energy resources are hydroelectricity, natural gas, condensate, a small amount of oil, and coal. In net energy terms, it is self-sufficient in all energy forms except oil.[11]

Hydroelectricity supplied 87 PJ in 2000; natural gas supplied 235 PJ. About 100 PJ/yr of gas was converted to chemicals, mainly methanol for export. We imported about 240 PJ of oil, which supplied 42% of New Zealand's fossil fuels in the year. More than half of coal production is now exported. The condensate that comes from the gas fields earns more money by exporting it than by using it as a feedstock for New Zealand's refinery. Any increase in use of coal will now be under a cloud because of its greenhouse gas impacts.

Electricity is used extensively for home heating and water heating, as well as lighting, motors, and other uses which require electricity. Natural gas is reticulated in the North Island. About 45% of gas today is exported as methanol and another 40% used in thermal power generation.[12]

Before 1984, electricity was generated and transmitted by a Government department. Central Government was also heavily involved in coal and gas production. A levy of 25%, or sometimes more, on the bulk electricity tariff provided the money to expand the electricity system. The Ministry of Energy published annual energy plans from 1981 to 1985, giving information on resources of fossil fuels and sustainable energy resources, and government's plans for their development.

The public sector was drastically restructured from 1984 onwards.[13] All government trading departments were converted to commercially-driven corporations. The Ministry of Energy was abolished in 1989. There remains a Minister of Energy, who is advised by officials in the Ministry of Economic Development.

In 1992 the local power distributors were restructured into companies. Government expected these to end up in private ownership, but the majority of communities decided to keep them in public ownership. Retail electricity prices rose because the companies valued their networks in a different way, which gave higher values. Prices from private companies rose still more, because mergers and takeovers were giving market values even higher than the new valuations.

Legislation in 1998 required local power companies to sell off either their retail and generation businesses, or their local networks. Network values rose yet again. The corresponding price rises are only beginning now, because most of the new companies promised price freezes for two to three years.

An amendment in 2000 allowed network owners to own renewable generating plants. This was too late to prevent the "fire sales" of all their small hydro power stations and wind farms (see discussion under indicator 4). This amendment also attempted to control the very high prices faced by small electricity users, but most companies found ways around that provision.

A competitive wholesale electricity market was developed by EMCO (now M-co), a company originally owned by the power companies, later sold to a South African company. The market was launched in 1996. In 1998, market participants began to

[11] The Dynamics of Energy Efficiency Trends in NZ, EECA Monitoring and Analysis Unit, 2000, p. i

[12] Energy Data File July 2001, summary available on MED website www.med.govt.nz

[13] A full summary of electricity restructuring is at www.med.govt.nz/ers/electric/chronology/index.html

design ways to buy and sell security of transmission services. In 2000 Government carried out a major review of the electricity system. It concluded that self-regulation by the industry players would be more effective than relying on a regulator.

In the winter of 2001, a shortage of hydro energy led to skyrocketing spot prices. This led to a Government review of the operation of the wholesale electricity market.[14] The review concluded that competition between the electricity generator-retailers was not working well, but that new governance arrangements should fix the problem. The cost of implementing the proposed self-regulation system is now estimated to be $42m NZ per year.[15]

Deregulation has been much more complete in New Zealand than in other countries. There is no regulator at all for electricity or other essential industries. The Commission so far has been surprisingly tolerant of market power. It allowed Shell to buy out its largest competitor, Fletcher Energy - this gives Shell an iron grip on New Zealand's gas resource during the coming critical years when the successor to the Maui gas field is being planned (see discussion under indicator 5). So-called "light regulation" of the gas industry has been unsuccessful in preventing the main pipeline owner, Natural Gas Corporation, from exploiting its dominant position.[16]

"Governance" of the electricity industry is being set up with Government's blessing (and funding) by a committee of industry players. The aim is to make permanent the present experimental self-regulation system. Consumer representation on this committee has been ineffectual to date - the present regime clearly favours business interests at the expense of consumers and the environment. The governance arrangements were stalled "mainly because of differences between the players and stakeholders taking part"[17].

In the four years since our last report to HELIO, public unease about electricity supply has increased markedly. The system set up to allow customers to switch power companies has worked poorly. The rate of switching peaked at over 70,000 in the month of June 2000, but fell to 13,000 in January 2002.[18] Many customers are being switched to other retailers without their approval.[19]

An independent report confirms that the wholesale market is readily manipulated for profit[20]. The failure of so-called "competition" to benefit small consumers, low-income consumers and rural consumers was thoroughly explained by the American Public Power Association; it describes the pressures on the New Zealand industry accurately.[21]

On the positive side, the Energy Efficiency and Conservation Authority (EECA) was established in 1992 as an independent government agency, to implement practical measures for achieving greater energy efficiency in New Zealand. Its brief was soon extended to the promotion of new renewable energy resources. It established a voluntary energy-efficiency programme for companies, now involving some 700 businesses. For residential energy efficiency it distributed $9 million over five years to supply low-cost energy efficiency improvements in some 48,000 homes. Many of these

[14] www.electricityinquiry.govt.nz

[15] "Power regime estimated to cost $42m", Dominion 2 April, 2002

[16] NZ Herald 6 April 2002.

[17] "Electricity board a year behind schedule", Dominion 20 March 2002.

[18] "Electricity Market regains stability", Dominion 27 February, 2002

[19] "Customers switched without their approval, says Genesis", Dominion 29 April, 2002

[20] www.med.govt.nz/ers/electric/hedgemarkets/index.html

[21] "Price Discrimination, Electronic Redlining and Price Fixing in Deregulated Electric Power, attached to CAFCA submission to the winter review: www.electricityinquiry.govt.nz/submissions/index.html; look for submission #245.

programmes were operated by local power companies or the trusts that owned the companies, and separate local trusts supporting energy efficiency have also been formed.

In 2000 EECA was given a basis in statute, and its funding increased to $46 million over a 5-year period. It published a National Energy Efficiency and Conservation Strategy in 2001, after extensive consultation with the public. It has expanded its criteria for residential energy initiatives beyond purely saving kilowatt-hours, to include health and employment benefits. It has worked to improve the energy efficiency provisions in the building code, though these are still not stringent. It has developed minimum energy performance standards for major household appliances, to be introduced this year.

Locally owned power companies keenly supported new renewable electricity generation. Between 1996 and 1999, they installed enough wind power, geothermal, and landfill gas generation to meet 2/3 of the electricity demand growth in that time (see indicator 4). Further expansion was stifled by the installation of almost 1000 MW of large-scale gas-fired generation. But local network companies are again considering renewable energy - some have recently joined the New Zealand Photovoltaic Association.

Energy research and development now receives public-good funding of approximately 6 million dollars/year[22]. In 2000, this funding was allocated in approximately equal shares to fossil fuels, renewable energy and energy efficiency, geothermal energy, and "other" - in earlier years research on petroleum and coal resources received by far the greatest share of funding. The pendulum continues to swing towards funding of sustainable energy research.

The future shape of New Zealand's primary energy supply is now very uncertain. The giant Maui gas field, commissioned in 1979, provided up to half New Zealand's primary energy in the 1980s. Late in 2001 Shell International, the company that owns the field, announced that reserves were declining faster than expected. They expect the field to shut down in 2007, two years earlier than had been planned. Unless petroleum exploration suddenly becomes more successful in finding gas than it was in the last 30 years, New Zealand will face some hard choices. New power stations may have to be run on coal or even liquefied natural gas (LNG - strongly advocated by Shell).

Industry spokespersons insist that a new power station is needed by 2005. Such decisions are being made on purely commercial grounds, and energy officials support that approach. But environmental groups have appealed against the resource consents granted for two of the three proposed combined cycle gas turbines stations. Bankers are unlikely to finance a new power station unless the company has firm contracts for both fuel supply and sale of electricity. In practice this means the company must sell to its own customers. So much for competition! (See indicator 3). A coal-fired power station would be a cheaper option by commercial standards, but would make nonsense of any commitment to the Kyoto protocol.

Meanwhile advocates of sustainability are proceeding down a separate track. Public support for this is strong and increasing - many sustainable options are now cheaper than many on the mainline track; also they employ New Zealanders and keep profits in the country. Sustainable options are small-scale and cannot capture the monopoly profits that are now rife in both gas and electricity. But they have not been a commercial success. The cartels created through industry self-regulation can quickly and legally deal to any initiatives in energy efficiency or renewable energy as soon as they present a real commercial threat. Complaints about predatory pricing, gaming on the spot market to hike spot prices, and use of network bottlenecks to shut out competition, have fallen on deaf ears. Exhaustive lobbying has failed to achieve government support for a market that treats mainline energy businesses and sustainable ones on an equal footing.

[22] NZ Yearbook 2000

Unless industry self-regulation is replaced by effective regulation for the public interest, there would seem to be little future for more than token initiatives in sustainable energy in New Zealand.

Environmental sustainability

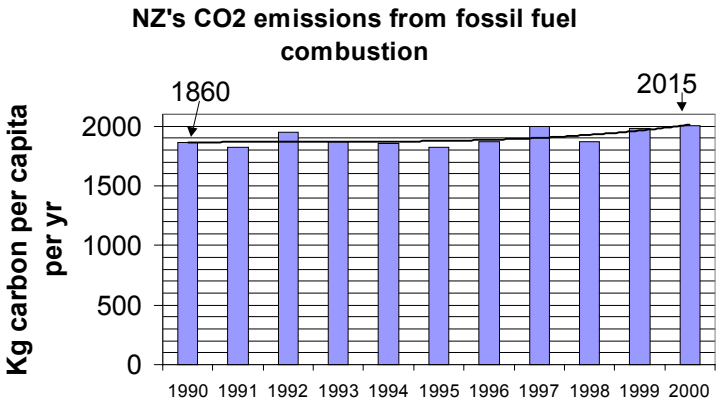
►Indicator 1: per capita carbon emissions

New Zealand's carbon dioxide emissions derive 90% from fossil fuel combustion, with 40% of that figure coming from transport emissions. Transport emissions have increased 44% since 1990.[23]. Aluminium, steel, and cement manufacture emit CO2 from chemical processes as well as from combustion, and those parts of their emissions are excluded from these figures.

Electricity generation from gas and coal varies widely, because two thirds of New Zealand's electricity comes from hydro power systems which can only store a few weeks of New Zealand's annual generation. Emissions from thermal power generation have increased 33% since 1990 . [24]A hydro shortage in the winter of 2001 led to a 30% increase in total gas use. The impact of thermal power on emissions will increase when the Pohukura gas field begins to replace the declining Maui field in 2005, because the new field will be much less able to change its output from month to month[25]. Thus more oil or (probably) coal will be needed to make up for variations in hydroelectricity.

Geothermal energy releases the CO2 dissolved in the geothermal fluids, at rates very specific to each site and method of development. The largest geothermal plant emits just 6% of the CO2 that would be emitted by a combined cycle gas turbine; the second largest geothermal plant emits 96%. Overall, the geothermal sector is now emitting 41% of the CO2 of our most efficient gas-fired generators.

The Ministry of Energy's Energy Outlook[26] now projects some 800 MW of coal-fired power being introduced after 2010 - this also assumes rather optimistically that 80PJ/yr gas will become available from the present until 2020. The baseline forecast projects greenhouse gas emissions from the energy sector in 2020 to be 68% higher than they were in 1990. The document does not mention the Kyoto Protocol.



New Zealand's other greenhouse gas emissions are particularly strong. They come mainly from the farming sector, as methane from anaerobic digestion in ruminant livestock, and nitrous oxide from soils. In the local debate about the Kyoto protocol, energy sector interests are calling for their emissions to be offset by the growing plantation forest estate. But environmental interests consider that wrong to mix up energy sector agendas with land use issues.

[23] NZ Greenhouse Gas Inventory 1990-1999, Ministry for the Environment 2001

[24] MFE op. cit.

[25] Lloyd Taylor, Business News on Radio NZ, 6:45 am 25 Feb. 2002

[26] on www.med.govt.nz

HELIO INDICATOR:
The value 1 of this indicator is the global average of emissions per capita in 1990 of carbon dioxide expressed as carbon, namely 1130 kgC/cap. The value 0 is 30% of that value, or 339 kgC/cap. The indicator value in 2000 comes to 2.12.

►Indicator 2: Local environmental impacts

Local environmental impacts from New Zealand's energy production include the loss of cultural and environmental values from the damming of almost every economically viable major river system, and many smaller ones. Low lake or river levels, variations in river flows, and sometimes flooding are matters of continuing concern. Past geothermal power proposals have also given rise to major cultural concerns, but consultation with Maori has overcome concerns in most recent projects. Cooling water discharged from a 1000 MW thermal power station raises river temperatures and generation must be constrained at times in summer months. There are some local impacts from onshore gas and oil production and coal mining, but these are generally well contained.

The environmental impacts from energy use affect many more people in New Zealand than those from energy production, because of its largely urban population.

Emissions of small particulates (PM10), mainly from domestic solid fuel burners, are monitored in Christchurch, where an inversion layer in winter traps polluted air and affects a substantial population. Many suburbs throughout New Zealand are subject to similar trapping of particulates. The Canterbury Regional Council now prohibits open fires and requires closed wood burners to meet a stringent emissions standard of 1.5g/kg.

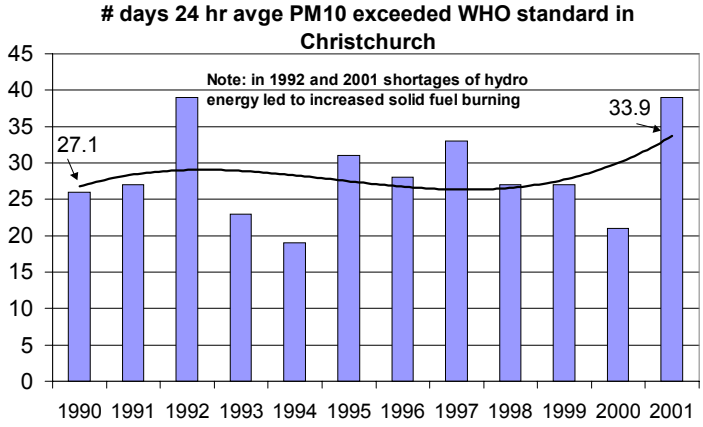
Emissions from vehicles in Auckland, New Zealand's largest city, cause a high level of pollution in some areas. Data on pollution are collected by Auckland Regional Council; a variety of monitoring methods were used, at several stations. At present the number of days per year that the WHO limits on air pollution are exceeded are fewer than those found in the Christchurch study. Nelson is another city in a basin subject to winter inversions; the number of days WHO levels were exceeded were substantially greater this year than those in Christchurch.

A significant local impact from energy use arises from a steadily increasing use of portable LPG (liquified petroleum gas) heaters in houses. About 1/3 of New Zealand houses have these heaters[27]. The heaters discharge combustion gases including moisture directly into living areas, producing levels of nitrogen dioxide which are usually near or above the WHO limit of 160 ppb.[28] The moisture can cause serious dampness in the house; this in turn is an important contributing cause of asthma, which is increasing in New Zealand. Dampness can also damage the structure and contents of houses. A two-year study of the relationship between asthma and the air quality and temperatures in houses began last year, and its results can be expected to have significant policy implications.

The indicator we choose for local pollution is based on outcomes not inputs - that is, days in a year when the WHO standard for PM10 in Christchurch has been exceeded - not emissions of PM10 per capita. Furthermore, instead of taking values for 1990 and 2000

[27] "An Unflued Heater in your Home? Consumer, March 1998, p. 368

[28] "Domestic Indoor Air Quality, a survey of the impact of gas appliances", Bettany, B. L. et. al., MESC Report S93/191, from the Building Research Institute of NZ, 1993



as the basis for the HELIO indicator, we take the values derived from a trendline (fit with a power series). Other indicators will use this approach where possible, as it is particularly suitable for New Zealand with its small size, large variations in each indicator, and statistics which allow confidentiality of data on energy supply and use by certain industries.

The HELIO indicator for local pollution is 1.28.

Social sustainability

►Indicator 3 : Households with access to electricity

Well over 99% of New Zealand's households are reticulated with electricity.[29] Rural reticulation was subsidised between 1945 and 1990, from a small levy on the revenues of local power companies. Some of the later schemes were very ambitious and would be considered entirely uneconomic today. Households not connected to the grid almost invariably generate their own electricity, usually from diesel generators but increasingly from micro-hydro dams, wind generators or photovoltaic cells, or a combination of these.

Power network companies are required to maintain uneconomic lines until 2013. During that time, one might hope that distributed power generation from renewable energy might be introduced widely. (See discussion under Indicator 8). This would reduce not only greenhouse gas emissions but also the noise and nuisance of diesel generators. However small backup generators will always be needed as small renewable sources are subject to high variability in supply. In the absence of such schemes, some rural lines will have to be rebuilt at very high cost.

Most households without access to electricity are those that have been cut off for non-payment of power bills, as discussed below. The other major access issue in New Zealand is temporary loss of supply, either from faults in the network, or because power station failure or shortage of hydro energy requires cutbacks in consumption.

In February 1998 (in the NZ summer), the entire Auckland central business district lost electricity supply for five weeks as four underground cables failed in quick succession. Remaining smaller transmission lines together with diesel generators in the streets provided partial supplies for a few hours per day, but many businesses had to close down. The power company had been held up by the business community as an example of aggressive and successful corporatisation policies[30], but its focus on management of financial rather than physical assets had allowed managers to ignore the signs of incipient failure of the cables.

In June and July 2001 a hydro shortage - the second in a decade - led to spot market prices up to $1/kWh for brief periods, and 25-50 c/kWh for days at a time. This compared to prices of 2-4c the previous year. Because domestic customers were on fixed tariffs they had no incentive other than exhortations from the Minister of Energy to save electricity (which were effective). But those large industrial users which bought some of their electricity on the spot market were affected immediately. Many which had been on fixed price tariffs have found their supplier would not renew the contracts, but are forcing companies to buy at spot prices, or at drastically inflated fixed prices.

Since the 1998 breakup of power companies, most companies have increased fees for disconnections and reconnections, and fixing faults. They are also tougher in requiring bonds for customers considered unreliable payers. These moves affect low-income customers disproportionately. One company is believed to have increased the number of disconnections of domestic consumers during the power shortage, simply to reduce its exposure to skyrocketing spot prices[31]. No statistics are kept on disconnections for non-payment of bills, as this is considered to be a commercial rather than a public policy issue.

[29] Alan Jenkins, Electricity Networks Association, pers. comm.

[30] Management, December 1997

[31] NZ Herald 11 August 2001

In the wake of the shortage domestic power prices are rising - at a time when hydro energy is abundant and savings are no longer needed. And there is a continuing exchange of customer blocks between different retailers. Consumers in most districts now find their incumbent retailer is acting as a monopoly. The discipline of a competitive market is no longer effective, and both industrial and domestic consumers are paying higher prices as a result. Government exhorts consumers to change suppliers if they are dissatisfied with price or service, but the billing systems have proved unable to cope. Many customers who have switched are not billed for many months; some are then threatened with disconnection. An Electricity Commissioner has just been set up to arbitrate consumer complaints - but not all retailers have subscribed to this scheme.

Power companies have no commercial incentive to support energy efficiency measures which save electricity at lower cost than electricity from new power stations. But Christchurch's network company, owned by its city council and supported by its community, has done so for a decade. As long as Government continues to allow commercial agendas to drive energy decisions, energy efficiency initiatives will remain sporadic and do little to actually reduce electricity demand.

Although power connections are virtually universal, the affordability of electricity is becoming an issue increasingly. We consider that the most important available measure of access to electricity is the proportion of households which spend more than 10% of their income on domestic fuel and power, which we consider a threshold defining "fuel poverty".

In our 1998 report to HELIO we predicted this would increase. Since that year, only one figure has been released, and surprisingly it is little different from the 1997 figure. It would appear that the "price holiday" that accompanied the 1998 breakup of local power companies has kept this indicator value down. But since the breakup most companies have increased their fees for disconnections, and reconnections, for fixing faults and for pay-as-you-go meters. These moves have impacted far more on low-income people than on the average New Zealander. Retail price hikes are predicted by all power retailers. These factors are very likely to cause fuel poverty to increase.

The HELIO indicator is nominally simple to calculate: 100% access to electricity, in 1990 and 2000 alike.

►Indicator 4: Investment in clean energy

"Clean Energy" is defined for the purpose of this report as including hydro generation from stations less than 100 MW, small recently built geothermal power stations, and new renewable energy sources.

Energy efficiency investment is also counted as "clean energy", and has the potential to substitute for a great deal of power generation that is now being planned. EECA has recently subsidised residential energy efficiency by around $2millionNZ/yr mainly to low-income households - but this is small in comparison with the continuing capital investment in inefficient energy-using equipment in all sectors - household, commercial and industrial.

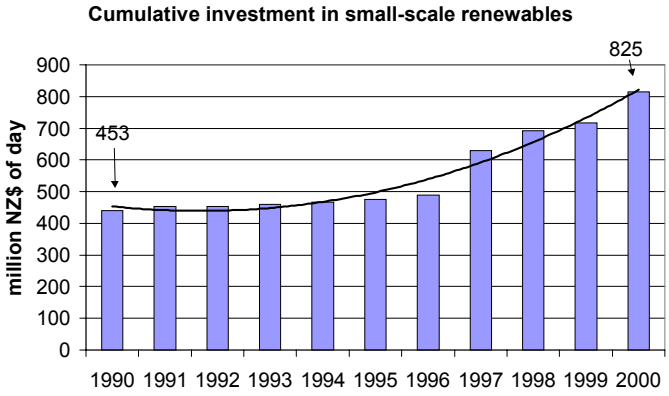
During the mid 1990s small-scale renewable energy was on track to become very significant in meeting the still-modest growth in electricity demand. Some 350 MW of such power stations were built by local power companies during this brief period when there appeared to be an imminent shortfall of generation.

However the commissioning of almost 1000 MW of large-scale gas-fired generation after 1998 has kept wholesale prices low - some 2.5-5c/kWh at most times - and stifled the planned expansion of two wind farms.

Clean Energy also includes the "un-sexy" but important conversion of industrial wastes to heat. This has proceeded steadily, and now produces a large proportion of New Zealand's renewable energy other than hydro and geothermal.

Domestic fires remain an important energy source, and the fact that efficient wood burners are increasingly common allows their use to be described as potentially clean. Eucalyptus coppice fuelwood is being introduced; this is clean and convenient to handle and can dry naturally to 25% moisture content in 2 months or less after harvest[32]. This gives hope that fuelwood might be available at short notice, thus able to offset high spot prices in the occasional years when hydro energy is in short supply. Investment costs for this technology include plantations, highly efficient wood burners, and some handling equipment and vehicles for distribution; they cannot be estimated at this stage.

The baseline investment in New Zealand's energy sector will be estimated in extremely broad terms, being a very large number to which a small number is compared. We take the Maui development as costing $1 billion for each of the two offshore platforms (actual numbers, but in dollars of the day, say 1980 and 1990), another $1 billion for onshore facilities (say 1980), and another $1 billion for non-Maui gas and oil fields (say 1980; Kapuni was earlier , small oil fields, later). We take the investment in the oil refinery as another $1 billion. We take electricity investments as the value of Crown electricity assets in 1986, $6.3 billion, plus another $3 billion for all local authority electricity assets. Coal assets are small by comparison. Thus in dollars of the day, we take conventional energy assets as worth $13 billion in 1990.



The last decade saw some $1 billion invested in almost 1000 MW of gas-fired generation and cogeneration.[33] There was one major upgrade of large hydro generation and several small upgrades, costing over $200 million. Exploration and development of several small oil fields cannot be costed, but could amount to several hundred million. In all we will count $2 billion of additional investment in conventional energy supply between 1990 and 2000.

The HELIO indicator is much more sensitive to the definition of "clean energy" assets in 1990. Hydro stations of less than 100 MW capacity in that year summed to approximately 400 MW; some of these had particularly major environmental impacts (two collapsed as they were being commissioned, and a third did so in 1998). Yet others were built with strong support from their communities after extensive consultation. Here we arbitrarily take half the small hydro power stations as "clean energy", and their investment cost as a generic 1.9 million NZ$ per MW

[32] Ralph Sims, Massey University, Palmerston North, pers. comm.

[33] A 400 MW combined cycle plant on an existing site commissioned in 1998 in Taranaki cost approximately $NZ1000/MW; costs in US$ for combined cycle plants of various sizes cluster in the neighbourhood of $1000US/MW. www.fe.doe.gov/coal_power/special_rpts/market_systems/appc.pdf

Renewable generation commissioned in the period 1990-1995 were 17 MW of geothermal and 9 MW of landfill gas. In 1995-1999, 60 MW of geothermal, 7 MW small hydro, 3 MW landfill gas and 35 MW of wind power were commissioned. 2000 saw another xx MW of geothermal.

Generic costs will be taken as follows:

-The cost to Alpine Energy of the 1998 7 MW hydro station was approximately $13m including repair costs. Given the cost overruns in earlier small hydro schemes, an estimate of 1.9 nz$/watt seems reasonable for all small hydro. Geothermal costs will be prorated to the $42 million cost of the Rotokawa power station for 24 MW.

-Wind costs will be prorated to the $50m cost for the 32 MW Tararua wind farm.

-Landfill gas will be put at $1200/MW US, times a PPP factor of 1.44 NZ$/US$ for 2000.

Based on these numbers, the HELIO indicator for 2000 is 12.57.

The outcomes from renewable energy investments are tracked in the Energy Data File, and are reported in Indicator 8.

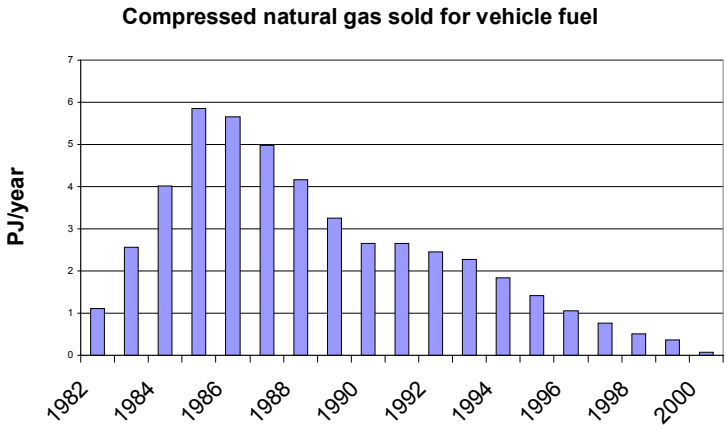
Economic sustainability

►Indicator 5: Resilience: energy trade

The HELIO indicator for "resilience" is conceived on the basis that oil importing countries are vulnerable to international oil price hikes. Imported oil comprises 42% of New Zealand's net fossil fuel supply (a good deal of coal and indigenous oil is exported). Indigenous oil is also priced at international oil prices, and ownership of the indigenous resource is almost entirely foreign. Thus New Zealand's ratio of imported oil to total fossil fuel consumption does not affect prices.

Trading in energy can increase resilience by increasing the number and type of energy sources and markets. Resilience suffers when there is excessive dependence on a single source of supply, whether it be natural gas, OPEC oil, or local rainfall. In this matter, the imminent decline of the giant Maui gas field is a major issue. This supplied up to half New Zealand's primary energy during the 1980s. Its abundance and low cost suppressed development of other energy sources. It is the coming shortage of primary energy that is critical - and is affecting even electricity prices right now.

Commercial natural gas resources were developed just in time to offset the economic impact of the first OPEC oil crisis. Gas fields of about 1000 PJ and 5000 PJ were commissioned in 1973 and 1979 respectively. It was easy to believe that other large discoveries would follow - but after 30 years of further exploration, only another 140 PJ of recoverable gas reserves have been developed, with a further approximately 1360 PJ now considered commercially attractive at forecasted future gas prices.[34]



For a brief few years in the 1980s, New Zealand was on track to be truly resilient in its supply of vehicle fuels. From 1979 through to 1984, the government promoted compressed natural gas (CNG) and LPG (liquified petroleum gas) as a move towards self-sufficiency in vehicle fuels. Subsidies paid half the cost of installing CNG filling stations and a proportion of the cost of converting cars to CNG. LPG was promoted for use in areas not reticulated for natural gas. A network of almost 300 CNG filling stations ensured wide availability, and about 5% of cars were converted at the peak.[35] The technology to convert large truck engines to CNG was developed and commercialised. But in 1985, Government according to its new philosophy removed the subsidies "so the industry could stand on its own feet". Car conversions slowed to a trickle thereafter, and CNG filling stations gradually lost business and closed down. Over $20 million of government funds, and several times that amount of private investment in CNG, were almost totally wasted, as CNG equipment was sold at salvage value, mostly to Pakistan, or simply thrown away. Sales of gas for CNG peaked at 5.85 PJ in 1987, and by 2000 had declined to .073 PJ/year[36].

[34] www.med.govt.nz/crown_minerals/petroleum/facts/index.html

[35] Ministry of Energy Annual Report 1984.

[36] Energy Data File 2001

The Maui gas field is now expected to run out early, and is believed to contain only 70% as much recoverable gas as originally predicted. The information source is suspect, as it gives an incorrect figure for the original size of the Maui field 4085 PJ instead of the actual figure 5440 PJ, which was published in l973 and not challenged until 1985. The total gas in the field is now put at only 3880 PJ.[37]

Shell International, who manages the gas field, warns that the wholesale price of gas may have to triple to support petroleum exploration and development. Retail electricity prices are already rising, to support the higher costs of power from proposed new gas-fired power stations.

Shell's warning is an example of the "tyranny of scale", to which New Zealand is particularly vulnerable. Oil companies generally seek very large and profitable fields, which in the New Zealand context require exporting much of the energy content. New Zealand had to resort to highly energy-intensive exports, including methanol (made from gas), aluminium, and pulp and paper to utilise energy from major supply projects. The companies involved now expect (and make this clear to successive governments) a continued supply of energy at low prices. That is not resilience!

Nor is it necessary. A gas field discovered recently, Pohukura, is a quarter the size of Maui. If dedicated to New Zealand use instead of export industries, it could be the basis for continuing supply for 20 to 30 years, augmented by the remaining gas in existing fields, and gas associated with oil fields that would continue to be discovered and developed in the absence of subsidies. This could enable a transition to fully renewable biogas supply from wastes and low-cost biomass resources.

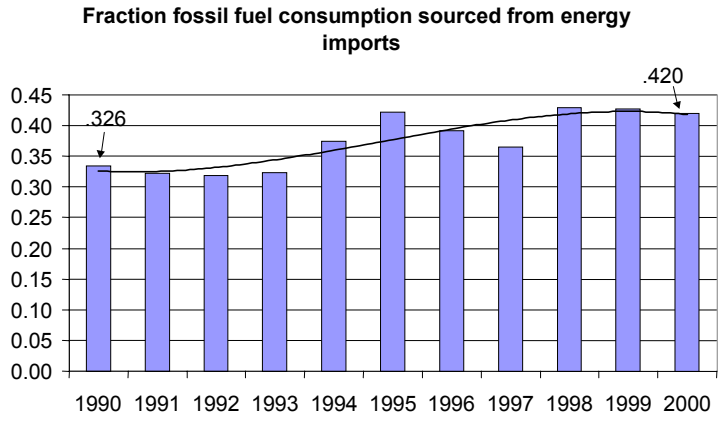
Unlike the Maui field, Pohukura cannot vary its flow easily from month to month to make up for seasonal shortages of hydroelectricity. The Ministry of Economic Develoment expects an increase in coal-fired electricity will be needed both in dry years and to meet electricity demand growth. If so, greenhouse gas emissions would increase 37% from 2000 to 2020. That is not resilience, either!

What the New Zealand electricity system requires (and if the market allowed, could develop in abundance) is a diversity of renewable resources which would reduce our dependence on hydroelectricity, together with major investment in energy efficiency designed to tailor total energy demand to indigenous supplies. Biomass energy could then be more than adequate to supplement hydro energy in dry years (see discussion, indicator 4). New Zealand's remaining gas could be increasingly shifted to highly efficient uses, ranging from CNG for vehicles, to cogeneration of heat and electricity, to fuel cells.

That sustainable development path would be highly competitive, and would keep prices close to costs - higher but not a lot higher than today's. But true competition is anathema to the private owners of the electricity system - and their bankers want firm contracts for both fuel supply and sales of power for any new power station. The government, which owns the large majority of hydro generation, is more than happy to take its share of the higher profits from today's deregulated industry.

Government's "Energy Outlook" document examines a scenario based on conservation and efficiency - but not a very ambitious one, as its greenhouse gas emissions are projected to be 19% higher in 2020 than those in 2000. This is better than the 37% projected for its baseline scenario, but still far from our commitments under the Kyoto protocol. It still assumes large-scale gas fired power stations dependent on new gas finds - and would almost certainly rely on energy exports to achieve the "economy (tyranny) of scale" that is now the norm.

[37] NZ Herald 6 April 2002, Maui White Paper, Government Printer, 1973.



It is counterintuitive, but undoubtedly true, that New Zealand would become more resilient - and probably lessen the expected electricity price hikes - by abandoning all promotion of petroleum exploration, shutting down the export methanol plant, and relying on Pohukura alone to provide the bridge from fossil fuels to truly sustainable energy.

Resilience in a physical sense requires not only adequate primary resources, but reliability of the systems that convert them into consumer energy. In this respect, the commercialisation of formerly publicly-owned energy businesses has raised serious concerns. The failure of the Auckland power cables has already been noted (Indicator 3). New investments are not immune either: a 370 MW combined cycle gas generator was delayed in its commissioning for a year, attributed by some to cost-cutting during its construction.

These physical aspects of resilience are impossible to quantify; they have more to do with business planning and geological prospectivity than with trends in production of already-developed resources. As a guide to the financial impact of imported energy, the subsequent indicator, "burden of investment" actually says much about resilience.

But the HELIO indicator does give a useful picture of trends in self-sufficiency in fossil fuel, and is reported here as defined in the brief: 1.29

►Indicator 6: Burden of energy investments

This indicator is based on the idea that government investment in energy supply displaces higher priority government expenditure, such as health and social welfare. But in the deregulated New Zealand energy market, existing government-owned energy assets are not a burden as they can often extract high profits. The burden of energy investments is better described as the increasing flow overseas of profits and dividends from foreign-owned energy supply businesses.

Before the energy reforms that followed the 1984 election, New Zealand's central government owned the monopoly electricity supplier, half the giant Maui gas field, and much of the country's coal business. Under the policies of privatisation and deregulation, government has sold all its gas and petroleum investments, though it still owns and collects royalties on the resources. The gas and petroleum investments were sold to a New Zealand company (which always had substantial foreign shareholding). But last year that company sold its all its energy interests to Shell. Government's attempt to sell its coal business failed, and public pressure has prevented privatisation of four of the five state owned electricity businesses.

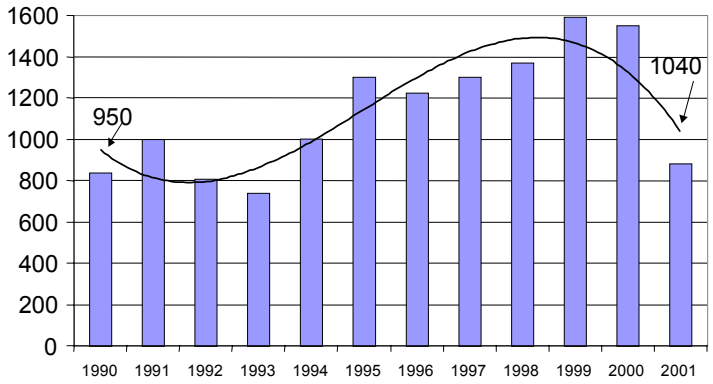
If foreign-owned businesses used their capital more efficiently than New Zealand-owned ones, there would be less concern. But for those assets that were sold, the prices and

terms of the asset sales, and subsequent weak regulation, has allowed their new overseas owners to extract excessive profits and capital gains.[38]
During the decade 1990-2000, central government made only small investments in electricity supply compared to earlier years. From 1998 the private sector invested in about 1000 MW of thermal generation, costing some $1 billion NZ in round terms. The system now generates a significant surplus of electricity in most years. An exception was the winter 2001 hydro shortage, when spot prices skyrocketed. A foreign-owned generator-retailer, the Natural Gas Corporation, had insufficient generation to cover its consumers' demand, and lost some $300 million of shareholder value. In this case it was indeed the private sector that was burdened by the extraordinary risks of the wholesale electricity market. The figures for 2001 in the spreadsheet attached to this report show this as effect as a sharply reduced net "income from foreign investment in NZ".

The burden of investment concept applies also to local community-owned power companies, which over the years built many small hydro projects (using large subsidies from central government). Many or most of these suffered from cost escalation, and three schemes suffered collapse of their dams or canals. However like all hydro projects these have practically no operating costs, and are now essentially cash cows for their owners. As noted before, the 1998 breakup of local power companies into separate retail and network businesses forced most of these power stations to be sold off to other generators.

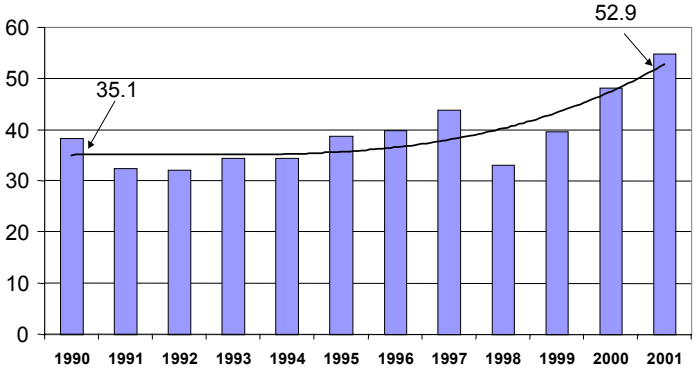
Most local electricity network companies are still publicly owned, but by far the largest, United Networks, is overseas-owned. It purchased the networks supplying a large proportion of New Zealand's city residents, who are less costly to supply than town and rural customers - and so is particularly able to take monopoly profits to whatever extent a tolerant Commerce Commission will allow.

Total profits from NZ energy sector
(million NZ$ of the day)



In 1990, foreign investment in energy supply comprised approximately half of the gas and oil producing fields plus New Zealand's oil refinery. In 1993 the first foreign company bought into a local power company. Thereafter several foreign companies bought substantial shareholding in local power companies, and successive mergers and takeovers hiked share values, sometimes to four times their original book values. In 1999 one of the four state-owned generators was privatised, with 40% foreign ownership, since increased to almost 60%. And in 2001 the New Zealand-owned interests in the Maui gas field and other small oil and gas fields was sold to Shell Oil, which now dominates the gas and oil sector. The Commerce Commission surprisingly permitted the sale.

Percentage of energy company profits going offshore



The flow overseas of profits and dividends from these investments

[38] Easton, "A hubris of managers", Listener Nov 17 2001 p. 38.

makes up the true burden to New Zealand of our energy sector. For the indicator, we take the ideal state as 80% publicly owned. This allows for a significant foreign ownership in gas fields which are already discovered, and which would provide a valuable diversity to an otherwise entirely renewable primary energy resource.

The spreadsheet attached to this report shows that the after-tax profits of the local power supply sector have risen several hundred percent since the sector was corporatised and partly privatised. The gas sector, also largely privatised, has also gained in profit. By contrast, the oil and central electricity supply sectors grew in profits during the mid 1990s but have tailed off since.

Technological sustainability

►Indicator 7: Energy intensity

The data below are based on consumer energy supply (energy consumption) rather than primary energy supply. The latter is distorted by the substantial contribution of geothermal energy to New Zealand's primary supply, which generates electricity at only 10% efficiency (new geothermal stations are likely to generate at 15% efficiency). This is partially balanced by the contribution to primary energy supply of hydroelectricity, at 19% in 2000, which is taken as supplying consumer energy at 100% efficiency.

Between 1990 and 2000, New Zealand's energy consumption rose by 19%. The GDP grew slowly until 1994, and then more rapidly. Combining these shows a fall in ratio of energy to GDP by 5.6% over the decade.

A recent analysis by EECA[39] compared New Zealand's energy intensity to that of other IEA countries. It noted that in 1999, the transport sector produced 46% of New Zealand's energy-derived CO2 - this is the highest proportion in the OECD.

Transport energy is the largest and fastest-growing form of energy use, with increasing demand for both passenger and freight transport overwhelming technical improvements in vehicles. Growth in passenger transport has been stimulated by the importing of second-hand cars from Japan; these now account for half of new car registration. Personal mobility increased by about 70% from 1980 to 1998. Public transport in New Zealand cities is the lowest in per capita terms amongst IEA countries, and cars consumed 90% of the energy used in domestic travel.[40] Growth in transport demand is expected to continue.

Household energy demand is also expected to increase substantially. Indoor air temperatures in winter are often below 16 degrees, compared to WHO's recommended standard of 18 degrees[41]. This combined with a larger than average residential floor area for New Zealand, and relatively poor insulation suggests the household sector needs careful attention. Extensive research is now underway to better understand the value of "interventions" (such as home insulation, heating and ventilating), for both saving energy and improving health.[42]

The industrial sector consumed 33% of New Zealand's primary energy and contributed 25% to New Zealand's GDP in 1998. By far the largest energy users are an aluminium smelter and a refinery converting ironsands to steel; together these used almost 45% of all energy used by the industrial sector in 1998, while contributing around 3.4% to New Zealand's GDP. Since 1995, only the electricity use of the industrial sector is published; other energy uses are shown as "unallocated". The estimates above use previous years' use of the energy types to estimate the actual use. Also the figures exclude natural gas converted to methanol, as this is exported and not counted as "consumer energy". Forestry processing supplies half its own electricity from its own waste wood.[43]

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[39] "Future Energy Use Prospects", Energywise Monitoring Quarterly, May 2001, p.2-8

[40] The Dynamics of Energy Efficiency Trends in NZ, EECA Monitoring and Analysis Unit, 2000, p. iv-v

[41] Isaacs, Nigel, "Poverty and Comfort?", presented to Fourth National Food Bank Conference, 13 November 1998

[42] see http://www.wnmeds.ac.nz/academic/dph/research/housing/index.html

[43] "The Dynamics of Energy Efficiency Trends in NZ, p. 77

These figures do not count the energy exported as non-energy products. In fact 42% of New Zealand's natural gas was converted to chemicals in 2000, mostly into methanol for export. The figures do include electricity that is in effect exported as aluminium: the aluminium smelter uses about 15% of all electricity generated in New Zealand. Aluminium and steel production generate substantial CO2 emissions through chemical reduction by carbon; these are not counted as fossil fuel-derived CO2 emissions.

The commercial sector used 9% of New Zealand's consumer energy in 1999. Its energy intensity declined from 1000 GJ/NZ$ in 1991 to 760 GJ/NZ$ in 1998. Technical improvements and improved energy management practices have both contributed to this decline. EECA analysed bank buildings, local government operations, and hotels and restaurants in detail, giving the basis for specific suggestions for further improving the energy efficiency in these sectors.

Official projections of growth in energy use by industrial and commercial sectors in the next two decades are very modest - 0.3%/year compared to projected growth of residential energy use - 2.1%, and transport energy use, 2.0%. It must be noted that most New Zealand energy-intensive industries were established on the back of large-scale energy projects, a linkage not noted in the official projections. Such linkage could again occur if for example another giant offshore gas field were found and developed, or if there were large-scale imports of LNG.

A further impact on energy intensity is the recent closure of a substantial amount of pulp and paper manufacturing capacity, apparently because of tariff barriers. An increasing amount of our wood resource is likely to be exported as logs, with little energy input, but also with little contribution to GDP.

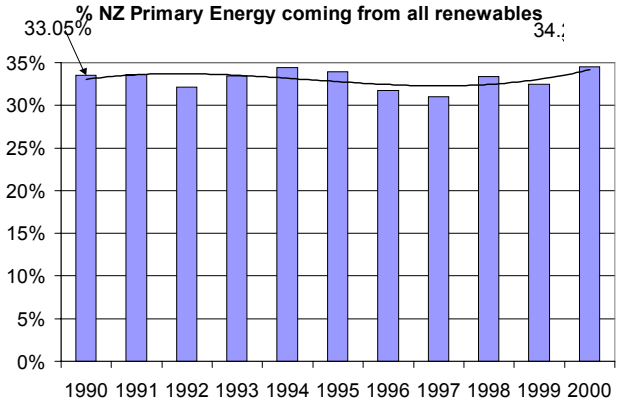
In calculating the HELIO indicator of energy intensity in terms of "primary energy consumed/GDP", we use NZ's primary energy supply corrected for the very low efficiency of geothermal energy: we use 10% efficient for geothermal energy developed before 1990, and 15% efficient for incremental geothermal developed after 1990.

Vector: We compare the NZ energy intensity, given in PJ per million NZ$GDP, to a "target figure" which is set at 1/10 the global average energy intensity in 1990, namely 1.06 MJ/US$ GDP We do not need to add in non-commercial energy, as its main component is gathered firewood, which we estimate at less than 0.5% of New Zealand's energy consumption.

▶Indicator 8: Renewable Energy

There is no subsidy for renewable energy, nor any regulatory requirement to purchase it.

In 2000, hydroelectricity supplied 87 PJ, geothermal electricity about 14 PJ, and direct use of geothermal energy and biomass energy, about 44 PJ. This adds up to 31% of New Zealand's consumer energy supply of 464 PJ.[44]



So-called "new renewable" electricity generation has increased substantially since 1990, with 7 MW of geothermal, 9 MW of landfill biogas generation added

[44] Energy Data File July 2001.

before 1995, and a further 37 MW of wind, 60 MW of geothermal, and 3 MW of landfill gas generation by the year 2000.[45]

Solar water heating is a good example of the disadvantages that renewable energy face in a commercially driven marketplace. It is costly only in the short term. Over a 20 year lifetime, the marginal cost of a solar water heating system in a new house is about 5 c/kWh, the same as the undiscounted cost of a combined cycle gas turbine operating at 50% load factor over its lifetime, and using gas at $3/GJ[46] The high discount rates used in commercial evaluation of costs reduces the apparent cost of gas-fired generation by about half - but also leads to rapid depletion of gas. If wholesale gas prices rise threefold, gas-fired generation could actually be more costly than solar water heating. The future cost of solar water heating can only decline as technology improves - this is a low-risk option. Similar economics apply to wind energy which could contribute a very substantial amount of New Zealand's electricity generation.

A very significant use of renewable energy will be in remote rural areas served by very long distribution lines. Power companies now charge typically 20,000 to 50,000 NZ$ for a new connection. To supply a house with photovoltaic panels, inverter, and batteries costs around $30,000-40,000 for a 15-year lifetime, with a further $6000-9000 for new batteries giving a further 15 years.[47] For an old house there would be further investment in energy-efficient appliances.

The choice to "go solo" off the grid, must balance the time perspective of the home owner against the cost of connecting to the grid. If one is concerned with immediate cost then the break-even point is at around $40,000. If one looks at one battery lifetime, it will be at around $30,000 or less. If one looks at two battery lives it would be at $20,000 or less.

Any off-grid power schemes to supply existing houses would require major improvements in energy efficiency of appliances and building insulation. The legislation allowing rural power companies to abandon "uneconomic" lines allowed a 15-year transition period, during which remote rural communities could plan the best approach to maintaining their electricity supply. It is tragic, though typical, that little or no effort appears to be made in this direction.

[45] References are given in the excel spreadsheet attached to this report.

[46] Arthur Williamson, Professor of Chem. Engineering, Canterbury University, pers. comm

[47] Arthur Williamson, pers. comm.

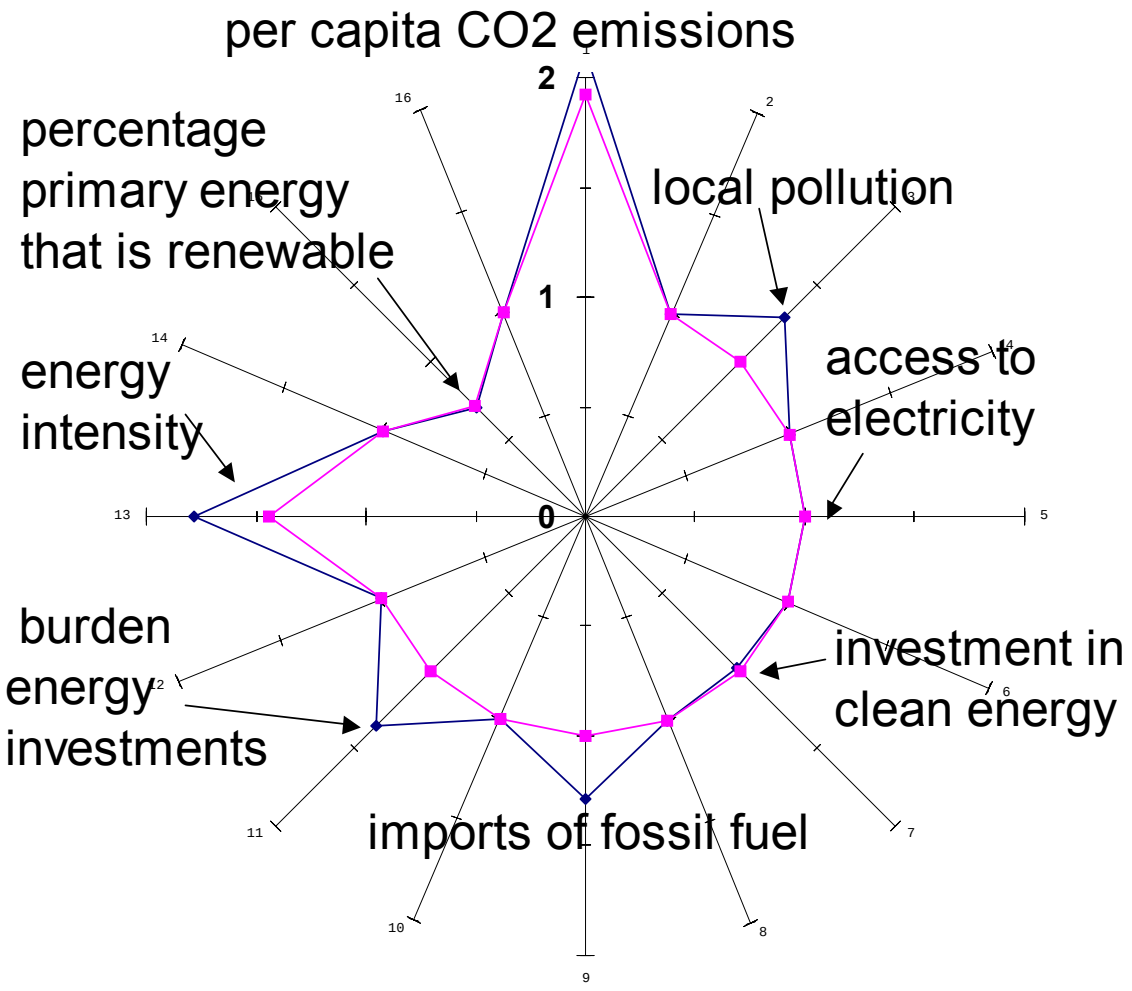
HELIO indicators

Each of the eight indicators are worked up into a measure of progress towards (or away from) a chosen sustainability target, by comparing the indicator value in the year 2000 with that in 1990. The results are shown in the table below.

indicator	NZ value in yr 2000,	1990	comments	Helio indicator 2000	1990
CO2 emissions, kg C/capita	2015	1860	emissions depend strongly on hydro input to electricity and growth in electricity demand which is now met mainly by gas.	2,12	1.92
local emissions, days WHO standard exceeded	34	27,1	mainly from domestic solid fuel in winter; affect basins subject to temperature inversions -	1,28	1
access to electricity	100%	100%	rural reticulation is complete; some is uneconomic	1	1
investment in clean energy, million NZ$	825	453	Investment in 'new renewables' increased rapidly in mid to late 1990s, but is now stalled	0,978	1
fraction fossil fuel sourced from imports	0,42	0,33	driven recently by increasing transport demand; future local oil production uncertain after giant Maui gas field closes in 2007	1,29	1
burden of energy investments, mNZ$	1040	950	defined as profits going to overseas owners of NZ energy businesses; variable but definite increasing trend	1,51	1
energy intensity, MJ/$NZ	0,783	0,89	decreasing as new equipment increases energy efficiency	1.44	1.78
% renewable energy,PJ/yr	145	123	has been increasing but future depends on whether more gas/oil is found and if so whether energy prices are driven downwards	0,704	0,718

▶The "HELIO Star" for the year 2000

Each of eight indicators is graphed on a star-shaped diagram. The centre represents a goal considered achievable by the HELIO team. The value "1" represents the value of each indicator in 1990, either a global average (for per capita CO2 emissions and energy intensity), or the actual local value in 1990 (the other indicators).



The lighter line is the 1990 value; the darker one is the 2000 value.

You will see that NZ's CO2 emissions are about twice the world global average, and getting worse. The chosen local pollution indicator (particulate emissions in Christchurch) was also getting worse, as are imports of fossil fuel, burden of debt, and energy intensity.

▸Events subsequent

Since this report was completed, further decisions have been made relevant to New Zealand's energy sustainability.

- The Commerce Commission has provisionally declined the proposed electricity governance arrangements, saying that generators have too much market power, and consumers have too little say.
- The Commission has proposed a means to implement the "threat of regulation" of electricity network companies - on an economic model that explicitly promotes growth in electricity sales.
- Government released its greenhouse policy - to ratify the Kyoto protocol but defer any mandatory or market implementation for a further five years. It also exempts any industry whose competitiveness is at risk.
- Government's new policy on renewable uses a commercially oriented model, as was used for lines regulation:

  "Unlike the energy efficiency side … the investment climate for renewables is less certain and the return on renewable energy investments is less assured. Because most renewable energy technologies require large, up-front capital investments the risks are considerable in pushing investment in renewable energy too fast, too soon. If we get it wrong it could be costly for energy users, for taxpayers and for the economy as a whole."[48]

  It proposes mostly extremely modest targets, with no sanctions if targets are not met. On the positive side, the target for domestic solar water heaters is 10,000 per year, six times the rate of installation today. Government will commit some funding towards purchase, and also facilitate development of industry standards, and promotion of the technology.

These moves, taken as a group, reinforce this report's conclusion - that New Zealand's progress towards energy sustainability will remain slow in the absence of real policy change.

[48] "Renewable Energy" consultation document - foreword by the Minister of Energy.

Annexe

▸About the reporter

This report was written by Molly Melhuish, with assistance from a number of people, particularly Ian Shearer of Energy Solutions, Arthur Williamson of Canterbury University, and Harbans Aulakh from the Energy Efficiency and Conservation Authority.

Molly published privately a journal, "Energywatch", from 1978-1987, with analysis and commentary on energy technology and policy. Lack of data and the financial effect of government departments withdrawing their subscriptions made the journal impossible to continue, but her work on analysis and commentary has continued. As a trustee of one of the local power company trusts, she was able to observe from the inside some of the impacts of the energy reforms. Many of the statements here are not referenced, coming directly from her own experience; many others were able to be referenced from recent newspaper articles after most of the text was written.

▸Quality of data

New Zealand keeps a vast quantity of data on many economic, social and environmental indicators, reminiscent of the data found in company annual reports. It is not the quantity of numbers but their precision and definition that allow meaningful interpretation of trends. In the years before the 1984 "cultural revolution", officials in most departments were more than willing to provide information on data sources and definitions. There was then, as now, much political "spin" to the way the numbers were reported, but it was easier then to find the basis for the spin. Information issues include:

- Cost: Now the most useful of the energy publications cost $50 to $100, and it costs upwards of $100 to obtain public but unpublished information from Statistics NZ. The information that is available free of charge is often too limited for full analysis - especially when one wants to sift through a great deal of raw information in deciding what information is really useful.

- Confidentiality: Much important information from the energy sector is confidential. Statistics NZ aggregates data in order to suppress information on specific companies or industries. Recently some energy suppliers and users have withheld information formerly supplied to Statistics NZ, as noted in Indicator 6.

- Relevance: Information on prices, profits, and availablity of resources are of greatest interest to the public. The price of electricity used by the aluminium smelter is widely reported (but never confirmed) to be only half the price to other industrial users, despite the fact that extra transmission lines provide the smelter with a uniquely high standard of reliability. Prices for domestic electricity have become so complicated that they can no longer be disclosed directly.

- Official negligence. Information on New Zealand's gas reserves is available to the government under its petroleum legislation, confirmed in the Maui contract. But the government did not take up its rights to the information when its scientists warned that the field might fall short, in 1985. Now it appears the field is will supply 30% less gas than expected - in my opinion probably caused by excessive draw-off at times, especially during very dry years. Information on gas reserves is not easy to find on the publicly available web sites.

- Definition: The information disclosure regulations for electricity companies permit a range of interpretations of revenues, rates of return, etc. This makes it impossible to compare the performance of different companies.

Reflecting on these issues, it appears that statistics are an important tool in selling unpopular policies - such as energy price rises - to the public. Independent assessments of such statistics are all too easily dismissed where data are suspect. This report has been very hard to make both complete and credible. Official statistical publications appear seamless, but this is usually achieved by papering over the cracks.