F. Renewables

Overview of Renewable Energy Sources in New Zealand

Renewable energy sources (hydro, geothermal, biomass – mainly wood and landfill gas – wind and solar) are already making a significant contribution to New Zealand's total primary energy, especially now that Maui gas is near the end of its production life.

Table F.1 shows total primary supply – incorporating transformation energy – and direct use of renewable energy for the calendar years. During September year 2004, electricity generation from hydro, wind, wood and waste heat increased by about 16%, 44%, 19% and 57% respectively. Generation from geothermal was down by about 8%. Contribution from renewable energy to total primary energy supply for the same period was about 41% compared with 36% in the previous year. Total renewable primary energy increased by about 8% (237 PJ), compared with 220 PJ in the previous year.

Hydro and **geothermal** are the main well-established renewable energy sources in New Zealand. During the year ended September 2004, renewable energy contributed about 76% of electricity generation, of which hydro contributed 66%, geothermal 6% and the other renewables (biogas, wastes, wood and wind) about 4%.

Of the total renewable energy supply during the September year 2004, hydro contributed 42% and geothermal 34%, while wind, biomass and wastes contributed 24%, as shown in Chart F.1. Energy contribution from each of the major renewable sources is shown in Figure F.1: hydro 99.6 PJ, geothermal 80.8 PJ, and wind, waste and biomass 56.9 PJ. With the low net efficiency of converting geothermal heat into electricity (15% is assumed), useful electrical energy transformed from geothermal heat is much less than from hydro (for which 100% is assumed). Some geothermal, wood and biogas energy is used directly for heating and as biofuel for commercial and industrial applications.

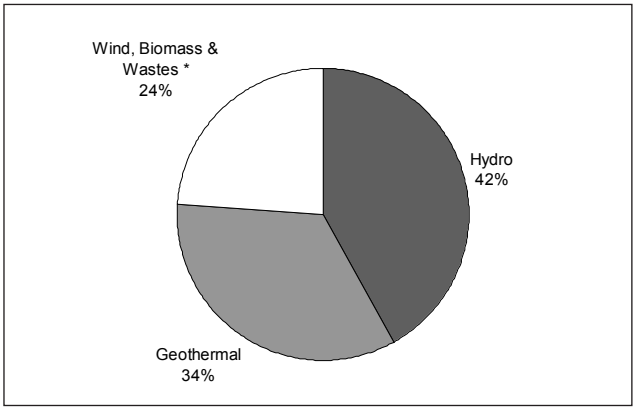
There has been an increasing commercial interest in **wind** as another energy source. Four wind generation developments currently supply energy in New Zealand. The first wind turbine, now owned by Meridian Energy, has been operating successfully in Brooklyn, Wellington, since 1993. Hau Nui, owned by Genesis, was commissioned in 1997 and consists of seven 500 kW Enercon turbines with a total installed capacity of 3.5 MW. This wind farm was expanded and was operational in the second half of 2004 with a further five turbines giving a total capacity of 6 MW. The second stage of TrustPower's Tararua wind farm completed construction in May 2004, bringing its total capacity to 68 MW. The WindFlow Technology wind turbine at Gebbies Pass with a capacity of 500 kW was commissioned in July 2003. A fifth development, Meridian's Te Apiti wind farm, commenced supplying electricity to the national grid in August 2004 with a total generating capacity of 91 MW. During the year ended September 2004, the total wind generating capacity in New Zealand was 166 MW.

Biomass (mainly bark and wood residues from timber, pulp and paper industries) utilisation and application in New Zealand are mainly through combustion of wood residues for process heat in the wood processing industry (eg, kiln drying) and for residential space heating.

Electricity from cogeneration forms a significant but smaller proportion of energy production from biomass.

Landfill gas from sites in Auckland, Wellington and Dunedin has been successfully used for commercial applications. Electricity generation from landfill gas has been in operation for some time. The Government recently announced a standard for control of landfill gas. This will require all operative landfills with total capacity of over 1 million tonnes of refuse to collect and destroy or utilise the landfill gas.

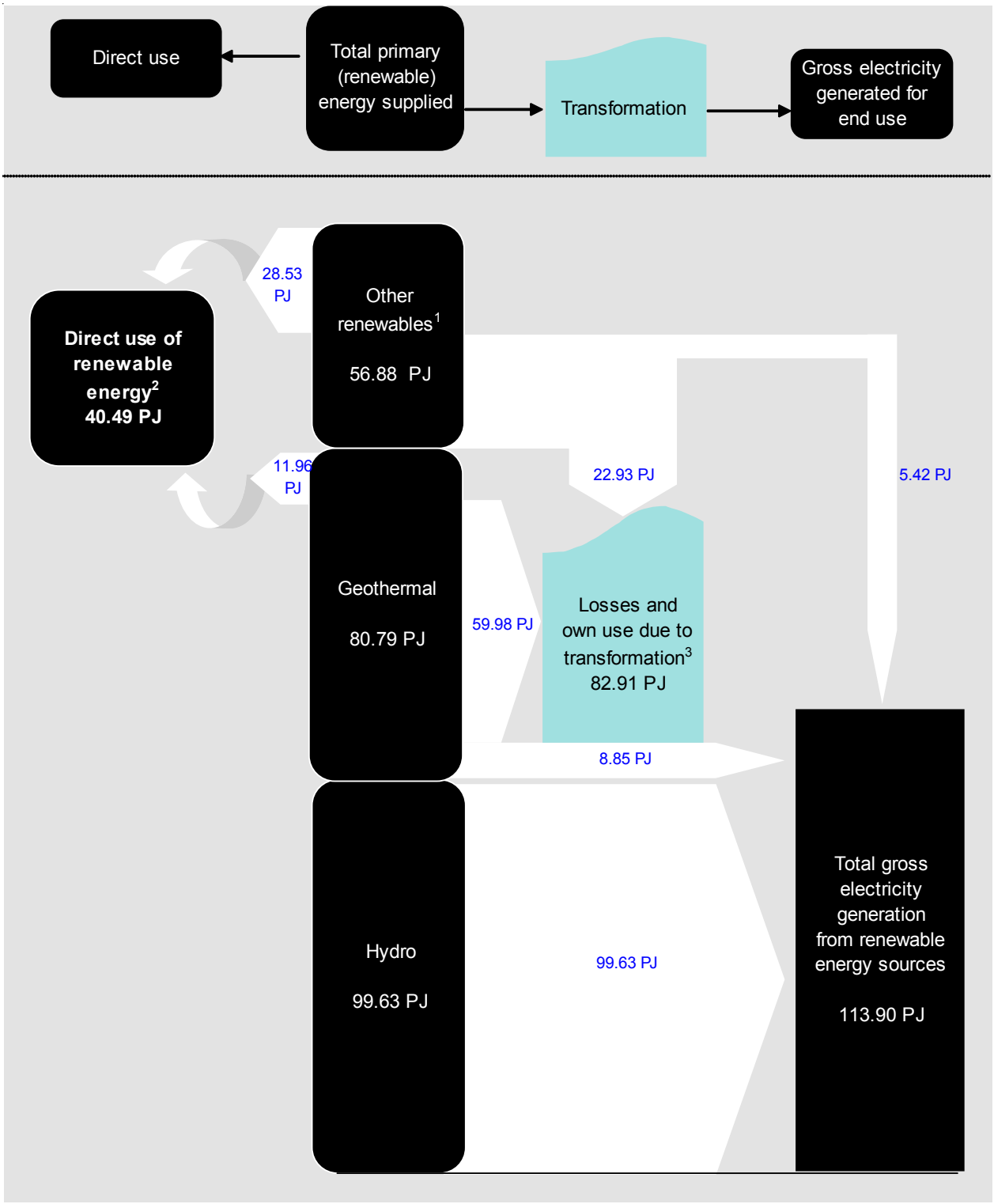
Chart F.1: Renewable Primary Energy for December Year 2004



* "Biomass and wastes" includes biogas, landfill gas, wood and wastes.

Figure F.1: Renewable Energy Flow for September Year 2004

Petajoules (to approximate vertical scale)



Notes:
[1] "Other renewables" includes wind, industrial waste-heat and biomass (wood, wastes, biogas and landfill gas).
[2] Direct use of renewables energy covers mainly heat and biofuel for commercial and industrial applications.
[3] Energy efficiency for geothermal is assumed to be 15% and for other renewables (average for those listed in footnote 1) to be 30% for electricity transformation.
[4] Totals may not add up due to rounding.

Biogas (mainly methane) from sewage treatment plants, farm wastes and the food processing industry has been used on-site for decades to produce power and heat for local consumption or for vehicle fuel. Biogas from animal waste and green crop as feedstock has been demonstrated and several on-farm biogas plants are being successfully operated.

Solar energy in New Zealand is mainly used for hot water systems and passive solar heating in buildings by means of architectural features to collect, store and distribute space heat. On a smaller scale, photovoltaic technologies allow sunlight to be directly converted to electricity. This is widely used in New Zealand to recharge batteries for power supply systems at remote sites. The main users of photovoltaic panels have been government departments for activities in parks and reserves, harbour companies on their light beacons and telecommunication companies for their site monitoring activities. Other users include organisations and individuals using stand-alone area power supply systems (SAPS) including homeowners in urban areas with grid-connected photovoltaic systems.

Municipal solid waste (MSW) conversion to energy in New Zealand is not significantly utilised. There is only one incineration technology scheme in the Auckland region (the Auckland airport incinerator). It processes waste from the airport and visiting planes. The waste stream is a very wet combination of organic waste (food leftovers, mixed plastics, paper, glass and tins), and so it requires additional fuel (natural gas) to completely burn the fuel. At present, this incinerator does not recover useful energy and is substantially under-utilised.

Industrial waste, as an energy source in New Zealand, arises mainly from heat attributed to chemical processes used in fertiliser plants and in the iron and steel industries. Other sources of industrial waste are still unavailable or not utilised.

Waste heat is used to produce steam to drive steam turbines which generate electricity for on-site consumption. Any excess electricity produced is sold to local electricity companies.

Wave, tidal and other ocean power developments in New Zealand are yet to occur, although some site resource evaluations have been conducted for these energy sources. It is unlikely that electricity generation from these energy sources will be commercially viable in the medium term.[1]

According to a recent report,[2] some renewable energy resources in New Zealand can compete with fossil fuels in generating electricity and heat. However, in most cases renewable energy technologies have not proved to be cost effective when competing with cheap fossil fuels. The exception is hydro power, which currently supplies about 62% of total electricity supply, and geothermal and woody biomass, which currently supply about 99% of direct industrial energy use from renewables.

There are interests in small hydro scheme developments in areas where topography (giving storage and head) and weather conditions (giving rainfall and river flow) favour such small schemes.

Summary

Many advanced and innovative renewable energy technologies are likely to be commercially viable in New Zealand within the next decade and are already being demonstrated or are used commercially somewhere in the world. Examples of such technologies include biomass gasification, new high-temperature solar thermal conversion systems and photovoltaic systems. These, like hydro and geothermal, will soon become competitive with fossil fuels as new and more advanced technologies emerge.

The Government has developed the "Projects to Reduce Emissions" programme to support initiatives that will reduce emissions of greenhouse gases. The support will be over the first commitment period of the Kyoto Protocol (2008–2012) and such initiatives or projects will be awarded emissions units. The first tender round, held last year, offered 4 million emission units and resulted in emission units being awarded for a number of projects including wind farms, bioenergy, landfill gas schemes and hydro-electricity which will potentially deliver around 5 PJ per year of renewable energy. Six million emission units are available for the second "Projects to Reduce Emissions" tender round, the results of which were announced in late 2004.

Notes:

[1] *New and Emerging Renewable Energy Opportunities in New Zealand,* joint publication by the Energy Efficiency and Conservation Authority (EECA) and the Centre of Advanced Engineering (CAE), University of Canterbury, July 1996.

[2] *Availability and Costs of Renewable Sources of Energy for Generating Electricity and Heat,* a report by East Harbour Management Services Ltd for the Ministry of Economic Development, June 2002.

Table F.1: Renewable Energy[1] Supply and Consumption (PJ)

Calendar Year	1985	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004[7]
Total Primary Energy Supply[2]	**180.24**	**210.51**	**227.81**	**222.82**	**240.73**	**251.69**	**227.13**	**217.10**	**226.73**	**219.34**	**235.70**
Hydro[3]	**70.24**	**82.63**	**98.13**	**84.94**	**86.99**	**84.43**	**87.79**	**81.42**	**90.79**	**85.28**	**97.34**
Geothermal[3, 4]	**78.93**	**92.65**	**93.30**	**95.95**	**105.49**	**115.24**	**85.97**	**87.24**	**85.08**	**82.67**	**79.48**
Other renewables	**0.000**	**0.000**	**0.004**	**0.048**	**0.079**	**0.141**	**0.428**	**0.500**	**0.561**	**0.526**	**0.899**
Solar[5]											
Wind	0.000	0.000	0.004	0.048	0.079	0.141	0.428	0.500	0.561	0.526	0.899
Tide, wave and ocean[5]											
Biomass & Wastes[2, 6]	**31.07**	**35.23**	**36.37**	**41.89**	**48.17**	**51.87**	**52.94**	**47.94**	**50.30**	**50.86**	**57.98**
Woody biomass and animal products	28.02	31.77	32.37	31.71	34.53	35.21	35.88	31.46	32.19	33.21	38.50
Biogas and landfill gas	1.30	1.62	2.13	1.74	1.71	1.61	1.41	1.48	1.58	1.58	1.61
Municipal waste[5]											
Industrial waste	1.76	1.84	1.87	8.44	11.93	15.05	15.65	15.01	16.52	16.07	17.88
Total Final Consumption[2]	**34.76**	**38.69**	**41.49**	**40.93**	**42.72**	**43.76**	**43.39**	**38.89**	**40.36**	**41.98**	**47.47**
Geothermal	**11.30**	**11.38**	**13.53**	**13.26**	**13.61**	**14.31**	**13.83**	**13.12**	**13.30**	**13.48**	**14.63**
Biomass & Wastes[2, 6]	**23.46**	**27.31**	**27.96**	**27.67**	**29.10**	**29.45**	**29.56**	**25.77**	**27.05**	**28.50**	**32.84**
Woody biomass and animal products	23.18	26.93	27.52	27.22	28.64	28.90	29.00	25.15	26.42	27.96	32.28
Biogas and landfill gas	0.04	0.05	0.06	0.07	0.07	0.14	0.15	0.18	0.19	0.17	0.14
Municipal waste[5]											
Industrial waste	0.25	0.34	0.37	0.39	0.40	0.41	0.42	0.44	0.44	0.37	0.41

Notes:
1 Sources of data include the Ministry of Economic Development's electricity annual questionnaires (MED-E) and Statistics New Zealand.
2 Totals and sub-totals may not add up due to rounding.
3 Data series for hydro and geothermal have been updated for 2002 and 2003.
4 Efficiency of geothermal plants for electricity generation had been assumed to be 10% prior to 2000. From 2000, it is assumed to be 15%.
5 No data available.
6 Data series for wood, biogas and industrial waste have been updated for 2001, 2002 and 2003.
7 Data for 2004 are provisional.