

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 EECA³⁹ 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 degrees⁴¹. 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

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.

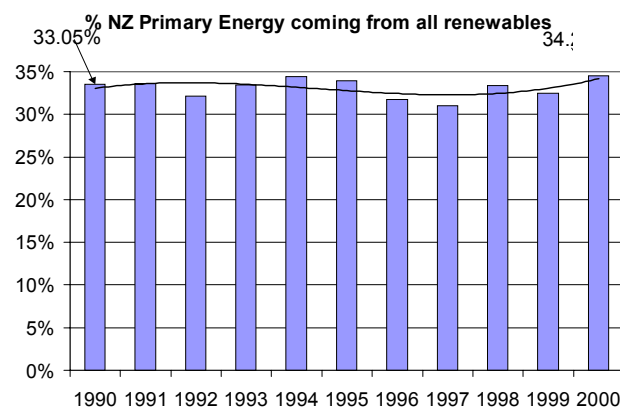
Vector: We compare the NZ energy intensity, given in PJ per million NZ\$GDP, to a "target figure" which is set at 1/10 the global average energy intensity in 1990, namely 1.06 MJ/US\$ GDP. We do not need to add in non-commercial energy, as its main component is gathered firewood, which we estimate at 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/GJ⁴⁶. 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.