



F. Renewables

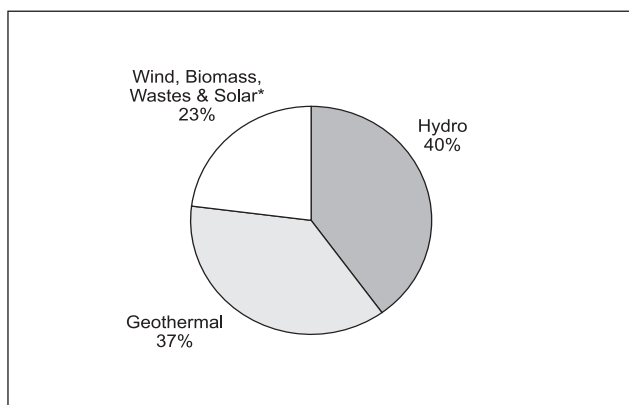
Overview of Renewable Energy Sources in New Zealand

Renewable energy sources (hydro, geothermal, biomass, wind and solar) are already making a significant contribution as sources of New Zealand's total primary energy.

Table F.1 shows total primary supply – incorporating transformation energy – electricity generation and direct use of renewable energy for the calendar year. From 2003 to 2004, electricity generation from hydro, geothermal, wind and wood increased 14%, 3%, 142% and 7% respectively. Generation from biogas and landfill gas was down about 8%. Direct use of primary renewable energy was up 8%. Contribution from renewable energy to total primary energy supply for 2004 was up to 31% compared with 29% in the previous year. Total renewable primary energy was up 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. Of the total renewable energy supply, hydro contributed 40% and geothermal 37% to electricity generation and direct use combined while wind, biomass, wastes and solar contributed 23% as shown in Chart F.1. Energy contribution from each of the major renewable sources is shown in Figure F.1: hydro 95 PJ, geothermal 87 PJ, and wind, waste and biomass 53 PJ. With the low net efficiency of converting geothermal heat into electricity (15% is assumed),

Chart F.1: Renewable Primary Energy for March Year 2005



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

useful electrical energy transformed from geothermal heat is much less than from hydro or wind (for which 100% is assumed). Biogas, wood and waste heat also have low efficiencies at 30%, 25% and 15% respectively. Some geothermal, wood and biogas energy is used directly for heating and as biofuel for commercial and industrial applications. During the year ended March 2005, renewable energy contributed about 74% of electricity generation, of which hydro was 64%, geothermal 6% and the other renewables (biogas, wastes, wood and wind) about 4% of total generation.

Wind is currently providing the majority of new electricity generation being commissioned. Five 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 consisting of seven 500 kW Enercon turbines with a total installed capacity of 3.5 MW. This wind farm was expanded in 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 Transpower grid in August 2004 with a total generating capacity of 91 MW. By March 2005, the total wind generating capacity in New Zealand was 166 MW.

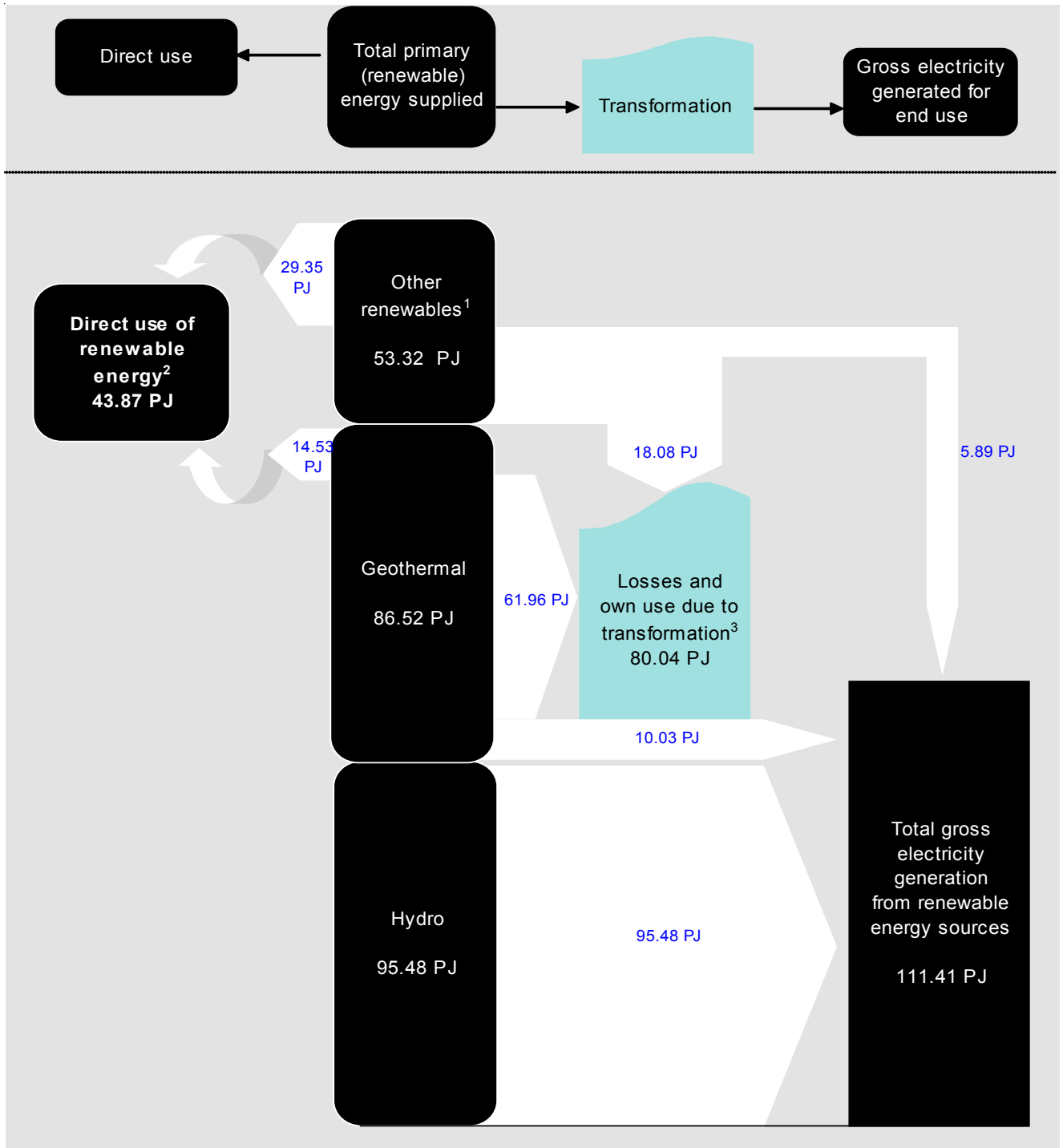
Biomass (mainly bark and wood residues from timber, pulp and paper industries) utilisation and application in New Zealand is mainly through combustion of production wood residues for process heat in the wood processing industry (eg, kiln drying) and for residential space heating.

Electricity from cogeneration forms a significant but small 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 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.

Figure F.1: Renewable Energy Flow for March Year 2005

Petajoules (to approximate vertical scale)



Notes:

¹ "Other renewables" includes wind, industrial waste heat and biomass (wood, wastes, biogas and landfill gas) and solar.

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 electricity 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. The solar water heating industry has been growing at a consistent 50 to 60% annual growth for the last three years with proven products. The industry has established a network of accredited suppliers and has a programme of quality assurance to assist new entrants to be properly trained and install appropriate systems.

On a smaller scale, photovoltaic technologies allow sunlight to be directly converted to electricity. Photovoltaic generation 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) and homeowners in urban

areas with grid-connected photovoltaic systems.

Renewable Municipal Solid Waste (RMSW) conversion to energy in New Zealand is not significantly 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 tend not to be utilised for provision of energy.

Waste heat is used to produce steam to drive steam turbines which generate electricity for on-site consumption, with any excess exported to the grid where appropriate commercial and technical arrangements are in place.

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. The commercial viability of electricity generation from these energy sources is expected to increase.

Summary

Renewables are a very significant contribution to New Zealand's energy supplies. Proven technologies such as hydro and geothermal are being increasingly supplemented by wind, solar, and biomass in particular.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.

Table F.1: Renewable Energy¹ Supply and Consumption (PJ)

Calendar Year	1985	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004 ⁶
Total Primary Energy Supply²	180.24	210.51	227.81	222.82	240.73	251.69	227.13	217.10	226.89	220.13	237.36
Hydro	70.24	82.63	98.13	84.94	86.99	84.43	87.79	81.42	90.79	85.28	97.28
Geothermal³	78.93	92.65	93.30	95.95	105.49	115.24	85.97	87.24	85.08	82.67	84.95
Other renewables	0.000	0.000	0.004	0.048	0.079	0.141	0.428	0.500	0.721	0.722	1.488
Solar									0.16	0.19	0.20
Wind	0.000	0.000	0.004	0.048	0.079	0.141	0.428	0.500	0.561	0.532	1.288
Tide, wave and ocean ⁴											
Biomass & Wastes^{2, 5}	31.07	35.23	36.37	41.89	48.17	51.87	52.94	47.94	50.30	51.46	53.64
Woody biomass and animal products	28.02	31.77	32.37	31.71	34.53	35.21	35.88	31.46	32.19	32.71	35.00
Biogas and landfill gas	1.30	1.62	2.13	1.74	1.71	1.61	1.41	1.48	1.58	1.59	1.47
Renewable Municipal waste ^{4, 5}											
Industrial waste	1.76	1.84	1.87	8.44	11.93	15.05	15.65	15.01	16.52	17.17	17.17
Total Final Consumption²	34.76	38.69	41.49	40.93	42.72	43.76	43.39	38.89	40.52	41.66	44.43
Geothermal	11.30	13.38	13.53	13.26	13.61	14.31	13.83	13.12	13.30	13.48	14.64
Other renewables									0.16	0.19	0.20
Solar									0.16	0.19	0.20
Biomass & Wastes^{2, 5}	23.46	27.31	27.96	27.67	29.10	29.45	29.56	25.77	27.05	27.99	29.59
Woody biomass and animal products	23.18	26.93	27.52	27.22	28.64	28.90	29.00	25.15	26.42	27.45	29.12
Biogas and landfill gas	0.04	0.05	0.06	0.07	0.07	0.14	0.15	0.18	0.19	0.17	0.11
Renewable Municipal waste ^{4, 5}											
Industrial waste	0.25	0.34	0.37	0.39	0.40	0.41	0.42	0.44	0.44	0.37	0.37

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

⁴ No data available.

⁵ Refers to biomass and wastes only.

⁶ Data for 2004 are provisional.