CHAPTER 13

New Zealand Country Report

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CHAPTER 13

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1. Background

New Zealand is an island country in the southwestern Pacific Ocean, about 1,500 kilometres (km) east of Australia. It consists of two large islands (the North Island and South Island) and several smaller ones, of which Stewart Island is the largest. Its land area is approximately 269,000 square kilometres (km2), 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 5.0 million as of 31 March 2020. Although it has some light and heavy industry, foreign trade is heavily dependent on agriculture, tourism, forestry, and fishing. In 2017, New Zealand had a nominal gross domestic product (GDP) of about $181.1 billion in United States dollars, or about $37,800 per capita[1]. Although close to the per capita average for Organisation for Economic Co-operation and Development countries, New Zealand tends to rank high in international quality-of-life surveys.

New Zealand possesses significant indigenous energy resources, including hydropower, 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, in 2018 about 76% of all of New Zealand's imported oil was sourced from the Middle East. Remaining energy reserves as of 1 January 2019 included 70.5 million barrels of oil (2P [2]) and 52.5 billion cubic metres of natural gas (2P1),

[1] All United States dollars in this report are in constant 2010 values unless specified.
[2] 2P values may be totalled safely using arithmetic summation since they are the mid-point of the probability distribution.
Source: Ministry of Business, Innovation and Employment (2019), New Zealand Energy in New Zealand 2019 Report.

as well as in-ground resources of over 15 billion tonnes of coal, 80% of which is lignite in the South Island.

In 2017, New Zealand's total primary energy supply (TPES) was around 20.7 million tonnes of oil equivalent (Mtoe). By share, oil represented the largest source at about 33%, followed by natural gas at 20% and geothermal energy at 24%. The remainder of the primary energy supply came from hydropower (10%), coal (6%), biomass (6%), and a smaller percentage of other renewables such as wind, solar photovoltaics, and biofuels.

Final energy consumption was about 14.6 Mtoe in 2017. By share, the transport sector was the largest at around 36% because New Zealand depends heavily on private road vehicles, road freight, and air transport. The industrial sector was the second largest with about 30%, followed by the agricultural, residential, and commercial sectors with 26% altogether. The non-energy sector consumed the remaining 8%.

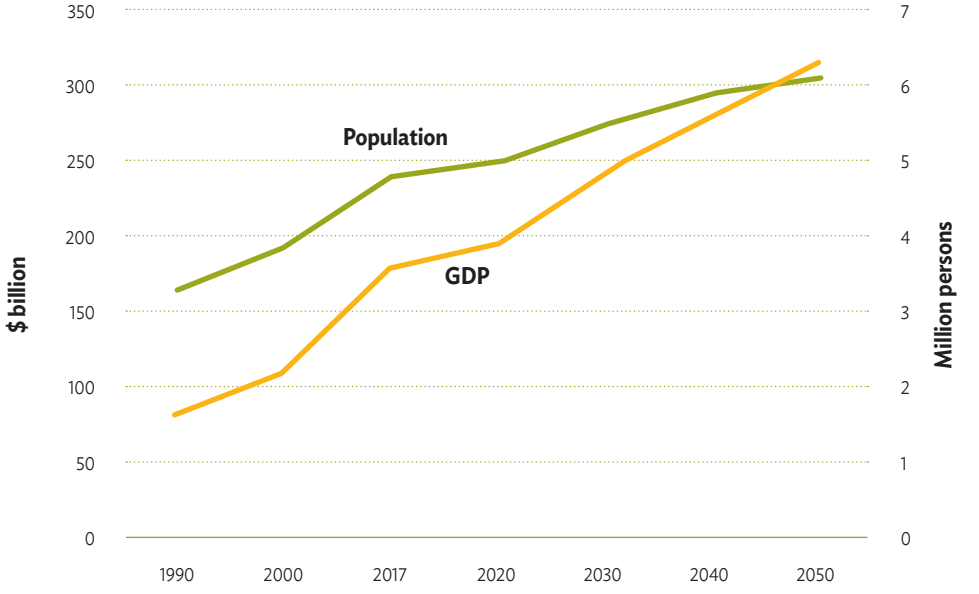
In 2017, the total gross power generation output was about 44.2 terawatt-hours, of which hydropower accounted for about 57% (the most utilised source), followed by geothermal with about 18%, natural gas with about 16%, coal with 3%, and other renewables with 6%. Oil, a minor source in electricity generation, is only used for peaking and emergency supply.

2. Modelling Assumptions

This outlook assumes that New Zealand's GDP will grow at an average annual rate of 1.7% between 2017 and 2050, and its population will increase by about 28% from 4.8 million in 2017 to 6.1 million by 2050 (Figure 13.1).

Under business as usual (BAU), generation from renewable sources is projected to increase as new capacities for geothermal and wind will increase in the future. Hydropower is projected to decrease slightly at an annual average rate of 0.6% from 2017 to 2050. Generation from natural gas-based plants is projected to increase slightly, at an annual average rate of 0.4%. Geothermal power generation will increase at an annual average rate of 1.7% and wind generation will continue to grow, but will still only account for a small share of New Zealand's electricity by 2050. In contrast, coal power generation will decrease at an annual average rate of 0.3% (Figure 13.2). Thermal efficiency of gas- and oil-fired power plants may not increase so much in the future, because no new large fossil fuel-based plants are planned. Moreover,

Figure 13.1. Gross Domestic Product and Population



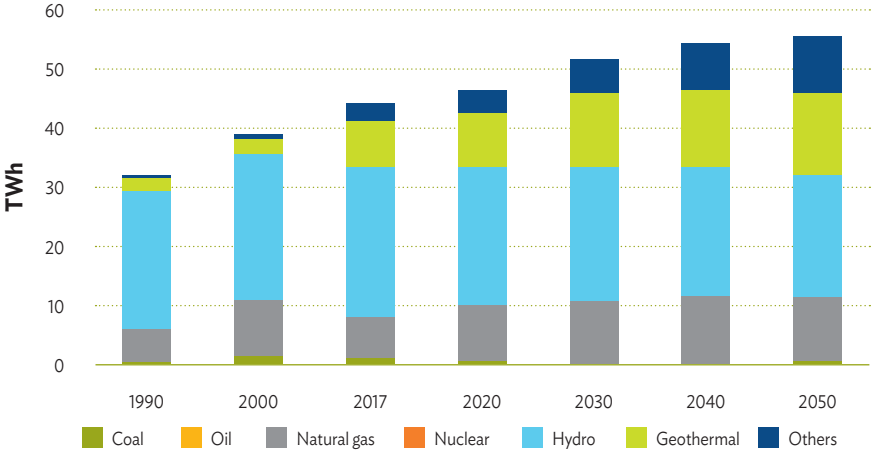
GDP = gross domestic product.

Source: Author's calculations.

Genesis Energy (New Zealand's largest energy company) has decided to decommission its coal-fired power plants by 2023.

In terms of primary energy supply, the overall energy intensity of the economy improved in real terms at an annual average rate of 1.1% from 1990 to 2017.

Figure 13.2. Power Generation by Fuel, Business as Usual



GDP = gross domestic product.

Source: Author's calculations.

The Government of New Zealand implemented an emissions trading scheme in 2010 and is currently 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% 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

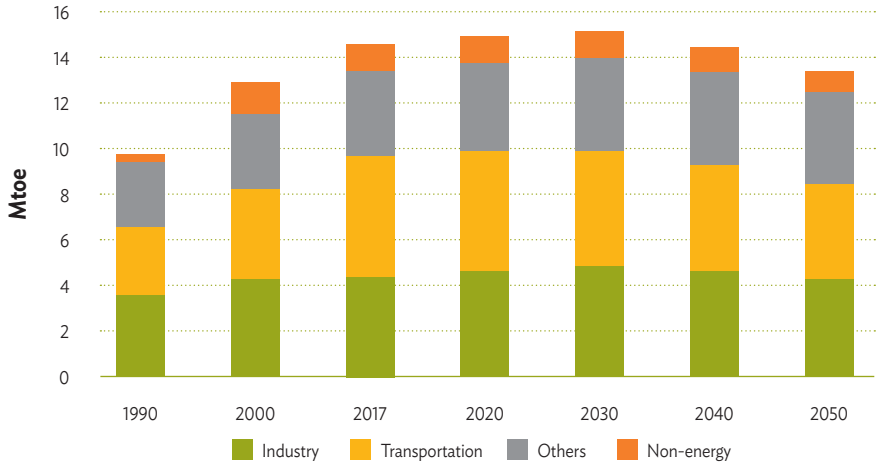
New Zealand's final energy consumption grew by 1.5% per year from 9.7 Mtoe in 1990 to 14.6 Mtoe in 2017. Oil increased from 4.0 Mtoe to 6.6 Mtoe, electricity rose from 2.4 Mtoe to 3.4 Mtoe, and natural gas rose from 1.8 Mtoe to 2.8 Mtoe for the same period. 'Other' energy sources, which include biomass, solar, wind, liquid biofuels, and biogas, also increased from 0.8 Mtoe to 1.3 Mtoe. On the other hand, coal was in decline, falling from 0.7 Mtoe to 0.6 Mtoe.

3.1.1. Business as Usual Scenario

Under BAU, final energy consumption from 2017 to 2050 is projected to decrease by 1.2 Mtoe at an average rate of 0.3% per year. The 'others' sector (agricultural, residential, and commercial) will see a smaller rise of 0.2 Mtoe between 2017 and 2050, an average annual growth rate of 0.1%. Transport sector consumption is projected to decrease by 1.0 Mtoe at an annual rate of 0.7% and the industry sector is also projected to decrease by 0.2 Mtoe in 2050. Non-energy sector consumption is projected to fall by 0.1 Mtoe from 2017 to 2050 (Figure 13.3).

By source, final electricity demand will steadily increase by 0.9 Mtoe between 2017 and 2050 at an average rate of 0.7% per year. Final demand of other renewable energy, including geothermal, solar, biogas, and woody biomass used for direct-use heat applications, will decrease slightly from 2017 to 2050 at an average rate of 0.2% per year. By 2050 final oil demand will decrease by 1.6 Mtoe at an average rate of 0.8% per year, coal demand will decrease by 0.1 Mtoe at an average rate of 0.6% per year, and natural gas will decrease slightly by 0.3 Mtoe at an average rate of 0.3% per year (Figure 13.4).

Figure 13.3. Final Energy Consumption by Sector, Business as Usual

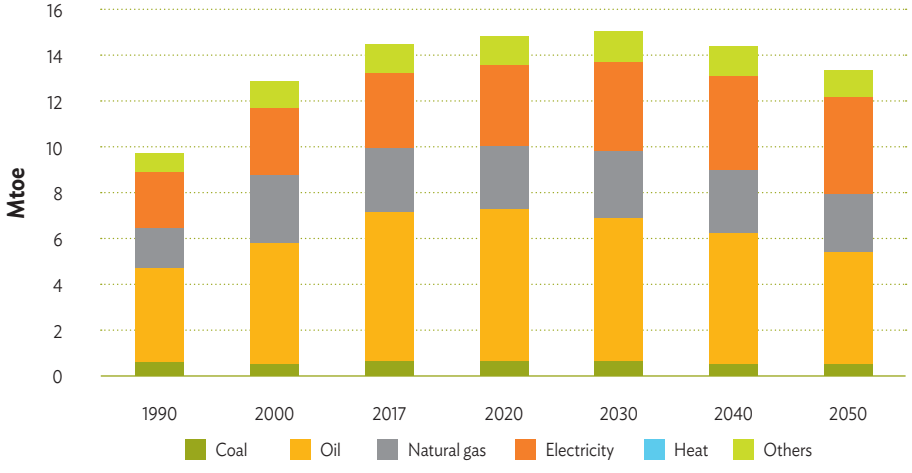


BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Note: 'Others' includes the agricultural, residential, and commercial sectors.

Source: Author's calculations.

Figure 13.4. Final Energy Consumption by Fuel, Business as Usual



BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Note: The 'Others' sector includes geothermal, solar, biogas, and woody biomass.

Source: Author's calculations.

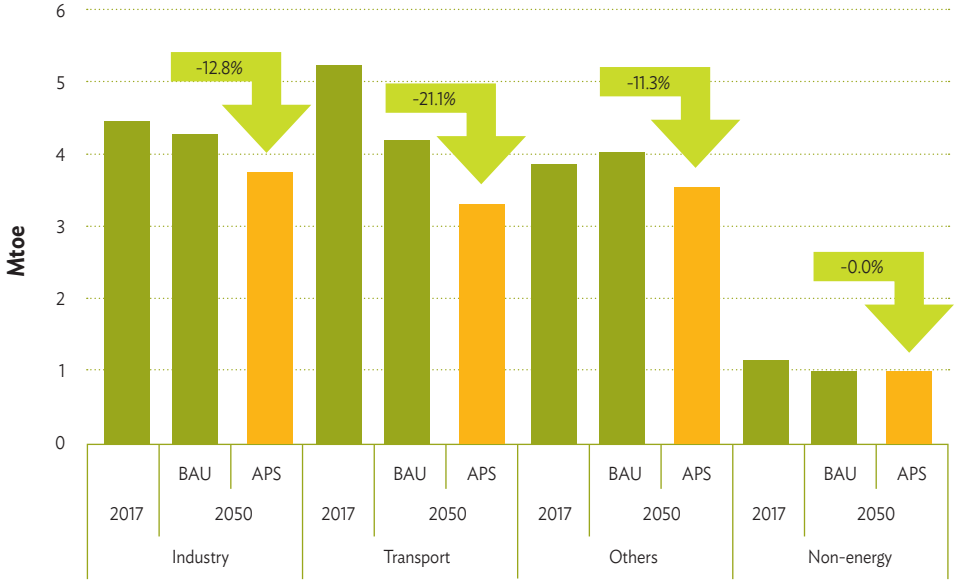
3.1.2. Alternative Policy Scenario

In the alternative policy scenario (APS), final energy consumption will be slightly lower in 2050. Final energy consumption will decrease by 3.1 Mtoe between 2017 and 2050. Energy use in the 'others' sector (agricultural, residential, and commercial) will decrease at an average

rate of 0.2% per year, reflecting the use of efficient appliances and highly energy-efficient heat pumps, and the replacement of incandescent bulbs with compact fluorescent lamp and light-emitting diode light bulbs in the residential and commercial sectors.2 Energy use in the industrial sector is projected to decrease at an annual average rate of 0.5%. Energy use in the transport sector will decrease at an average rate of 1.4% per year, reflecting a shift to more energy-efficient vehicles, particularly electric vehicles. Energy use in the non-energy sector is projected to decrease at an annual average rate of 0.4%.

Final energy consumption by in 2017 and 2050 under BAU and in the APS is shown in Figure 13.5.

Figure 13.5. Final Energy Consumption by Sector, Business as Usual and the Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual scenario, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.2. Primary Energy Supply

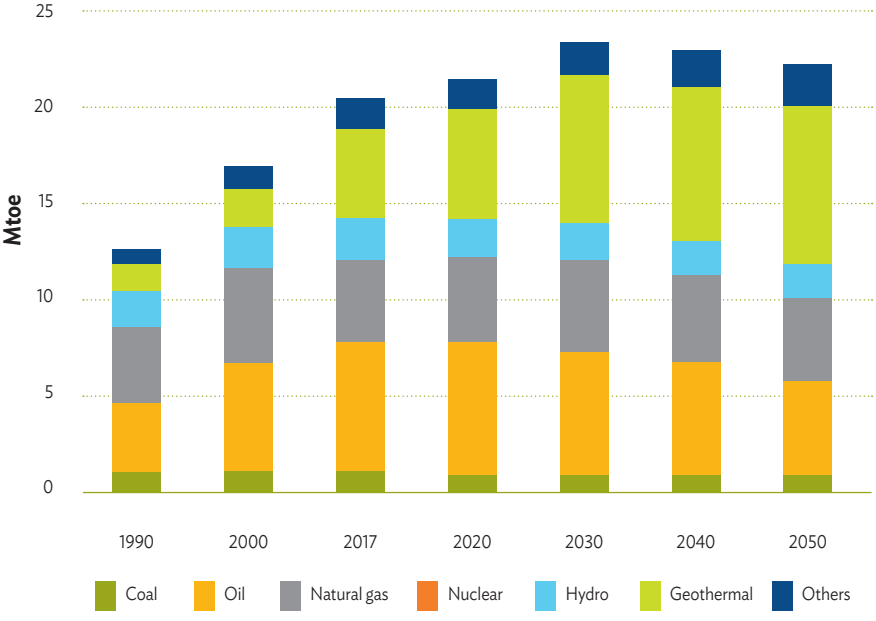
Primary energy supply in New Zealand grew at an average annual rate of 1.8% per year from 12.8 Mtoe in 1990 to 20.7 Mtoe in 2017. The fastest growing primary fuel in absolute terms was oil, rising from 3.5 Mtoe in 1990 to 6.8 Mtoe in 2017. The increase in oil is due to the rapid growth in transport energy demand.

Natural gas consumption increased at an average annual rate of 0.3% and oil consumption increased at an annual average rate of 2.5%. Geothermal energy use for electricity generation grew from 1.5 Mtoe in 1990 to 4.9 Mtoe in 2017, an annual rate of 4.5%; while hydropower demand for electricity production increased slightly from 2.0 Mtoe in 1990 to 2.2 Mtoe in 2017. 'Other' energy sources, which include biomass, solar, wind, liquid biofuels, and biogas, increased at an annual average rate of 2.2% per year.

3.2.1. Business as Usual Scenario

Under BAU, New Zealand's primary energy supply will grow at an average annual rate of 0.3% to 22.5 Mtoe in 2050 from 20.7 Mtoe in 2017. Geothermal energy is projected to contribute the most to the incremental growth of the primary energy supply between 2017 and 2050, and will account for 37.1% of the TPES in 2050. 'Other' primary energy will grow at an annual average rate of 1.2% per year, mainly reflecting the expected growth in wind power; and 'others' will account for 9.6% of the TPES in 2050. In contrast, primary fossil fuel will decrease slightly at an average rate of 0.5%, and will account for 45.4% of the total in 2050, down from 58.8% in 2017. Hydropower for electricity generation will account for the remaining 7.9% of the total by 2050, decreasing at an annual average rate of 0.6% (Figure 13.6).

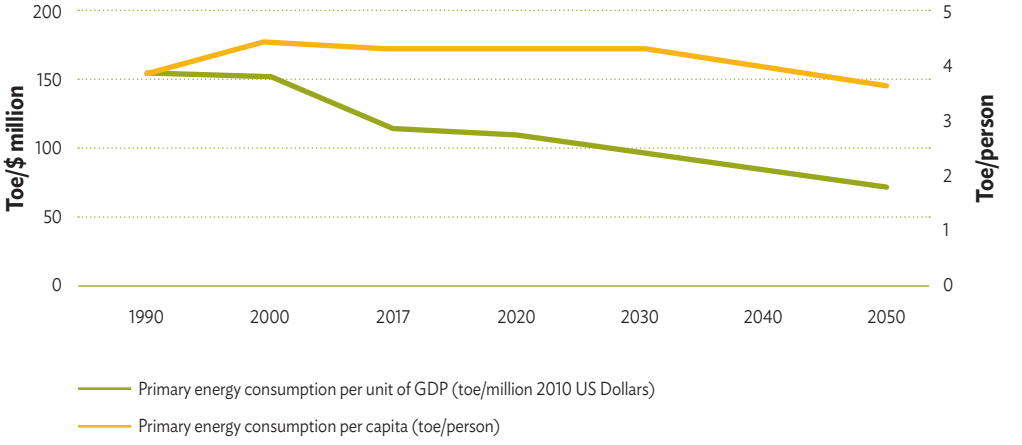
Figure 13.6. Primary Energy Supply by Fuel, Business as Usual



BAU = business as usual, Hydro = hydropower, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Figure 13.7. Primary Energy Intensity and Energy per Capita Indicator, Business as Usual



BAU = business as usual, GDP = gross domestic product, toe = tonnes of oil equivalent.

Source: Author's calculations.

The lower growth of the primary energy supply relative to GDP growth will result in lower energy intensity in the future. From 114 tonnes of oil equivalent per million dollars (toe/$ million) in 2017, energy intensity will improve to 72 toe/$ million in 2050. Primary energy supply per capita will decrease from 4.3 toe per person in 2017 to 3.7 toe per person in 2050. Figure 13.7 shows the primary energy intensity and energy per capita as indicators.

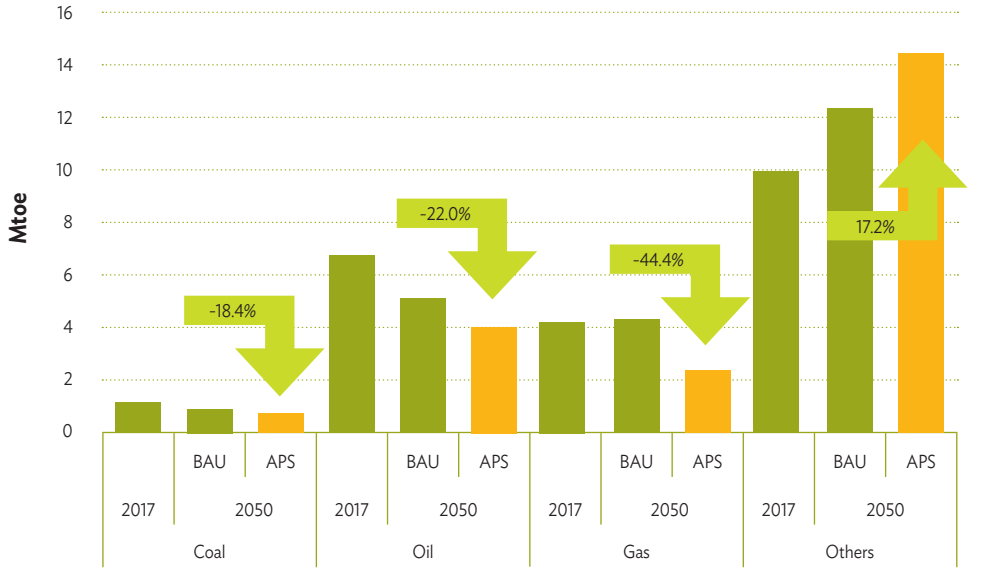
3.2.2. Alternative Policy Scenario

In the APS, the energy supply is projected to grow at a lower rate of 0.1% per year to 21.5 Mtoe in 2050. Significant declines are expected in gas (1.7%), oil (1.6%), and coal (1.5%). Geothermal primary energy is expected to grow by 2.3% per year. 'Other' primary energy, which includes biomass, solar, wind, liquid biofuels, and biogas, is expected to grow by 1.6% per year (Figure 13.8).

3.3. Projected Energy Savings

In the APS, the primary energy supply is projected to save about 1.1 Mtoe or 4.7% less than BAU in 2050 (Figure 13.9).

Figure 13.8. Primary Energy Supply by Fuel, Business as Usual and the Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Note: The 'others' sector includes biomass, solar, wind, liquid biofuels, biogas, hydropower, and geothermal.

Source: Author's calculations.

Figure 13.9. Total Primary Energy Supply, Business as Usual and the Alternative Policy Scenario

APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The above savings in primary energy are mainly due to the switch to more efficient vehicles, particularly electric vehicles, in the transport sector, along with improved insulation, use of more efficient appliances, and replacement of incandescent bulbs with compact fluorescent lamp and light-emitting diode light bulbs in the residential and commercial sectors.

3.4. Carbon Dioxide Emissions

Under BAU, carbon dioxide (CO2) emissions will decrease slightly, from 8.9 million tonnes of carbon (Mt-C) in 2017 to 7.4 Mt-C in 2050. In the APS, CO2 emissions will decrease by 1.7% per year from 2017 to 2050, reflecting the switch to renewable energy in electricity generation, and the switch to electric vehicles in the transport sector. Figure 13.10 shows the difference in CO2 emissions from energy consumption between BAU and the APS in 2050 compared with 1990 and 2017 in New Zealand.

Figure 13.10. Carbon Dioxide Emissions from Energy Consumption, Business as Usual and Alternative Policy Scenario

APS = alternative policy scenario, BAU = business as usual, CO2 = carbon dioxide, Mt-C = million tonnes of carbon.

Source: Author's calculations.

4. Implications and Policy Recommendations [3]

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 over 80% of its electricity from renewable sources. In the first quarter of 2020, increases in hydropower generation (up 2.1%), wind (up 8.2%), and geothermal (up 3.8%) helped lift renewable sources' share of electricity generation. Meanwhile, generation from non-renewable sources declined: generation from gas fell 1.6%, and generation from coal fell 22.6%, despite historically high coal consumption during this quarter.

In 2011, New Zealand set an ambitious goal to generate 90% of its electricity from renewable sources by 2025; and to reduce greenhouse gas emissions by 30% from 2005 to 2030, and by 50% from 1990 to 2050. However, New Zealand's large base of renewable generation limits the opportunity to reduce CO2 emissions in the electricity generation sector. The goal of the New Zealand Energy Efficiency and Conservation Strategy (2017–2022), titled Unlocking Our Energy Productivity and Renewable Potential, is for New Zealand to become an energy-productive and low-emissions economy. It encourages businesses, individuals, and public sector agencies to take actions to help unlock renewable energy, energy efficiency, and productivity potential. The strategy's three priority areas are (i) the renewable and efficient use of process heat, (ii) efficient and low-emission transport, and (iii) the innovative and efficient use of electricity. It also contains targets for renewable energy and greenhouse gas emissions reduction.

Other opportunities for New Zealand to boost energy efficiency include improving vehicle efficiency, building insulation, and the efficiency of heat production in industry, as well as switching to lower-carbon fuels. The largest potential energy and carbon savings are in the transport and process heat sectors. 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.

In late 2019 the government announced a $200 million fund aimed at reducing the state sector's carbon footprint. The first projects announced in a 'clean-powered public service' are the replacement of coal-fired boilers in schools and hospitals. Switching to electric vehicles and increasing the use of biofuels can further reduce emissions from the transport

[3] Ministry of Business, Innovation and Employment and the Energy Efficiency and Conservation Authority (2017), New Zealand Energy Efficiency and Conservation Strategy (2017–2022), Unlocking Our Energy Productivity and Renewable Potential. Auckland.

sector. Electric vehicles are a good match for New Zealand given the high proportion of electricity generated from renewables, the relatively short distance of average trips, and the fact that charging infrastructure already exists in most residential dwellings. Aiming to reach 64,000 electric vehicles by the end of 2021, the government has introduced several measures to encourage their use by removing barriers preventing households and businesses from choosing electric cars; these include a limited selection of available models and lack of widespread public charging infrastructure. Government funding for electric vehicles is available under the Low Emission Vehicles Contestable Fund, the purpose of which is to encourage innovation and investment and accelerate the uptake of electric and other low-emission vehicles in New Zealand, which might not otherwise happen.

In early 2019 the government announced a raft of changes to the Building Act 2004, signalling that this would result in significant reform of the sector's main legislation. New Zealand should consider a package of measures (including regulatory instruments) to improve the energy efficiency of industrial heat plants.

The government strategy includes a target for each priority area. Achieving these targets will require the government to work with businesses and individuals to develop the right mix of policies and programmes. The strategy builds on achievements to date and does not include a full list of government energy efficiency and renewable initiatives. This approach will ensure that the document stays relevant throughout its 5-year life, allowing initiatives to end and new programmes to begin. Public sector agencies list the full range of initiatives in their public accountability documents and websites. Investment in quality energy end-use data and analysis will support the government's approach. Good data is critical for reviewing existing programmes and informing new policy design. The Ministry of Business, Innovation and Employment; Statistics New Zealand; the Electricity Authority; the Gas Industry Company; the Ministry of Transport; and the Energy Efficiency and Conservation Authority will continue to publish such data.