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 kilometers and most of its land area is mountainous and thickly forested. Until 2010, it was the world's second largest economy after the United States with real gross domestic product (GDP) in 2010 of about US$ 5,029 billion (constant 2000 prices). In 2011, China surpassed Japan as the world's second-largest economy. Japan's population is currently about 127 million people with a per capita income of US$ 39,530 in 2010.

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. Proven energy reserves included around 44 million barrels of oil (2010), 738 BCF of natural gas (2010), 350 Mt of coal (2011).

In 2010, Japan's net primary energy supply was 494.0 Mtoe. By energy type, oil represented the largest share at 41.1 percent, coal was second at 23.3 percent, followed by natural gas (17.4 percent), and nuclear energy (15.2 percent). Others, such as hydro, geothermal, wind and solar, represented the remainder of 3 percent. In 2010, net imports of energy accounted for about 82 percent of the net primary

energy supply. With limited indigenous energy sources, Japan imported almost 99 percent of oil, 99 percent of coal, and 96 percent of gas.

Japan is 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 LNG. Natural gas is mainly used for electricity generation, followed by reticulated city gas and industrial fuels. In 2010, primary natural gas supply was 86.0 Mtoe.

Japan's final energy demand experienced a low growth of 0.4 percent per year from 300.1 Mtoe in 1990 to 324.6 Mtoe in 2010. The residential/commercial (other) sector had the highest growth rate during this period at 1.3 percent per year followed by the transport sector with 0.4 percent. Consumption in the industry sector decreased at a slow pace of 0.7 percent per year over the period 1990-2010. Oil was the most consumed product having a share of 61.3 percent in 1990, slightly decreasing to 52.8 percent in 2010. Electricity was the second most consumed product.

Japan's primary energy demand grew at a faster rate than final energy demand at 0.6 percent per year from 436.6 Mtoe in 1990 to 494.0 Mtoe in 2010. Among the major energy sources, the large growing fuels were natural gas and coal. Natural gas consumption and coal consumption grew at an average annual rate of 3.4 percent and 2.0 percent respectively while nuclear energy grew at 1.8 percent over the period 1990-2010. Oil consumption declined by 1.0 percent per year over the same period.

Japan has 282 GW of installed electricity generating capacity and generated about 1,111 TWh of electricity in 2010. The generation amount by energy type is broken-down as: thermal (coal, natural gas and oil) at 64 percent, nuclear (26

percent), hydro (7 percent) and geothermal, solar and wind taking up the remainder of 3 percent.

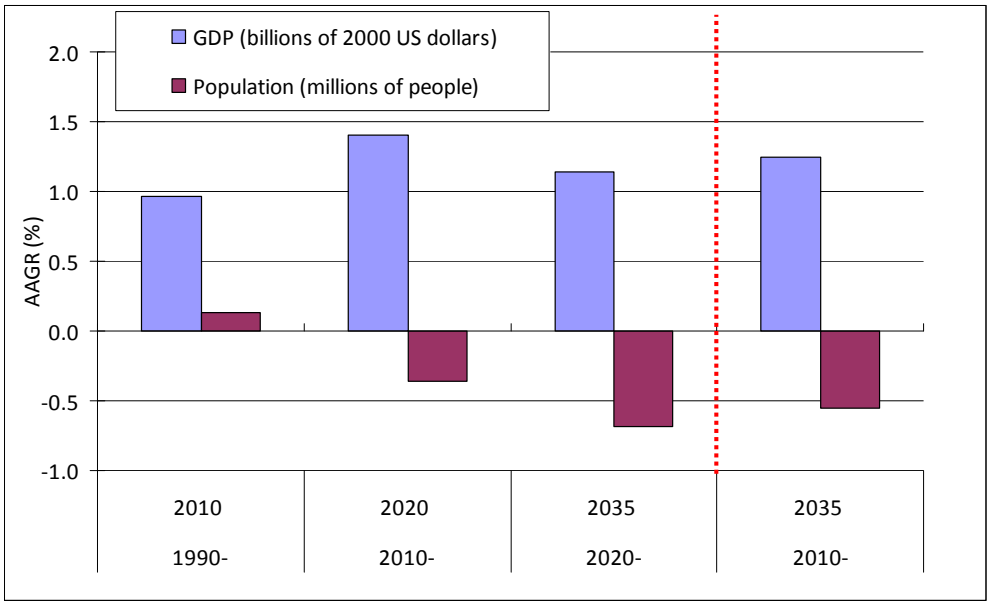
2. Modeling Assumptions

In this outlook, Japan's gross domestic product (GDP) is assumed to grow at an average annual rate of 1.2 percent from 2010 to 2035, and economic growth is projected to recover from economic recession. In 2013, Abenomics[1] is expected to increase GDP strongly. The industry structure, with the maturing of Japanese society and the Japan's economy, will become increasingly oriented toward services. Population growth, on the other hand, will decline by about 0.6 percent per year from 2010 to 2035 due to the declining birth rate. Japan's population is projected to decrease from 127 million in 2010 to 111 million in 2035.

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 program introduced by Prime Minister, Shinzo Abe upon his second term as Prime Minister of Japan in December 2012.

Figure 8-1: Growth rate of GDP and Population



Before the Great East Japan Earthquake, fourteen additional nuclear power plants were assumed to be constructed by 2030 and the capacity utilization rate was expected to grow through to 2035. However, it is now not clear as to how many nuclear power plants will be operating in 2035. The capacity of hydro power plants would be around 70 percent of the resource potential that would translate to an increase in capacity by 2035. Supply from oil fired power plants is projected to decrease, while natural gas power plant capacity is expected to increase to more than other fossil fuel power generation, due to natural gas high thermal efficiency and relatively small CO_2 emissions.

Figure 8-2: Power Generation, BAU

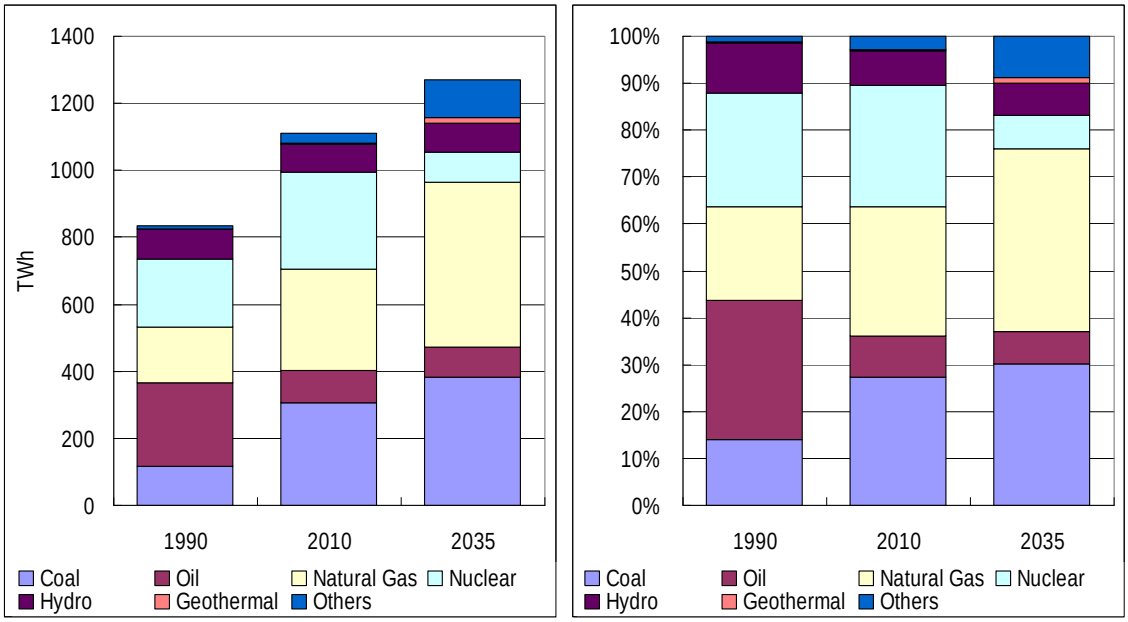
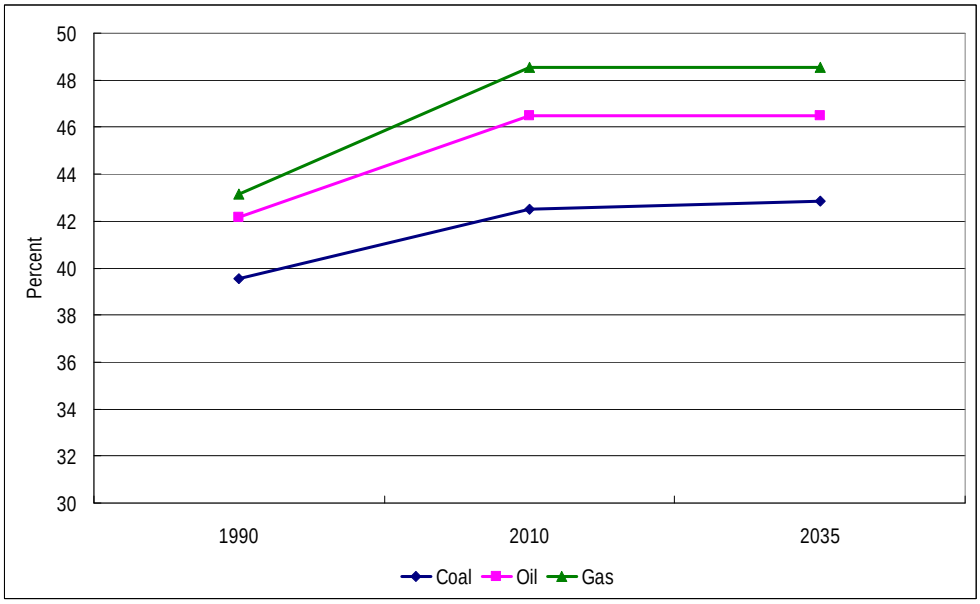


Figure 8-3: Thermal Efficiency, BAU



Japan's energy saving goals will be attained through the implementation of national energy efficiency programs in all energy consuming sectors. For 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 programs on energy management systems, improvements in adiabatic efficiency, lighting systems, and heat pump systems. In the transport sector, efficiency improvements will be achieved from improvements in vehicle fuel efficiency, including increases in the stock of hybrid cars and structural changes in vehicles.

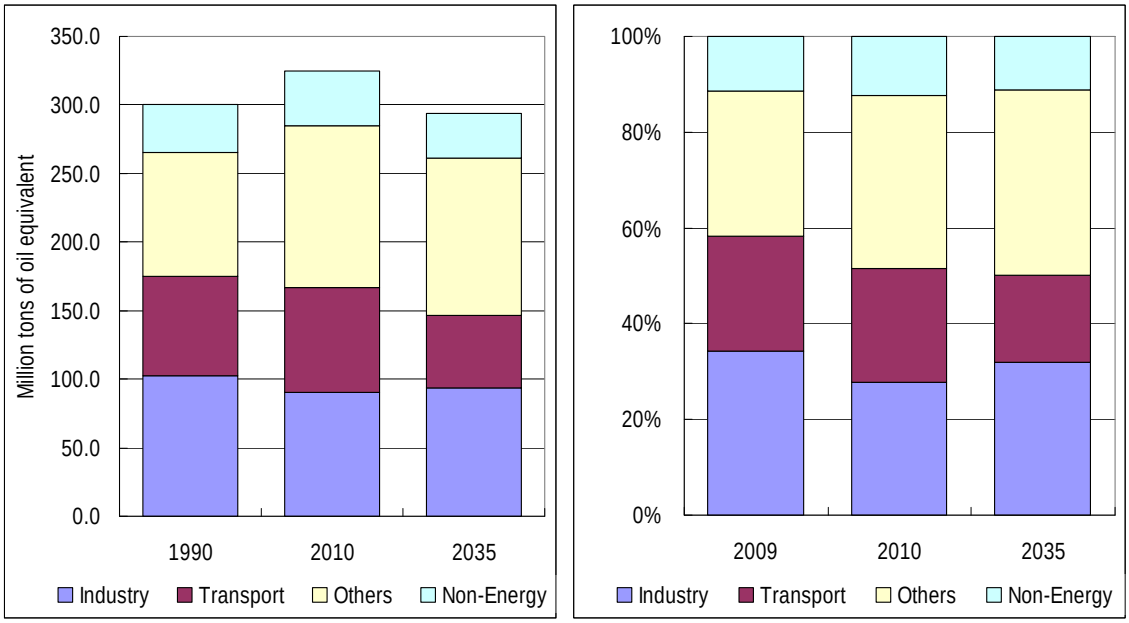
3. Outlook Results

3.1. Business as Usual Scenario (BAU)

3.1.1. Final Energy Demand

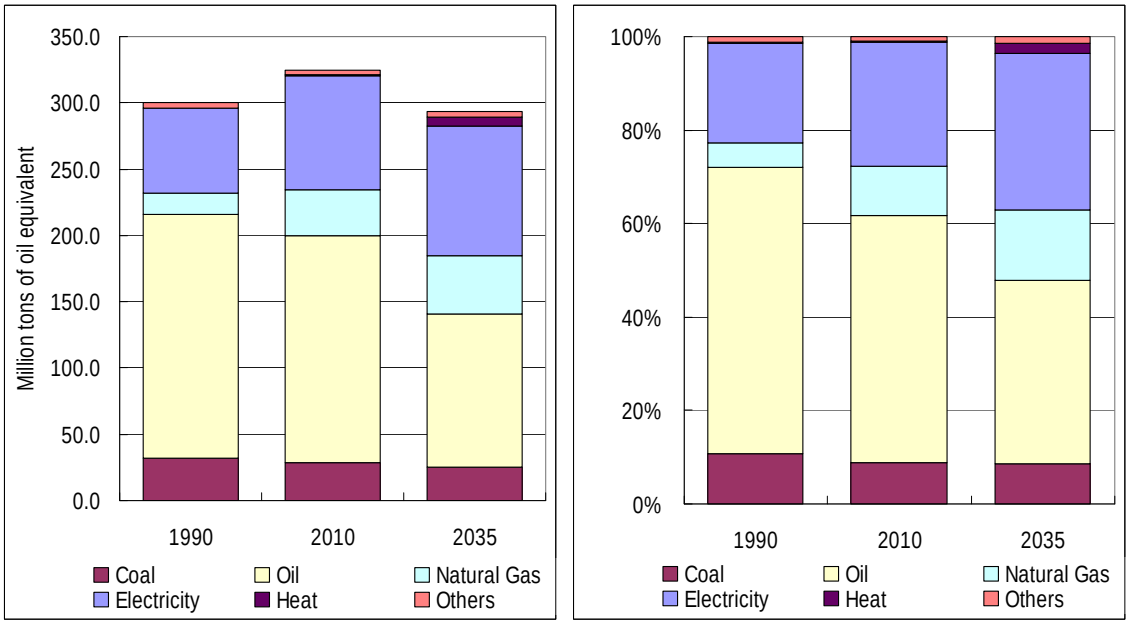
With the projected relatively low economic growth and the declining population, Japan's final energy demand from 2010 to 2035 is projected to decline at an average rate of 0.4 percent per year in the BAU scenario. This is also driven by the projected decline in the consumption of the transportation as well as residential and commercial (others) sectors brought about by improving energy efficiency. The final energy demand of the industrial sector is projected to increase at an average annual rate of 0.2 percent between 2010 and 2035.

Figure 8-4: Final Energy Demand by Sector



By fuel type, consumption of coal and oil is projected to decrease at an average annual rate of 0.5 and 1.6 percent respectively between 2010 and 2035. Consumption of natural gas and electricity are projected to increase, however, at a rate of 1.0 and 0.5 percent per year respectively over the period.

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

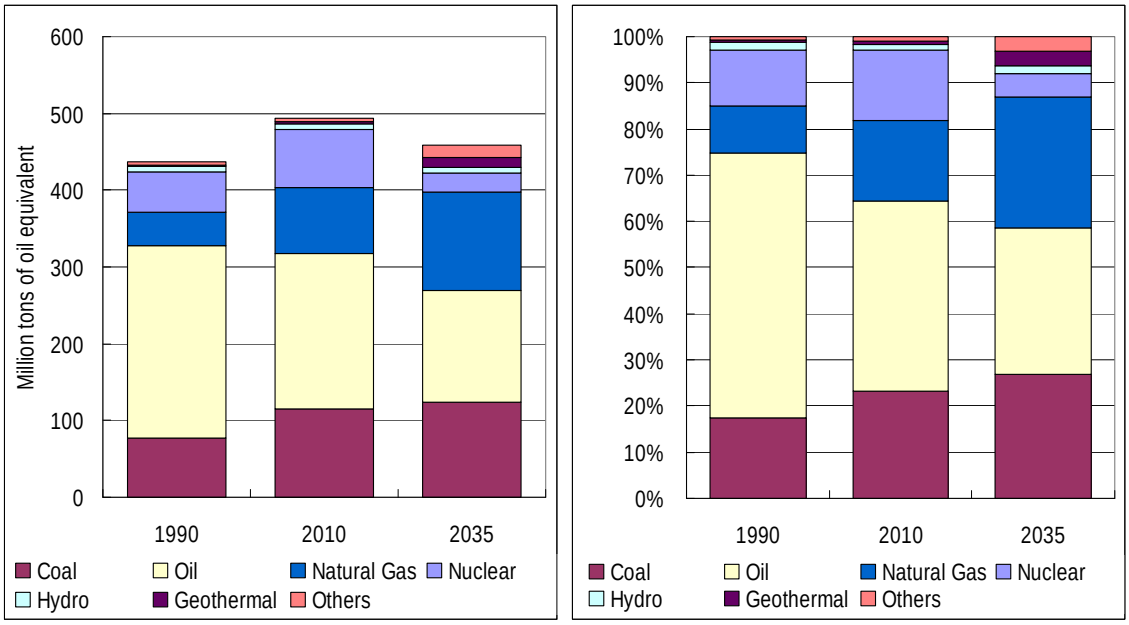


3.1.2. Primary Energy Demand

Under the BAU scenario, Japan's net primary energy supply is projected to decline at an average annual rate of 0.3 percent per year from 494.0 Mtoe in 2010 to 458.1 Mtoe in 2035. This decline is due to the decreasing use of oil and nuclear at annual average rates of 1.3 percent and 4.5 percent, respectively over the period 2010-35. The shares of oil and nuclear in 2010 and 2035 are projected to decrease from 38.7 percent to 31.7 percent and 13.9 percent to 5.2 percent, respectively.

Natural gas and coal consumption will, however, increase at average annual rates of 1.6 percent and 0.3 percent respectively over the same period.

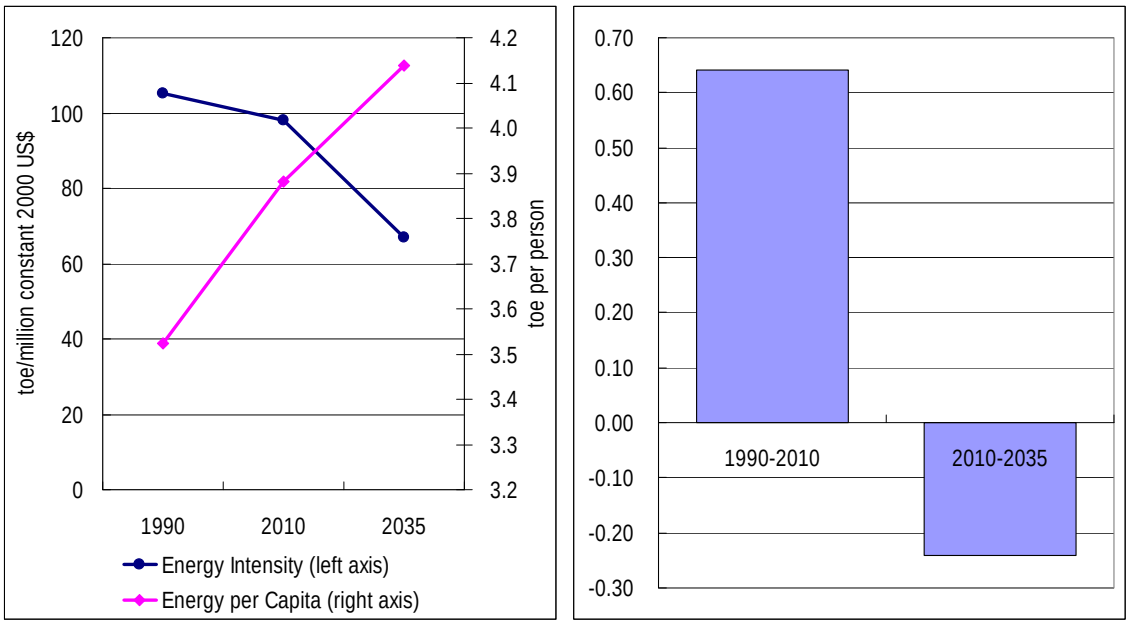
Figure 8-6: Primary Energy Demand, BAU



3.1.3. Energy Intensity and Elasticity

The primary energy intensity toward 2035 will be improved at faster rate than in the last decades. The elasticity[2] between 2010 and 2035 is expected to be negative due to further energy intensity improvement and the decrease in population.

Figure 8-7: Energy Intensity, BAU



3.2. Energy Saving and CO_2 Reduction Potential

3.2.1. Final Energy Demand

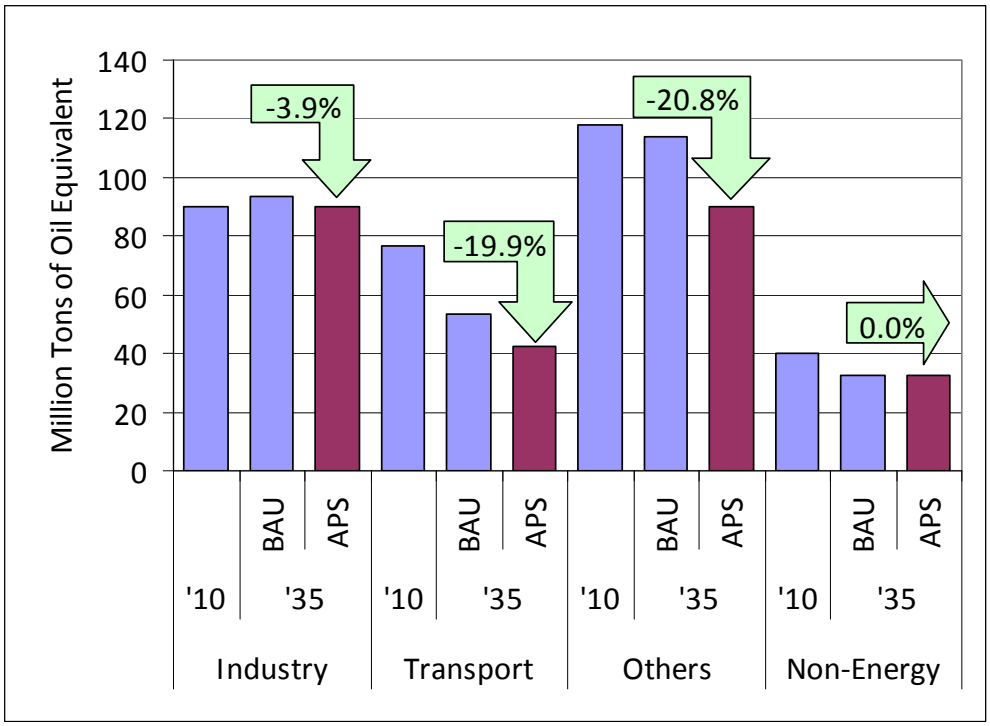
In the Alternative Policy Scenario (APS), final energy demand is projected to decline at a faster rate of 1.0 percent per year from 324.6 Mtoe in 2010 to 255.6 Mtoe in 2035. A rapid decline of 2.3 percent per year will be experienced in the transport sector due to the Top Runner Program and more aggressive energy management systems. Japan will implement continuous efforts to improve energy

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

efficiency, especially with regard to 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. The final energy demand by sector in the BAU and APS are shown in Figure 8-8.

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

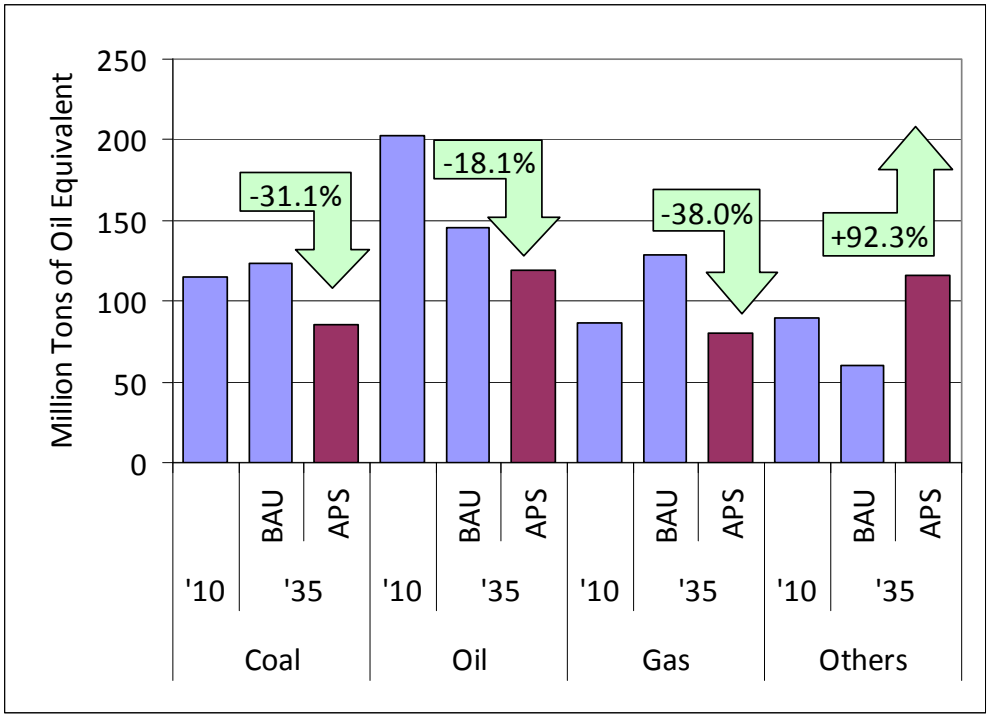


3.2.2. Primary Energy Demand

In the APS, the projected primary energy demand of Japan will decline at a rate of 0.8 percent per year to 400.1 Mtoe in 2035, lower by 93.9 Mtoe than the primary

demand in 2010. Coal, oil and natural gas will have decreasing average annual growth rates of 1.2 percent, 2.1 percent and 0.3 percent, respectively. These decreases are mainly due to energy efficiency and conservation measures in the demand side.

Figure 8-9: Primary Energy Demand by Source, BAU and APS



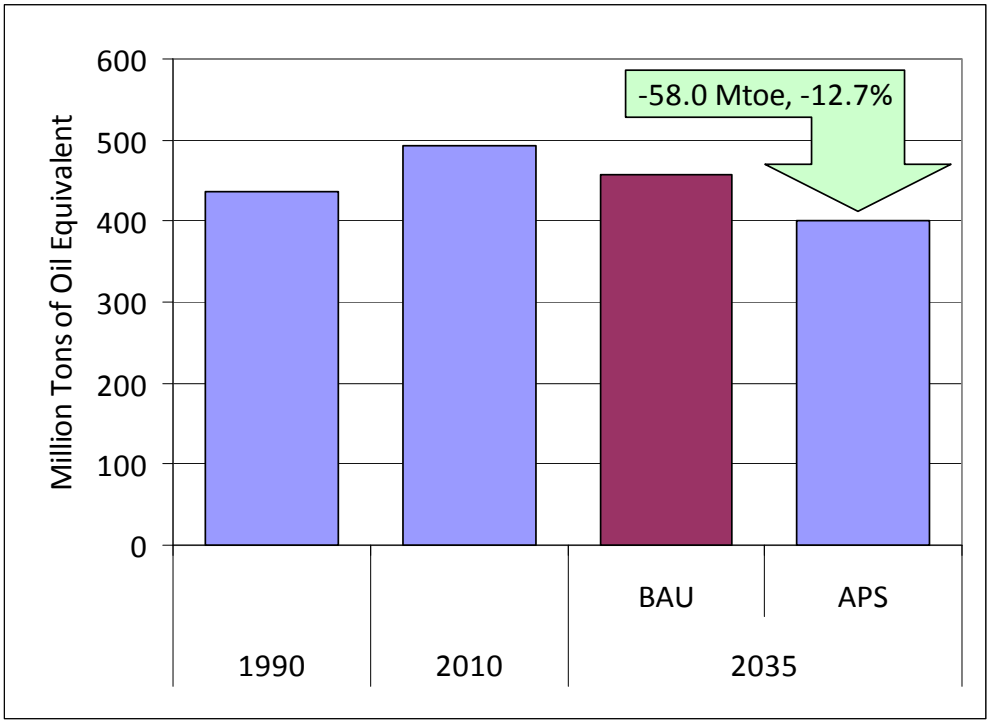
3.2.3. Projected Energy Saving

The energy savings that could be derived from the EEC goals and action plans of Japan are 58.0 Mtoe, the difference between the primary energy demand of the BAU and the APS. This is equivalent to 12.7 percent reduction of Japan's BAU consumption in 2035.

In terms of savings in final energy demand, there is an estimated saving of 23.8 Mtoe in the residential/commercial sector, 10.6 Mtoe in the transportation sector in

2035 in the APS, relative to BAU. The energy savings in transportation achieved from 2010 to 2035 are 23.7 Mtoe and 34.3 Mtoe in the BAU and APS respectively, due to the increase of more efficient vehicles.

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



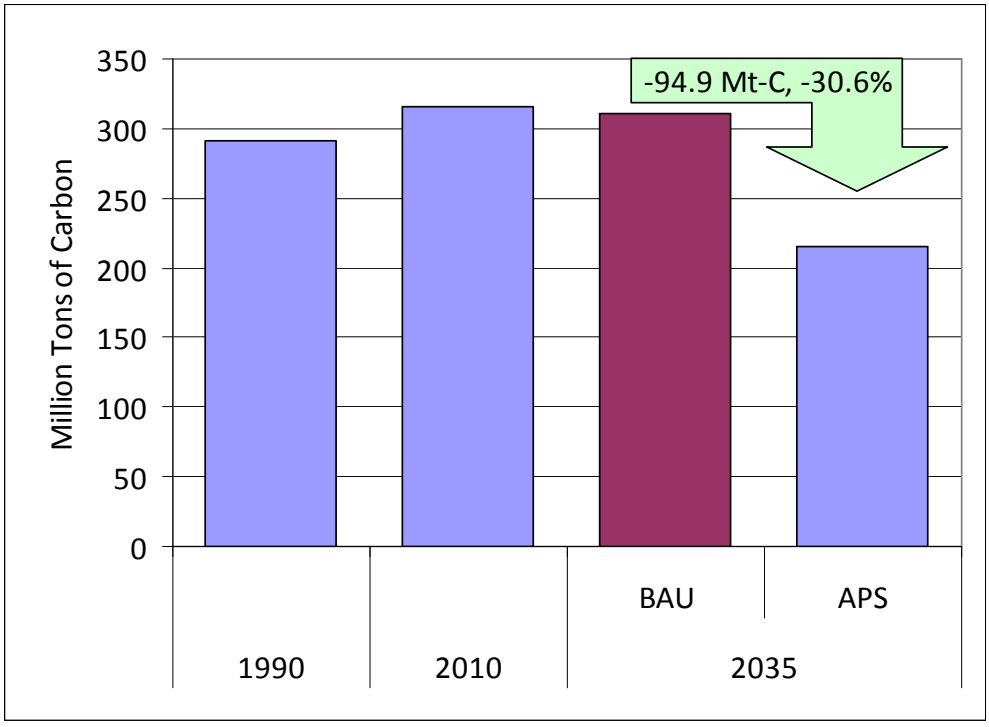
3.2.4. CO_2 Emissions from Energy Consumption

Under the BAU, CO_2 emissions from energy consumption are projected to decrease at average annual rates of 0.1 percent from 315.8 Mt-C in 2010 to 310.4 Mt-C in 2035. This decrease is lower than the decrease in primary energy demand indicating that Japan will need carbon intensive fuels to compensate for the limited nuclear power generation.

Under the APS, the annual decrease in CO_2 emissions from 2010 to 2035 is projected to decline at average annual rates of 1.5 percent. This decrease rate is also faster than the decrease in primary energy demand of 0.8 percent. In addition, CO_2 emissions in 2035 are projected to be lower than the 1990 level in the APS.

This indicates that the energy saving goals and action plans of Japan are very effective in reducing CO_2 emissions.

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



4. Implications and Policy Recommendations

Japan's primary energy intensity has been on a decline since 1980 and it is 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 in very aggressive in improving energy efficiency.

In the APS, CO_2 emissions in 2035 are projected to be lower than the 1990 level. This indicates that Japan could be on the downward trend to achieve its target of reducing GHG emissions by half from 2005 to 2050. However, 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, renewable energy, and so on.

In addition, as the leader in the world in energy efficiency, Japan should introduce such successful policies to other countries as early as possible. By doing this, Japan is able to contribute to reducing world energy consumption. This would not only benefit Japan economically but it would also benefit from 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 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 is still under discussion in Japan. Political change will occur under the new administration but this modeling analysis still considers the assumptions of previous administrations, namely METI's projection in 2010 and government discussion in 2012. While the current reduction target is 25% from 1990 to 2020, the Government has a policy to withdraw the current target and make a more realistic target consistent with the New Basic Energy Plan.