Chapter 7

Indonesia Country Report

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CHAPTER 7

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1. Background

Indonesia is the largest archipelagic state in Southeast Asia comprising of 17,504 islands scattered over both sides of the equator. The five largest islands are Java, Sumatra, Kalimantan (the Indonesian part of Borneo), New Guinea (shared with Papua New Guinea), and Sulawesi. The country shares land borders with Papua New Guinea, East Timor and Malaysia. Other neighbouring countries include Singapore, the Philippines, Australia, and the Indian territories of Andaman and Nicobar Islands.

Indonesia covers an area of 1,910,931 square kilometres and is the world's 16th largest country in terms of land area. The 2010 population census showed that Indonesia's population reached 237.6 million people, and it is still the world's fourth most populous country. Its average population density is 124 people per square kilometer. The population has continued to increase, reaching 241 million people in 2011, resulting in a population density of 126 people per square kilometer. By end of 2012, the population reached almost 250 million people.

Economic growth in Indonesia in 2011 was the fastest since before the Asian financial crisis as rising investment and domestic spending countered a slowdown in export demand due to Europe's debt crisis. Real GDP grew at almost 6.5 percent in 2011 after a revised 6.2 percent gain the previous year (2010). In 2011, Indonesia's real GDP was US$ 292 billion (constant 2000 US$) and reached. For 2012, the real GDP of the country was 311 billion rupiah, increasing at an average ate of 6.2% per

year..

From 1990, GDP has grown at an average rate of 4.7 percent per year to 2010. GDP per capita in 2010 was around US$1200 dollars while in 1990 it was only US$600.

Indonesia is richly endowed with natural resources. It was previously an OPEC member, but the increasing demand for oil products had made the country became a net importer of oil. Indonesian crude oil proven reserves were 11.6 billion barrels in 1980, declining to 9 billion barrels by 1988. Since then, Indonesia's oil reserves continued to decline reaching 5.4 billion barrels in 1990 and 4.2 billion barrels in 2009. As of January 2013, proven crude oil reserves are estimated at around 3.5 billion barrels.

Indonesia is the world's largest liquefied natural gas (LNG) exporter. Its natural gas proven reserves were 2.9 trillion cubic meters (TCM) in 1990, these declined slightly in 2005 to 2.5 TCM. Proven reserves increased to 3.2 TCM (around 110 trillion cubic feet) in 2010. Indonesia is also a coal exporter with proven coal reserves of around 5.5 billion tons at the end of 2010.

In addition to fossil energy resources, Indonesia's non-fossil energy resources include hydro, geothermal, biomass and other renewables such as solar and wind. For hydro, the estimated potential is around 75 GW while the estimated geothermal potential is more than 28 GW.

Indonesia's total primary energy consumption was almost 159 Mtoe in 2010. Oil represented the largest share of primary energy consumption in 2010 at almost 46 percent, followed by natural gas at 25 percent and coal at 19 percent. The remaining share of about 10 percent represents hydro, geothermal and others.

Indonesia has around 34 GW of installed electricity generating capacity and generated almost 160.5 TWh of electricity in 2010. The state electricity company of Indonesia, PT PLN PERSERO, owns and operates generation plants with a combined capacity of about 26.5 GW in 2010 composed of: 75.0 percent oil, 6.0 percent coal, 3.7 percent gas, 13.7 percent hydro, and 1.6 percent geothermal. There are also wind and solar power plants but the capacity is still small.

2. Modelling Assumptions

Indonesia's GDP growth was 6.14 percent in 2010 because of high export demand for mining products and non-oil and gas products. In early 2013, the Indonesian Bureau of Statistics (BPS) announced that GDP growth will continue to increase and is expected to reach 6.7 percent in 2013, higher than 2012 which was recorded as 6.2 percent.

GDP growth is assumed to continue to be 6.7 percent per year until 2015. From 2015, the National Energy Council assumptions of 8 percent up to 2025 and 7.5 percent until 2035 have been applied. On the average, the assumed annual growth in Indonesia's GDP between 2009 and 2035 is around 7.5 percent.

Although the prediction of the GDP for Indonesia is around 7 to 7.5 percent per year, for the purpose of this study it was assumed that real GDP would grow slower at an average annual growth rate of 5.4 percent over the 2010 to 2035 period.

Population growth is assumed to increase at an average of 1.0 percent per year between 2010 and 2035. This is higher than the assumption used in previous study (0.9 percent per year) which was based on the assumptions of the National Energy Council.

With regards to future electricity supply, Indonesia will increase its usage of coal as part of the Government Crash Program for power generation. During the First Phase of the program an additional 10,000 megawatts (MW) of coal-fired electricity capacity will be built by 2014. In addition, the Government is also embarking on the Second Phase where additional capacities will be mainly coming from geothermal energy and other renewable energy sources. This is in line with the projected increasing share of renewable energy in the future electricity supply mix in response to the renewable portfolio standard (RPS).

Supply from gas-fired power plants is also expected to increase. However, improvements to gas supply infrastructure are required. In contrast, generation from oil-fired power plants is assumed to decline significantly. Last year's study assumed that nuclear will become part of the future electricity supply mix in Indonesia from 2018 onwards. This was deferred following the incident at the Fukushima nuclear power station in Japan in March 201. As a result of this deferral, nuclear power plants are only assumed to be available in the APS after 2020. In this regard, the

study will include nuclear after 2020 with 2 units each with a capacity of 1000MW. The number of nuclear plants to be built by 2035 was limited to a maximum of 3 units with a total combined capacity of 3000MW.

For the energy efficiency scenario, the National Energy Council has yet to issue the National Energy Policy 2010-2050. In this regard, the national goal to achieve GDP energy elasticity of less than 1 by 2025 has been used as the energy saving target for this year's study. Like the previous study, specific energy saving targets by sector was assumed as shown in Table 7-1.

Table 7-1: Energy Conservation Potential to 2020

Sector	Energy Conservation Potential (RIKEN) (%)	Energy Conservation Potential* (%)	Energy Conservation Potential** (%)
Industry	15-30	31	20
Transportation	25	34	24
Residential/Commercial	10-30	34	16

Note: * Sectoral target submitted at ECTF in Myanmar in 2009. ** Sectoral target assumed for the study

3. Outlook Results

3.1 Business as Usual Scenario (BAU)

3.1.1. Final Energy Demand

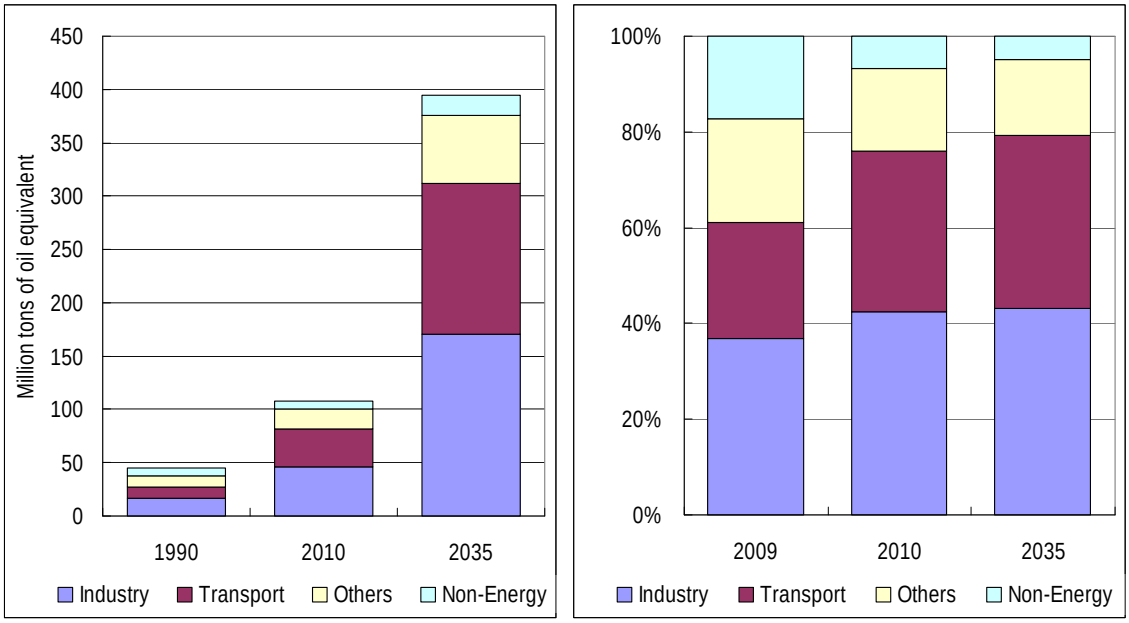
Indonesia's final energy demand increased at an average annual rate of 4.4 percent between 1990 and 2010 period, increasing from 45 Mtoe to 108 Mtoe. Given the assumed economic and population growth, the growth in the final energy consumption will continue but at a faster rate of 5.3 percent per year between 2010 and 2035 in the BAU scenario.

This growth stems from the rapid increase of the energy consumed in the transportation sector, which is still heavily dependent on oil. In the past, the final energy demand of the transport sector grew at an average rate of 6.1 percent per year over the 1990-2010 period. In fact the transport sector experienced the highest

growth as compared to the other sectors. It is expected that this growth will continue up to 2035, but at a slower rate of 5.6 percent per year for the BAU scenario.

Final energy consumption in the industrial and other sectors (mainly consisting of the residential and commercial), grew at an average rate of 5.2 percent and 3.3 percent per year, respectively over the 1990-2010 period. The final energy demand of these sectors for the period 2010-2035 are projected to increase more rapidly under the BAU scenario, at an average annual growth rate of 5.4 percent and 5.0 percent, respectively.

Figure 7-1: Final Energy Demand by Sector



The industrial sector had the highest share in the total final energy demand over the past decade (1990-2010). The share increased from 37 percent in 1990 to around 42 percent in 2010. For the future, the share of the industrial sector in the total final energy demand will increase to 43 percent in 2035. The rapid increase of the various alternative fuels demand will contribute to the increase of the sector's share in the total final energy demand mix.

The transport sector share in the total final energy demand had also increase from 22 percent in 1990 to 33 percent in 2010. This share will continue to increase, reaching 36 percent in 2035. The combined share of oil and alternative fuels for transport contributed more to the increase of the transport's share in the total final

energy demand. Oil comprised majority of fuels in the transport sector while alternative fuels for transport grows rapidly at a rate of 6.6 percent for the period 2010-2035.

The remaining sectors share in the total final energy demand declined from 39 percent in 1990 to 24 percent in 2010. These sectors share are expected to continue declining to 21 percent by 2035 as a result of a slower growth in the total energy demand as compared to the industrial and transport sector.

By fuel type, coal experienced the fastest growth over the 1990-2010 period, at an average rate of 16.5 percent per year. This rapid growth of coal demand was due to its significant increase in the industrial sector, from 0.6 Mtoe in 1990 to almost 13 Mtoe in 2010. Electricity is also increasing significantly over the same period as industry expands and more households were electrified. Electrification rate has improved from 28 percent in 1990 to 66.5 percent in 2010. Total electricity demand increased from 2.3 Mtoe to 13 Mtoe, growing at an average rate of 8.9 per year.

As for natural gas and oil, the average annual growth of these fuels over the 1990-2010 period were similar at around 4 percent while other fuels demand (mostly biomass for industries and charcoal for households) remained the same, at around 6 Mtoe. In households, biomass is mainly used as a non-commercial fuel so not included in the current projection.

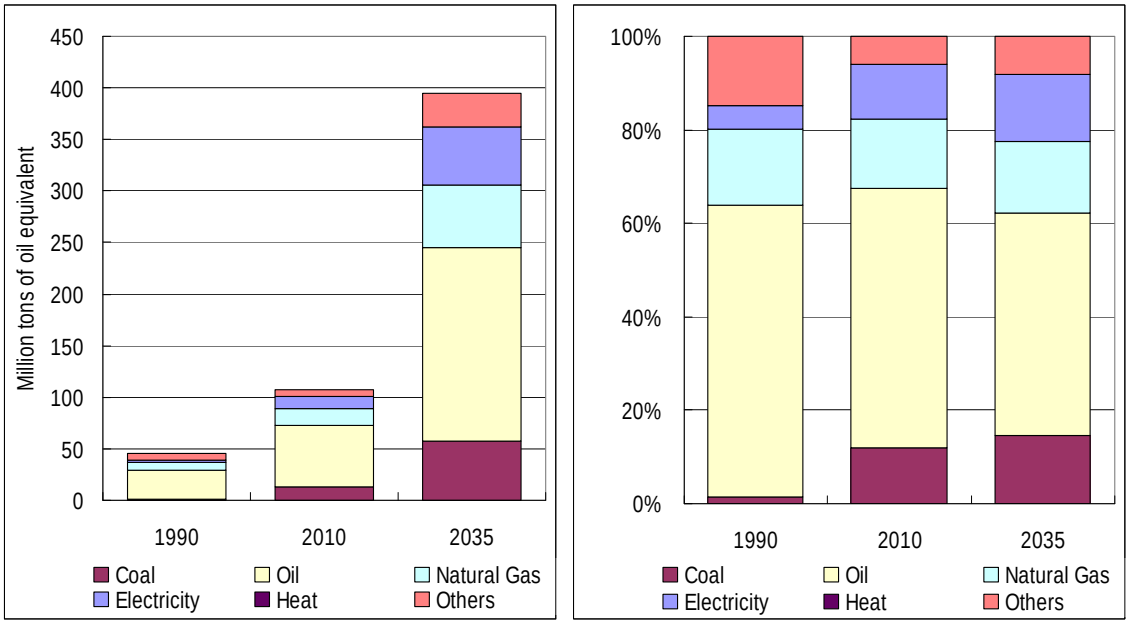
In the future, the demand of all fuels will continue to increase. For coal, the demand will increase at a much slower rate than the past. It is expected that coal demand will increase at an average rate of 6.2 percent per year, from 13 Mtoe in 2010 to around 58 Mtoe in 2035. Electricity is also expected to grow but at a slower rate than the past. The average annual growth rate for electricity demand is similar to that of coal, i.e 6.2 percent per year over the 2010-2035 period.

Natural gas and oil demand will grow at an average rate of 5.5 percent per year and 4.7 percent per year between 2010 and 2035. Other fuels demand will increase the fastest over the same period, at an average growth rate of 6.6 percent per annum. This is mainly due to the introduction of biofuels both in the transport sectors and the industries.

In terms of fuel, oil still plays a major role in the country’s final energy demand.

The relative importance of oil, however, has been declining with its share falling from 63 percent in 1990 to 56 percent in 2010. This decline in the share of oil in the total final energy demand is projected to continue as more alternatives fuels are being consumed by the end-use sectors. It is expected that this share will decline to around 47 percent in 2035.

Figure 7-2: Final Energy Demand by Fuel, BAU



3.1.2. Primary Energy Consumption

Primary energy consumption in Indonesia grew faster than the final energy demand at about 5.2 percent per year from 58 Mtoe in 1990 to 159 Mtoe in 2010. Among the major energy sources, the fastest growing fuels between 1990 and 2010 were coal and geothermal energy. Geothermal energy consumption grew at an average annual rate of 11.6 percent while coal grew at 10.8 percent a year. Oil consumption increased at a slower rate of 3.8 percent per year while natural gas consumption grew slightly faster at 3.9 percent per year. Despite the relatively slow growth in natural gas consumption, it still accounts for a relatively large proportion of primary energy consumption.

In the BAU scenario, Indonesia's primary energy consumption is projected to increase at an average annual rate of 5 percent reaching 530 Mtoe in 2035. Coal is

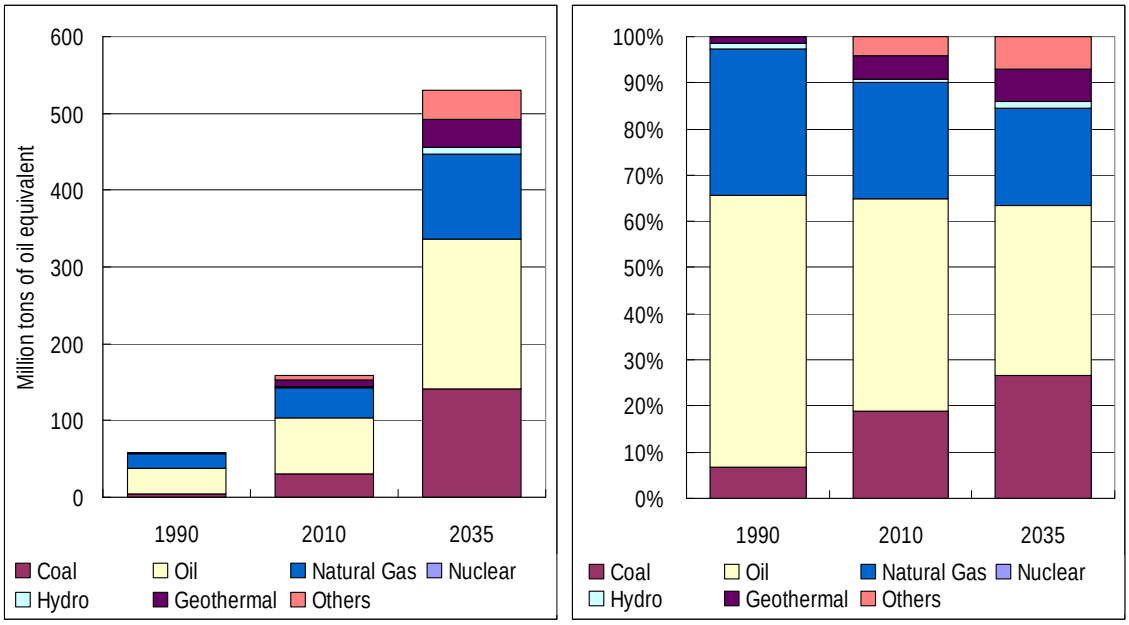
projected to continue growing but at a slower rate of 6.4 percent per year over the projection period. Geothermal energy is also expected to increase over the projection period, but will be slower than the growth witnessed over the past two decades because of the difficulties expanding exploration in protected forest areas. In addition, exploration will also become more expensive as the areas to be explored become smaller and are increasingly located in difficult terrains such as those in the eastern part of Indonesia. The growth rate of geothermal energy consumption until 2035 is projected to be 6.3 percent per year.

Hydro, on the other hand, will increase at a faster rate of 6.8 percent per year between 2010 and 2035 compared with 1990-2010 periods. This is because more hydro plants will be built in the future such as in East Kalimantan. Consideration is being given to building more run-of river type hydro rather than reservoir type. The average annual growth rate of hydro will be 6.8 percent per year between 2010 and 2035.

Oil consumption is projected to increase at an average annual rate of 4.0 percent over the projection period. Natural gas consumption is expected to increase faster than oil at an average rate of 4.2 percent per year.

There is assumed to be no uptake of nuclear in the BAU scenario. Thus, other renewable energy will have a significant role in the future primary energy supply mix as the uptake of cleaner alternatives to oil increases. The rate of increase of other renewable resources such as solar, wind and biomass will be faster than the other fuels at an average annual rate of 7.4 percent

Figure 7-3: Primary Energy Consumption, BAU



Oil constituted the largest share of total primary energy consumption but declining from 59 percent in 1990 to 46 percent in 2010. The share of natural gas in the total mix also declined from 32 percent in 1990 to 25 percent in 2010. The declined in the shares of oil and gas indicated that its growth over the 1990-2010 period was slower than the other fuels.

Since both coal and geothermal experienced the rapid growth over the 1990-2010 period, its share in the total fuel mix has increased significantly. Coal shares in the total primary energy mix increased from around 7 percent to 19 percent while geothermal the shares increased from 1.5 percent to around 5 percent. Other renewables shares, except hydro, also increased from virtually zero in 1990 to 4 percent in 2010. Hydro's share remains slightly constant.

In the BAU scenario, oil's share will still be dominant throughout the 2010-2035 period and with a continously declining share. The share of oil in the total primary energy mix will be around 37 percent in 2035. Similarly, natural gas share will continue to decline over the projection period reaching 21 percent in 2035.

Hydro's share in the total primary energy mix will still be below 2 percent even though hydro grows faster than geothermal.

3.1.3. Power Generation

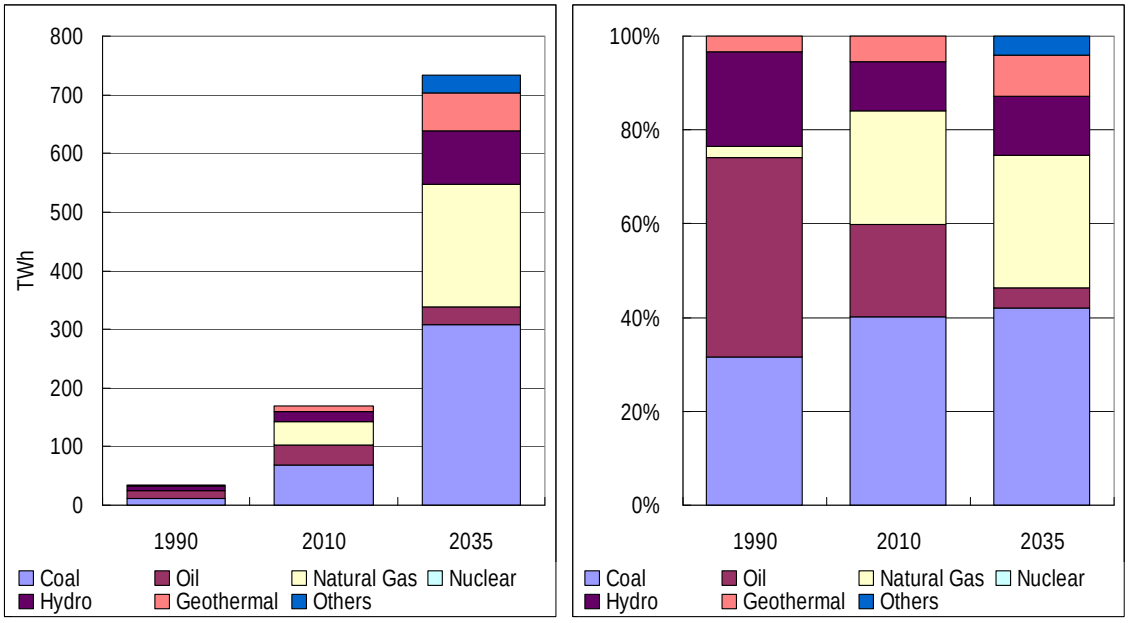
Power generation output increased at an average rate of 8.5 percent per year over the past two decades, from 33 TWh in 1990 to almost 170 TWh in 2010. The fastest growth occurred in the production of electricity from natural gas plants at almost 22 percent per year. This is due to the increase in gas turbine and combine cycle capacities as natural gas became increasingly available

In the BAU scenario, to meet the demand of electricity, power generation is projected to increase at a slower rate of 6 percent per year reaching 733 TWh in 2035. By type of fuel, generation from "Others" will have the fastest growth at an average rate of almost 26 percent per years. The main reason for this very rapid growth is that generation from these other sources was very small in 2010 but is expected to increase significantly as a result of the Government's policy to increase the use of new and renewable energy sources including solar PV, wind, oean energy, etc. which are classified as 'Others"

Generation from geothermal and hydro are also growing fast, but much slower than "Others", at 6.8 percent per year and 8 percent per year, respectively.

Power generation from natural gas will continue to increase but at a much slower rate of 6.7 percent per year while coal thermal power generation will be growing at an average annual rate of 6.2 percent. No nuclear plant is considered under the BAU scenario.

Figure 7-4: Power Generation by Type of Fuel (TWh)



The share of coal remains dominant in the total power generation of the country. The share of coal in total power generation increased from 31.5 percent in 1990 to 40.1 percent in 2010. It is expected under the BAU scenario, this share will continue to increase.2035, the share of coal in the total power generation will be 42 percent.

Oil had the largest share in power generation which was 42.6 percent in 1990. By 2010, the share of oil declined to 19.9 percent as natural gas production increased rapidly. Natural gas share in 2010 reached 24.1 percent and is expected to increase to 28.4 percent by 3035 under the BAU scenario,

Hydro had also an important role in the total electricity production of the country. Its share in 1990 reached 20.1 percent. But in 2010, the share declined to 10.4 percent. It is expected under the BAU scenario, hydro share will experience slight growth to 12.5 percent in 2035.

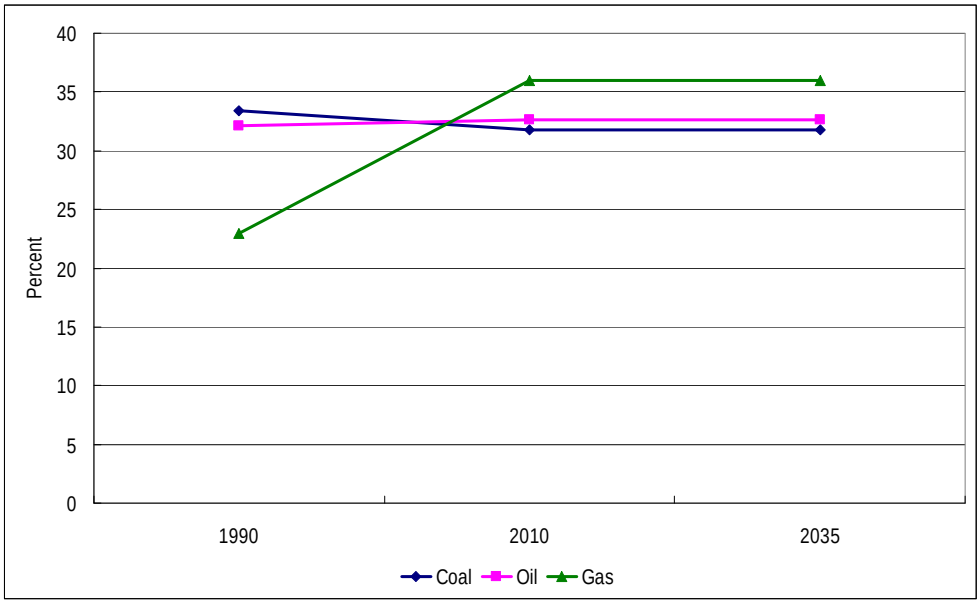
Geothermal and other renewables share will constitute in total about 5.6 percent of the power generation.in 2010. It is expected that the role of these renewables will increase significantly in the future and thus, the share will increase to 12.2 in total by 2035.

The average thermal efficiency of fossil power plant was around 32.3 percent in 1990 and improved to 33.1 percent in 2010. In the BAU scenario, thermal efficiency

of fosssil plants is expected to remain at around 33 percent in 2035.

By fuel, coal power plants thermal efficiency will be around 32 percent in 2035 while oil will remain at 33 percent and natural gas at 36 percent.

Figure 7-5: Thermal Efficiency, BAU

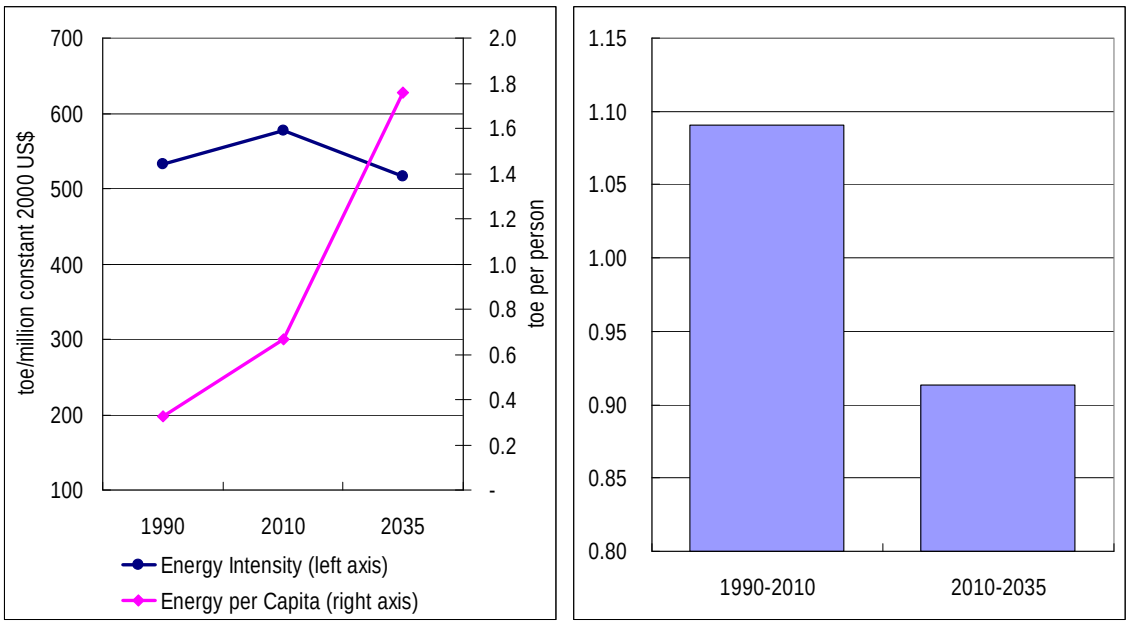


3.1.4. Energy Indicators

As a developing country, Indonesia's primary energy intensity (TPES/GDP) has been increasing until up to 2000. Since then, the intensity declined and reached a level of 577 toe/million 2000 USD in 2010. This is an indication that energy producers and consumers has started to effectively use energy through the implemetation of energy conservation measures and greater utilization of efficient energy technologies.

In the BAU scenario, the primary energy intensity is projected to decline at an average annual rate of 0.4 percent over the 2010 to 2035 period. The primary energy intensity of 2035 will be around 516 toe/million 2000 USD. Thus, the energy intensity ratio is expected to improve by almost 11 percent in 2035 as compared to 2010.

Figure 7-6: Energy Intensity and Energy per Capita



The per capita energy consumption, measured as the ratio of total primary energy consumption to the total population, has been increasing since 1990 from 0.33 to 0.67 in 2010. This level of energy consumption per capita is an indication that energy access of the society is still low which can be reflected by the ratio. The current electrification ratio is around 66.5 percent, indicating that there is still 33.5 percent of households in the country that have no access to electricity. The main reason is that there is a lack of energy infrastructure development particularly in the remote area and the outer islands due to the high investment cost.

Under the BAU scenario, the energy consumption per capita will continue to increase and will reach 1.76 toe per person in 2035. This result is in accordance with the existing national energy policy (2006) which targeted a level of 1.4 TOE in 2025.

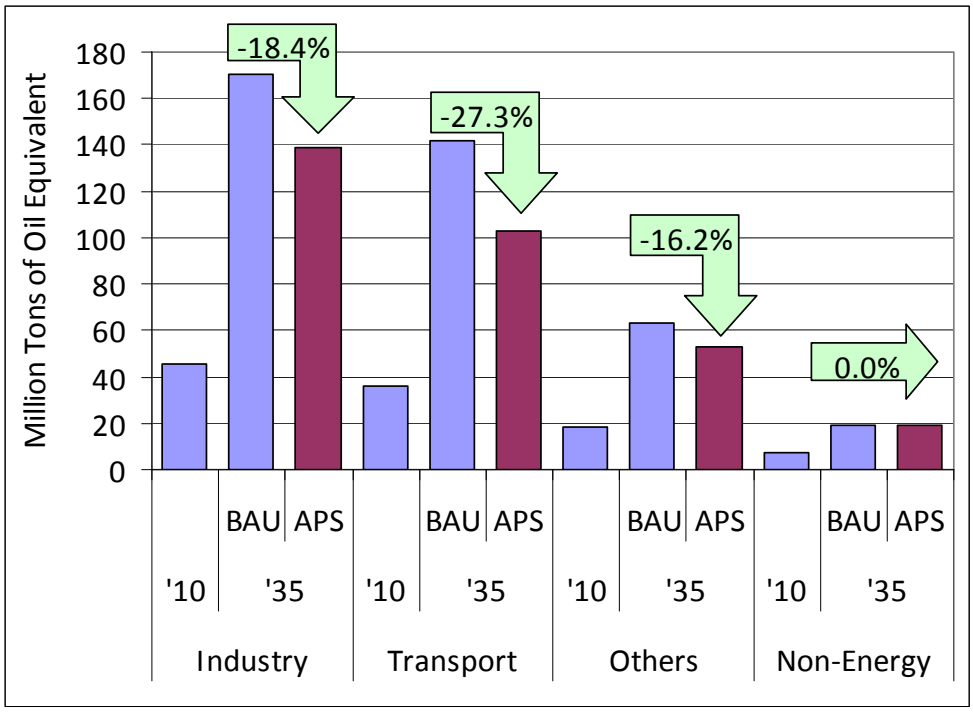
In the BAU scenario, the elasticity of final energy consumption is expected to continue declining and will reach 0.9 in 2035. Elasticity below 1.0 is an indicator that growth in final energy consumption will be slower than growth in GDP over the period 2010-2035.

3.2. Energy Saving and CO_2 Reduction Potential

3.2.1. Final Energy Demand

In the APS, final energy demand is projected to increase at a slower rate than in the BAU scenario, increasing at an average rate of 4.4 percent per year from 108 Mtoe in 2010 to 314 Mtoe in 2035. Slower growth under the APS, relative to the BAU scenario, is projected across all sectors as a result of the government program for energy efficiency and conservation, particularly in the transport sector. The growth rate of energy demand in the transport sector is projected to increase by 4.3 percent per year compared with 5.6 percent per year in the BAU. Figure 7-7 shows the final energy demand by sector in 2010 and 2035 in both the BAU and APS.

Figure 7-7: Final energy Demand by Sector, BAU and APS

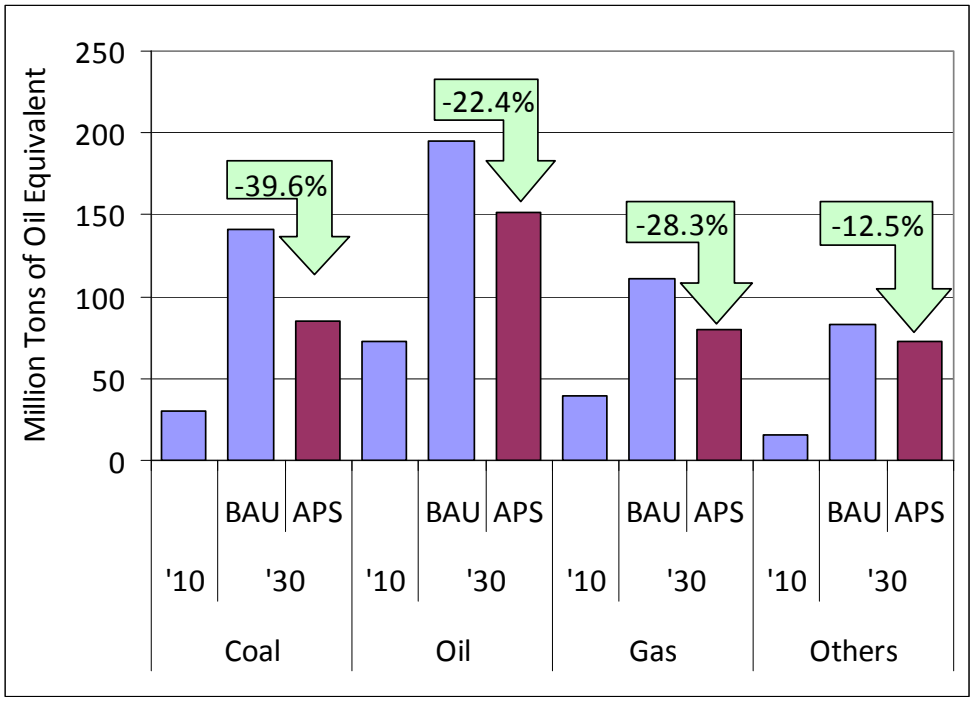


3.2.2. Primary Energy Consumption

In the APS, primary energy consumtion is projected to increase at a slower rate, relative to the BAU scenario, 3.7 percent per year to almost 390 Mtoe in 2035. All energy sources are projected to experience positive average annual growth rates. However, these will be slower than in the BAU scenario. The lower consumption relative to the BAU scenario reflects energy efficiency and conservation measures on the demand side.

In terms of final energy consumption savings, there is estimated to be a saving of almost 31 Mtoe in the industry sector, almost 40 Mtoe in the transport sector and around 10.2 Mtoe in the residential/commercial (other) sector by 2035 under the APS, relative to the BAU scenario.

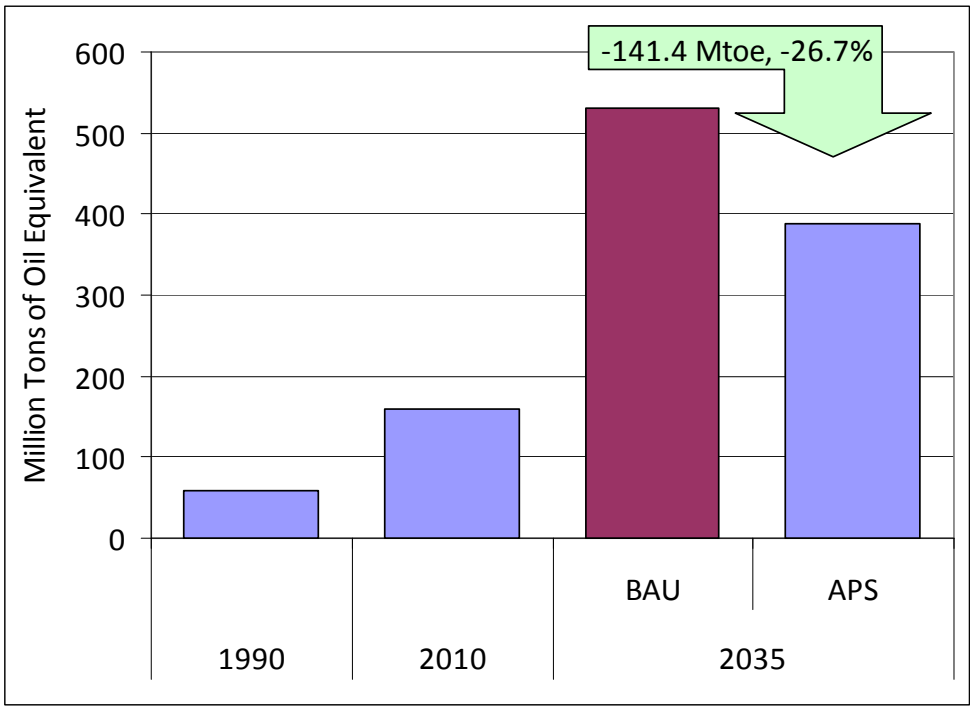
Figure 7-8: Primary Energy Demand by Source, BAU and APS



3.2.3. Projected Energy Savings

The energy savings (the difference between primary energy demand in the BAU scenario and the APS) that could be achieved through the energy efficiency and conservation goals and action plans of Indonesia are almost 141.4 Mtoe in 2035. This is lower than Indonesia's energy consumption in 2010 of around 159 Mtoe.

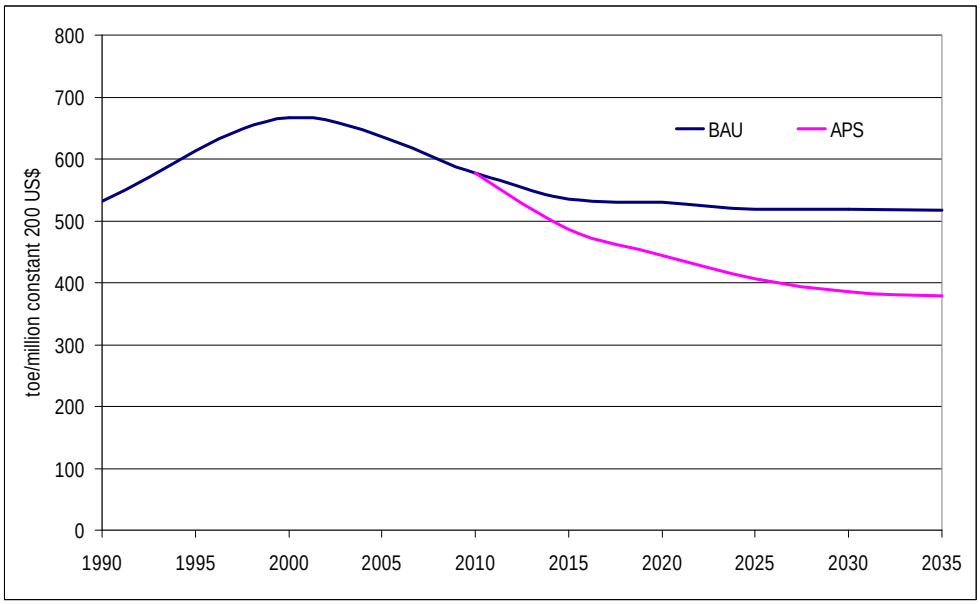
Figure 7-9: Total Primary Energy Demand, BAU and APS



3.2.4. Energy Intensities

Achieving the Government target of one percent per year reduction in energy intensity will require extensive implementation of the energy efficiency and conservation programs. Adaptation of the sectoral EEC targets under the Alternative Policy Scenario (APS) will result in a faster declining rate for the primary energy intensity; 1.8 percent per year over the projection period.

Figure 7-10: Energy Intensity, BAU and APS

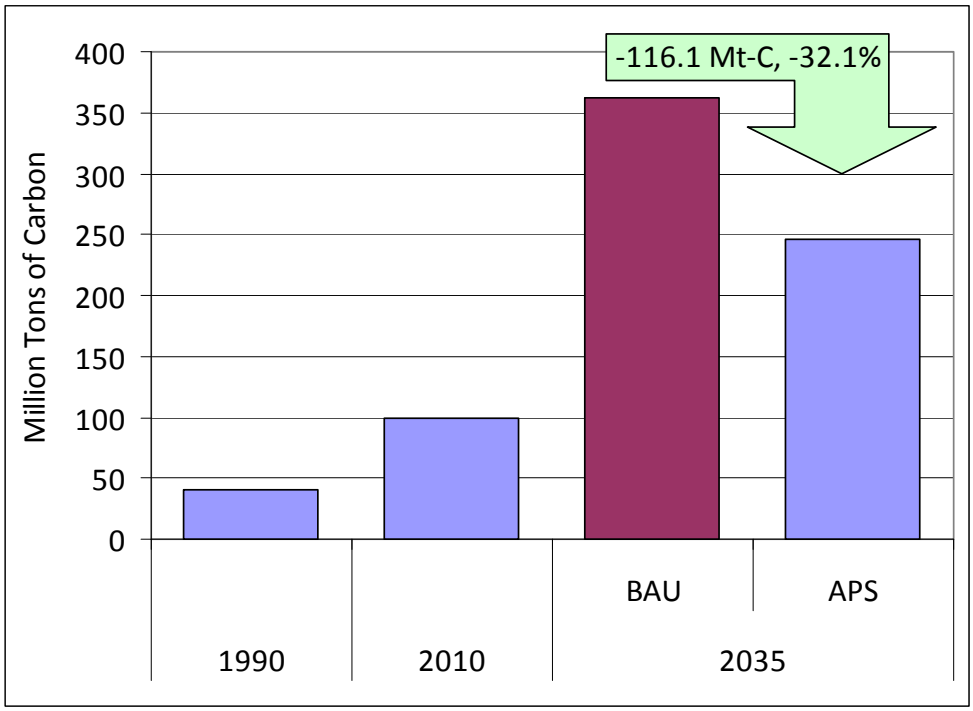


3.2.5. CO_2 Emissions from Energy Consumption

CO_2 emissions from energy consumption are projected to increase at an average annual rate of 5.3 percent from around 100 Mt-C in 2010 to 362 Mt-C in 2035 in the BAU scenario. This is driven by the increasing use of carbon intensive fuels, particularly the use of coal for power generation and industry, as well as oil in the transport sector.

In the APS, the annual average growth in CO_2 emissions from 2010 to 2035 is expected to be 32 percent lower than in the BAU scenario, increasing at 3.7 percent yearly. This lower growth rate is the result of an expected significant decline in coal consumption in the power sector in the APS, relative to the BAU scenario. The growth in emissions is projected to be slower than the growth in primary energy, indicating that the energy saving goals and action plans of Indonesia will be effective in reducing CO_2 emissions. The Government has committed to reduce CO_2 emissions in 2025 by 26 percent without international assistance and 41 percent with international assistance. This study result is above the committed target of 26 percent. Thus, more stringent energy saving and renewable targets need to be in place to achieve the committed CO_2 reduction targets of 41 percent.

Figure 7-11: CO_2 Emissions from Energy Combustion, BAU and APS



3. Implications and Policy Recommendations

Indonesia's primary energy intensity (TPES/GDP) has been declining since 2000 as a result of greater utilization of efficient energy technologies both by energy producers and consumers. Under the BAU scenario, the intensity declined lower than the target in the National Energy Policy of 2006 of one percent per year. Adapting the sectoral target under the APS will enable the country's projected target to decline even more at 1.8 percent per year. The elasticity of final energy consumption is also projected to decrease to below 1.0 only if the sectoral saving target is implemented fully as indicated in the APS scenario.

The primary energy consumption per capita is still below the neighboring countries like Thailand and Malaysia both under the BAU and APS scenario. Thus, there are still people without access to energy as indicated by the electrification ratio of 66.5 percent in 2010. Development of energy infrastructure particularly in the remote and small island areas will improve the electrification ratio, hence increase

accesibility to energy.

The transport sector, which is the main consumer of oil in the country, will be crucial to achieving energy savings. The savings in oil consumption between the BAU scenario and the APS could reach around 27 percent in 2035 by introducing more efficient vehicles and boilers in the transport and industrial sectors, respectively. Developed countries in the region such as Japan and Australia should increase efforts to introduce newly improved technologies to developing countries as early as possible.

The APS scenario assumed implementation of programs for achieving the sectoral energy saving targets. In this regards, the follwoing measures will be necessary:

- Enhance policy to move away from subsidies, but with the option to assist low income households
- Improve policy on the use of alternative transport fuels to make it more implementable
- Better enforcement of regulations in the industry sector
- Expand labelling and performance standards on appliances in the residential sector
- Encourage private sector participation such as banking sector financing of energy efficiency projects energy

Pursuing energy efficiency and conservation programs is one of the measures to reduce CO_2 emission in order to achieve the committed target of 26 percent (without international support) and 41 percent (with international support). Increasing the share of renewable energy sources in the supply mix would enhance further reductions in CO_2 emissions.

Both the BAU and the APS scenario projected that renewable energy will play a major role in the country's energy mix. Efforts to enhance renewable energy has been undertaken by the Government such as inclusion of geothermal and hydro resources in the second crash program for the acceleration of the 10000 MW power development; domestc obligation (DMO) for biofuels, provision of Feed-in Tariff (FIT) for both geothermal and biomass power generation; finalization of the FIT for solar and wind energy sources, fiscal incentives to promote renewable energy

development, etc. Nonetheless, further measures still need to be undertaken which can be attractive to increase private sector involvement such as improving the transparency and awareness of government support mechanisms; enhancing financial institution to participate in renewable energy projects, etc.