Chapter 13

New Zealand Country Report

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Chapter 13

New Zealand Country Report

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1. Background

New Zealand is an island country in the south-western Pacific Ocean. It is located some 1,500 kilometres (km) east of Australia. It consists of three main islands (the North Island, the South Island, and Stewart Island), and a number of other smaller, mostly uninhabited outer islands. The land area is approximately 269,000 square kilometres, making it smaller than Japan or Italy, but larger than the United Kingdom. Most of New Zealand is hilly or mountainous and has a mild temperate climate. The population was about 4.47 million at the end of 2013. Although there is some light and heavy industry, foreign trade is heavily dependent on agriculture, tourism, forestry, and fishing. In 2013, New Zealand had a nominal gross domestic product (GDP) of about US$173.0 billion, or about US$38,600 per capita. Although the latter figure is near the average of Organisation for Economic Co-operation and Development (OECD) countries, New Zealand tends to be ranked highly in international quality-of-life surveys.

New Zealand possesses significant indigenous energy resources, including hydro, geothermal, wind, natural gas, and coal. New Zealand is self-sufficient in natural gas and electricity, and is a net exporter of coal. New Zealand has locally produced crude oil, which is generally exported because of its high quality and, therefore, high value on the international market. To meet its oil demand, over half of all imported oil to New Zealand in 2013 was produced in the Middle East. Remaining energy reserves include 116.6 million barrels of oil (P90) and 56.4

billion cubic metres (BCM) of natural gas (P90), as well as in-ground resources of over 15 billion tons of coal, 80 percent of which are South Island lignites.

In 2013, New Zealand's total primary energy supply (TPES) was around 19.5 million tons of oil equivalent (Mtoe). By source, oil represented the largest share at about 33 percent. Natural gas and geothermal energy were second largest, contributing around 20 percent and 22 percent, respectively. The remainder of the primary energy supply were hydro at 10 percent, coal at 8 percent, biomass with 6 percent, and a smaller percentage of other renewables such as wind and solar photovoltaic (PV).

Final energy consumption was about 13.2 Mtoe in 2013. By sector, the transport sector accounted for the largest share at around 35 percent because New Zealand heavily depends on private road vehicles, road freight, and air transport. The share of the industrial sector was the second largest at about 31 percent, whereas the total of agricultural, residential, and commercial sectors were 25 percent. The balance of 9 percent was consumed by the non-energy sector.

The total gross power generation output in 2013 was about 43.3 TWh. Hydro accounted for about 53 percent as the most utilised source, whereas natural gas represented the second most utilised source at over 20 percent, followed by geothermal power at about 15 percent, coal at 6 percent, and other renewables at 6 percent. Oil is used in electricity generation only as a minor source for peaking and emergency supply.

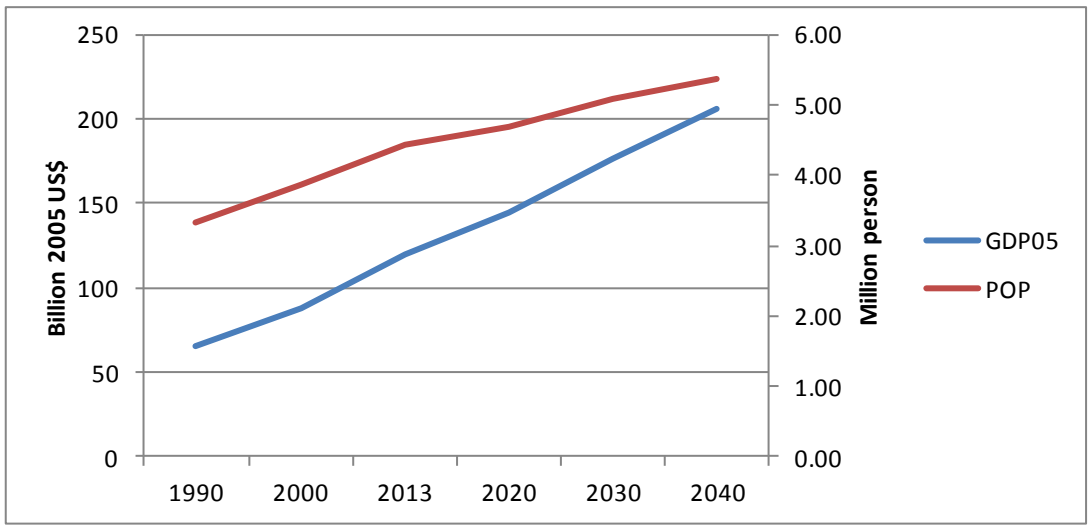
2. Modelling Assumptions

In this outlook, New Zealand's GDP is assumed to grow at an average annual rate of 2.0 percent between 2013 and 2040. Its population will increase by about 20 percent to 5.4 million by 2040, from 4.4 million currently. See Figure 13-1.

In the Business-as-Usual scenario (BAU), hydro use in power generation will remain constant, as most hydro sites have already been developed. Generation

from natural gas based plants is projected to increase slightly, at an annual average rate of 0.5 percent. Geothermal power generation will increase at an annual average growth rate of 2.4 percent and wind generation will continue to grow, but it will still contribute only a small share of New Zealand's electricity by 2040. In contrast, coal power generation will disappear (Figure 13-2). Thermal efficiency of gas- and oil-fired power plants may not increase so much in the future, because new large fossil fuel based plants are not planned. Moreover, Genesis Energy (New Zealand's largest energy company) has decided to decommission its coal-fired power plants by 2023.

Figure 13-1. GDP and Population

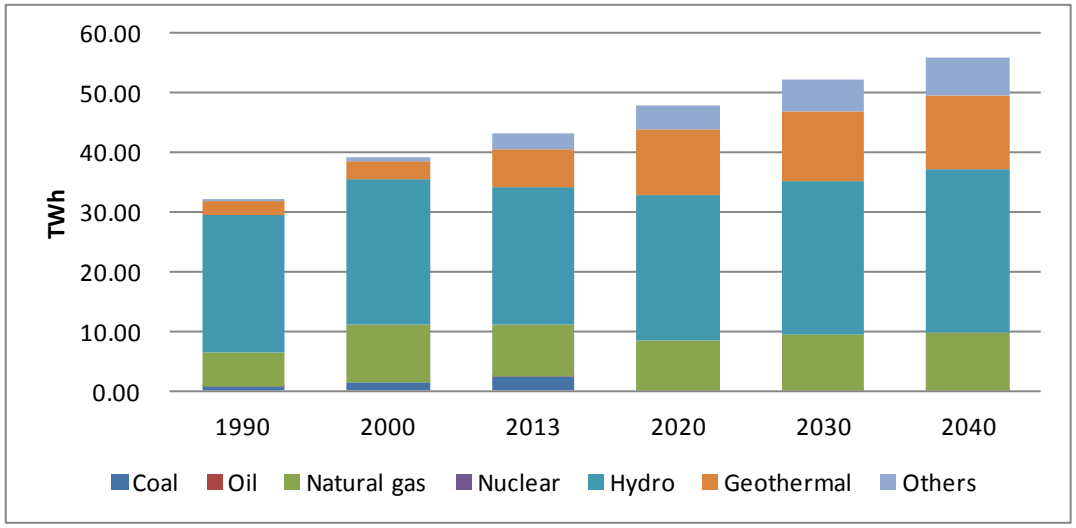


GDP = gross domestic product; GDP05 = GDP at 2005 constant prices; POP = Population.
Source: Author's calculations.

In terms of energy demand, the overall energy intensity of the economy improved in real terms at an annual average rate of 0.8 percent from 1990 to 2013.

On the supply side, new gas discoveries are assumed at an average of 60 petajoules per year (PJ/year) – about 1.6 BCM – with production from new discoveries starting in 2014.

Figure 13-2. Power Generation by Fuel, BAU



BAU = Business-as-Usual scenario; TWh = terawatt-hour.
Source: Author's calculations.

The New Zealand government implemented an emissions trading scheme in 2010 and is currently (May 2016) undertaking a review of that scheme to determine how it can best support New Zealand in both meeting its climate change targets and transitioning to a low emissions economy. New Zealand has also, through its Energy and Energy Efficiency and Conservation Strategies, set a target for 90 percent of electricity to be generated from renewable sources by 2025. The government also maintains a range of programmes to promote energy efficiency at home, work, and in transport, as well as the development and deployment of sustainable energy technologies.

3. Outlook Results

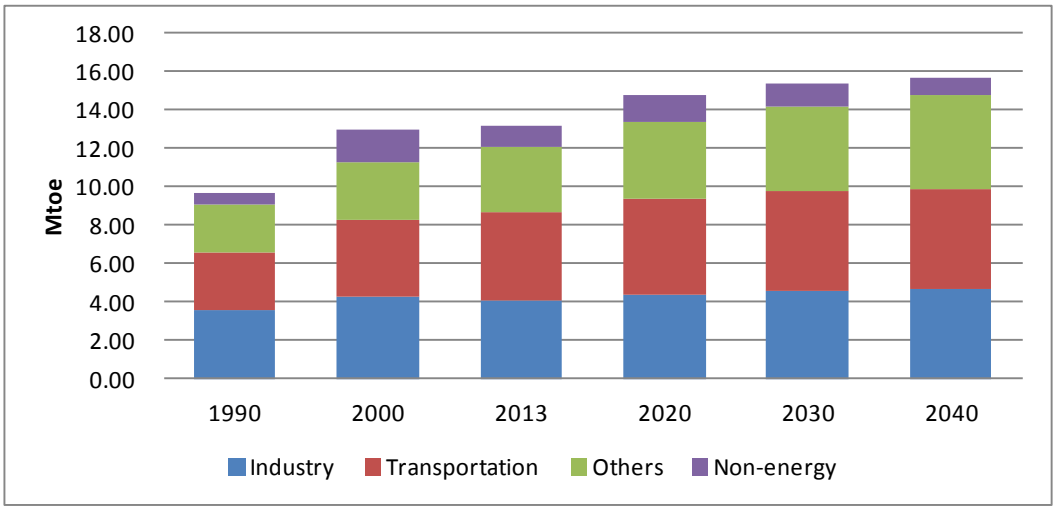
3.1. Final Energy Consumption

New Zealand's final energy consumption grew by 1.4 percent per year from 9.7 Mtoe in 1990 to 13.2 Mtoe in 2013. Oil increased from 4.03 Mtoe to 5.93 Mtoe, electricity also rose from 2.43 Mtoe to 3.26 Mtoe, and natural gas also rose from 1.80 Mtoe to 2.16 Mtoe for the same period. On the other hand, coal was in decline, falling from 0.67 Mtoe to 0.62 Mtoe.

3.1.1. Business-as-Usual Scenario (BAU)

In the Business-as-Usual scenario (BAU), final energy consumption from 2013 to 2040 is projected to grow by 2.4 Mtoe at an average rate of 0.6 percent per year. The 'others' sector (agricultural, residential, and commercial) will have the largest rise of 1.5 Mtoe between 2013 and 2040, growing at an average annual rate of 1.4 percent. Transport sector consumption is projected to increase by 0.6 Mtoe at an annual rate of 0.5 percent and the industry sector is projected to increase by 0.6 Mtoe in 2040. Non-energy sector consumption will decline by 0.3 Mtoe at an annual rate of 1.0 percent (Figure 13-3).

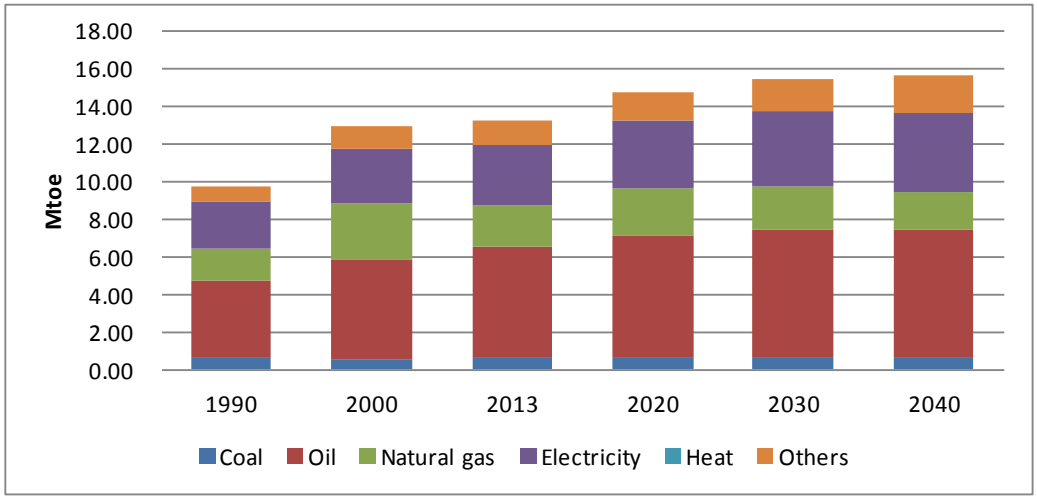
Figure 13-3. Final Energy Consumption by Sector, BAU



BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Note: The 'others' sector includes the agricultural, residential, and commercial sectors.
Source: Author's calculations.

By source, final demand of electricity will steadily increase by 1.0 Mtoe between 2013 and 2040 at an average rate of 1.0 percent per year. Final demand of other renewable energy – which includes geothermal, solar, biogas, and woody biomass used for direct-use heat applications – will increase by 0.7 Mtoe at an average rate of 1.6 percent per year. Final demand of oil will also rise, by 0.9 Mtoe at an average rate of 0.5 percent, whereas coal demand in 2040 will remain at the same level as in 2013. Natural gas will decrease slightly, by 0.2 Mtoe at 0.3 percent per year (Figure 13-4).

Figure 13-4. Final Energy Consumption by Energy, BAU



BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Note: The 'Others' sector includes geothermal, solar, biogas, and woody biomass.
Source: Author's calculations.

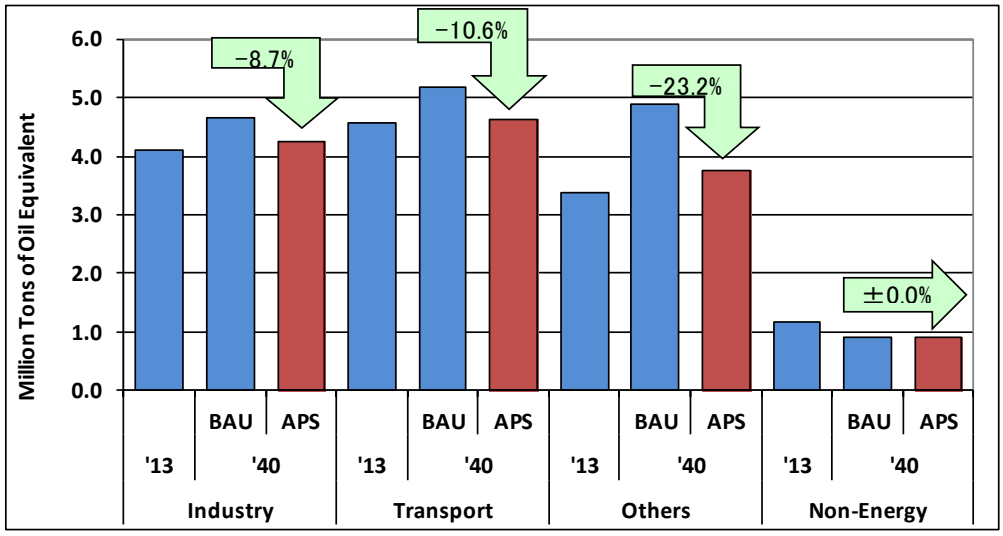
3.1.2. Alternative Policy Scenario (APS)

In the Alternative Policy Scenario (APS), final energy consumption will be slightly higher in 2040. The increase in final energy consumption will be 0.3 Mtoe between 2013 and 2040. Energy use in the 'Others' sector will increase at an average rate of 0.4 percent per year, reflecting increasing use of efficient appliances in the residential and commercial sectors. Energy use in the industrial sector is projected to increase at an annual average rate of 0.2 percent. Energy use in the transport sector will rise slightly, reflecting a shift to more energy efficient vehicles, particularly electric vehicles. The sectoral final energy consumption in 2013 and 2040 in the BAU and the APS is shown in Figure 13-5.

3.2. Primary Energy Supply

Primary energy supply in New Zealand grew at a rate of 1.8 percent per year from 12.8 Mtoe in 1990 to 19.5 Mtoe in 2013. The fastest growing primary fuel in absolute terms was oil, rising from 3.5 Mtoe in 1990 to 6.4 Mtoe in 2013. The increase in oil consumption is due to the rapid growth in transport energy demand.

Figure 13-5. Final Energy Consumption by Sector, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Source: Author's calculations.

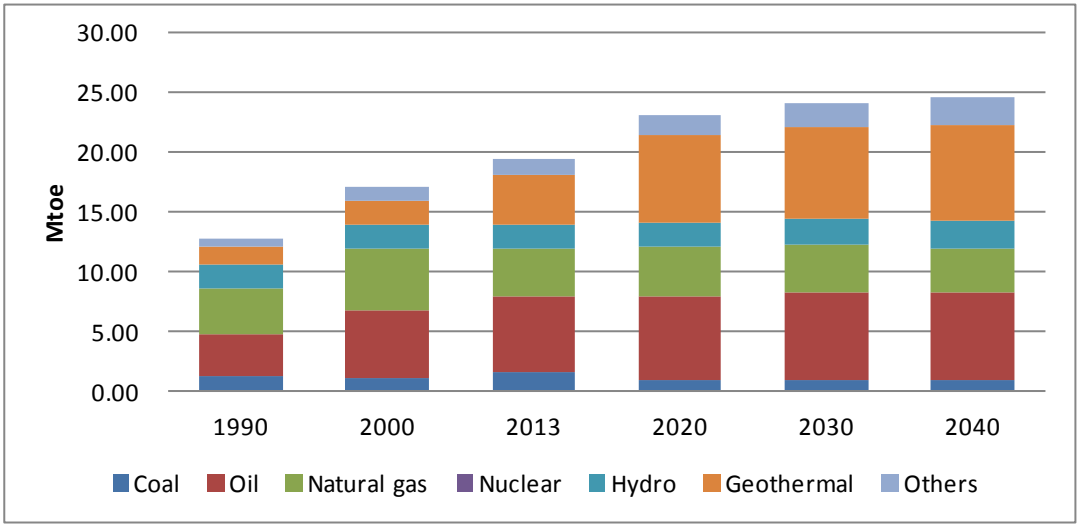
Coal consumption also increased, at an annual average growth rate of 1.2 percent, whereas natural gas demand remained nearly unchanged from 1990 to 2013, reflecting a decrease in gas production from the Maui gas field. Geothermal energy use grew from 1.5 Mtoe in 1990 to 4.2 Mtoe in 2013 at an annual rate of 4.7 percent for electricity generation, while hydro demand for electricity production was unchanged. 'Other' energy sources, which include biomass, solar, wind, liquid biofuels, and biogas, increased by 2.3 percent per year.

3.2.1. Business-as-Usual (BAU) Scenario

In the BAU, New Zealand's primary energy supply will grow at an average annual rate of 0.9 percent to 24.7 Mtoe in 2040 from 19.5 Mtoe in 2013. Geothermal energy is projected to contribute most to the incremental growth of primary energy supply between 2013 and 2040 and will account for 32.2 percent of the total primary energy supply in 2040. 'Others' primary energy will grow by 2.1 percent per year, reflecting mainly the expected growth in wind power, and the share of 'Others' will account for 9.8 percent of the total primary energy supply in 2040. In contrast, primary fossil fuel will slightly increase, at an average rate of 0.01 percent and its share of the total will account for 48.5 percent in 2040, down from 61.1 percent in 2013. The remaining 9.5 percent of the total share in 2040

will be hydro for electricity generation, increasing at an annual average growth rate of 0.6 percent (Figure 13-6).

Figure 13-6. Primary Energy Supply by Source, BAU



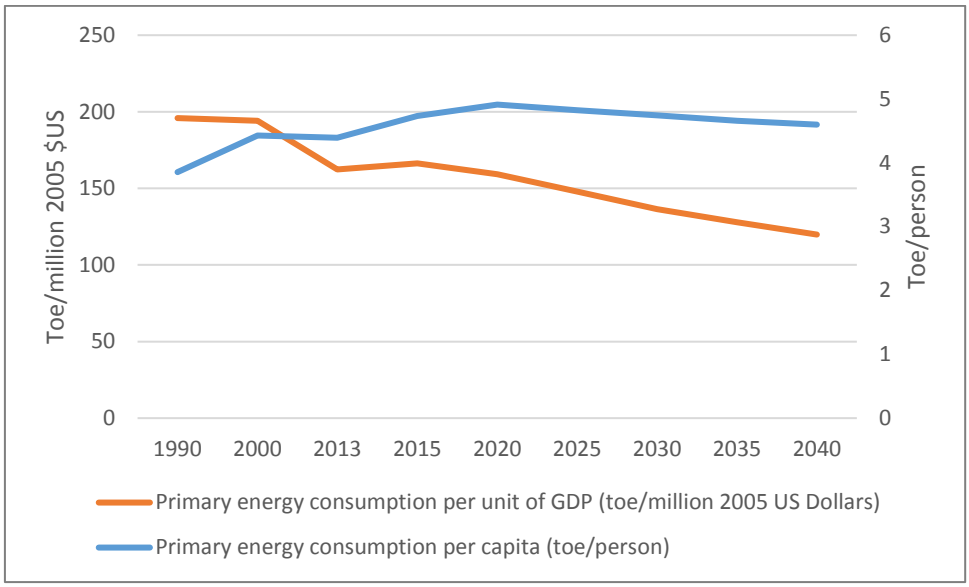
BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

The lower growth of primary energy supply relative to GDP growth will result in lower energy intensity in the future. From 162 toe/million US$ in 2013, energy intensity will improve to 120 toe/million US$ in 2040. Primary energy supply per capita will increase, however, from 4.39 toe per person in 2013 to 4.60 toe per person in 2040. Figure 13-7 shows the primary energy intensity and the energy per capita as indicators.

3.2.2. Alternative Policy Scenario (APS)

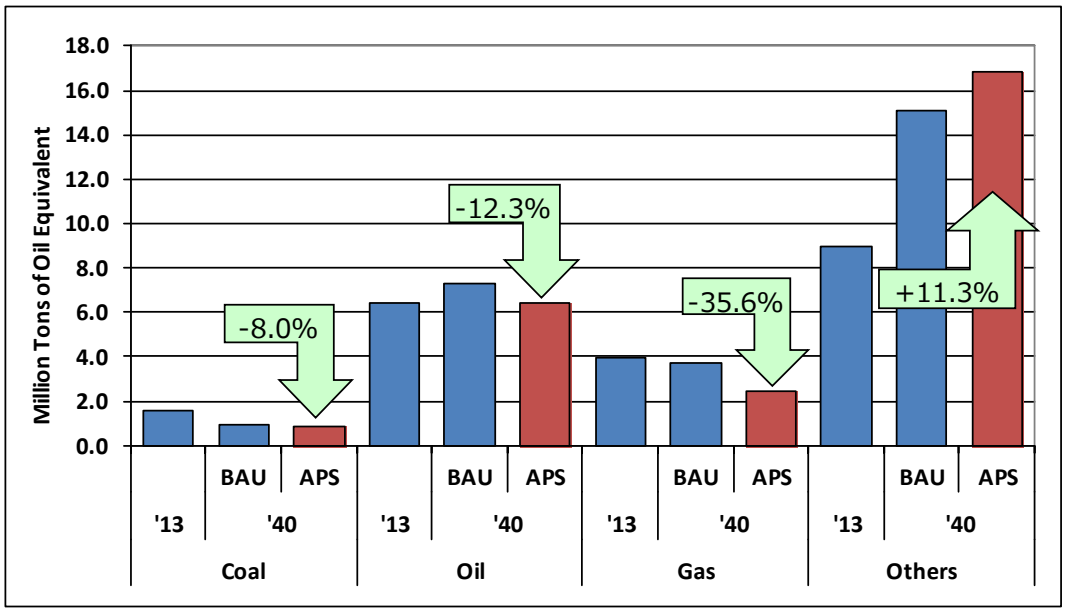
In the APS, primary energy supply is projected to grow at a lower rate of 0.8 percent per year to 24.0 Mtoe in 2040. Coal and gas are expected to show significant declines of 2.3 percent and 1.8 percent per year, respectively. Oil demand remained almost unchanged from 2013 to 2040, whereas geothermal primary energy is expected to grow by 3.3 percent per year (like in the BAU). 'Others' primary energy, which includes biomass, solar, wind, liquid biofuels, and biogas, is expected to grow by 2.3 percent per year (Figure 13-8).

Figure 13-7. Primary Energy Intensity and Energy per Capita Indicator, BAU



BAU = Business-as-Usual scenario; GDP = gross domestic product; toe = tons of oil equivalent.
Source: Author's calculations.

Figure 13-8. Primary Energy Supply by Source, BAU and APS

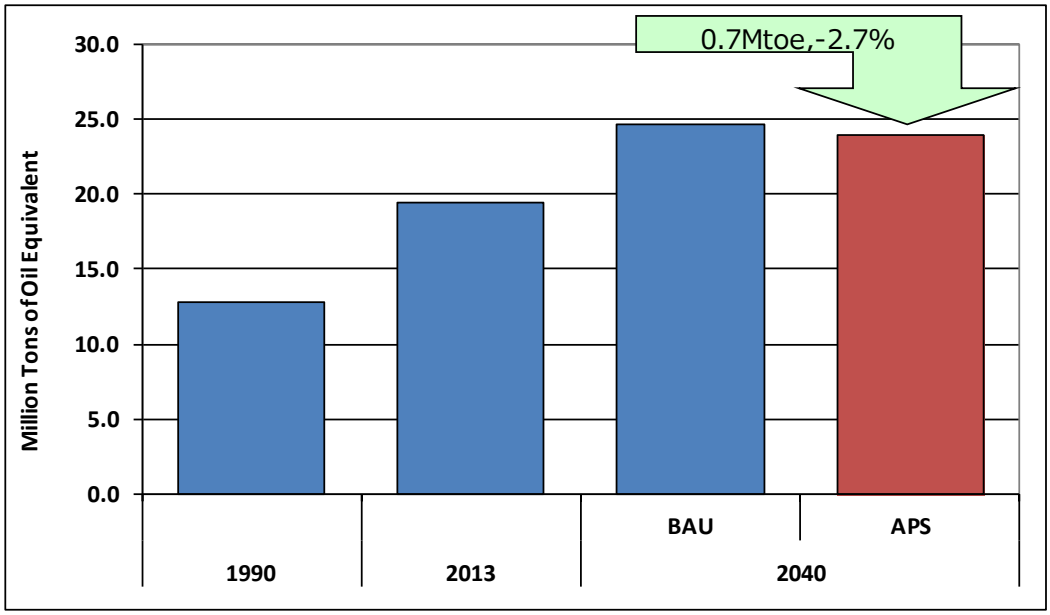


BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Note: The 'others' sector includes biomass, solar, wind, liquid biofuels, biogas, hydro, and geothermal.
Source: Author's calculations.

3.3. Projected Energy Savings

Under the APS, energy savings could amount to 0.7 Mtoe in 2040, the difference between the primary energy supply in the BAU and the APS – 2.7 percent less than under the BAU in 2040 (Figure 13-9).

Figure 13-9. Total Primary Energy Supply, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

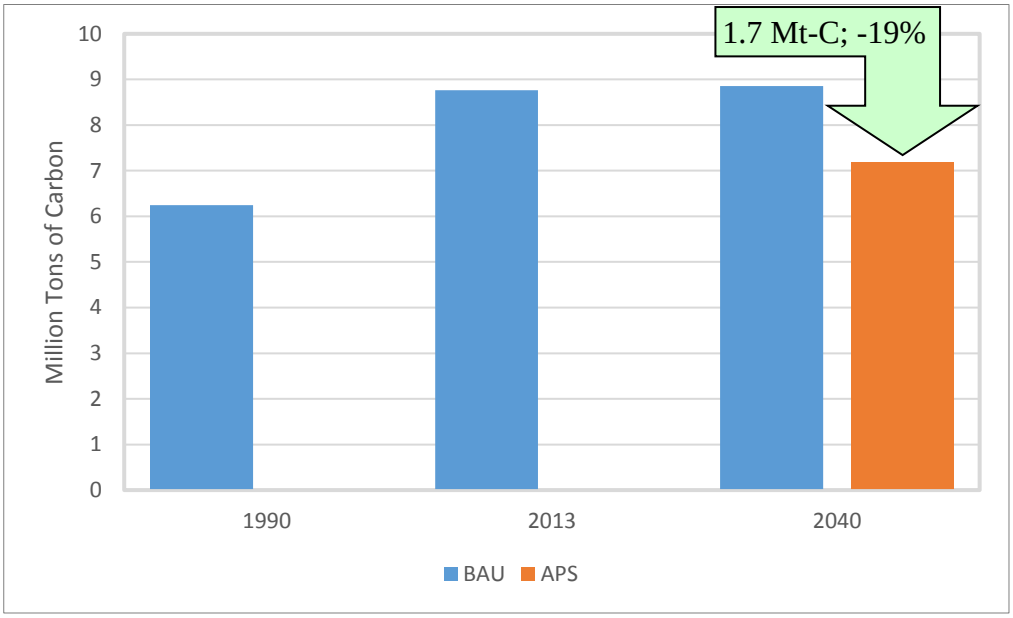
The above savings in primary energy are mainly due to a switch of automobiles to more efficient vehicles, particularly electric vehicles, in the transport sector, along with improved insulation and more efficient appliances in the residential and commercial sectors.

3.4. CO_2 Emissions

Carbon dioxide (CO_2) emissions in the BAU will increase slightly, from 8.8 million tons of carbon (Mt-C) in 2013 to 8.9 Mt-C in 2040. In the APS, CO_2 emissions will decrease from 2013 to 2040 by 0.7 percent per year. Since primary energy supply, excluding geothermal, is more or less stable over this period, the decrease reflects the switch to renewable energy in electricity generation, and the switch of automobiles to electric vehicles in the transport sector. Figure 13-10 shows the

difference of CO_2 emissions from energy consumption between the BAU and the APS in 2040 compared with 1990 and 2013 in New Zealand.

Figure 13-10. CO_2 Emissions from Energy Consumption, BAU and APS



CO_2 = carbon dioxide; BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mt-C = million tons of carbon.
Source: Author's calculations.

4. Implications and Policy Recommendations

Although New Zealand's primary energy intensity (energy per dollar of GDP) has been declining since 1990, energy use has continued to grow steadily, reflecting economic growth, population growth, and increasing numbers of private road vehicles.

New Zealand generates a high proportion of its electricity from renewable sources, particularly hydro, although CO_2 emissions from this sector have grown with large investment in fossil fuel based generation in the 1990s and 2000s. Trading of carbon credits will incentivise investment into new renewable generation technologies, with geothermal and wind as prospective options, provided CO_2 trading prices rise above the current levels. As the Acting Minister of Energy and Resources announced on 30 August 2011, New Zealand's ambitious goal is for 90 percent of electricity generation to be from renewable

sources by 2025. New Zealand's large base of renewable generation, however, limits the room for CO_2 emissions reduction in the electricity generation sector. In March 2016, the minister announced that the targets will be developed and the New Zealand Energy Efficiency and Conservation Strategy (NZEECS) 2011–2016 will be replaced by mid-2017. The NZEECS's successor will have a carbon reduction focus.

New Zealand has some other opportunities to improve energy efficiency, for example through improving the efficiency of vehicles, improving the insulation of buildings, and improving the efficiency of heat production in industry, or switching to lower-carbon fuels.

The largest potential energy and carbon savings are in the transport sector. Growth in energy consumption in the transport sector has been slowing in recent years, mainly because of high fuel prices and a shift to smaller vehicles. Furthermore, reduction in emissions from the transport sector is possible through a switch to electric vehicles and increased use of biofuels. Electric vehicles are a good match for New Zealand given the high proportion of electricity generated from renewables, and the relatively short distances of average trips. Also, charging infrastructure already exists in most residential dwellings. The government recently announced a package of measures designed to encourage the use of electric vehicles. The target is to double the number of electric vehicles every year through to 2021 and to do so by removing barriers that have until now prevented households and businesses from choosing electric cars. Current barriers include the limited selection of models available; a lack of widespread public charging infrastructure; and lack of awareness about electric vehicles.

In the building sector, stronger regulation to enhance the energy efficiency of new and existing buildings in the residential and commercial sectors should be considered. In addition, New Zealand should give consideration to a package of measures (including regulatory instruments) to improve the energy efficiency of industrial heat plants.