



# F. Renewables

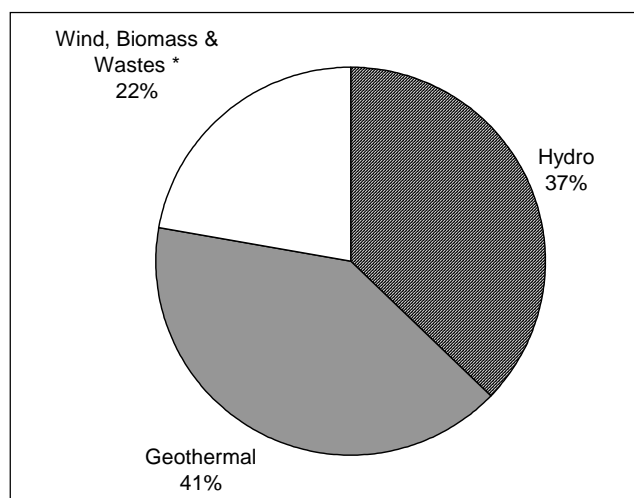
## Overview of Renewable Energy Sources in New Zealand

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.

**Hydro and geothermal** are the main well-established renewable energy sources in New Zealand. During the year ended September 2002, renewable energy contributed about 73% of electricity generation, of which hydro contributed 63%, geothermal 7% and the other renewables (biogas, wastes, wood and wind) 3%.

Renewable energy contributed about 34% of total primary energy supply in New Zealand for September year ending 2002. Of the total renewable energy supply, hydro contributed 37% and geothermal 41% while wind, biomass and wastes 22% as shown in Chart F.1. Figure F.1 shows the contribution from each of the major renewable sources; hydro (85.8 PJ), geothermal (82.0PJ), wind, waste and biomass (51.1 PJ). Because the net efficiency of converting geothermal heat into electricity is low (15% is

**Chart F.1: Renewable Primary Energy for September Year 2002**



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

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 are used directly for heating and as biofuel for commercial and industrial applications.

Fifteen high-temperature geothermal fields between Lake Taupo and the Bay of Plenty and one in Northland still have the potential to supply more significant quantities of energy in the future.

There has been an increasing commercial interest in **wind** as another energy source. The first demonstration wind generator, now owned by Meridian Energy, has been operating successfully since 1993. New Zealand's two commercial wind farms (Haunui, consisting of seven wind turbines with a total capacity of 3.5 MW, owned by Genesis, and the 32 MW Tararua wind farm, the largest in the southern hemisphere, owned by TrustPower) are fully operational. In June 2002, Genesis was granted resource consent to build sixteen additional wind turbines at Haunui.

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

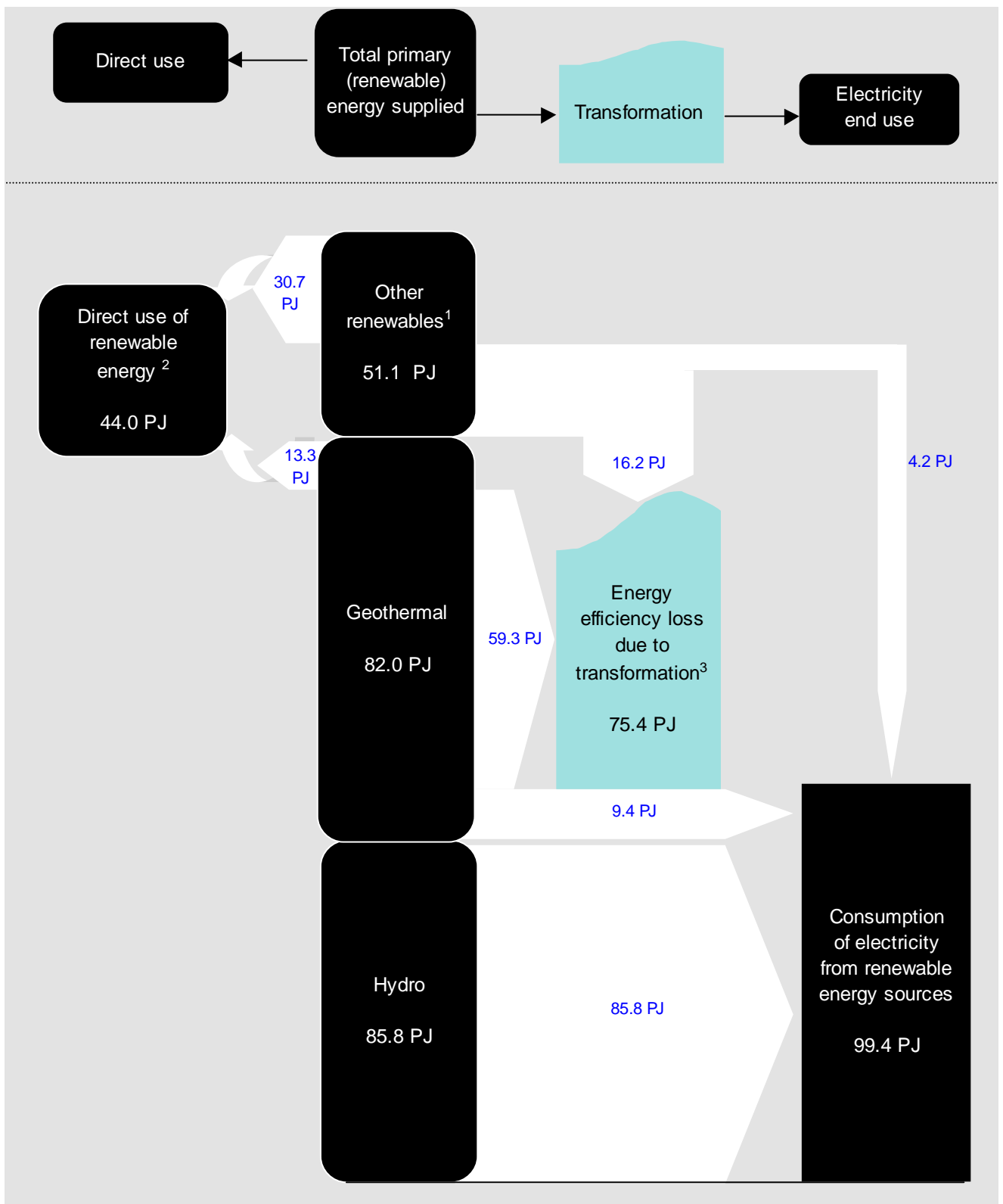
Electricity from cogeneration forms a significant but smaller proportion of energy production from biomass.

**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. Other landfills are being investigated for their methane-producing potential.

**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.

**Figure F.1: Renewable Energy Flow for September Year 2002**

Petajoules (to approximate vertical scale)



<sup>1</sup> Other renewables include wind, industrial waste heat and biomass (wood, wastes, biogas and landfill gas).

<sup>2</sup> Direct use of renewable energy covers mainly heat and biofuel for commercial and industrial applications.

<sup>3</sup> 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.

**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).

**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 before 2005 <sup>1</sup>.

According to a recent report <sup>2</sup>, *Availability and Costs of Renewable Sources of Energy For Generating Electricity and Heat* (Ministry of Economic Development, 2002), 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 57% of total electricity demand, **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.

---

<sup>1</sup> *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.

<sup>2</sup> *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<sup>1</sup> Supply and Consumption (PJ)**

Calendar Year	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002
<b>Total Primary Energy Supply<sup>2</sup></b>	<b>180.24</b>	<b>210.51</b>	<b>227.81</b>	<b>223.38</b>	<b>222.82</b>	<b>240.73</b>	<b>249.80</b>	<b>225.66</b>	<b>220.83</b>	<b>240.59</b>
<b>Hydro</b>	<b>70.24</b>	<b>82.63</b>	<b>98.13</b>	<b>92.57</b>	<b>84.94</b>	<b>86.99</b>	<b>83.60</b>	<b>87.79</b>	<b>76.48</b>	<b>89.20</b>
<b>Geothermal<sup>3</sup></b>	<b>78.93</b>	<b>92.65</b>	<b>93.30</b>	<b>91.87</b>	<b>95.95</b>	<b>105.49</b>	<b>115.24</b>	<b>85.97</b>	<b>92.86</b>	<b>98.87</b>
<b>Other renewables</b>	<b>0.000</b>	<b>0.000</b>	<b>0.004</b>	<b>0.030</b>	<b>0.048</b>	<b>0.079</b>	<b>0.140</b>	<b>0.428</b>	<b>0.488</b>	<b>0.555</b>
Solar <sup>4</sup>										
Wind	0.000	0.000	0.004	0.030	0.048	0.079	0.140	0.428	0.488	0.555
Tide, wave and ocean <sup>4</sup>										
<b>Biomass &amp; Wastes<sup>2, 5</sup></b>	<b>31.07</b>	<b>35.23</b>	<b>36.37</b>	<b>38.91</b>	<b>41.89</b>	<b>48.17</b>	<b>50.82</b>	<b>51.47</b>	<b>51.01</b>	<b>51.97</b>
Woody biomass and animal products	28.02	31.77	32.37	32.09	31.71	34.53	35.21	35.43	33.91	35.59
Biogas and landfill gas	1.30	1.62	2.13	1.81	1.74	1.71	1.51	1.38	1.38	1.30
Municipal waste <sup>4</sup>										
Industrial waste	1.76	1.84	1.87	5.01	8.44	11.93	14.09	14.66	15.72	15.08
<b>Total Final Consumption<sup>2</sup></b>	<b>34.76</b>	<b>38.69</b>	<b>41.49</b>	<b>41.24</b>	<b>40.93</b>	<b>42.72</b>	<b>43.76</b>	<b>43.39</b>	<b>42.86</b>	<b>44.55</b>
<b>Geothermal</b>	<b>11.30</b>	<b>11.38</b>	<b>13.53</b>	<b>13.17</b>	<b>13.26</b>	<b>13.61</b>	<b>14.31</b>	<b>13.83</b>	<b>13.12</b>	<b>13.50</b>
<b>Biomass &amp; Wastes<sup>2, 5</sup></b>	<b>23.46</b>	<b>27.31</b>	<b>27.96</b>	<b>28.07</b>	<b>27.67</b>	<b>29.10</b>	<b>29.45</b>	<b>29.56</b>	<b>29.74</b>	<b>31.05</b>
Woody biomass and animal products	23.18	26.93	27.52	27.63	27.22	28.64	28.90	29.00	29.13	30.41
Biogas and landfill gas	0.04	0.05	0.06	0.06	0.07	0.07	0.14	0.15	0.18	0.19
Municipal waste <sup>4</sup>										
Industrial waste	0.25	0.34	0.37	0.38	0.39	0.40	0.41	0.42	0.43	0.45

**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.