Chapter 7

Indonesia Country Report

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Chapter 7

Indonesia Country Report

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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 had reached 238 million people with an average population density of 124 people per square kilometre. The population increased to 247 million people in 2013.

Indonesia's real gross domestic product (GDP) increased by 6.0 percent in 2012 and 5.6 percent in 2013, reaching US$449 billion (constant 2005 US$). From 1990 to 2013, GDP grew at an annual average rate of 4.9 percent. GDP per capita rose from only US$840 (constant 2005 US$) in 1990 to around US$1,820 (constant 2005 US$) in 1990.

Indonesia is richly endowed with natural resources. Its proven crude oil reserves were 11.6 billion barrels in 1980, 5.4 billion barrels in 1990, and at the end of 2013 were estimated at 3.7 billion barrels.

Indonesia is the world's largest liquefied natural gas (LNG) exporter. Its proven reserves were 2.9 trillion cubic meters (TCM) in 1990, 2.5 TCM in 2005, and 2.9 TCM (around 101.5 trillion cubic feet) in 2013. Indonesia is also a coal exporter with proven coal reserves of around 32.3 billion tons at the end of 2013.

In addition to fossil energy resources, Indonesia's non-fossil energy resources include hydro, geothermal, biomass, and other renewable energy such as solar and wind. For hydro, the estimated potential is 75 gigawatt (GW) and that of geothermal more than 28 GW.

Indonesia's total primary energy supply (TPES) was around 224 million tons of oil equivalent (Mtoe) in 2013. Oil represented the largest share of primary energy supply in 2013 at around 34 percent, followed by 'others' (mainly biomass) at 24 percent, natural gas at 18 percent, and coal at 16 percent. The remaining share of 8 percent represents hydro and geothermal.

Indonesia has around 51 GW of installed electricity generating capacity and generated around 216 TWh of electricity in 2013. The state electricity company of Indonesia, PT PLN PERSERO, owned and operated generation plants with a combined capacity of about 36 GW in 2013, composed of: 25 percent oil, 36 percent coal, 27 percent gas, 10 percent hydro, and 2 percent 'others' (geothermal, solar, and wind).

2. Modelling Assumptions

As mentioned above, Indonesia's real GDP growth was 5.6 percent in 2013. This is lower than the targeted growth of 6.3 percent in the revised state budget (APBN–P) 2013. The state budget (APBN) 2016 targeted real GDP growth of 5.5 percent

for 2016 and between 6.0 and 7.2 percent for 2017. For 2018 and 2019, the growth rate is forecast at 6.2–7.8 percent and 6.5–8.2 percent, respectively.

The National Energy Council (DEN) assumed 8 percent GDP growth from 2015 to 2025 and slowed to 7.25 percent in 2035 and 6.5 percent in 2050. The assumed GDP growth rates were used in the formulation of the National Energy Policy (KEN) issued through Government Regulation no. 79 of 2014. On average, Indonesia's assumed annual GDP growth from 2013 to 2040 for the KEN is around 7.6 percent.

Although the prediction of GDP growth for Indonesia is around 7 to 7.6 percent per year, for the purpose of this study it was assumed that real GDP would grow more slowly, at an average annual rate of 5.4 percent from 2013 to 2040. This is based on the economic projections of the International Monetary Fund (IMF) and The World Bank. Population growth of 0.9 percent per year is assumed over the same period, based on the revised population projection of the Central Bureau of Statistic (BPS).

The scenarios are similar to last year's report, i.e. the Business-as-Usual scenario (BAU) and the five Alternative Policy Scenarios (APS). These APS reflect the additional policy interventions that are likely to be implemented, such as energy efficiency and conservation (EEC) targets and action plans; efficiency improvement in power generation plants; more aggressive adoption of renewable energy; and introduction of nuclear energy. In the case of Indonesia, the five APS considered are as follows:

1) More efficient final energy consumption (APS1), with specific energy saving targets by sector (Table 7-1), were considered as the basis for the analysis. In addition, Article 9 of the 2014 National Energy Policy (KEN) stated that energy elasticity achievement shall be less than one in 2025 and that the reduction in final energy intensity of 1 percent per year will be achieved up to 2025. These goals and targets have also been considered as the energy saving target for this year's study.

Table 7-1. Energy Conservation Potential to 2025

Sector	Energy Consumption Per Sector Year 2012 (Million BOE) *)	Potential of EC	Target of Energy Conservation Sectoral (2025)
Industry	305 (39,7%)	10 – 30%	17%
Transportation	311 (40,4%)	15 – 35%	20%
Household	92 (12%)	15 – 30%	15%
Commercial	34 (4,4%)	10 – 30%	15%
Others (Agriculture, Construction, and Mining)	26 (3,4%)	25%	-

source: Draft National Energy Conservation Master Plan (RIKEN) 2011

Note:
- exclude biomass and non-energy used
- *) temporarily data on December 2013

BOE = barrel of oil equivalent; EC = Energy Conservation.
Source: Harris (2014), Energy Efficiency Implementation to Reduce GhG Emission, Directorate of Energy Conservation, Directorate General of New, Renewable Energy, and Energy Conservation (DGNREEC), Ministry of Energy Mineral Resources Republic of Indonesia (MEMR).

2) More efficient thermal power generation (APS2), where higher improvement of existing coal power plant and the introduction of cleaner coal technologies have been considered in the analysis. In addition, the most efficient natural gas combined-cycle technologies were also considered for this scenario.

3) Higher contribution of NRE and bio-fuels (APS3) – In this case higher penetration of new and renewable energy (NRE) for electricity generation and utilisation of liquid biofuels in the transport sector are assumed as compared with the BAU.

4) Introduction or higher utilisation of nuclear energy (APS4), where the assumption was it will be in operation after 2020, similar to the assumption in the previous study. This is in line with current plans of two units to be constructed after 2020, each with a capacity of 1,000 MW.

5) The combination of APS1 and APS4 constitutes the assumptions of the APS (APS5).

3. Outlook Results

3.1. Business-as-Usual Scenario (BAU)

3.1.1. Final energy consumption

Indonesia's final energy consumption increased at an average annual rate of 3.1 percent between 1990 and 2013, increasing from around 80 Mtoe to 159 Mtoe. Given the assumed economic and population growth, the growth in final energy consumption will continue, but at a faster rate of 4.3 percent per year between 2013 and 2040 in the BAU.

This growth stems from the rapid increase in energy consumed in the transportation and industrial sectors. The transportation sector is still heavily dependent on oil. In the past, the final energy consumption of the transport sector grew at an average rate of 6.3 percent per year over the 1990–2013 period. This growth is expected to continue up to 2040 for the BAU, but at a slightly lower rate of 5.2 percent per year.

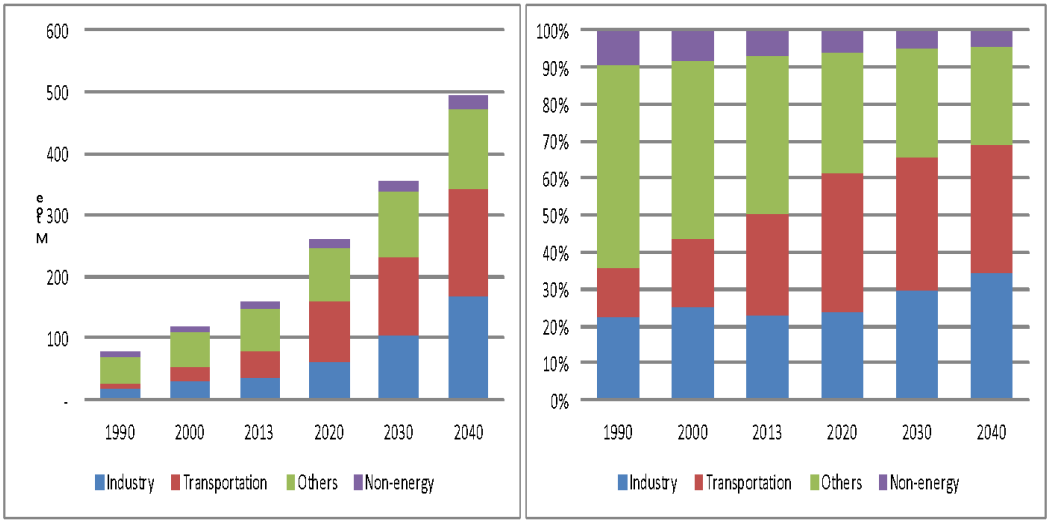
Final energy consumption in the industrial sector grew at a slower rate than the transportation sector over the 1990–2013 period (3.1 percent per year). It will see the highest growth as compared with the other sectors from 2013–2040, at an average rate of 5.8 percent per year.

The 'other' sector's (mainly consisting of the residential and commercial) final energy consumption grew at an average rate of 1.9 percent per year over the 1990–2013 period. The final energy consumption of this sector for the period 2013–2040 is projected to increase more rapidly under the BAU, at an average annual growth rate of 2.4 percent.

The 'others' sector had the highest share in total final energy consumption from 1990 to 2013 because of the high consumption of biomass mainly in the residential sector. But the share decreased from around 55 percent in 1990 to 43 percent in 2013. It is expected that the share will continue to decline in the future

as household appliances become more efficient and more alternatives such as natural gas and liquefied petroleum gas (LPG) are used. The sector's share in total final energy consumption will fall to 26 percent in 2040.

Figure 7-1. Final Energy Consumption by Sector



Mtoe = million tons of oil equivalent.
Source: Author's calculations.

The transportation sector's share in total final energy consumption increased from around 13 percent in 1990 to 27 percent in 2013. This share will continue to increase, reaching 35 percent in 2040. The combined share of oil and alternative fuels for transport will contribute more to the increase of the transportation sector's share in total final energy consumption.

The industrial sector's share in total final energy consumption was 23 percent over the 1990 to 2013 period and it is expected to increase to 34 percent by 2040 in line with the expected growth in industrial activities.

By fuel type, electricity experienced the fastest growth over the 1990–2013 period, at an average rate of 8.6 percent per year. This rapid growth of electricity demand was due to the significant increase in industrial and residential sector consumption, from 2.4 Mtoe in 1990 to 16.1 Mtoe in 2013. Coal will also increasing significantly over the same period as industry expands, particularly the

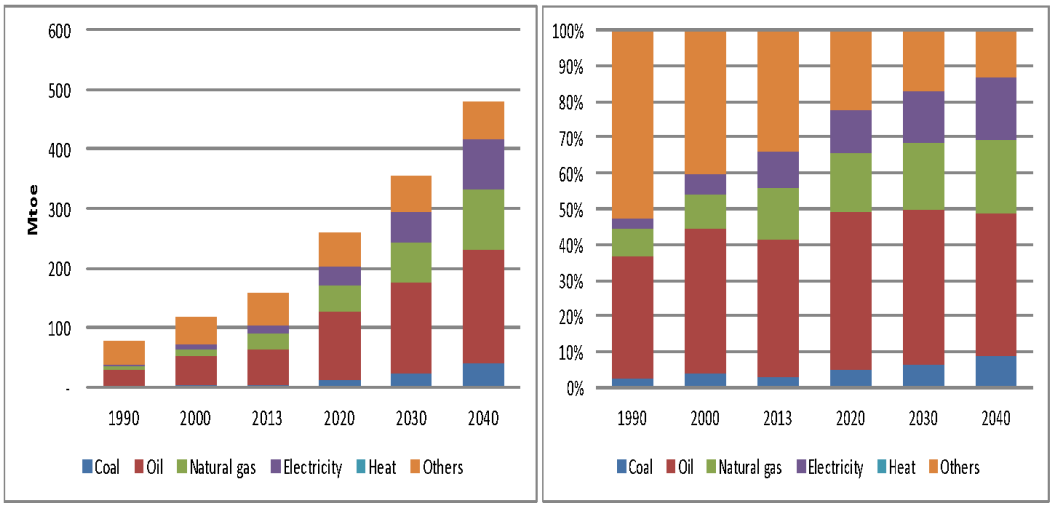
cement industries. Total coal demand increased from 2 Mtoe in 1990 to almost 5 Mtoe in 2013, growing at an average rate of 3.4 percent per year.

As for natural gas and oil, average annual growth of these fuels over the 1990–2013 period was 6.1 percent and 3.6 percent, respectively. Demand for other fuels (mostly biomass for households) increased by around 12 Mtoe, at an average rate of 1.1 percent per year.

In future, demand for all fuels will continue to increase. For coal, demand will increase the fastest at an average rate of 8.5 percent per year, to 41 Mtoe in 2040. Electricity is also expected to grow, but at a slower rate than in the past. The average annual growth rate for electricity demand is forecast at 6.2 percent per year over the 2013–2040 period.

Natural gas and oil demand will grow at average rates of 5.5 percent per year and 4.3 percent per year, respectively, between 2013 and 2040. Demand for 'Other' fuels will increase the slowest over the same period, at an average growth rate of 0.6 percent per year. This is mainly due to an expected fall in the growth rate of biomass consumption of the residential sector.

Figure 7-2. Final Energy Consumption by Energy, BAU



BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

Oil will continue to play a major role in the country's final energy consumption, although more alternative fuels will be consumed by the end-use sectors. It is

expected that the share of oil will be around 40 percent in 2040, increasing from 38 percent in 2013. The remaining shares will be those of coal (9 percent), natural gas (21 percent), electricity (17 percent), and 'others' (13 percent).

3.1.2. Primary energy supply

Primary energy supply in Indonesia grew faster than final energy consumption, at about 3.6 percent per year from 99 Mtoe in 1990 to 224 Mtoe in 2013. Among the major energy sources, the fastest growing fuels between 1990 and 2013 were coal and geothermal energy. Coal consumption grew at an average annual rate of around 11 percent while geothermal energy grew at 10 percent per year. Gas consumption increased at a slower rate of 4 percent per year while oil consumption grew slightly more slowly at 3.7 percent per year.

In the BAU, Indonesia's primary energy supply is projected to increase at an average annual rate of 4.5 percent, reaching 729 Mtoe in 2040. Coal is projected to continue growing but at a slower rate of 6.1 percent per year over the projection period. Geothermal energy is also expected to increase over the projection period, but growth will be slower than that witnessed over the past two decades because of the difficulties of expanding exploration in protected forest areas. Moreover, 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 projected growth rate of geothermal energy until 2040 is 5.3 percent per year.

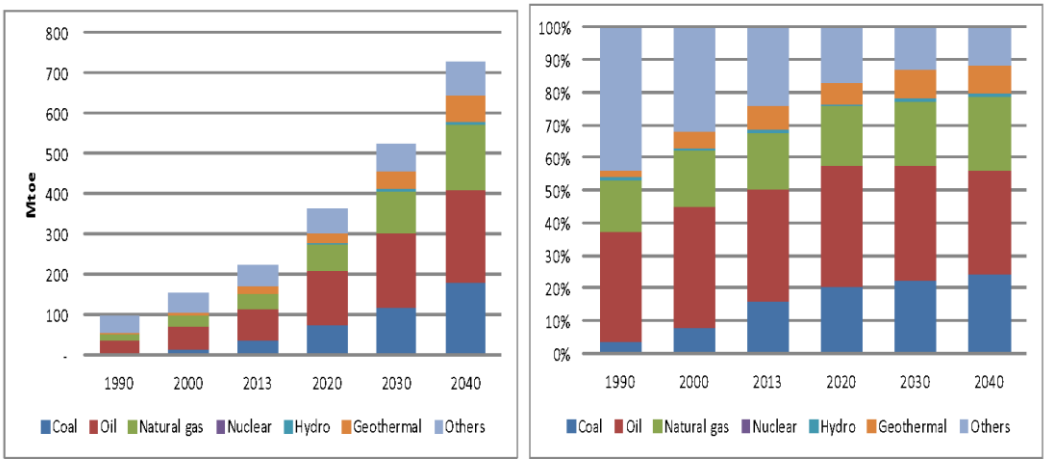
Hydro, on the other hand, will increase at a faster rate of 6.3 percent per year between 2013 and 2040 compared with the 1990–2013 period. This is because more hydro plants will be built in future, such as in East Kalimantan. Consideration is being given to building more run-of-river type hydro rather than the reservoir type.

Oil consumption is projected to increase at an average annual rate of 4.2 percent over the projection period from 2013 to 2040. At the same time, natural gas

consumption is expected to increase slightly faster than oil at an average rate of 5.4 percent per year.

It is assumed that there will be no uptake of nuclear energy in the BAU. Thus, renewable energy will have a significant role in the future primary energy supply mix as the uptake of cleaner alternatives to oil increases. Other renewable energy resources include solar, wind, biofuels, and biomass.

Figure 7-3. Primary Energy Supply, BAU



BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

Oil constituted the largest share of TPES and had increased slightly from 33.8 percent in 1990 to 34 percent in 2013. The share of natural gas in the total mix also increased slightly, from 16 percent in 1990 to 18 percent in 2013.

Since both coal and geothermal experienced rapid growth over the 1990–2013 period, the shares or these energy sources in the total fuel mix increased significantly. Coal's share in the total primary energy mix increased from around 4 percent to 16 percent and that of geothermal from 2 percent to 7 percent. Hydro's share increased slightly, from 0.5 percent to 0.7 percent. As the 'others,' which include biomass, solar, wind, ocean, biofuels, and electricity, grew slower than the other fuels, its share declined from 44 percent in 1990 to 24 percent in 2013.

In the BAU, oil's share will still be dominant throughout the 2013–2040 period and the share of oil in the total primary energy mix will continue to decline,

reaching 32 percent in 2040. The share of natural gas will increase to 22 percent by the end of the projection period and that of coal will increase to 24 percent.

Hydro's share in the total primary energy mix will increase slightly, to 1 percent even though hydro grows faster than geothermal.

3.1.3. Power generation

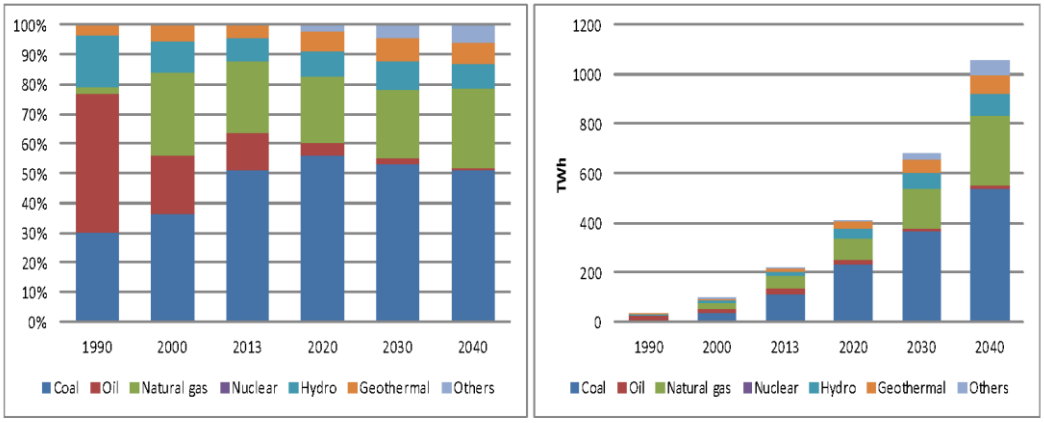
Power generation output increased at an average rate of 8.6 percent per year over the past two decades, from around 33 TWh in 1990 to almost 216 TWh in 2013. The fastest growth occurred in the production of electricity from natural gas plants at 20 percent per year. This is due to the increase in gas turbine and combined cycle capacities as natural gas became increasingly available.

In the BAU, to meet the demand for electricity, power generation is projected to increase at a slower rate of 6.1 percent per year reaching 1,061 TWh in 2040. By type of fuel, generation from 'others' will see the fastest growth at an average rate of 22.4 percent per year. The main reason for this very rapid growth is that generation from these other sources was very small in 2013, but is expected to increase significantly as a result of the government's policy to increase the use of NRE sources including solar PV, wind, biomass, etc., which are classified as 'others.'

Generation from geothermal and hydro are also growing fast, but much slower than 'others,' at 8.1 percent per year and 6.3 percent per year, respectively.

Power generation from natural gas will continue to increase, but at a much slower rate of 6.5 percent per year while coal based power generation will grow at an average annual rate of 6.1 percent. No nuclear plant is considered under the BAU.

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



TWh = terawatt-hour.
Source: Author's calculations.

The share of coal will remain dominant in the total power generation of the country. The share of coal in total power generation was lower than oil in 1990 (30 percent). The share increased over time as more coal power plants were constructed. In 2013, the share increased to 51 percent, higher than that of oil. It is expected that this share will not change significantly in the future. In 2040, the share of coal in total power generation will still be around 51 percent.

Oil had the largest share in power generation in 1990 (47 percent). By 2013, the share of oil declined to around 12 percent as production from coal and natural gas plants increased rapidly. The share of natural gas in 2013 reached 24 percent and will continue to increase, to 26.5 percent by 2040 under the BAU.

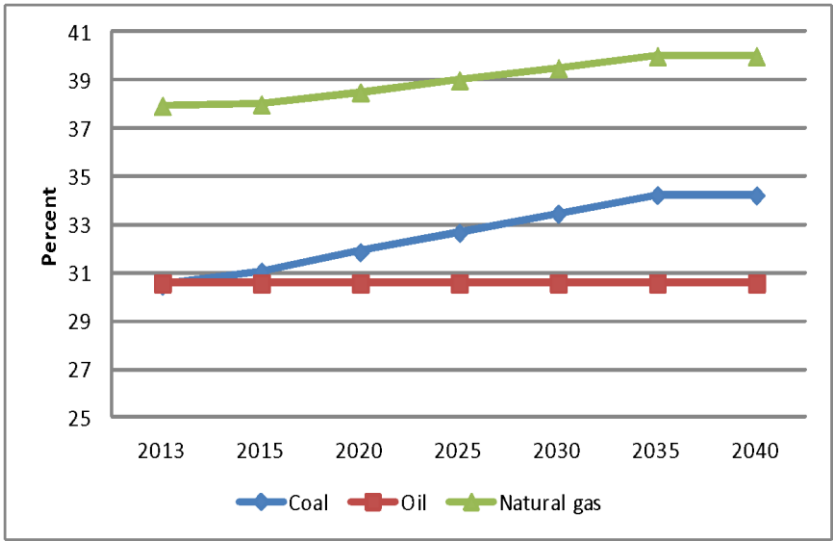
Hydro also had an important role in the total electricity production of the country. Its share in 1990 reached 17.5 percent. But in 2013 the share had declined to 7.9 percent. It is expected that under the BAU, hydro's share will increase slightly to 8.3 percent in 2040.

Geothermal and other renewables' share made up about 4.5 percent of total power generation in 2013. The role of these renewables is expected to increase significantly in the future and the share is projected to increase to 13.3 percent by 2040.

The average thermal efficiency of fossil fuel-based power plants was around 32 percent in 2013. In the BAU, it was assumed that there will be a slight improvement in the efficiency of the coal and natural gas power plants causing the thermal efficiency of fossil fuel plants to increase to almost 36 percent in 2040.

By fuel, coal fired power plants' thermal efficiency will increase from 30.5 percent in 2013 to 34.2 percent in 2040 while natural gas is assumed to increase from 38 percent to 40 percent. Oil will remain below 31 percent over the 2013–2040 period.

Figure 7-5. Thermal Efficiency, BAU



BAU = Business-as-Usual scenario.
Source: Author's calculations.

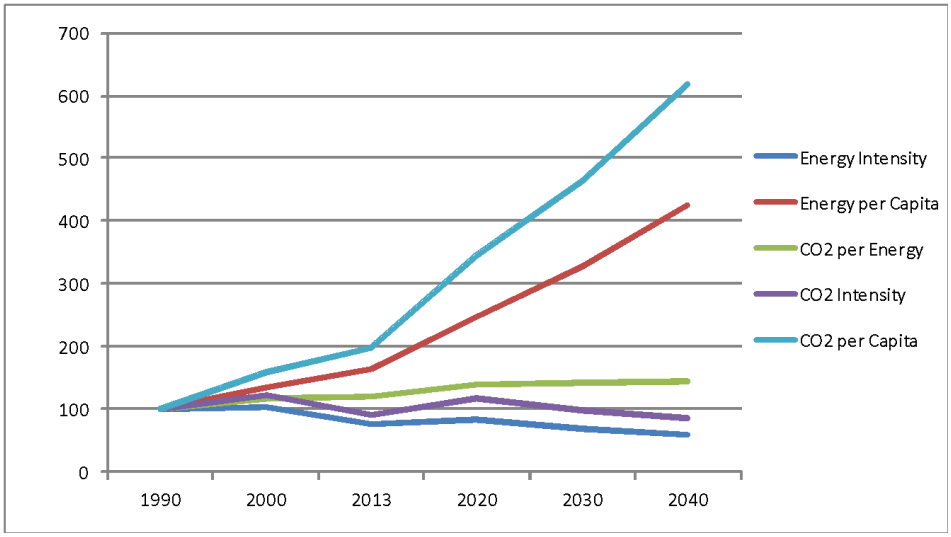
3.1.4. Energy indicators

Indonesia's primary energy intensity (TPES/GDP) had been increasing up until 2000. Since then, the intensity declined and reached a level of 499 toe/million 2005 US$ in 2013. Final energy intensity had been declining and reached a level of 355 toe/million 2005 US$ in 2013. These are indications that energy producers and consumers have started to use energy more effectively through the implementation of energy conservation measures and greater utilisation of efficient energy technologies.

In the BAU, primary and final energy intensity is projected to decline at an average annual rate of 0.9 and 1.1 percent, respectively, over the 2013 to 2040 period. Primary energy intensity in 2040 will be around 392 toe/million 2005 US$ and final energy intensity is projected to be 267 toe/million 2005 US$. Thus, the energy intensity ratio is expected to improve by almost 21 percent (primary) and 25 percent (final) in 2040 as compared with 2013.

Per capita energy consumption, measured as the ratio of TPES to the total population, increased from 0.55 in 1990 to 0.91 in 2013. This level of energy consumption per capita is an indication that people's energy access is improving, which is reflected by the electrification ratio. In 2013, the electrification ratio was around 80.5 percent and it reached 88.5 percent in 2015. The government expects that all households will have access to electricity by 2020.

Figure 7-6. Energy Intensity and Other Energy Indicators (1990=100)



CO_2 = carbon dioxide.
Source: Authors' calculations.

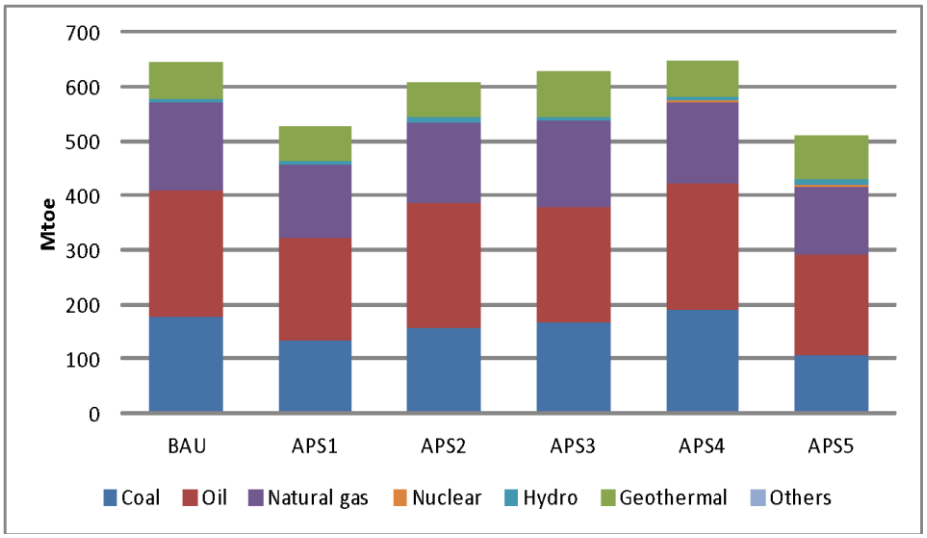
Under the BAU, energy consumption per capita will continue to increase and will reach 2.3 toe per person in 2040. This result is in accordance with the existing national energy policy (2014), which targeted a level of 1.4 toe in 2025 and 3.2 to in 2050.

In the BAU, the elasticity of final energy consumption is expected to continue to decline and reach 0.79 in 2040. Elasticity below 1.0 indicates that growth in final energy consumption will be slower than growth in GDP from 2013 to 2040.

3.2. Energy Saving and CO_2 Reduction Potential

The assumptions in the APS were analysed separately to determine the individual impacts of each assumption in APS1, APS2, APS3, APS4, and the combination of all these assumptions, APS5. Figure 7-7 shows the changes in primary energy supply in all the scenarios.

Figure 7-7. Comparison of Scenarios to Total Primary Energy Supply in 2040



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

In Figure 7-7 above, APS1 and APS5 have the largest reduction in primary energy supply in 2040 due to the energy efficiency assumptions on the demand-side. Energy efficiency assumptions in APS1 could reduce primary energy supply in BAU by as much as 121 Mtoe or 16.6 percent. For APS5, the reduction will be higher, amounting to 141 Mtoe or 19.4 percent

APS2, which assumes higher efficiency in thermal electricity generation, will also reduce the TPES in 2040, by 37 Mtoe or 5.1 percent as compared with the BAU. Under APS2, no efficiency measures were assumed for the final sector, thus it will have a lower impact than APS1. Therefore, the projected reduction is due mainly to the use of more efficient power generation and some of the conventional plants will cease operation after reaching the end of their technical life.

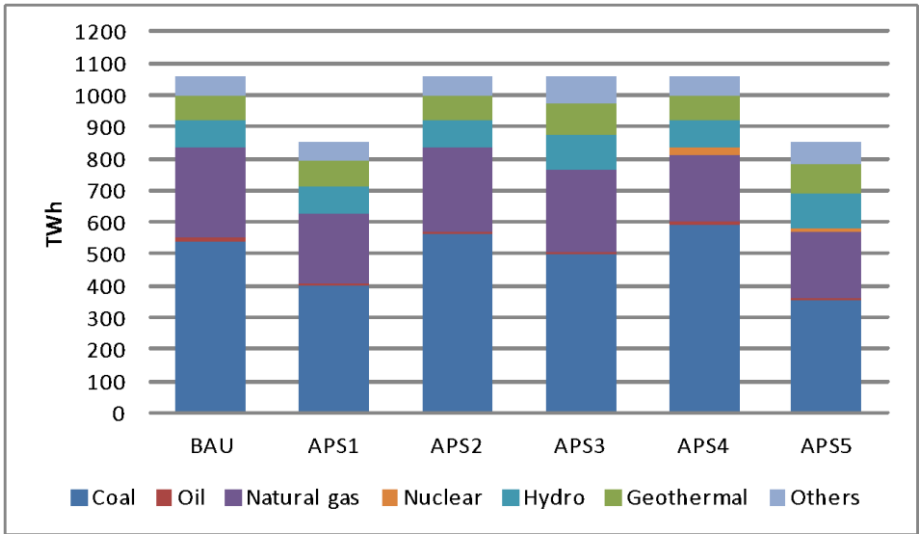
For APS3, the TPES increases slightly as more renewable energy for power generation comes into operation and more biofuels are expected to be consumed in the transportation sector. The difference between APS3 and BAU for 2040 is only around 7 Mtoe or 0.9 percent.

The planned introduction of nuclear power generation after 2020 (APS4) will increase the total primary energy mix of 2040 by only 2.8 Mtoe or 0.4 percent as compared with BAU. The result indicate that the introduction of nuclear plants will reduce the consumption of fossil fuels (coal, oil, gas) in generating power. However, considering that the efficiency of nuclear plants is slightly lower than the average thermal efficiency of fossil fuel plants, no savings compared with the BAU are expected.

Figure 7-8 shows the total electricity generation in 2040 in all scenarios. In APS1, due to the lower electricity demand, the shares of fossil-fired electricity generation will be lower than in the BAU – 73 percent as compared with 79 percent. In APS2, the share is the same as that of the BAU. In APS3, due to the assumption of more renewable energy, the shares of fossil fuel-fired generation could be reduced by 6.2 percent, while in APS4, nuclear energy could reduce fossil fuel's share by almost 2 percent. In APS5, where all scenarios are combined, the reduction in the share of fossil energy-based generation will be significant, i.e. almost 12 percent lower than the BAU.

In terms of CO_2 emission reduction, the energy efficiency assumption in APS1 could reduce emissions by 23 percent in 2040 as compared with the BAU.

Figure 7-8. Comparison of Scenarios to Electricity Generation in 2040



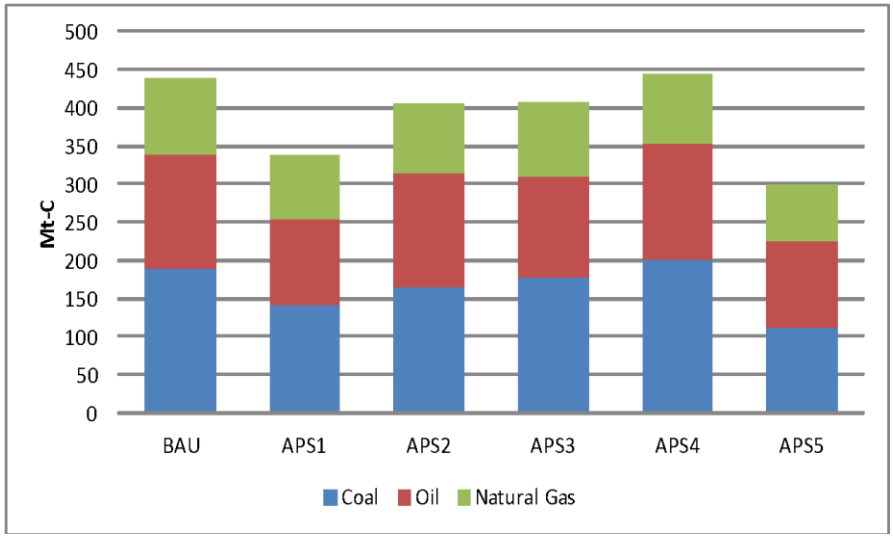
BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; TWh = terawatt-hour.
Source: Author's calculations.

In APS2, the installation of more efficient new power plants is projected to reduce emissions by 7.4 percent. Higher contributions from renewable energy could reduce emissions by 7.0 percent. All these assumptions combined (APS5) could reduce BAU CO_2 emissions by 31.5 percent in 2040.

3.2.1. Final energy consumption

In the combined APS (APS5), final energy consumption is projected to increase at a slower rate than in the BAU, increasing at an average rate of 3.4 percent per year from 159 Mtoe in 2013 to 393 Mtoe in 2040. Slower growth under the APS, relative to the BAU, is projected across all sectors as a result of the government programme for EEC, particularly in the transport sector. Energy demand in the transport sector is projected to increase at a rate of 3.5 percent per year compared with 5.2 percent per year in the BAU. Figure 7-10 shows the final energy consumption by sector in 2013 and 2040 for both the BAU and the APS.

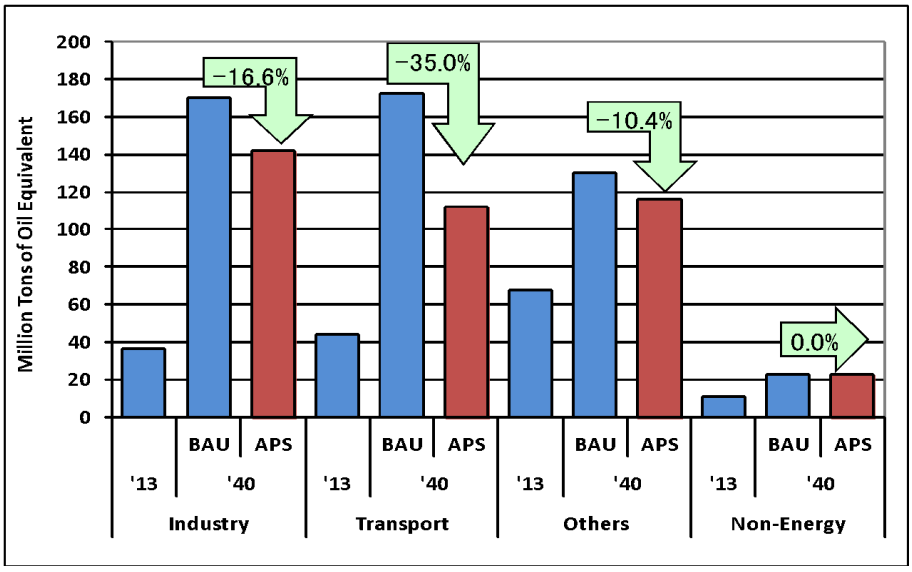
Figure 7-9. Comparison of Scenarios to CO_2 Emission in 2040



CO_2 = carbon dioxide; Mt-C = million tons of carbon; BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Source: Author's calculations.

In terms of final energy consumption savings, there is estimated to be a saving of 31 Mtoe in the industry sector, 42 Mtoe in the transport sector, and 13 Mtoe in the residential/commercial (other) sector by 2040 under the APS, relative to the BAU.

Figure 7-10. Final Energy Consumption by Sector, BAU and APS



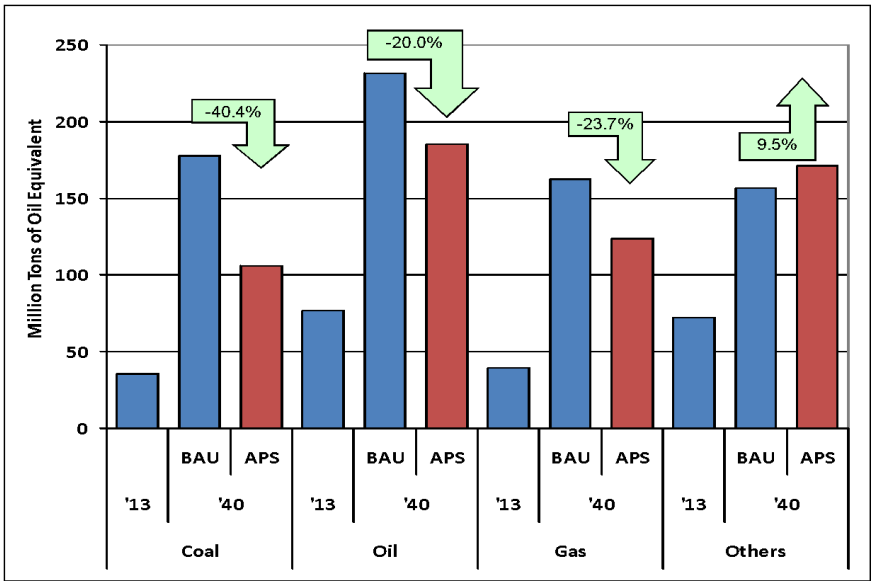
BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Source: Author's calculations.

3.2.2. Primary energy supply

In the combined APS (APS5), primary energy supply is projected to increase at a slower rate, relative to the BAU, at 3.6 percent per year to 587 Mtoe in 2040. All energy sources are projected to see positive average annual growth rates. However, some of these will be slower than in the BAU. The lower projected consumption relative to the BAU reflects EEC measures on the demand side and increased supply due to the use of more efficient technology for power generation.

In terms of the fuel type, there is estimated to be a saving of almost 72 Mtoe for coal, around 46 Mtoe for oil, and almost 39 Mtoe for natural gas by 2040 under the APS, relative to the BAU. In case of other resources (new and renewable resources, nuclear, and 'others') consumption in the APS in 2040 is expected to be 15 Mtoe higher than in the BAU.

Figure 7-11. Primary Energy Supply by Source, BAU and APS

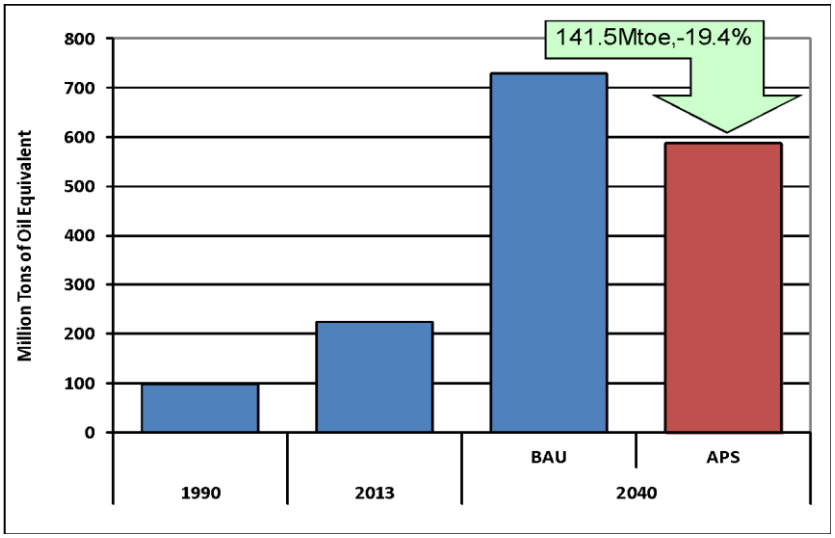


BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Source: Author's calculations.

3.2.3. Projected energy savings

The total energy savings (the difference between primary energy supply in the BAU and the APS) that could be achieved through the implementation of EEC and Indonesia's renewable energy targets and action plans, improved power plant efficiency, and the introduction of nuclear are projected to amount to 141.5 Mtoe in 2040. This is more than a half of Indonesia's primary energy supply in 2013, which was about 224 Mtoe.

Figure 7-12. Total Primary Energy Supply, BAU and APS

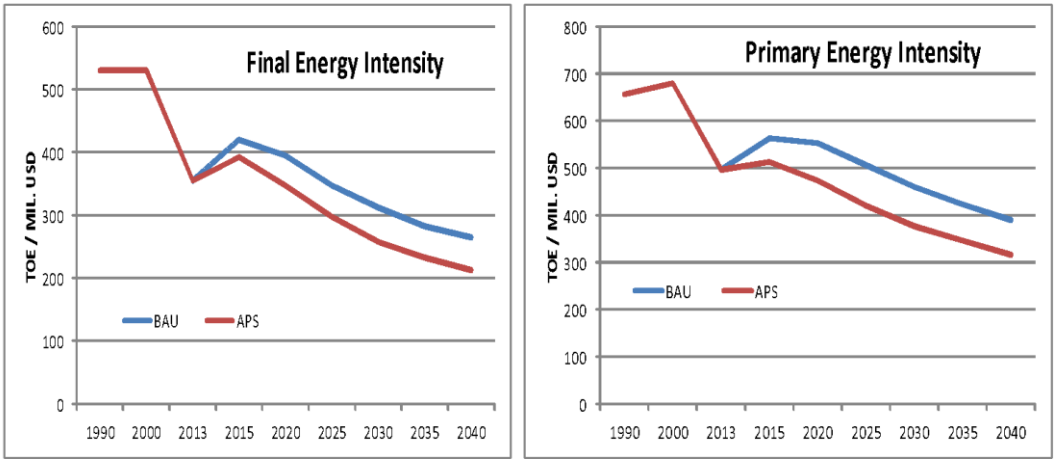


BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

3.2.4. Energy intensities

The 2014 national energy policy emphasised the target of a 1 percent per year reduction in final energy intensity up to 2025. Under the BAU, the final energy intensity already declines at an average rate of 1.1 per year over the 2013–2040 period. Implementation of the sectoral EEC targets under the APS will result in a higher rate of decline rate for final energy intensity – 1.9 percent per year over the projection period. In terms of primary energy intensity, the annual reduction will be 0.9 percent under the BAU. In the APS, the annual reduction in primary energy intensity will be 1.7 percent due to comprehensive implementation of the sectoral EEC targets.

Figure 7-13. Energy Intensity, BAU and APS



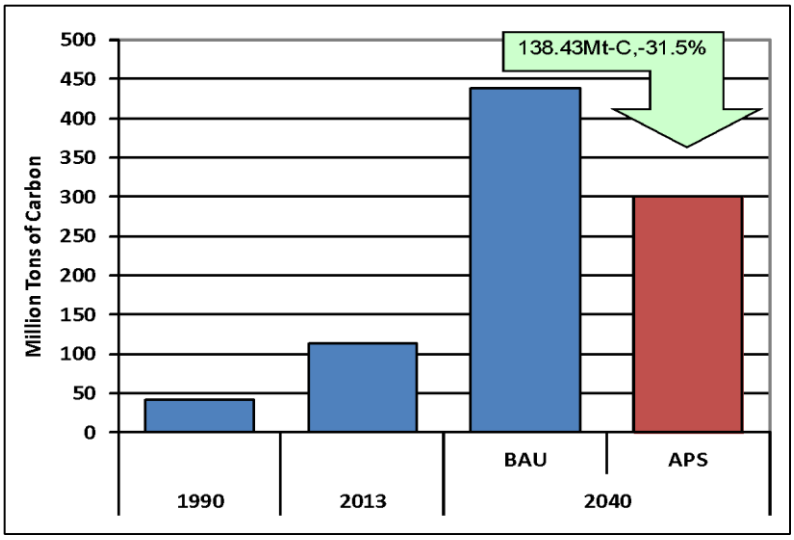
BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; TOE = tons of oil equivalent; MIL = million; USD = United States dollars.
Source: Author's calculations.

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 5.2 percent, from around 113 Mt-C in 2013 to 439 Mt-C in 2040 in the BAU. 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 combined APS (APS5), CO_2 emissions from 2013 to 2040 are expected to be 31.5 percent lower than in the BAU. This projected reduction will be due in great part to the inclusion of more energy conservation, higher efficiency, and elevated renewable targets assumed in the APS, and the inclusion of nuclear energy after 2020. The Indonesian government has committed to reducing CO_2 emissions by 29 percent in 2030 without international assistance and by 41 percent with international assistance.

Figure 7-14. CO_2 Emissions from Energy Consumption, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mt-C = million tons of carbon.
Source: Author's calculations.

This study's result is above the committed target of 29 percent. But to achieve the CO_2 reduction target of 41 percent, the combined target and action plan specified under APS5 would not be sufficient and should therefore be more aggressive.

4. Implications and Policy Recommendations

Indonesia's primary energy intensity (TPES/GDP) and final energy intensity (TFEC/GDP) have been declining as a result of greater utilisation of efficient energy technologies both by energy producers and consumers. Under the BAU, the primary energy intensity declines by 0.9 percent per year over the projection period. This nearly achieves the 1 percent goal stated in the 2014 National Energy Policy. Adapting the sectoral target under the APS1 combined with the renewable portfolio, efficient power plant technology, and introduction of nuclear, will allow the country's energy intensity to decline even more strongly, by 1.7 percent per year. The elasticity of primary energy supply is also projected to fall to below 1.0 under the BAU (0.8), and further to 0.7 under the assumption that the sectoral saving targets and the other policy interventions under APS2, APS3, and APS4 are fully implemented, as in the combined APS (APS5) scenario.

The primary energy supply per capita is in the range of 1.9 to 2.3 toe/person for all scenarios by 2040. This is still lower than for neighbouring countries like Thailand and Malaysia. Thus, there are still people without access to energy, as indicated by the electrification ratio of 88.5 percent in 2015. Further development of energy infrastructure, particularly in the remote and small island areas, will improve the electrification ratio and hence increase access to energy.

Oil will still have the largest share in the total primary energy mix over the projection period. The 2014 National Energy Policy sets the target at less than 25 percent in 2025 and less than 20 percent in 2050. The transport sector, which is the main consumer of oil in the country, will be crucial for achieving these energy saving targets. Government should further encourage the transport sector programme through:

- Improving the public transport system
- Promoting the use of alternative fuels and more efficient vehicles

The current analysis, which assumed increased use of alternative fuels and more efficient vehicles in the transport sector and efficient boilers in the industries, resulted in oil consumption savings between the BAU and the APS as high as 23 percent in 2040. Developed countries in the region such as Japan and Australia should increase their efforts to introduce newly improved technologies to developing countries as early as possible.

The combined APS scenario (APS5) assumed implementation of programmes for achieving the sectoral energy saving targets. In this regard, the following measures will be necessary:

- Expand the EEC programme to achieve a 10 percent electricity saving in government buildings and commercial buildings;
- Encourage revitalisation programmes of industries to improve the performance of boilers, burners, etc.;
- Expand labelling and performance standards for appliances in the residential sector;
- Developing regulatory framework to increase participation of the private sector and energy service companies in EEC;
- Formulating funding mechanism to develop efficient technologies and equipment.

Pursuing EEC programmes is one of the measures to reduce CO_2 emission to achieve the target of 29 percent committed to (without international support) and the target of 41 percent (with international support). Increasing the share of renewable energy sources in the supply mix, increasing the thermal efficiency of fossil fuel plants, and the introduction of nuclear, would result in further CO_2 emission reductions.

Both the BAU and the combined APS (APS5) project that renewable energy will play a major role in the country's energy mix. The government has made efforts to enhance renewable energy, such as increase the NRE shares in the 35 GW power development programme, put in place a domestic obligation for biofuels, provision of a Feed-in-Tariff (FiT) for geothermal, solar, hydro, and biomass power generation; finalisation of the FiT for wind energy sources, and fiscal incentives to promote renewable energy development. Nonetheless, further measures need to be taken to increase private sector involvement, such as improving transparency and awareness of government support mechanisms, encouraging financial institutions to participate in renewable energy projects, improving the mechanism for providing incentives to promote NRE sources, and increase collaboration with developed countries to promote low-carbon technologies.

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