Chapter 8

Japan Country Report

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CHAPTER 8

Japan Country Report

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1. Background

Japan is a small island nation in Eastern Asia. It consists of several thousand islands spanning a land area of approximately 377,960 square kilometres and most of its land area is mountainous and thickly forested. Until 2009, it was the world's second largest economy after the United States, but in 2010 Japan was overtaken by China. Japan's real gross domestic product (GDP) in 2012 was US$4,622 (constant 2005 prices), and the population is currently about 128 million.

1.1. Energy Situation

Japan possesses limited indigenous energy resources and imports almost all of its crude oil, coal, and natural gas requirements to sustain economic activity.

In 2012, Japan's net primary energy consumption was 452.3 Mtoe. By energy type, oil represented the largest share, at 46.5 percent, coal was second at 24.8 percent, followed by natural gas (23.3 percent), and nuclear energy (0.9 percent). Others, such as hydro, geothermal, wind, and solar, represented the remainder of 4.5 percent. In 2012, net imports of energy accounted for about 99 percent of the net primary energy supply. With limited indigenous energy sources, Japan imported almost 100 percent of oil, 100 percent of coal, and 97 percent of gas.

Japan is a large importer of coal: steam coal for power generation, pulp and paper, and cement production; and coking coal for steel production. Domestic demand for natural gas is met almost entirely by imports of liquefied natural gas (LNG). Natural gas is mainly used for electricity generation, followed by reticulated city gas and industrial fuels. In 2012, primary natural gas consumption was 105.3 Mtoe.

Japan's final energy grew slowly, at 0.2 percent per year on average, from 297.8 Mtoe in 1990 to 308.8 Mtoe in 2012. The residential/commercial ('Other') sector had the highest growth rate during this period, at 1.1 percent per year, followed by the transport sector with 0.2 percent. Consumption in the industry sector decreased at a rate of 0.9

percent per year on average from 1990 to 2012. Oil was the most consumed product, with a share of 61.2 percent in 1990 and 53.0 percent in 2012. Electricity was the second most consumed product.

Japan's primary energy demand grew at a rate of 0.1 percent per year from 439.2 Mtoe in 1990 to 452.3 Mtoe in 2012. Amongst the major energy sources, the fastest growing fuels were natural gas and coal. Natural gas and coal consumption grew at an average annual rate of 4.0 percent and 1.7 percent, respectively, and nuclear energy declined by 10.9 percent from 1990 to 2012, due to the Great East Japan Earthquake. Oil consumption declined by 0.8 percent per year over the same period.

Japan has 281 GW of installed electricity generating capacity and generated about 1,026 TWh of electricity in 2012. Generation by energy type is broken-down as follows: thermal (coal, natural gas, and oil) at 85.9 percent; nuclear (1.6 percent); hydro (7.4 percent); and geothermal, solar, and wind taking up the remainder of 5.2 percent.

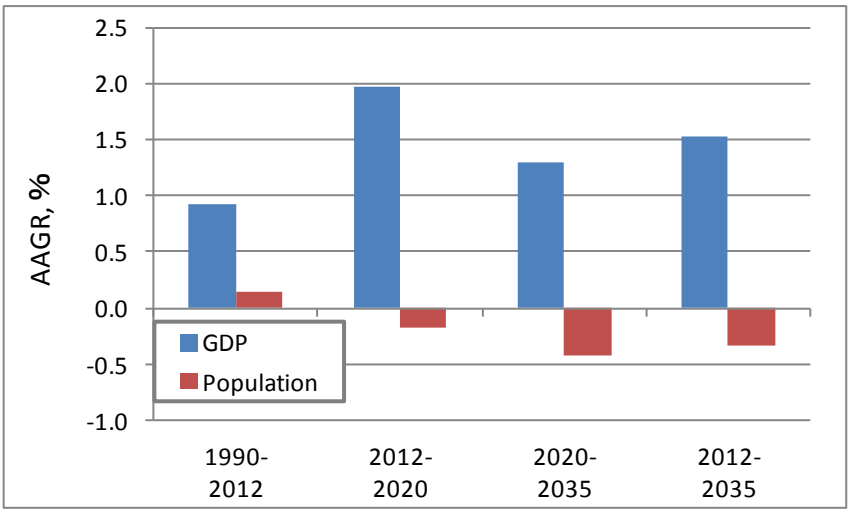
2. Modelling Assumptions

In this outlook, Japan's real gross domestic product (GDP) is assumed to grow at an annual average rate of 1.6 percent from 2012 to 2035, projecting recovery from economic recession. In 2014, Abenomics[1] is estimated to have strongly increased GDP The industry structure, with the maturing of Japanese society and Japan's economy, will become increasingly oriented toward services. Population growth, on the other hand, will decline by about 0.3 percent per year from 2012 to 2035 due to the declining birth rate. Japan's population is projected to decrease from 128 million in 2012 to 118 million in 2035. Figure 8-1 shows the assumptions of GDP and population growth used in this study.

The development of Japan's infrastructure and the expansion of its manufacturing industry will be saturated over the outlook period and production of crude steel, cement, and ethylene will gradually decline. The number of automobiles will decline with the decline in population.

[1] An economic programme introduced by Shinzo Abe upon starting his second term as Prime Minister of Japan in December 2012.

Figure 8-1. Growth Rate of GDP and Population

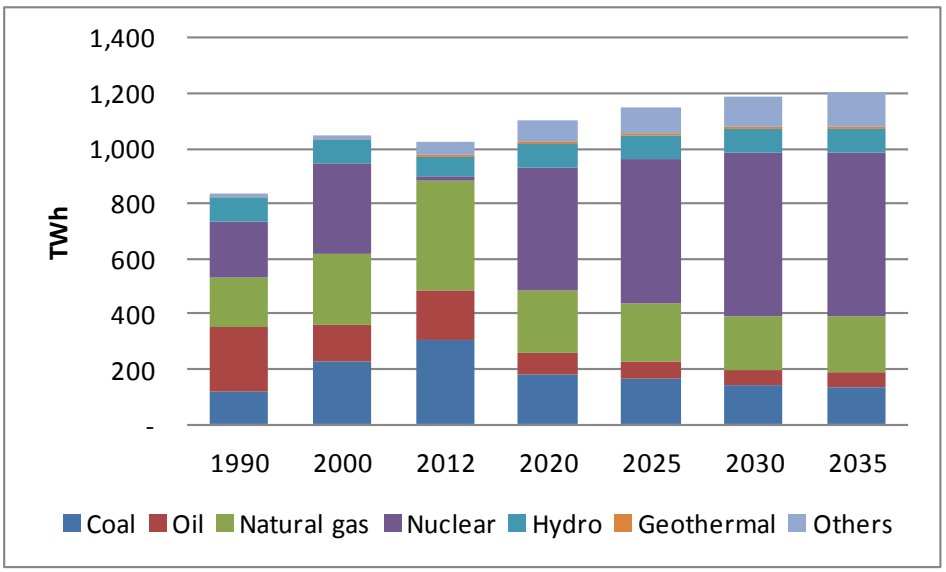


GDP = gross domestic product.

Source: Author's calculation.

The Strategic Energy Plan approved by the Cabinet in June 2010 highlighted that the share of zero emission power generation, including nuclear and renewable energy, will increase to 67 percent in 2030. It also assumed fourteen additional nuclear power plants would be constructed by 2030 and the capacity utilisation rate was expected to grow through to 2035. The capacity of hydro power plants would be around 70 percent of the resource potential, which would translate to an increase in capacity by 2035. On the other hand, supply from fossil fuel–fired power generation was projected to decrease.

Figure 8-2. Power Generation, BAU

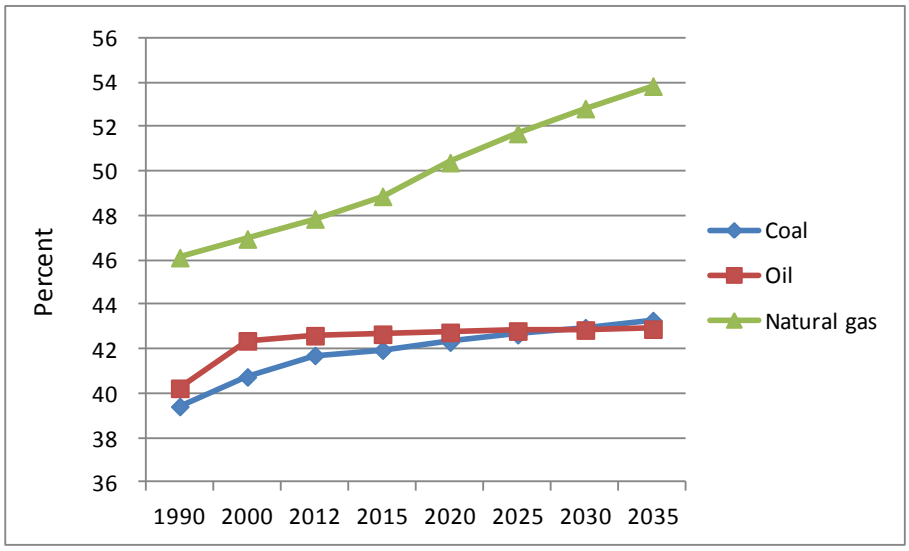


BAU = Business-as-Usual.

Source: Author's calculation.

Figure 8-2 shows the projected power generation mix in Japan to 2035 under the Business-as-Usual (BAU) scenario and Figure 8-3 shows the assumed thermal efficiencies of thermal power plants in the BAU scenario.

Figure 8-3. Thermal Efficiency, BAU



Source: Author's calculation.

Japan's energy saving goals will be attained through the implementation of national energy efficiency programmes in all energy consuming sectors. In the industry sector, energy savings are expected from improvements in manufacturing technologies. In the residential and commercial sectors, the 'Top Runner Program' is projected to induce huge savings in addition to programmes on energy management systems, improvements in adiabatic efficiency, lighting systems, and heat pump systems. In the transport sector, efficiency improvements will be achieved by improvements in vehicle fuel efficiency, including increases in the stock of hybrid cars and structural changes in vehicles.

3. Outlook Results

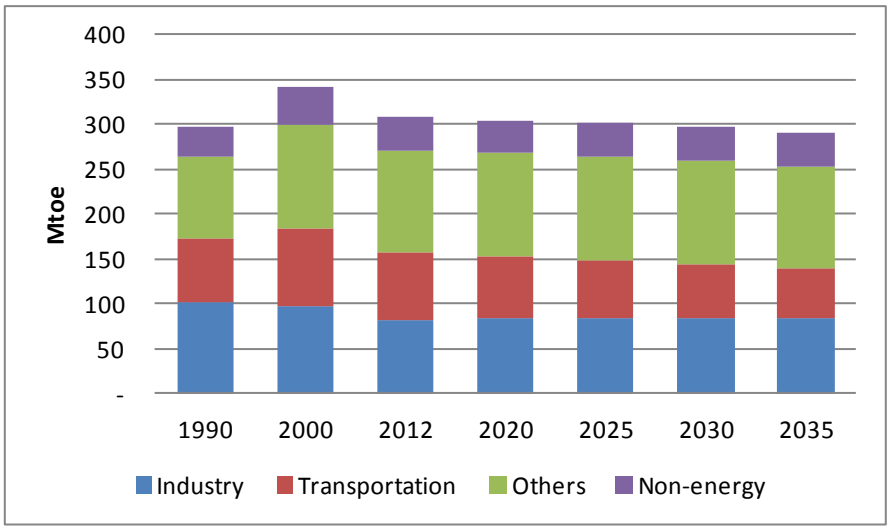
3.1. Business-as-Usual Scenario (BAU)

3.1.1. Final Energy Demand

With relatively low projected economic growth and a declining population, Japan's final energy demand from 2012 to 2035 is projected to decrease at an average rate of 0.3 percent per year in the BAU scenario. This is also driven by a projected decline in the consumption of the transportation as a result of improvements in energy efficiency. Final energy demand of the industrial sector is projected to increase at an annual average rate

of 0.1 percent from 2012 to 2035. Figure 8-4 shows projected final energy demand by sector from 1990 to 2035 under the BAU.

Figure 8-4. Final Energy Demand by Sector, BAU

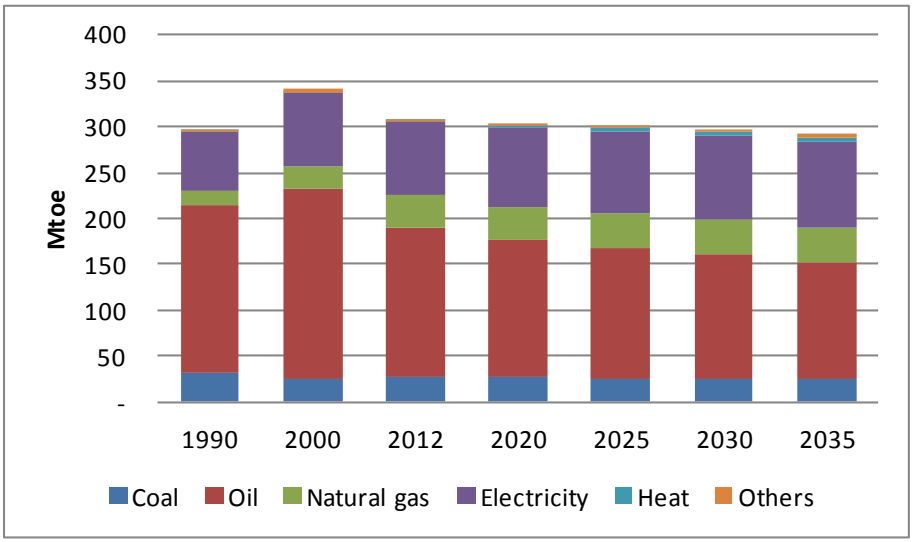


BAU = Business-as-Usual.

Source: Author's calculation.

By fuel type, consumption of coal and oil is projected to decrease at an average annual rate of 0.4 and 1.1 percent, respectively, from 2012 to 2035, whereas consumption of natural gas and electricity are projected to increase, at a rate of 0.4 and 0.7 percent per year, respectively, over this period. Figure 8-5 shows projected final energy demand by source from 1990 to 2035 under the BAU.

Figure 8-5. Final Energy Demand by Source, BAU



BAU = Business-as-Usual.

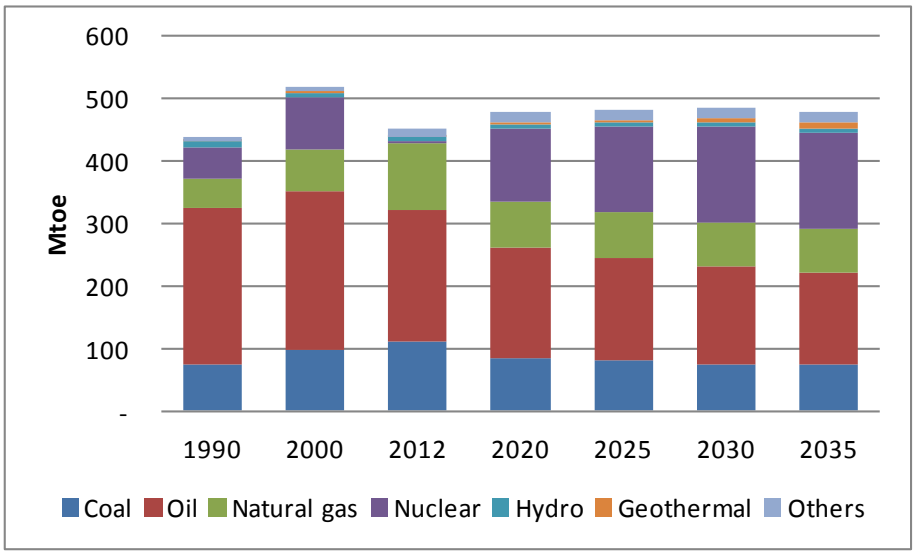
Source: Author's calculation.

3.1.2. Primary Energy Demand

Under the BAU scenario, Japan's net primary energy supply is projected to increase at an average annual rate of 0.3 percent per year, from 452.3 Mtoe in 2012 to 479.3 Mtoe in 2035 (Figure 8-6). This increase is mainly due to an expected increase in the use of nuclear energy, which is projected to grow at annual average rate of 17.0 percent from 2012 to 2035. The share of nuclear energy is projected to increase from 0.9 percent to 32.2 percent over this period. The Strategic Energy Plan of 2010 highlighted that the self-sufficiency rates of primary energy consumption, including renewable energy, will increase to 40 percent in 2030.

Consumption of coal, oil, and natural gas is expected to decrease at average annual rates of 1.8 percent, 1.5 percent, and 1.8 percent, respectively, from 2012 to 2035, due to the projected increase in consumption of nuclear and renewable energy.

Figure 8-6. Net Primary Energy Supply, BAU



BAU = Business-as-Usual.

Source: Author's calculation.

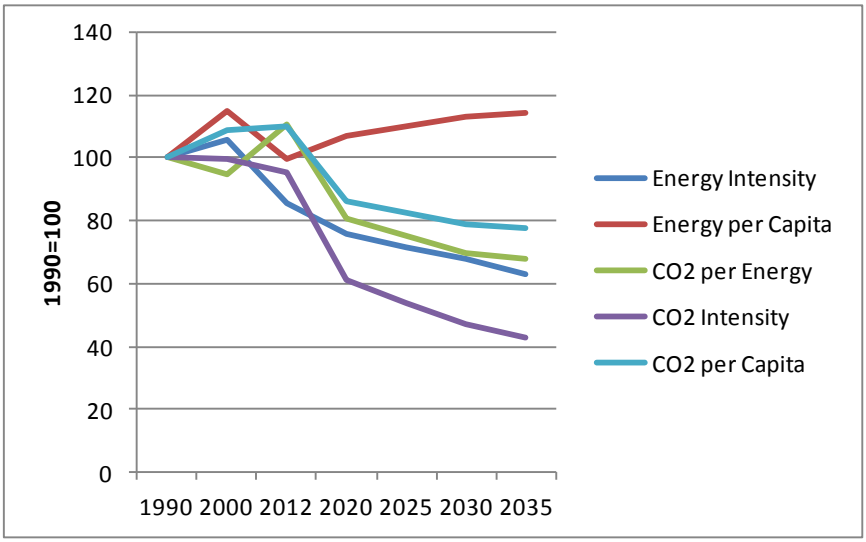
3.1.3. Energy Indicators

Energy consumption per capita up to 2035 will increase at a faster rate than in recent decades. The elasticity[2] between 2012 and 2035 is expected to be negative due to further energy intensity improvements and the decrease in population.

[2] Growth rate of GDP divided by the growth rate of energy consumption. For Japan, elasticity will be negative in the future as the growth rate of energy consumption will be negative whereas the growth rate of GDP is assumed to be positive.

Except for energy consumption per capita, all energy indicators will decrease from 2012 levels to 2035. CO_2 emission per person and the CO_2 intensity carbonisation rate (CO_2 emission per unit of energy consumption) will be about 60 percent lower than 1990 levels and about 20 percent lower than 2012 levels. Figure 8-7 shows the projected trends in various indicators of energy consumption in Japan from 1990 to 2035 under the BAU scenario.

Figure 8-7. Indices of Energy and CO_2 Intensities, Energy per Capita, and Carbonisation Rate, BAU



BAU = Business-as-Usual.

Source: Author's calculation.

3.2. Energy Saving and CO_2 Reduction Potential

3.2.1. Final Energy Demand

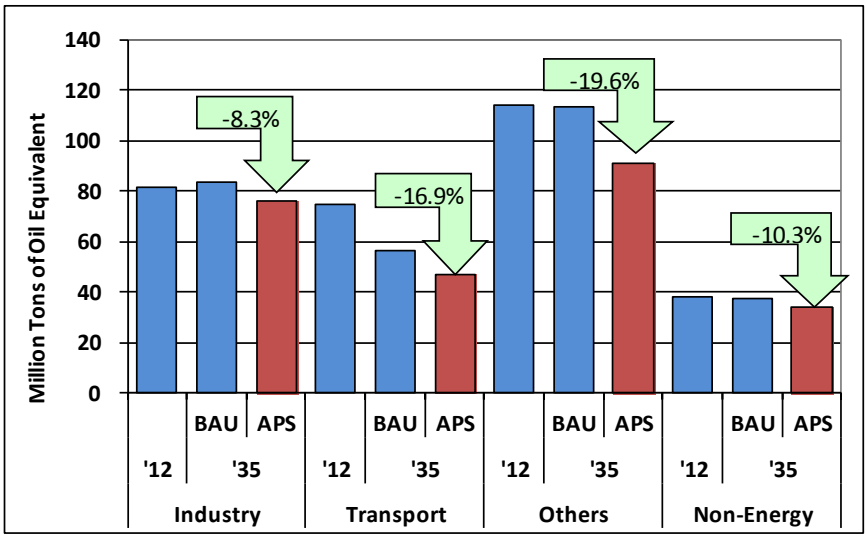
Under the Alternative Policy Scenario (APS), final energy demand is projected to decline at a faster rate, of 0.9 percent per year, from 308.8 Mtoe in 2012 to 248.8 Mtoe in 2035. A rapid decline of 2.0 percent per year is expected in the transport sector due to the Top Runner Program[3] and more aggressive energy management systems. Japan will implement continuous efforts to improve energy efficiency, especially with regard to

[3] The 'Top Runner Program' is Japan's energy efficiency programme that aims to improve the energy efficiency of household and office appliances as well as vehicles by setting the end-use energy performance of the best technology available on the market as the standard for each product category.

introducing energy efficient automobiles such as hybrid vehicles (HV), electric vehicles (EV), and plug-in hybrid electric vehicles (PHEV).

The industry sector and service sector will also improve their energy efficiency, but, despite their efforts, the steel and cement sectors will see a decline in energy efficiency. It will be difficult for these sectors to improve their energy efficiency drastically, because their capacity factors will be decreasing and they will use more renewable energy. Final energy demand by sector in the BAU scenario and APS are shown in Figure 8-8.

Figure 8-8. Final Energy Demand by Sector, BAU and APS



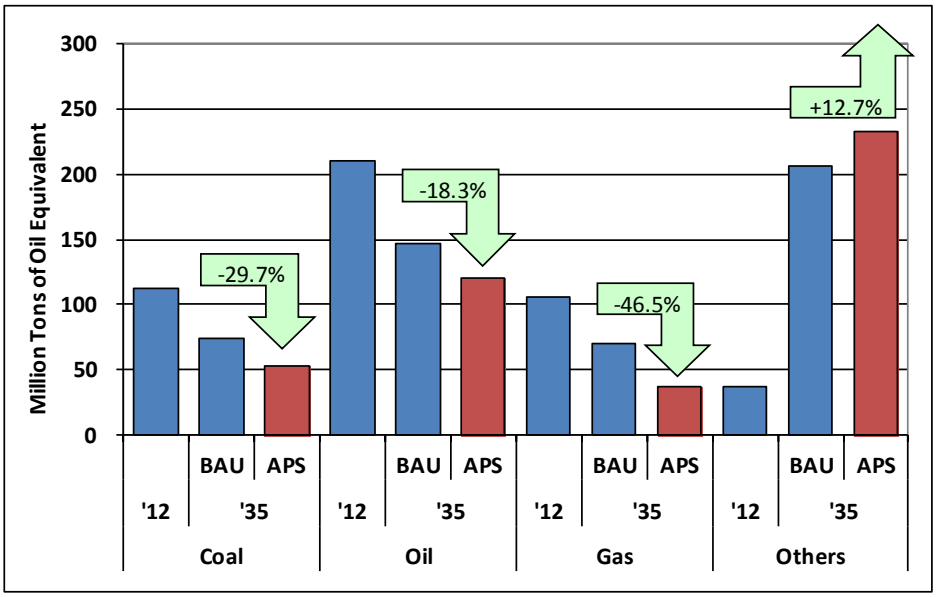
BAU = Business-as-Usual; APS = Alternative Policy Scenario.

Source: Author's calculation.

3.2.2. Primary Energy Consumption

In the APS, projected primary energy consumption of Japan will decline at a rate of 0.4 percent per year to 415.8 Mtoe in 2035, which is 36.4 Mtoe lower than primary demand in 2012. Coal, oil, and natural gas are expected to see decreasing annual average growth rates of 3.3 percent, 2.4 percent, and 4.4 percent, respectively, mainly due to the increase of nuclear energy, which is expected to grow at an annual average rate of 17.0 percent. Figure 8-9 shows primary energy supply by source under the BAU scenario and the APS.

Figure 8-9. Net Primary Energy Consumption by Source, BAU and APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.

Source: Author's calculation.

3.2.3. Projected Energy Saving

The energy savings that could be derived from the energy efficiency and conservation (EEC) goals and action plans of Japan are 63.5 Mtoe, the difference between the primary energy demand of the BAU scenario and the APS (Figure 8-10). This is equivalent to a 13.2 percent reduction in Japan's BAU consumption in 2035.

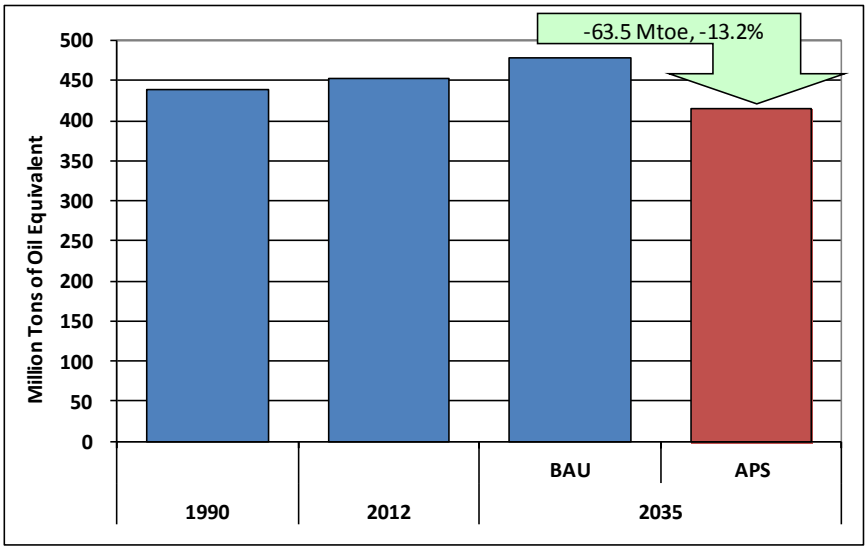
In terms of savings in final energy demand, an estimated saving of 22.3 Mtoe is expected in the residential/commercial sector and 9.6 Mtoe in the transportation sector in 2035 in the APS, relative to BAU. The projected decreases in consumption of the transportation sector from 2012 to 2035 are 17.8 Mtoe in the BAU scenario and 27.4 Mtoe in the APS. This can be attributed to an increase in the use of more efficient vehicles.

3.2.4. CO_2 Emissions from Energy Consumption

Under the BAU scenario, CO_2 emissions from energy consumption are projected to decrease at an average annual rate of 1.9 percent from 332.8 Mt-C in 2012 to 216.6 Mt-C in 2035 (Figure 8-11).

Under the APS, the annual decrease in CO_2 emissions from 2012 to 2035 is projected to decline at a faster average annual rate, of 3.3 percent. This rate of decrease is higher than that in primary energy demand, which is 0.4 percent. CO_2 emissions in 2035 are projected to be about half of emissions in 1990. This indicates that Japan's energy saving goals and action plans are very effective in reducing CO_2 emissions.

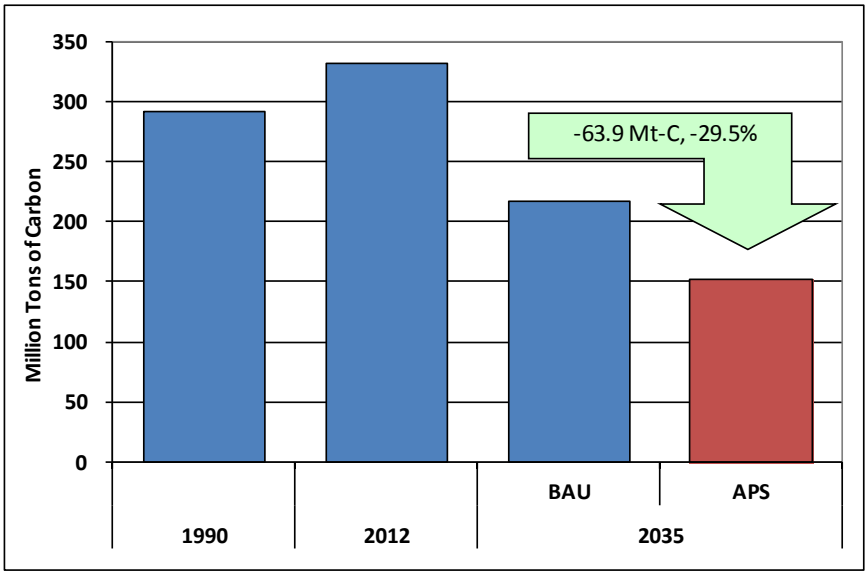
Figure 8-10. Primary Energy Demand, BAU and APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.

Source: Author's calculation.

Figure 8-11. CO_2 Emissions from Fossil Fuel Combustion, BAU and APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.

Source: Author's calculation.

4. Implications and Policy Recommendations

Japan's primary energy intensity has been declining since 1980 and it has the lowest level in the world. This could be due to the enormous improvements in energy efficiencies in both supply side and demand side technologies that have been developed and implemented in Japan. The fact that Japan imports most of its energy requirements is another reason why the country is very aggressive in improving energy efficiency.

In the APS and even under the BAU scenario, CO_2 emissions in 2035 are projected to be much lower than the 1990 level. This indicates that Japan could achieve its target of reducing greenhouse gas (GHG) emissions by half from 2005 to 2050. But to achieve the final target, Japan should effectively implement its policies on low carbon technology, including energy efficiency and zero emission energy, such as the Top Runner Program and on renewable energy.

Moreover, as the world leader in energy efficiency, Japan should introduce such successful policies to other countries as early as possible as doing so would enable Japan to contribute to reducing world energy consumption. This would benefit Japan not only economically, but also in that there would be more available energy in the market.

Therefore, Japan should not only look at its own market but also to the world market as a whole when developing energy efficiency policies and low carbon energy policies. Reduced energy consumption of the world would mean more available energy for years to come.

The New Basic Energy Plan had been finally approved by the cabinet in April 2014. Nuclear energy is referred to as ‘an important base load power source’ with no concrete figures, while renewables are written with strong expression of the additional introduction. That is, the introduction of renewables should be accelerated as much as possible, followed by continuous active promotion. Although new specific numerical targets are being discussed under the New Basic Energy Plan, nuclear and renewable energy must be a great progress for Japan to be able to create a realistically qualitative energy plan.