F. Renewables

Overview of Renewable Energy Sources in New Zealand

Renewable energy sources – hydro, geothermal, biomass, wind and solar – are significant sources of New Zealand's total primary energy.

As a significant change from previous editions of the *Energy Data File*, in this edition we have removed waste heat from this chapter to better align the reporting of renewables with international convention. This means that industrial waste, which was previously categorised under Biomass & Wastes in Table F.2, has now been removed and inserted under the primary energy source from which the Industrial Waste heat was derived (principally coal). This change is also reflected throughout the document, specifically in the Energy Balances and Electricity chapters.

Figure F.1 shows total primary supply for the 2005 calendar year incorporating direct use of renewable energy and electricity generation.

For the year ending December 2005, total renewable primary energy was down 4% (212 PJ), compared with 221 PJ in the previous year.

Hydro generation decreased by 14%, while geothermal increased slightly by 4% as shown in Table F.1. Generation from biogas and landfill gas also decreased slightly by 4%.

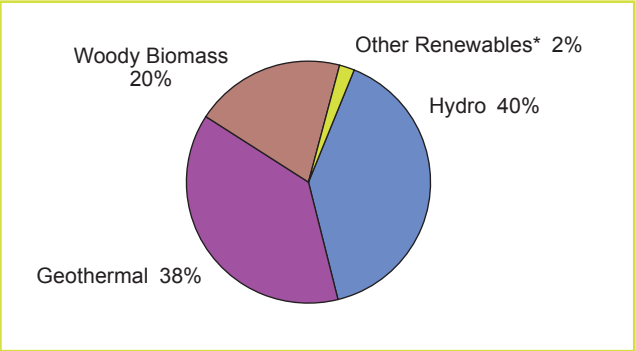
Table F.1: Gross Electricity Generation by Calendar Year (PJ)

	2003	2004	2005	Δ2004/2005
Hydro	85.3	97.9	84.5	-14%
Geothermal	9.8	9.8	10.2	4%
Wind	0.5	1.3	2.2	69%
Biogas and Landfill Gas	0.5	0.4	0.4	-4%
Woody Biomass	1.4	1.6	2.0	31%
Total	**97.6**	**111.0**	**99.3**	**-11%**

Electricity generation from wind increased by 69%, and biomass increased by 31%. Direct use of primary renewable energy rose by 2%, while renewable energy's contribution to total primary energy supply was relatively steady at around 29%.

Hydro and geothermal are well-established renewable energy sources. Chart F.1 illustrates energy contributions from each of the major renewable sources.

Chart F.1: Renewable Primary Energy for the 2005 Calendar Year



* "Other Renewables" includes wind, solar, biogas and landfill gas.

The transformation of geothermal heat into electricity (net efficiency of 15% is assumed), is much less than that from hydro or wind (for which 100% is assumed). Biogas also has low net efficiency of 30% and wood 25%. Some geothermal, wood and biogas energy is used directly for heating and as biofuel for commercial and industrial applications.

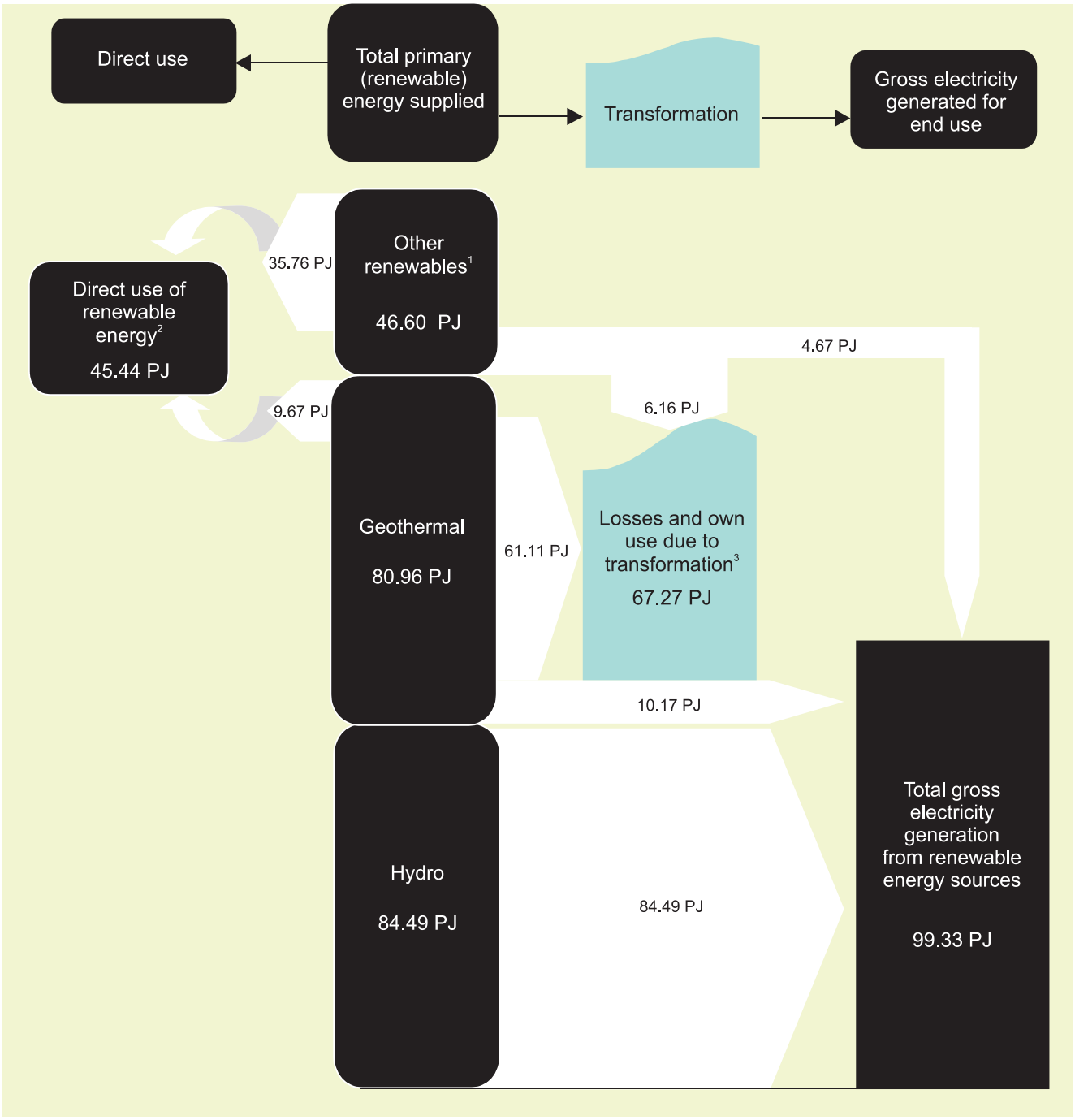
Much of the new electricity generation being commissioned comes from wind. Seven wind generation developments supply energy in New Zealand. The first wind turbine (225 kW), now owned by Meridian Energy, has been operating successfully in Brooklyn, Wellington, since 1993.

Hau Nui, owned by Genesis, was first commissioned in 1997 and now has a total capacity of 8.65 MW.

In 1999, TrustPower commissioned stage 1 of the Tararua wind farm, comprising 48 wind turbines rated at 660 kW each. The second stage of the Tararua wind farm was completed in May 2004, bringing its total capacity to 68 MW from 103 turbines.

Figure F.1: Renewable Energy Flow for the 2005 Calendar Year

Petajoules (to approximate vertical scale)



Note:

[1] "Other renewables" includes wind, solar, biogas and landfill gas.

The 500 kW WindFlow Technology wind turbine at Gebbies Pass was commissioned in July 2003.

A fifth development, Meridian's Te Apiti wind farm, began supplying electricity to the Transpower grid in August 2004, a total generating capacity of 91 MW.

In March 2005, Energy3 commissioned a 100 kW pilot project in Southbridge, Canterbury.

The first stage of Te Rere Hau windfarm was commissioned in September 2006. The Te Rere Hau wind farm is the first wind farm in New Zealand to be built using New Zealand designed and manufactured turbines. Stage I comprises five turbines with a total generating capacity of 2.5 MW.

As of September 2006, the total wind generating capacity in New Zealand was 171 MW.

The main use of biomass (mainly bark and wood residues from the timber, pulp and paper industries) in New Zealand involves combusting wood residues to provide process heat in the wood processing industry (such as kiln drying) and for residential space heating. Electricity from cogeneration forms a significant proportion of energy production from biomass.

Landfill gas from sites in Auckland, Wellington and Dunedin has been successfully used for electricity generation for some time. The Government has announced a standard to control landfill gas which requires all operative landfills with total capacity of over 1 million tonnes of refuse to collect and destroy or use the landfill gas.

Biogas (mainly methane) from sewage treatment plants, farm wastes and the food processing industry has been used on-site for decades to produce electricity and heat for local consumption or for vehicle fuel. Biogas from animal waste and green crop can be used as a feedstock, and there are several successful biogas plants operating on farms.

Solar energy in New Zealand is used mainly for hot water systems and passive solar heating in buildings, using architectural features to collect, store and distribute space heat. The solar water heating industry has been growing at an annual growth rate of approximately 40% for the past three years, with proven products. The industry has established a network of accredited suppliers and has a quality assurance programme to ensure new entrants are properly trained to install appropriate systems.

On a smaller scale, photovoltaic technologies allow sunlight to be converted directly to electricity. Photovoltaic generation is widely used in New Zealand to recharge batteries for power supply systems at remote sites. Photovoltaics are used by government departments for activities in parks and reserves, by harbour companies for light beacons, and by telecommunication companies for site monitoring. Organisations and individuals use Stand-alone Area Power Supply systems (SAPS), and homeowners in urban areas use grid-connected photovoltaic systems.

There is no significant use of Renewable Municipal Solid Waste (RMSW) conversion to energy in New Zealand.

There are no wave, tidal or other ocean power developments in New Zealand yet, although some site resource evaluations have been carried out. Electricity generation from these energy sources is expected to become increasingly commercially viable.

Summary

Renewables make very significant contributions to New Zealand's energy supplies. Proven technologies such as hydro and geothermal are increasingly being supplemented by wind, solar and biomass.[1]

[1] *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 2005. http://www.med.govt.nz/energy/modelling/papers/supply-cost-availability/

Table F.2: Renewable Energy[1] Supply and Consumption (PJ)

Calendar Year	1985	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005
Total Primary Energy Supply	**178.48**	**208.67**	**225.94**	**178.48**	**208.67**	**225.94**	**226.25**	**206.92**	**199.35**	**221.35**	**212.04**
Hydro	70.24	82.63	98.13	70.24	82.63	98.13	81.42	90.79	85.28	97.92	84.49
Geothermal[2]	78.93	92.65	93.30	78.93	92.65	93.30	111.40	81.49	78.77	79.85	80.96
Solar								0.16	0.19	0.20	0.23
Wind	-	-	0.004	-	-	0.004	0.50	0.56	0.53	1.31	2.22
Biogas and landfill gas	1.30	1.62	2.13	1.30	1.62	2.13	1.48	1.73	1.87	1.52	1.44
Woody biomass and animal products[3]	28.02	31.77	32.37	28.02	31.77	32.37	31.46	32.19	32.71	40.55	42.71
Tide, wave and ocean[4]											
Energy Transformation	**143.97**	**170.32**	**184.82**	**143.97**	**170.32**	**184.82**	**191.38**	**170.43**	**161.95**	**176.84**	**166.61**
Hydro	70.24	82.63	98.13	70.24	82.63	98.13	81.42	90.79	85.28	97.92	84.49
Geothermal[2]	67.63	81.27	79.77	67.63	81.27	79.77	101.86	71.78	69.19	70.31	71.28
Wind	-	-	0.004	-	-	0.004	0.50	0.56	0.53	1.31	2.22
Biogas and landfill gas	1.26	1.57	2.07	1.26	1.57	2.07	1.30	1.54	1.69	1.41	1.32
Woody biomass and animal products[3]	4.84	4.84	4.84	4.84	4.84	4.84	6.31	5.77	5.26	5.88	7.30
Consumer Energy	**34.51**	**38.35**	**41.12**	**34.51**	**38.35**	**41.12**	**34.87**	**36.49**	**37.41**	**44.51**	**45.44**
Geothermal[5]	11.30	11.38	13.53	11.30	11.38	13.53	9.54	9.72	9.58	9.54	9.67
Solar								0.16	0.19	0.20	0.23
Biogas and landfill gas	0.04	0.05	0.06	0.04	0.05	0.06	0.18	0.19	0.18	0.11	0.12
Woody biomass and animal products[3]	23.18	26.93	27.52	23.18	26.93	27.52	25.15	26.42	27.45	34.67	35.42

Notes:

1 Sources of data include the Ministry of Economic Development's electricity annual questionnaires (MED-E) and Statistics New Zealand.

2 Efficiency of geothermal plants for electricity generation had been assumed to be 10% prior to 2000. From 2000, it is assumed to be 15%.

3 In previous editions of the *Energy Data File* the figure for residential firewood wood use was based on an average use of 4.3 GJ per household. BRANZ recently released its findings (Report No SR 141 (2005)) on the *Household Energy End-use Project (HEEP)*, which monitored energy end use in the home including firewood use. For firewood, their studies found that the average annual use was 13.7 GJ per household and we have adopted this figure in our calculations from 2004 onwards.

4 No data available.

5 Revised figures from 2000 based on report: *An Assessment of Geothermal Direct Heat Use in New Zealand* prepared by Brian White, Executive Officer of the New Zealand Geothermal Association.