F. Renewables

Overview of Renewable Energy Sources in New Zealand

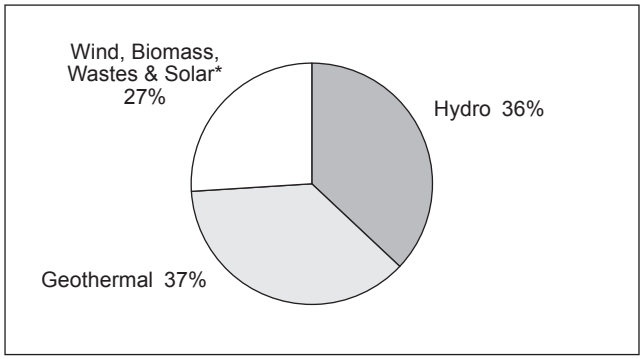
Renewable energy sources (hydro, geothermal, biomass, wind, solar and waste heat) make significant contributions as sources of New Zealand's total primary energy.

Table F.1 shows total primary supply – incorporating transformation energy, electricity generation and direct use of renewable energy – for the calendar year.

For the year end September 2005, total renewable primary energy was down 3% (235 PJ), compared with 242 PJ in the previous year. Hydro generation decreased by 13%, while geothermal showed an increase of 2%. Generation from biogas and landfill gas went down 12% and waste heat generation also went down 11%. Electricity generation from wind showed a large increase of 162% and biomass also increased by 15%. Direct use of primary renewable energy went up by 8%, while renewable energy's contribution to total primary energy supply was steady at around 31%.

Hydro and geothermal are well-established renewable energy sources in New Zealand. As shown in Chart F.1, hydro contributed 36% and geothermal contributed 37%, while wind, biomass, wastes and solar collectively contributed 27%. Energy contribution from each of the major renewable sources is shown in Figure F.1: hydro 87 PJ, geothermal 85 PJ, and wind, waste and biomass 62 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 that 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.

Chart F.1: Renewable Primary Energy for Year End December 2005



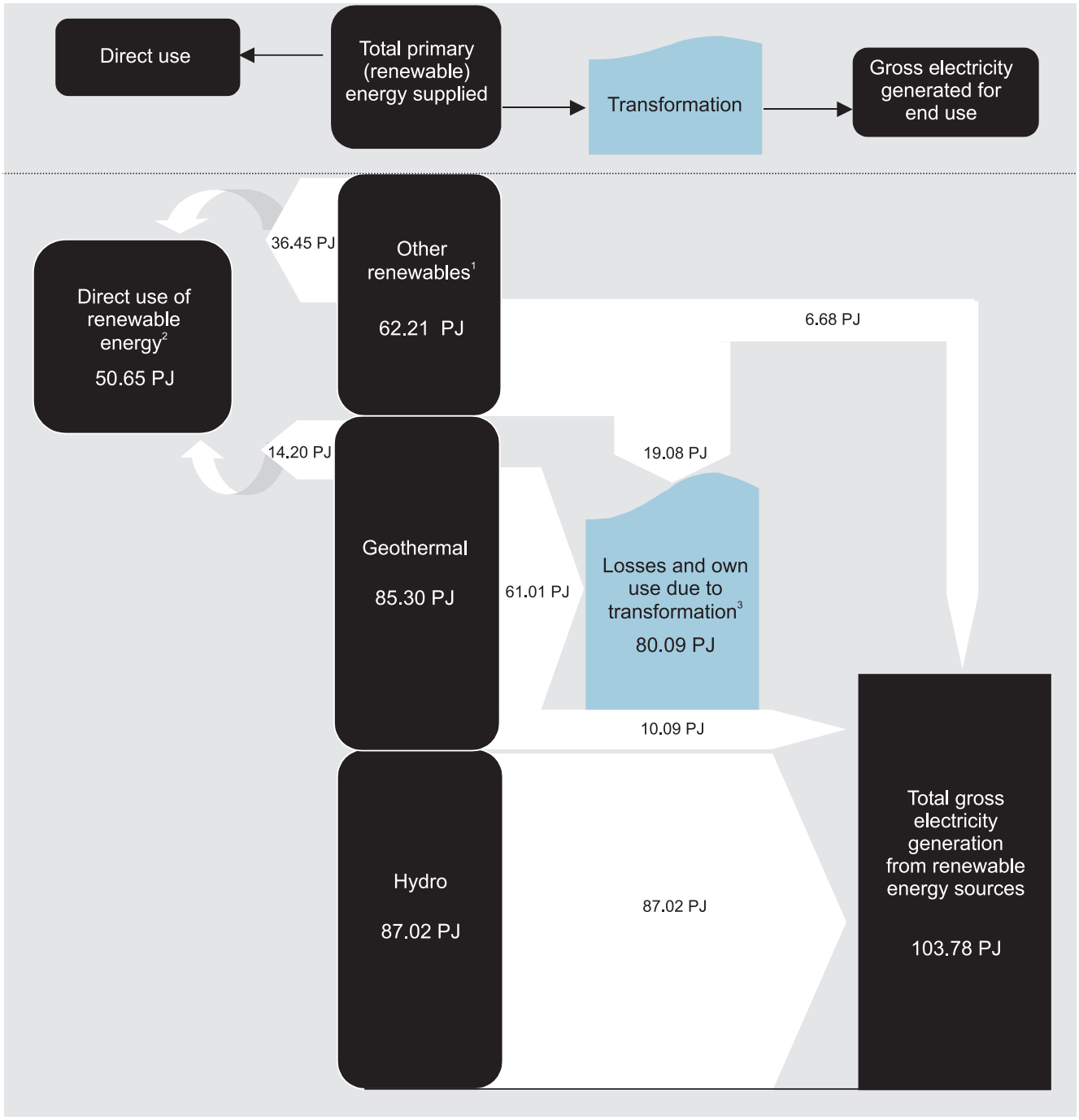
* "Biomass and Wastes" includes biogas, landfill gas, wood and wastes.

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 (225 kW), 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 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 500 kW WindFlow Technology wind turbine at Gebbies Pass 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. As of December 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 are mainly through combustion of wood residues for provision of 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.

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

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.

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, 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 make very significant contributions 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 Energy[1] Supply and Consumption (PJ)

Calendar Year	1985	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005[5]
Total Primary Energy Supply[2]	**180.24**	**210.51**	**227.81**	**240.73**	**251.69**	**227.13**	**217.10**	**226.89**	**220.13**	**243.65**	**231.89**
Hydro	**70.24**	**82.63**	**98.13**	**86.99**	**84.43**	**87.79**	**81.42**	**90.79**	**85.28**	**97.92**	**84.29**
Geothermal[3]	**78.93**	**92.65**	**93.30**	**105.49**	**115.24**	**85.97**	**87.24**	**85.08**	**82.67**	**84.95**	**85.43**
Other renewables	**–**	**–**	**0.004**	**0.08**	**0.14**	**0.43**	**0.50**	**0.72**	**0.72**	**1.51**	**2.45**
Solar								0.16	0.19	0.20	0.23
Wind	–	–	0.004	0.08	0.14	0.43	0.50	0.56	0.53	1.31	2.22
Tide, wave and ocean[4]											
Biomass & Wastes[2]	**31.07**	**35.23**	**36.37**	**48.17**	**51.87**	**52.94**	**47.94**	**50.30**	**51.46**	**59.26**	**59.72**
Woody biomass and animal products[6]	28.02	31.77	32.37	34.53	35.21	35.88	31.46	32.19	32.71	40.55	43.51
Biogas and landfill gas	1.30	1.62	2.13	1.71	1.61	1.41	1.48	1.58	1.59	1.54	1.39
Renewable Municipal waste[4]											
Industrial waste	1.76	1.84	1.87	11.93	15.05	15.65	15.01	16.52	17.17	17.17	14.82
Total Final Consumption[2]	**34.76**	**38.69**	**41.49**	**42.72**	**43.76**	**43.39**	**38.89**	**40.52**	**41.66**	**49.98**	**49.87**
Geothermal	**11.30**	**11.38**	**13.53**	**13.61**	**14.31**	**13.83**	**13.12**	**13.30**	**13.48**	**14.64**	**13.82**
Other renewables								**0.16**	**0.19**	**0.20**	**0.23**
Solar								0.16	0.19	0.20	0.23
Biomass & Wastes[2]	**23.46**	**27.31**	**27.96**	**29.10**	**29.45**	**29.56**	**25.77**	**27.05**	**27.99**	**35.14**	**35.82**
Woody biomass and animal products[6]	23.18	26.93	27.52	28.64	28.90	29.00	25.15	26.42	27.45	34.67	35.42
Biogas and landfill gas	0.04	0.05	0.06	0.07	0.14	0.15	0.18	0.19	0.17	0.11	0.08
Renewable Municipal waste[4]											
Industrial waste	0.25	0.34	0.37	0.40	0.41	0.42	0.44	0.44	0.37	0.37	0.32

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 Data for 2005 is provisional.
6 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 their 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.