CHAPTER 13

# NEW ZEALAND COUNTRY REPORT

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## 1. Background

New Zealand is an island country in the southwestern Pacific Ocean. It is located some 1,500 kilometres (km) east of Australia and consists of three main islands (the North Island, the South Island, and Stewart Island), and several smaller, mostly uninhabited outer islands. The land area is approximately 269,000 $km^2$, 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 4.6 million at the end of 2015. Although there are some light and heavy industries, foreign trade is heavily dependent on agriculture, tourism, forestry, and fishing. In 2015, New Zealand had a nominal gross domestic product (GDP) of about US$169.1 billion, or about US$36,800 per capita. Although the latter figure is near the average of countries of the Organisation for Economic Co-operation and Development, New Zealand tends to be ranked highly in international quality-of-life surveys.

The country 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. It has locally produced crude oil, which is generally exported because of its high quality and, therefore, has a high value on the international market. To meet its oil demand, over half of all imported oil to New Zealand in 2015 was produced in the Middle East. Remaining energy reserves as of 1 January 2018 include 71.1 million barrels of oil (2P[1]) and 50.1 billion cubic metres of natural gas, as well as in-ground resources of over 15 billion tons of coal, 80% of which are South Island lignite.

[1] 2P values may be totalled safely using arithmetic summation since they are the midpoint of the probability distribution.

In 2015, New Zealand's total primary energy supply (TPES) was around 20.6 million tons of oil equivalent (Mtoe). By source, oil represented the largest share at about 33%. Natural gas and geothermal energy were second largest, contributing around 20% and 24%, respectively. The remainder of the primary energy supply were hydro (10%), coal (7%), biomass (5%), and a smaller percentage of other renewables such as wind, solar photovoltaic (PV), and biofuels.

Final energy consumption was about 14.1 Mtoe in 2015. By sector, transport accounted for the largest share at around 34% because New Zealand heavily depends on private road vehicles, road freight, and air transport. The share of the industry sector was the second largest at about 31%, whereas the total of agricultural, residential, and commercial sectors was 25%. The non-energy sector consumes the balance of 10%.

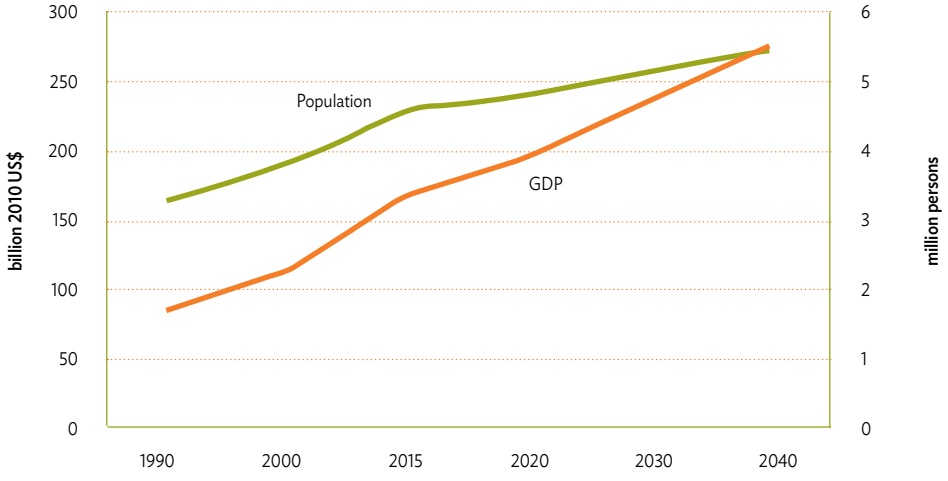
Total gross power generation output in 2015 was about 44.2 terawatt-hours (TWh). Hydro accounted for about 56% as the most utilised source, whereas geothermal represented the second most utilised source at about 18%, followed by natural gas (15%), coal (4%), and other renewables (7%). Oil is used in electricity generation only as a minor source for peaking and emergency supply (IEA, 2017).

## 2. Modelling Assumptions

In this outlook, New Zealand's GDP is assumed to grow at an average annual rate of 2% between 2015 and 2040. Its population will increase by about 19% to 5.5 million by 2040, from 4.6 million in 2015 (Figure 13.1).

In the Business-As-Usual (BAU) scenario, 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 1.1%. Geothermal power generation will increase at an average annual growth rate of 2.6% and wind generation will continue to grow, but it will contribute only a small share of New Zealand's electricity by 2040. In contrast, coal-fired 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 (1990–2040)**

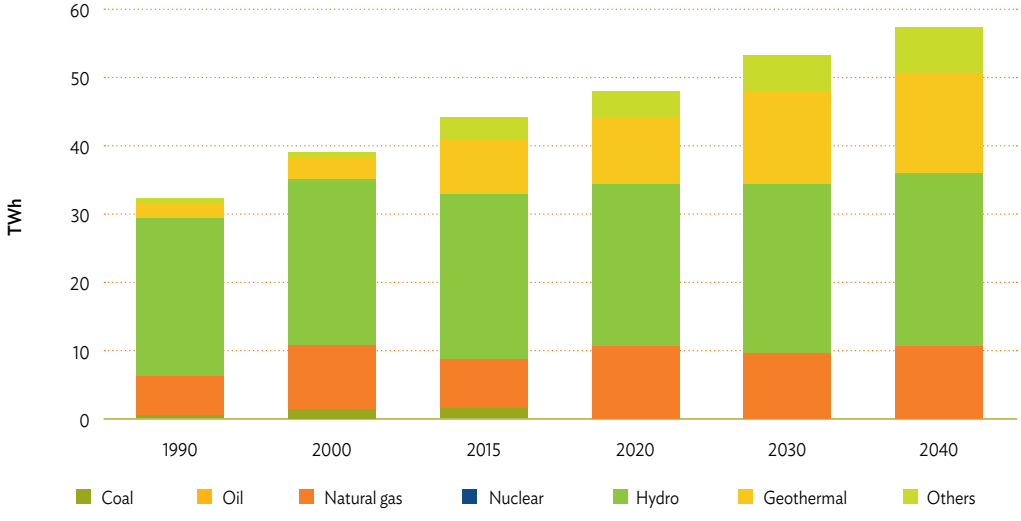



GDP = gross domestic product at 2010 constant prices.

Source: Authors' calculations.

In terms of primary energy consumption, the overall energy intensity of the economy improved in real terms at an annual average rate of 0.9% in 1990–2015.

**Figure 13.2: Power Generation by Fuel Type, BAU (1990–2040)**




BAU = Business-As-Usual, TWh = terawatt-hour.

Source: Authors' calculations.

The government implemented an emissions trading scheme in 2010 and is currently reviewing that scheme to determine how it can best support the country in meeting its climate change targets and transitioning to a low-emissions economy. New Zealand, through its Energy and Energy Efficiency and Conservation Strategies, has also 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, at work, and in transport, as well as the development and deployment of sustainable energy technologies.

# 3. Outlook Results

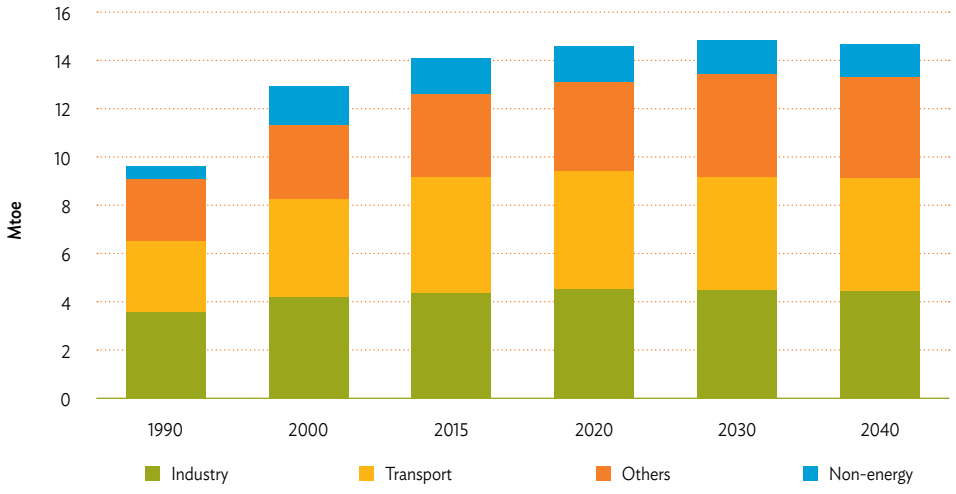
## 3.1. Final Energy Consumption

New Zealand's final energy consumption grew by 1.5% per year from 9.7 Mtoe in 1990 to 14.1 Mtoe in 2015. During the same period, oil increased from 4.0 Mtoe to 6.2 Mtoe; electricity, from 2.4 Mtoe to 3.4 Mtoe; and natural gas, from 1.8 Mtoe to 2.7 Mtoe. On the other hand, coal declined from 0.7 Mtoe to 0.6 Mtoe.

### 3.1.1. Business-As-Usual scenario

In the BAU scenario, final energy consumption in 2015–2040 is projected to grow by 0.6 Mtoe at an average rate of 0.2% per year. The 'others' sector (agricultural, residential, and commercial) will have the largest increase of 0.6 Mtoe during this period, growing at an average annual rate of 0.6%. Transport sector consumption is projected to decrease by 0.1 Mtoe at an annual rate of 0.1%, but that of the industry sector is projected to increase by 0.2 Mtoe in 2040. Non-energy sector consumption will remain constant in 2015–2040 (Figure 13.3).

**Figure 13.3: Final Energy Consumption by Sector, BAU (1990–2040)**



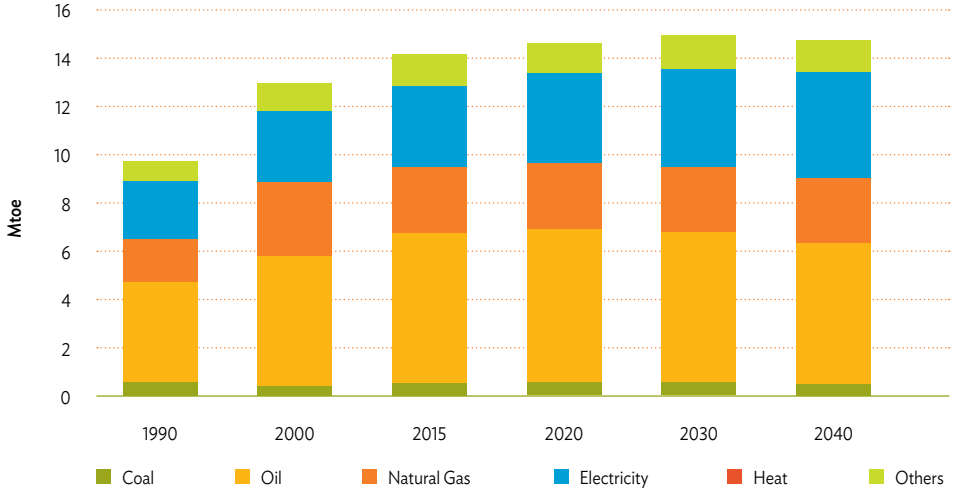

BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Note: The 'others' sector includes the agricultural, residential, and commercial sectors.

Source: Authors' calculations.

By source, final demand of electricity will steadily increase by 1.0 Mtoe between 2015 and 2040 at an average rate of 1.1% per year. Final demand of other renewable energy – which includes geothermal, solar, biogas, and woody biomass used for direct-use heat applications – will increase slightly in 2015–2040 at an average rate of 0.1% per year. By 2040, final demand for oil will decrease by 0.3 Mtoe at an average rate of 0.2%; coal demand, by 0.1 Mtoe at an average rate of 0.4%; and natural gas, by 0.1 Mtoe at an average rate of 0.1% per year (Figure 13.4).

**Figure 13.4: Final Energy Consumption by Fuel Type, BAU (1990–2040)**




BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

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

Source: Authors' calculations.

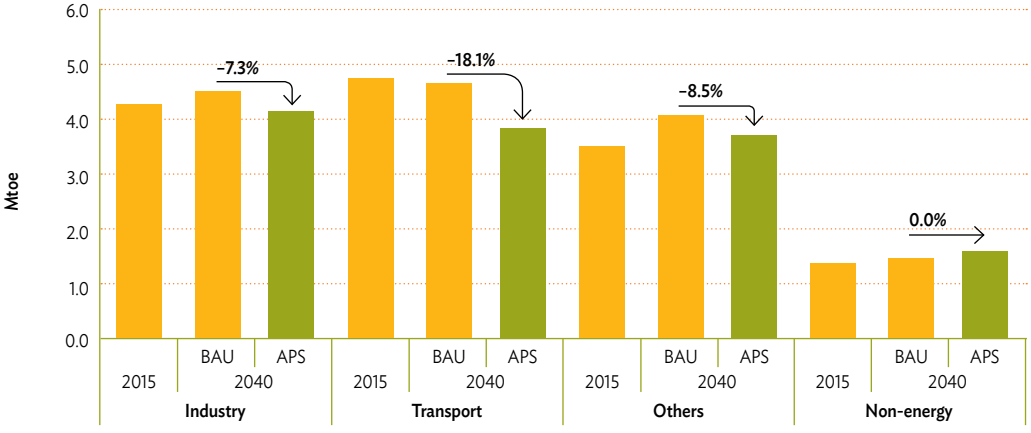
### 3.1.2. Alternative Policy Scenario

In the Alternative Policy Scenario (APS), final energy consumption will be slightly lower at 0.9 Mtoe between 2015 and 2040. Energy use in the 'others' sector will increase at an average rate of 0.2% per year, reflecting increasing use of efficient appliances in the residential and commercial sectors. Energy use in the industry sector is projected to decrease at an annual average rate of 0.2%. Energy use in the transport sector will decrease slightly, reflecting a shift to more energy-efficient vehicles, particularly electric vehicles. The sectoral final energy consumption in 2015 and 2040 in the BAU scenario 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 1.9% per year, from 12.8 Mtoe in 1990 to 20.6 Mtoe in 2015. The fastest-growing primary fuel in absolute terms was oil, rising from 3.5 Mtoe in 1990 to 6.8 Mtoe in 2015. The increase in oil consumption was due to the rapid growth in transport energy demand.

**Figure 13.5: Final Energy Consumption by Sector, BAU and APS (2015 and 2040)**




APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

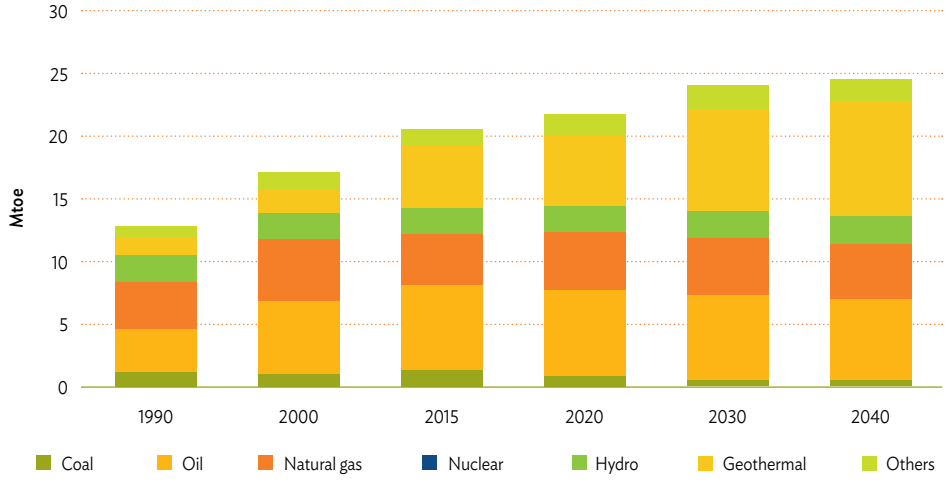
Source: Authors' calculations.

Between 1990 and 2015, natural gas and coal consumption increased at an annual average rate of 0.2% and 0.6%, respectively. Geothermal energy use grew from 1.5 Mtoe in 1990 to 4.9 Mtoe in 2015 at an annual rate of 4.9% for electricity generation, while hydro demand for electricity production slightly increased from 2.0 Mtoe in 1990 to 2.1 Mtoe in 2015. 'Other' energy sources, which include biomass, solar, wind, liquid biofuels, and biogas, increased by 2.3% per year.

### 3.2.1. Business-As-Usual scenario

In the BAU scenario, New Zealand's primary energy supply will grow at an average annual rate of 0.7% to 24.6 Mtoe in 2040 from 20.6 Mtoe in 2015. Geothermal energy is projected to contribute most to the incremental growth of primary energy supply between 2015 and 2040 and will account for 37% of total primary energy supply in 2040. Primary energy of 'others' will grow by 1% per year, reflecting mainly the expected growth in wind power. The share of 'others' will account for 7.4% of total primary energy supply in 2040. In contrast, primary fossil fuel will slightly decrease at an average rate of 0.2%. Its share of the total will account for 46.7% in 2040, down from 59.3% in 2015. The remaining 8.9% of the total share in 2040 will be hydro for electricity generation, increasing at an average annual growth rate of 0.2% (Figure 13.6).

**Figure 13.6: Primary Energy Supply by Fuel Type, BAU (1990–2040)**




BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

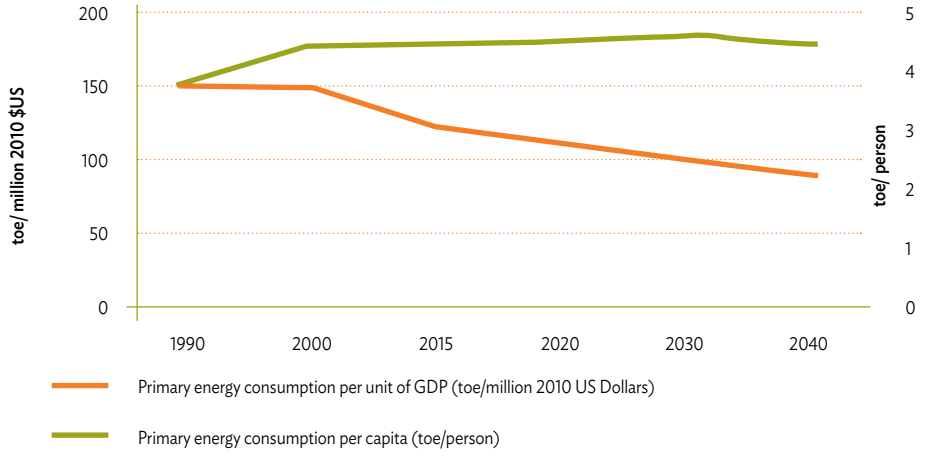
Source: Authors' calculations.

The lower growth of primary energy supply relative to GDP growth will result in lower energy intensity in the future. From 122 toe/million US$ in 2015, energy intensity will improve to 89 toe/million US$ in 2040. Primary energy supply per capita will remain constant at 4.5 toe per person in 2015–2040. Figure 13.7 shows primary energy intensity and energy per capita as indicators.

### 3.2.1. Alternative Policy Scenario (APS)

In the APS, primary energy supply is projected to grow at a lower rate of 0.5% per year to 23.2 Mtoe in 2040. Coal, oil, and gas are expected to show significant declines of 3.2%, 1.0%, and 0.7% per year, respectively. Geothermal primary energy is expected to grow by 2.9% per year. 'Others' primary energy, which includes biomass, solar, wind, liquid biofuels, and biogas, is expected to grow by 1.3% per year (Figure 13.8).

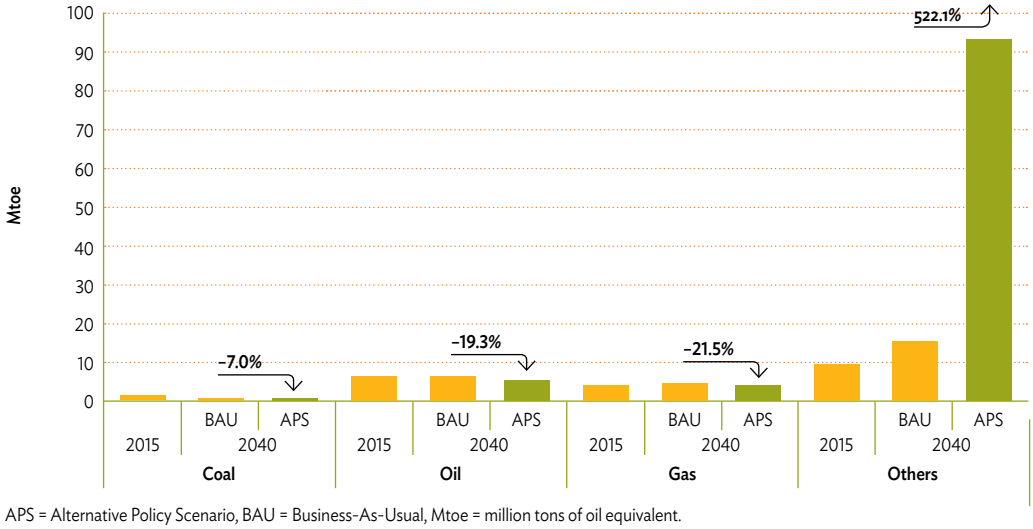
**Figure 13.7: Primary Energy Intensity and Energy per Capita Indicator, BAU (1990–2040)**




BAU = Business-As-Usual, GDP = gross domestic product, toe = tons of oil equivalent.

Source: Authors' calculations.

**Figure 13.8: Primary Energy Supply by Fuel Type, BAU and APS (2015 and 2040)**




APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

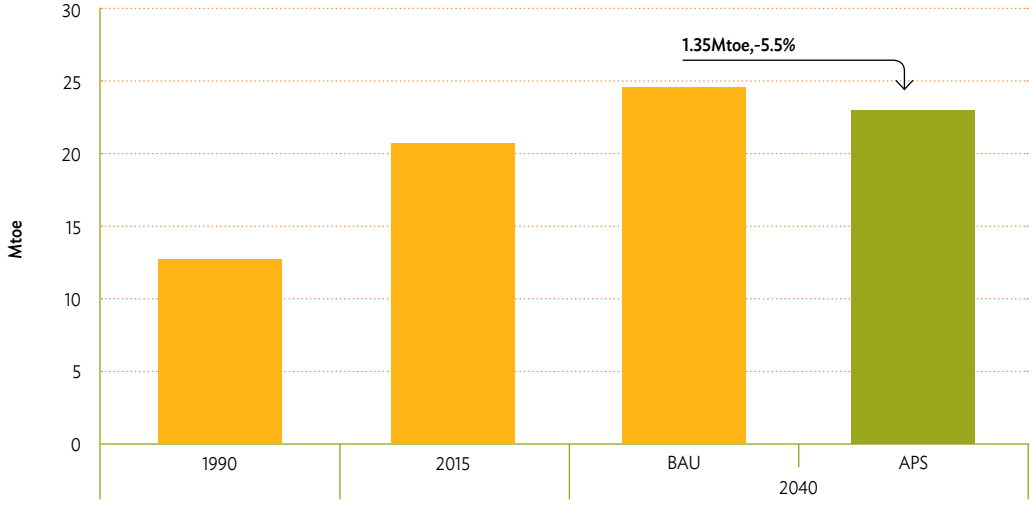
Note: The 'others' sector includes biomass, solar, wind, liquid biofuels, biogas, hydro, and geothermal.

Source: Authors' calculations.

## 3.3. Projected Energy Savings

Under the APS, energy savings could amount to 1.35 Mtoe or 5.5% less than under the BAU scenario in 2040. Energy savings is the difference between the primary energy supply in the BAU scenario and the APS (Figure 13.9).

**Figure 13.9: Total Primary Energy Supply, BAU and APS (1990, 2015, and 2040)**




APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

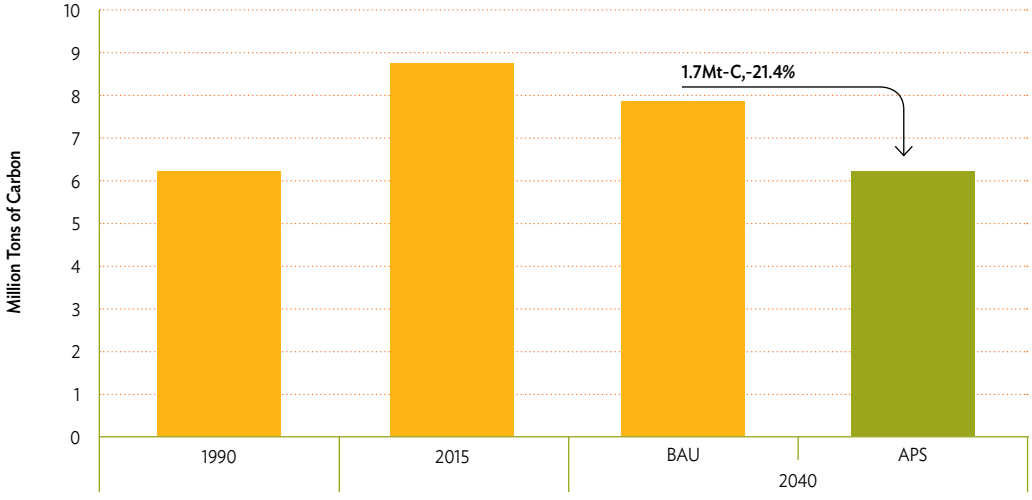
Source: Authors' calculations.

The above savings in primary energy are mainly due to a switch 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. Carbon Dioxide Emissions

Carbon dioxide ($CO_2$) emissions in the BAU scenario will decrease slightly, from 8.8 million tons of carbon (Mt-C) in 2015 to 7.9 Mt-C in 2040. In the APS, $CO_2$ emissions will decrease from 2015 to 2040 by 1.4% per year. The decrease reflects the switch to renewable energy in electricity generation, and the switch to electric vehicles in the transport sector. Figure 13.10 shows the difference of $CO_2$ emissions from energy consumption between the BAU scenario and the APS in 2040, compared with 1990 and 2015, in New Zealand.

**Figure 13.10: $CO_2$ Emissions from Energy Consumption, BAU and APS (1990, 2015, and 2040)**




APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mt-C = million tons of carbon.

Source: Authors' 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% 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-2019. 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. In early 2018, the government 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, the government should consider formulating and implementing stronger regulations to enhance the energy efficiency of new and existing buildings in the residential and commercial sectors. New Zealand should also consider a package of measures (including regulatory instruments) to improve the energy efficiency of industrial heat plants.

# References

International Energy Agency, (2017), *World Energy Balances*, Paris: IEA.