CHAPTER 14

PHILIPPINES COUNTRY REPORT

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1. Background

1.1. Socio-economic Background

The Philippines, officially known as the Republic of the Philippines, is amidst Southeast Asia's main water bodies, namely, the South China Sea on the west, Philippine Sea on the east, and Sulu and Celebes Sea on the southwest. The country comprises more than 7,000 islands, situated in the western Pacific Ocean, and is composed of three main geographical divisions: Luzon, Visayas, and Mindanao. The country's capital, officially known as the National Capital Region and commonly known as Metro Manila, is in Luzon. It is composed of 16 cities, namely, Caloocan, Las Piñas, Makati, Malabon, Mandaluyong, Manila, Marikina, Muntinlupa, Navotas, Parañaque, Pasay, Pasig, Quezon City (the country's most populous city), San Juan, Taguig, and Valenzuela.

In 2015, the Philippine economy sustained its 6.1% growth rate from the previous year. This was largely due to the vigorous economic activities in the industry and the services sectors during the period, which posted an annual growth rate of 6.4% and 6.9%, respectively. The increase in the industry sector was driven by the 5.7% growth in the manufacturing sector, as well as the double-digit hike of 11.6% in the construction sector. The increase in the services sector is attributed to the robust domestic trade and services and the boom in real estate businesses. Meanwhile, agriculture, hunting, forestry, and fishing posted a small 0.1% increase during the period, a slowdown from its 1.7% growth registered for 2014. Gross domestic product (GDP) per capita[1] of the country was recorded at US$2,616 per person in 2015.

[1] In constant 2010 US$ (World Bank ICP database/World Development Indicators).

1.2. Policy

The Philippine Department of Energy (DOE) has set forth strategic directions and energy agenda to assist President Duterte's administration in attaining its development goals as envisioned in Ambisyon 2040, the blueprint of a long-term, collective vision, and aspirations of Filipinos, and supported by national economic strategies that will provide opportunities for inclusive growth. Within Ambisyon 2040, the Philippine energy sector plays a vital role as an indispensable factor for economic growth. Foremost amongst the focus of the DOE is consumer-first policies, reliability of energy supply, and affordability of tariffs.

To achieve security and reliability of supply, as well as the vision of a low-carbon future, the DOE is adopting a technology-neutral policy in coming up with an optimal energy mix, especially for the power sector, for the baseload (70%), mid-merit (20%), and peaking (10%) requirements that match the peak demand and the required 25% reserve requirements on a per regional grid basis to meet the 43,765 MW additional capacity required by 2040. In addition, efforts on the development and promotion of indigenous energy, such as renewable energy (RE) and hydrocarbon fuels (oil, gas, and coal) and tapping into clean and smart technologies, have been on the priority list to augment the country's long-term energy needs. A Nuclear Energy Implementing Organization, created within the DOE, has recommended a firm national policy on nuclear. The country's liquefied natural gas (LNG) capacities and capabilities shall be harnessed through the development of the ₱100 billion[2] Batangas integrated LNG by 2020, with an initial 5 million tons per year throughput and initial reserve capacity of 200 MW.

The DOE is also pushing for greater energy access thru a 100% national and regional electrification rate by facilitating the completion of transmission projects, such as the Visayas–Mindanao Interconnection Project by 2020 and the Semirara–Mindoro–Panay Interconnection, by 2019 in support of our country's goal of a One-Grid Philippines. Consistent with its drive for consumer empowerment, the DOE is implementing a Pro-Consumer Distribution Framework for energy affordability, choice, and transparency. On the other hand, the finalisation of the Implementing Rules and Regulations of Executive Order No. 30,[3] which President Duterte signed in June 2017, tags energy projects amounting to at least US$70 million as projects of 'national significance', while creating the Energy Investment Coordinating Council mandated to fast-track the permitting process of such energy projects. Aside from this, the DOE is working towards drafting guidelines that will assist energy stakeholders and industry participants in coming up with

[2] Philippine peso.

[3] Full title: 'Creating the Energy Investment Coordinating Council In Order to Streamline the Regulatory Procedures Affecting Energy Projects'.

an Energy Sector Resiliency Compliance Plan (RCP). The RCP shall contain adaptation measures, both engineering and non-engineering options, to gauge infrastructure and human resource preparedness during and in the aftermath of disruptive events.

Below are some of the highlights of the energy sector's plans and programmes:

Renewable Energy

The passage of Republic Act (RA) No. 9513, or Renewable Energy Act of 2008, legally supports the policy and programme framework to promote the utilisation of RE resources and technologies. On 14 June 2011, the government unveiled the National Renewable Energy Program (NREP) or the 'Green Energy Roadmap' of the Philippines. NREP is anchored on the DOE's Energy Reform Agenda, which aims to ensure greater energy supply security for the country. It established the policy and programme framework for the promotion of RE and a road map to guide efforts in realising the market penetration targets of each RE resource in the country. Under the updated RE road map, the target of 15,304 megawatts (MW) installed RE capacity by 2030 is envisioned to be increased to 20,000 by 2040. To achieve this, NREP also provides for policy mechanisms to support the implementation of the RE Act. These policy mechanisms include the Renewable Portfolio Standards (RPS), feed-in tariffs (FiT), Green Energy Option Program, and Net-Metering for Renewable Energy.

The RPS sets the minimum percentage of generation from eligible RE resources, provided by generators, distribution utilities, and electric suppliers. Initially, an installation target of 760 megawatts (MW) from RE was set for the first 3 years, from 2013 to 2015, broken down as follows: biomass (250 MW), run-of-river hydro (250 MW), solar (50 MW), wind (200 MW), and ocean (10 MW).

On the other hand, FiT provides guaranteed payments on a fixed rate per kilowatt-hour for RE generation, excluding generation for own use. Effective October 2015, the Energy Regulatory Commission has approved FiT rates, which will apply to generation from RE sources, particularly run-of-river hydro, biomass, wind, and solar. Effective October 2015, the approved FiT rates for biomass, hydropower, solar, and wind are ₱6.63, ₱5.90, ₱8.69, and ₱7.40 per kilowatt-hour, respectively. Currently, there is no FiT rate for ocean energy since the technology is still for further study and not yet available in the country.

Alternative Fuels

Biofuels

The DOE is aggressively implementing RA 9367, or the Biofuels Act of 2006. The law intends to tap the country's indigenous agricultural resources as potential feedstock for biofuel to contribute to the country's goal of achieving energy security, as well as augmenting farmers' income, generating rural employment, and reducing greenhouse gas (GHG) emissions.

The mandatory 1% biodiesel blend in all diesel fuel sold in the country since May 2007 was increased to 2% in February 2009 on a voluntary basis. On the other hand, the country now enjoys an accelerated use of E10 (10%) bioethanol blend as supplied by most gasoline retailers. The DOE, together with the National Biofuels Board, is embarking on revisiting and/or re-evaluating the blending requirement with due consideration on the availability of feedstock and to facilitate the scheduled blending of biofuels in compliance with RA 9367.

In terms of research and development, the DOE initiated a partnership with the academe to implement biofuel projects using alternative feedstocks, such as sweet sorghum, cassava, and macro-algae. Four projects were implemented in 2016 to introduce and develop alternative feedstocks of biofuels in the country:

1. Village Scale Production of MMSU[4] Hydrous Ethanol as Feedstock for R&D in Biofuel Trials and Anhydrous Ethanol Production, which has been completed.
2. Establishment of a Community-Based Bioethanol Industry and Continued Research and Development on the Feasibility of Hydrous Bioethanol as Biofuel Blend, whose implementation started only in 2015. These projects are being implemented by the Mariano Marcos State University.
3. Bioethanol Production from Macro-algae and Socio-ecological Implications, which is being implemented by the University of the Philippines-Visayas Foundation Inc.
4. Bioethanol Production Potential of Different Cassava Varieties under Northern Mindanao Condition and Development of a Pilot-Scale Cassava Bioethanol Plant, which is being implemented by Xavier University.

[4] Mariano Marcos State University.

Compressed Natural Gas (CNG)

The DOE is keen to pursue the implementation of the Natural Gas Vehicle Program for Public Transport by engaging a third party to evaluate the feasibility of its project's implementation. To date, the DOE is coordinating with the Department of Transportation – Land Transportation Franchising and Regulatory Board – on the confirmation of franchise availability for the targeted 200 compressed natural gas (CNG) buses, of which 176 franchises were declared available for the CNG buses in March 2015. Accordingly, the DOE mandated the Philippine National Oil Company Exploration Corporation to take over the operation and maintenance of CNG refilling stations. However, the procurement of two modular CNG stations for Biñan, Laguna and Port Area, Batangas City has yet to be finalised; the issue of securing CNG supply and the negative impact of the current volatility of diesel prices on the economic viability of operating the CNG delivery system.

AutoLPG

In terms of using liquefied petroleum gas (LPG) as an alternative fuel for transport, the total number of commercial autoLPG-fuelled taxis nationwide stood at 9,718 units complemented by 192 refilling stations in 2015. In 2016, the total number of converted taxi units decreased to about 8,415, but the total number of refilling stations remained at 192. The decline of taxi units was brought about by various issues that hampered the programme's implementation.

Despite the setback, the DOE is exerting all efforts within its mandate to make autoLPG a viable option as a fuel for public transport. To sustain the programme, the DOE, in coordination with concerned national government agencies, promotes the mainstreaming of autoLPG in the transport sector through policy recommendations. In June 2016, the interim inter-agency AutoLPG Technical Working Group (TWG) was officially institutionalised through the adoption of Joint Administrative Order No. 1, Series of 2016, entitled 'Creating the Technical Working Group (TWG) on the Use of AutoLPG as Fuel for Public Transport and for Other Related Purposes'. The TWG is to be created in key areas in Luzon, Visayas, and Mindanao to harmonise all autoLPG-related policies, rules, and guidelines and develop a mechanism for collaboration, cooperation, and coordination amongst member national government agencies for the effective implementation of the AutoLPG Program (DOE, 2017).

E-vehicles

As of the end of 2015, 10 new companies were engaged in the manufacture of e-trikes and were registered under the Board of Investments' Investment Priority Projects. This has translated to about ₱500 million of fresh investments and generated more than 500 local jobs. For electric and hybrid vehicles, the Government of Japan coordinated with the Department of Foreign Affairs and the DOE for the Japan Non-Project Grant Aid for the Introduction of Japanese Advance Products and its System (Next-Generation Vehicle Package) for the Philippines. Under the terms of the grant aid, next-generation vehicles such as hybrid vehicles, plug-in hybrid electric vehicles, and electric vehicles, including charging stations, will be procured by the Government of Japan and delivered to the Philippines through the DOE for deployment to identified beneficiaries. Target beneficiaries of this grant aid include Philippine National Police stations in Leyte and Samar which were devastated by typhoon 'Yolanda', government agencies in Region 8 that are instrumental to emergency response operations and rehabilitation. Vehicles were also allocated to non-government agencies that could assist in conducting research, performance testing, and promoting alternative fuel vehicles.

Household Electrification

The provision of electricity access is now focused on households throughout the country. Household electrification levels increased from 89.6% in 2015 to 90.7% in 2016. This increase corresponds to a 3% growth in the number of households energised – from 19,994,430 in 2015 to 20,597,320 in 2016. It also implies that 20,597,320 out of the potential 22,721,430 households are reaping the benefits of electricity access. On a grid level, Luzon has the highest electrification and this increased from 94.6% in 2015 to 95.5% in 2016. Visayas and Mindanao posted electrification levels of 94.0% and 74.1% in 2016, respectively. Aside from these are various grid and off-grid programmes that also aim to contribute to 100% electrification of all targeted and identified households accessible to the grid by 2022. These are embodied in the Household Electrification Development Plan.

1.3. Energy

The country's total primary energy supply (TPES) in 2015 reached 51.3 million tons of oil equivalent (Mtoe). Oil accounted for the biggest share of 33.6% in the total energy supply, followed by coal (22.7%) and geothermal (18.5%). Total primary production reached 26.9 Mtoe, bringing the country's energy self-sufficiency level at 52.4% during the period.
Meanwhile, the country's total electricity generation in 2015 reached 82.4 terawatt-hours (TWh). Coal-fired power plants remained the major source for power generation, with total installed capacity of 5,963 megawatts (MW) during the period. Coal contributed 44.5% or 36.7 TWh in the total power generation mix of the country. Meanwhile, natural gas–fired power plants accounted for 22.9% or 18.9 TWh in the power mix, as the country's three existing natural gas power plants had a combined installed capacity of 2,862 MW. On the other hand, the combined share of renewable energy in the total power generation mix was registered at 25.4% during the period.

2. Modelling Assumptions

Five scenarios, aside from the Business-as-Usual (BAU) scenario, were developed to assess the energy savings potential of the country. the BAU scenario serves as the reference case in the projection of energy demand and carbon dioxide (CO_2) emissions of the energy sector. the BAU scenario incorporates the energy sector's existing energy policies, plans, and programmes which are being implemented and will be pursued within the forecast period.

Alternative Policy Scenario (APS) 1 assessed the impact of possible policy interventions in terms of possible utilisation of energy efficiency technologies for future energy use, together with their corresponding reductions in CO_2 emissions. This assumes that the energy saving goals of 10% in 2024, 25% in 2025, and 20% in 2035 from annual final energy demand of the country will be achieved through a range of measures, including intensified energy utilisation management programmes in the commercial and industry sectors as well as the continuous use of alternative fuels and technologies. The Information and Education Campaign Program of the DOE will also contribute to the energy-saving goals of the country. In the residential and commercial sectors, the use of more efficient electrical appliances is projected to induce savings. Energy labelling and ratings on major electrical appliances will also help consumers choose more efficient electrical products.

APS2 assessed the effect of more efficient thermal power generation, particularly for future coal and natural gas power plant technologies.

APS3 measured the results of combined contribution of renewable energy and alternative fuels to the total energy supply. As part of the government's initiative to ensure security of energy supply and, at the same time, to protect the environment and promote green technology, the targets set under the NREP were incorporated in the model to test their impact on the TPES. The NREP lays down the foundation for developing the country's RE resources, stimulating investments in the RE sector, developing technologies, and providing the impetus for national and local renewable utilisation. It sets out indicative interim targets for the delivery of RE within the time frame. In this scenario, the aggregated 20 GW RE capacity is assumed in 2040.

Although the Philippines currently has no firm policy direction on the use of nuclear energy in power generation, APS4 considered additional capacity from nuclear power to determine the impact of possible long-term nuclear option in the country. Lastly, APS5 will focus on the combined effects of the four scenarios: APS1, APS2, APS3, and APS4.

In the model, GDP is projected to grow at an annual rate of around 6% between 2015 and 2040. The population of the country is expected to grow at the rate of 1.5% yearly for the same period. Population growth is based on the adjusted 2000 census-based medium population projections using the results of the 2010 census of population.

Additional scenarios were simulated in the energy outlook model to investigate the feasibility of the 70% Intended Nationally Determined Contributions (INDC) of the country as a commitment to international environmental agreements for the planning period 2010–2030. INDC1 reflects the possibility of reducing CO_2 emissions according to the level of INDC submission of the country, which is 70% CO_2 reduction by 2030 from the BAU scenario level of the same period. The model for INDC1 sets the target of 70% CO_2 reduction by 2030. On the other hand, INDC2 was simulated to look for a more suitable level of CO_2 reduction at the end of the planning period in terms of realistic policy interventions and assumptions.

3. Outlook Results

3.1. Business-As-Usual Scenario

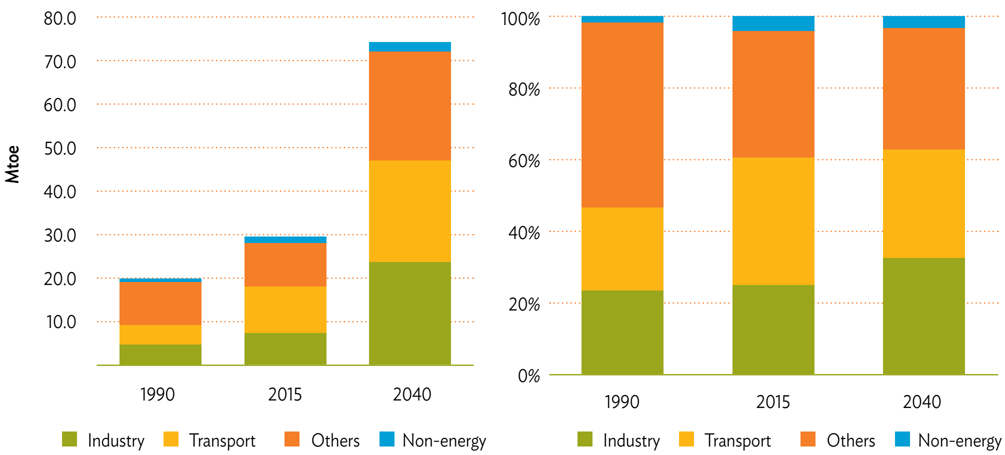
3.1.1 Total final energy consumption (TFEC)

3.1.1.1. TFEC by sector

The Philippines' final energy consumption grew from 19.7 Mtoe in 1990 to 29.6 Mtoe in 2015 at an average annual growth rate of about 1.7%. During this period, energy consumption in the transport sector grew the fastest at an average annual rate of 3.5%, followed by the industry sector with 1.9%. The 'others' sector (residential and commercial, and agriculture, fishery, and forestry) posted a sluggish average annual growth of 0.1% per year.

Final energy consumption is expected to grow at an average annual rate of 3.7% in the BAU scenario over 2015–2040. The transport sector will grow at an average rate of 3.1% per year. On the other hand, the industry and 'others' sectors are expected to grow faster at an average rate of 4.8% and 3.6% per year, respectively (Figure 14.1).

Figure 14.1: Final Energy Consumption by Sector, BAU (1990, 2015, and 2040)



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

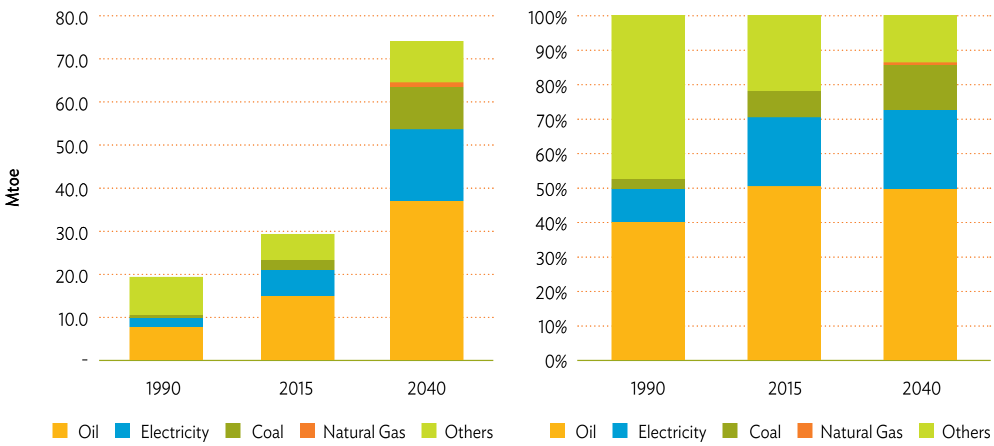
Source: Author's calculations.

Despite the sluggish growth of the aggregated energy consumption of the 'others' (such as residential and commercial) sector in 1990–2015, it continued to account for the biggest share in the total consumption mix for the period – albeit declining from 52.1% in 1990 to 35.6% by 2015. In the same period, the share of the transport sector in the demand mix increased from its level of 23.0% to 35.8%. However, across the planning period, 2015–2040, the share of transport in the demand mix is declining and will drop to 30.9% by 2040. On the other hand, as the energy requirement in the industry sector is expected to increase the fastest, its share to the demand mix is on a continuous uptrend from 23.7% in 1990 to 25.1% in 2015 and to 32.5% by 2040. Meanwhile, the combined consumption of other sectors will recover from its sluggish growth to sustain its share in the consumption mix at an average of 36.3% across the planning horizon.

3.1.1.2. TFEC by fuel

By fuel type, the consumption of natural gas is projected to grow the fastest at an average of 11.5% per year between 2015 and 2040. Increased requirements from industry, particularly in cement and other energy-intensive manufacturing sub-sectors, will contribute to the average hike in coal demand of 6.0% per year, while electricity is expected to maintain its steady pace with an average increment in demand of 4.3% for the next 25 years. On the other hand, demand for oil, mainly from the transport sector, is expected to grow by 3.7% during the period (Figure 14.2).

Figure 14.2: Final Energy Consumption by Fuel Type, BAU (1990, 2015, and 2040)



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

Source: Author's calculations.

Oil will remain as the most-consumed fuel throughout the planning period, with a share of 49.7% in 2040 in the total demand mix, slightly lower from its 2015 level of 50.7%. Electricity will contribute an average share of 22.7% by 2040, making it the second-most consumed energy source after oil. Coal is expected to increase its share of total demand by almost twice its 2015 share of 7.7% to 13.3% in 2040. On the other hand, the consumption of other fuels such as biomass and other RE, despite their projected lacklustre growth of 1.7% per year, will account for 13.3% of the demand mix in 2040.

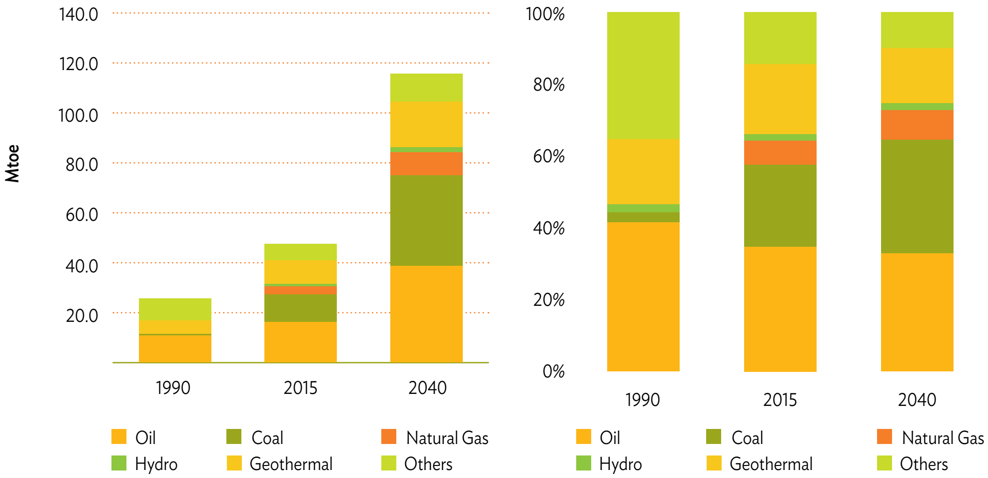
3.1.2. Total primary energy supply (TPES) by fuel type

Primary energy supply in the Philippines grew at an average annual rate of 2.4%, from 26.0 Mtoe in 1990 to 47.5 Mtoe in 2015. Amongst the major energy sources, coal grew the fastest at 11.5% per year. Geothermal, oil, and hydro each registered average increments of 2.9%, 1.7%, and 1.4%, respectively. On the other hand, primary energy supply of other fuels went down by 1.3 % per year.

For 2015–2040, the country's primary energy supply is expected to increase by 3.6% per year from its 2015 level to 115.8 Mtoe in 2040. Consumption of all major energy sources are projected to increase during the period, with coal growing the fastest at 4.9% per year. Natural gas is also expected to expand with a growth rate of 4.7% per year, while oil growth rate is estimated at 3.5% for the period in review. On the other hand, major RE consumption from geothermal and hydro will have an average growth rate of 2.9% and 2.7%, respectively, for the planning period, while other fuels' aggregated consumption level is expected to rise the slowest at 2.1%.

Oil will account for the largest share in the total energy supply of the country at 33.2%, on average, over the planning period. Coal and natural gas, being part of the country's major energy requirements, are projected to register the shares of 31.5% and 8.2%, respectively, by the end of 2040. During the same year, geothermal and hydro, which are mainly used for power generation, will register shares of 15.9% and 1.3%, respectively. Meanwhile, the requirement for other fuels in 2040 will contribute 9.6% to the supply mix (Figure 14.3).

Figure 14.3: Primary Energy Supply by Fuel Type, BAU (1990, 2015, and 2040)



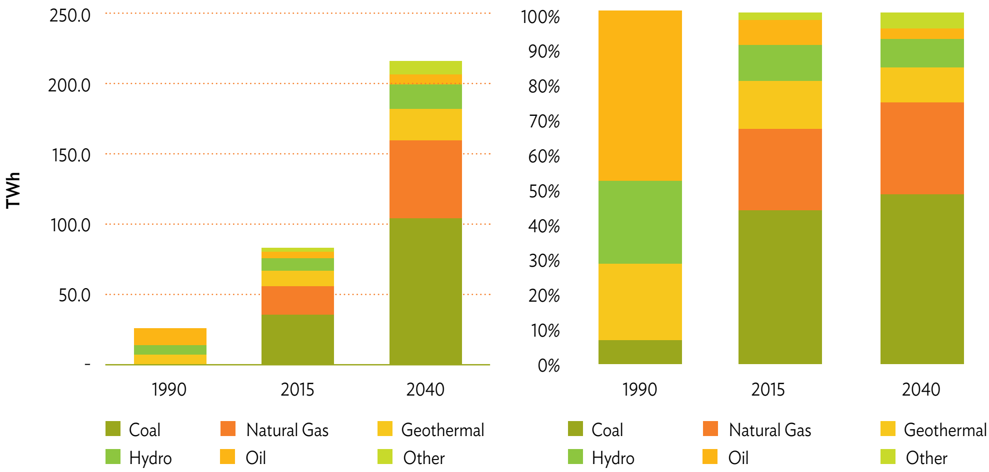
BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

3.1.3. Power generation

Total power generation in 2015 reached 82.4 TWh, more than thrice the country's level in 1990. Coal maintains its spot as the major source of power generation, accounting for a 44.5% share in 2015. With total power generation expected to increase by 3.9% yearly to 215.3 TWh by 2040, the share of coal in the generation mix will likewise increase to 48.7% for the period to reflect an average annual growth rate of 4.3% and reach the level of 105.0 TWh by 2040. Natural gas–fired power plants are also expected to follow the same trend as coal, with their generation levels rising by as much as three times its 2015 level of 18.9 TWh to 55.8 TWh in 2040, about one-fourth of total generation during the same year. Major RE sources, such as hydro and geothermal, are expected to contribute an aggregate share of 18.1% (8.2% share for hydro and 9.9% share for geothermal) to the country's generation mix in 2040, as output grows at an average annual rate of 2.9% and 2.7%, respectively. Generation from other energy (solar, wind, and biomass) is expected to increase at an average annual rate of 7.7%. Meanwhile, declining use of oil in the power sector is evident in its paltry average growth of 0.9% for the planning period (Figure 14.4).

Figure 14.4: Power Generation by Fuel Type, BAU (1990, 2015, and 2040)

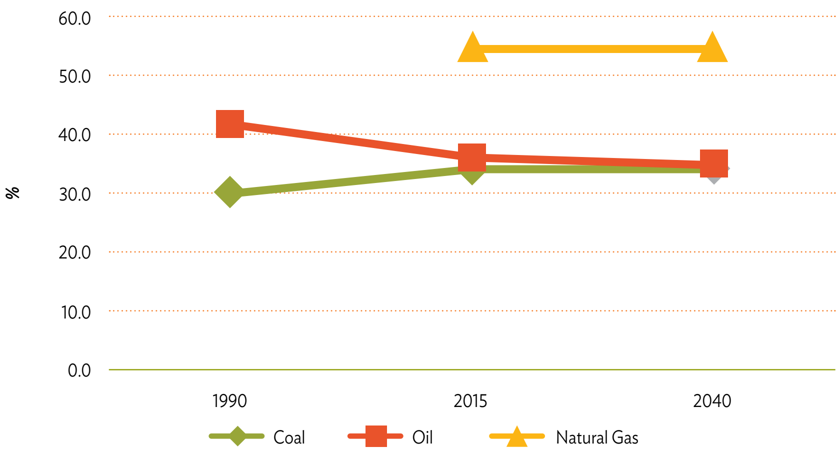


BAU = Business-As-Usual, TWh = terawatt-hour.

Source: Author's calculations.

The thermal efficiencies of coal, oil, and natural gas under the BAU scenario are projected to be constant for the whole planning period. Coal thermal efficiency is set at 34%, while oil and natural gas power plant efficiencies are set at around 35% and 55%, respectively (Figure 14.5).

Figure 14.5: Thermal Efficiency by Fuel Type, BAU (1990, 2015, and 2040)



BAU = Business-As-Usual.

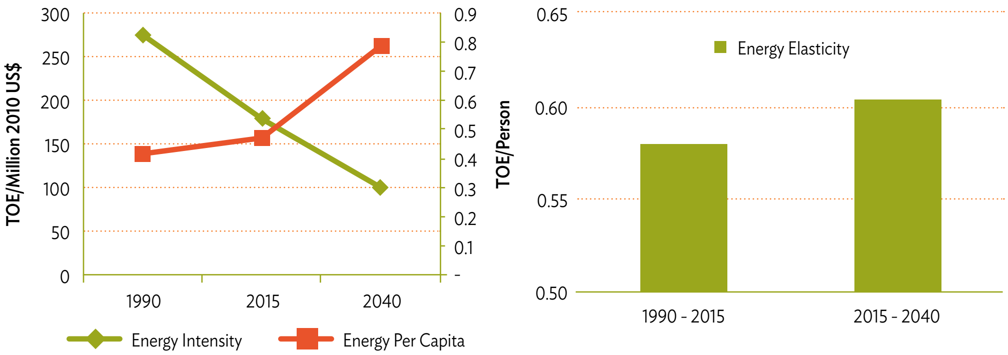
Source: Author's calculations.

3.1.4. Energy indicators

Under the BAU scenario, the energy intensity of the country tends to decrease at a rate of 2.3% for the period 2015–2040. Energy intensity is the ratio of total primary energy over GDP. The significant reduction of energy intensity is attributable to the government's efforts in promoting energy conservation and efficiency in the different sectors of the economy. Meanwhile, energy per capita has an increasing trend from 0.47 toe/person in 2015 to 0.78 toe/person in 2040, due to the improvement in the standard of living and income of the people.

Income elasticity of energy is the relationship between changes in the primary energy supply and the changes in GDP. The income elasticity for 2015–2040 is expected to be at approximately 0.6, indicating that energy demand is rising less than proportionately to income.

Figure 14.6: Energy Intensity, Energy Per Capita, and Income Elasticity of Energy (1990, 2015, and 2040)



Source: Author's calculations.

3.2 Alternative Policy Scenario

As mentioned, the assumptions in the APS were analysed separately to determine the individual impact of each assumption in APS1, APS2, APS3, APS4, and the combination of all these assumptions (APS5).

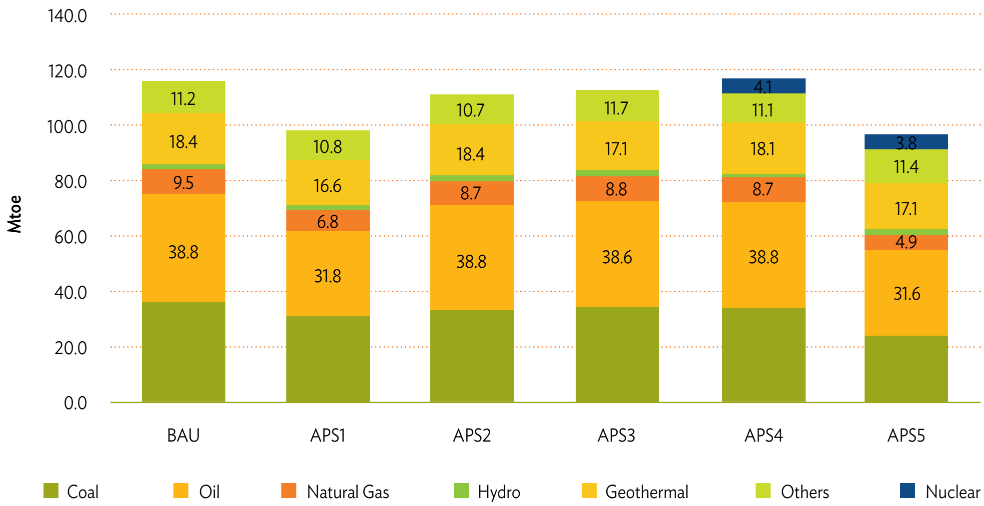
3.2.1. TPES

Figure 14.7 shows the changes in the TPES in all the scenarios. APS1, which assumes improved efficiency of final energy consumption, is projected to increase at a rate of 3% per year as levels reach 98.4 Mtoe by 2040. Compared to the BAU scenario, APS1 is lower by 17.4 Mtoe, or 15%, indicating the effectiveness of energy efficiency measures implemented in various sectors of the economy.

Based on the assumption of more efficient thermal power generation, APS2's TPES will be lower by 4.7 Mtoe or 4% compared to the BAU scenario as it will reach 111.06 Mtoe in 2040. The bulk of the reduction would be from coal as more efficient power plants are assumed to be used to generate power in this scenario.

Under APS3, where the bulk of the increase in the contribution of RE will be in the form of variable RE (solar and wind), TPES is lower by 3 Mtoe or 2.6% compared to BAU. This is mainly due to the slowdown in the use of geothermal energy in power generation vis-à-vis hydro and other RE. Under APS3, aggregate generation output from other RE (solar, wind, biomass, etc.) alone is expected to increase by as much as 10.5% per year, outpacing the 2.4% annual growth in geothermal generation output. This brings the TPES levels under APS3 to 112.8 Mtoe by 2040.

Figure 14.7: Comparison of Scenarios to Total Primary Energy Supply (2040)



Mtoe = million tons of oil equivalent.

Source: Author's calculations.

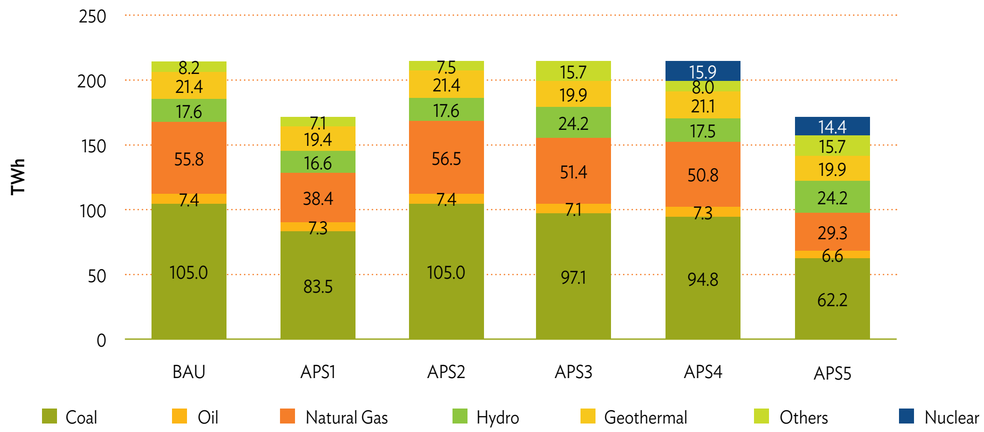
With the entry of nuclear in the energy mix, APS4 is the only scenario where the TPES is slightly higher than the BAU scenario by about 0.5 Mtoe, or 0.4%. This is due to the assumption that the thermal efficiency of nuclear power plants is 33% lower than the efficiencies of natural gas and coal power plants at 35.0% and 55.0%, respectively.

Combining all scenarios, the country's TPES under APS5 will grow at an average annual rate of 2.8% to reach 95.05 Mtoe in 2040. The combined effects of APS1 to APS4 is expected to yield the biggest reduction of 20.8 Mtoe, making the level of energy supply under APS5 17.9% lower than under the BAU scenario. This indicates the effectiveness of combining various energy assumptions – improved efficiency in the energy demand and thermal power generation, as well as higher contribution of RE and entry of nuclear in the supply mix – to achieve the feasible level of the TPES by 2040.

3.2.2. Total electricity generation

Figure 14.8 shows the total electricity generation in 2040 in all scenarios. Due to the efficiency measures resulting in lower electricity demand, APS1's total generation output was at 172.3 TWh as all fuels register reduced generation output vis-à-vis the BAU scenario. This makes APS1's level at 43.1 TWh or 20% less than 215.3 TWh under the BAU scenario, with lower shares for fossil-fired power plants, particularly for natural gas and coal.

Figure 14.8: Comparison of Scenarios to Electricity Generation (2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, TWh = terawatt-hours.

Source: Author's calculations.

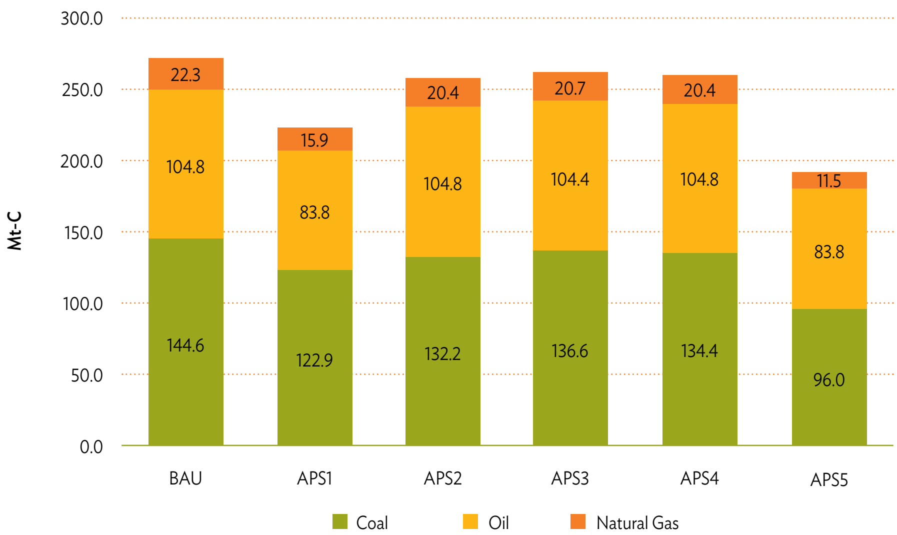
APS2, APS3, and APS4 yield the same total generation output with the BAU scenario. However, under APS2, coal share will increase slightly by less than a TWh compared with the BAU scenario level. This is because of the entry of highly efficient coal-fired power plants, which, although operating with higher thermal efficiency by 2% compared with conventional coal plants, will contribute significantly to the generation mix. Power generation from coal is projected to reach 105.0 TWh level by 2040 for APS2, slightly higher compared with its level in the BAU scenario. This is the same case with the power generation from natural gas that will also increase slightly in APS2 from the BAU scenario. On the total account, the effect of higher thermal efficiencies of fossil fuel plants is a slight reduction on the aggregated variable RE generation output for APS2. On the other hand, the shares of generation from fossil fuels are lower for the two other scenarios, as they are displaced by RE for APS3 and entry of nuclear in the generation mix for APS4.

While APS5's total generation output is equal to that of APS1 for 2040 at 172.3 TWh, there is a significant reduction in the aggregate level of fossil fuels' power output from the BAU scenario to APS5 at 41.7 %, or from 168.1 TWh to 98.02 TWh.

3.2.3. Total CO_2 emissions

In terms of reduction of CO_2 emissions, the energy efficiency assumption in APS1 will generate 222.6 million metric tons of carbon (Mt-C), which is 49.0 Mt-C or 18.0% lower than BAU for 2040. The decrease in CO_2 indicates that the energy-saving goals, action plans, and policies in the promotion of the energy efficiency and conservation programme will be effective in reducing CO_2 emissions (Figure 14.9).

Figure 14.9: Comparison of Scenarios to CO_2 Emissions (2040)



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

Source: Author's calculations.

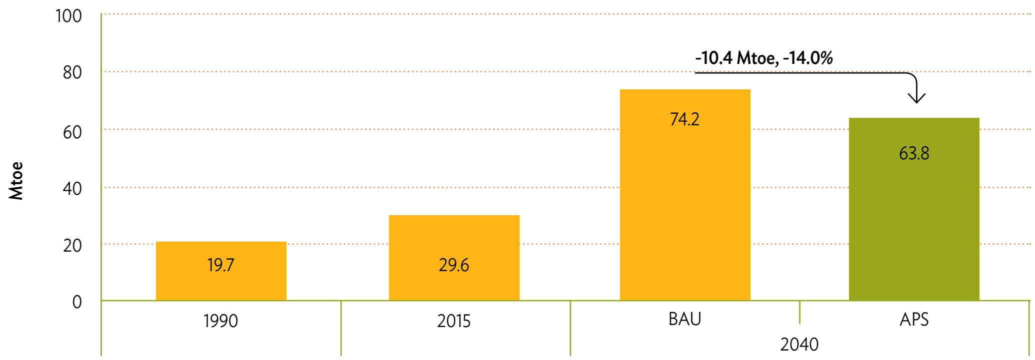
Under APS2, total CO_2 emissions are lower by 14.2 Mt-C or 5.2% relative to the BAU scenario's 271.6 Mt-C. In APS3, the reduction is the least amongst all alternative scenarios at 10 Mt-C. In APS4, the reduction will account for the level of 12.1 Mt-C or 4.4% compared with the BAU scenario.

Combining all the assumptions in APS1, APS2, APS3, and APS4 (APS5) will give the aggregate reduction of CO_2 emissions from the BAU scenario at 80.3 Mt-C or 29.6%.

3.2.4. Final energy consumption

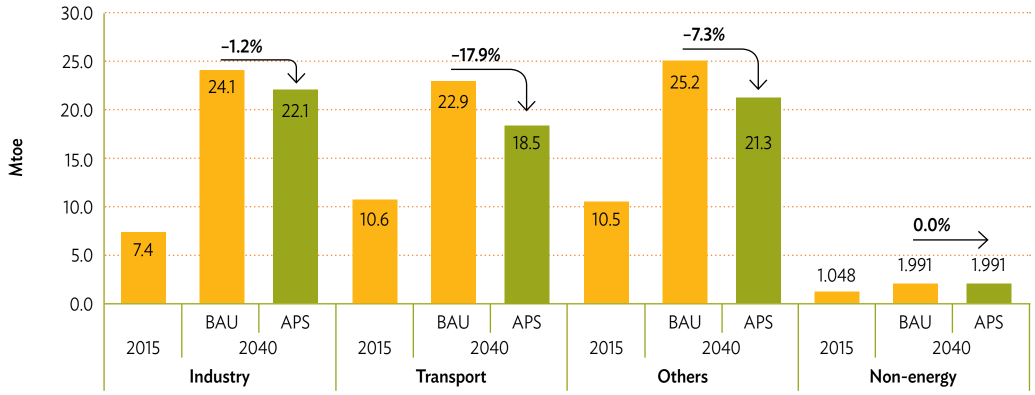
Figures 14.10 to 14.12 show the levels of the TFEC in 2040 between the BAU scenario and the APS (APS5), by sector and by fuel. Due to the improved economy-wide energy efficiency that will yield higher energy savings on the demand side under the APS, final energy demand is at 63.8 Mtoe, which is 10.4 Mtoe or 14% lower than the BAU scenario.

Figure 14.10: Comparison of Total Final Energy Consumption in 2040, BAU and APS



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mt-C = million tons of oil equivalent.
Source: Author's calculations.

Figure 14.11: Comparison of Final Energy Consumption in 2040, BAU and APS

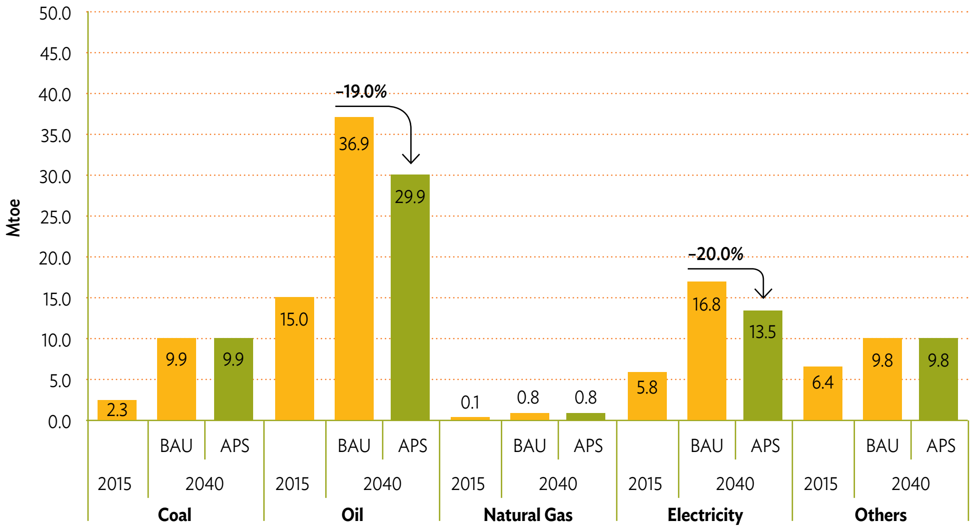


APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mt-C = million tons of oil equivalent.
Source: Author's calculations.

All economic sectors are expected to contribute to the aggregate reduction in energy demand under the APS. The transport sector will cut its demand by as much 19.5% to reach 18.5 Mtoe, from 22.9 Mtoe in the BAU scenario. Energy demand from the 'others' sector (residential, commercial, agriculture, fishery, and forestry) at 21.3 Mtoe is 15.4% lower than its BAU level of 25.2 Mtoe. The industry sector will also contribute 8.5% reduction – from 24.1 Mtoe under the BAU scenario to 22.1 Mtoe in the APS.

The impact of improved efficiency is evident in the 19% and 20% decline in the consumption of oil and electricity under the APS (APS5) vis-à-vis BAU (Figure 14.12).

Figure 14.12: Comparison of Final Energy Consumption by Fuel Type in 2040, BAU and APS



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

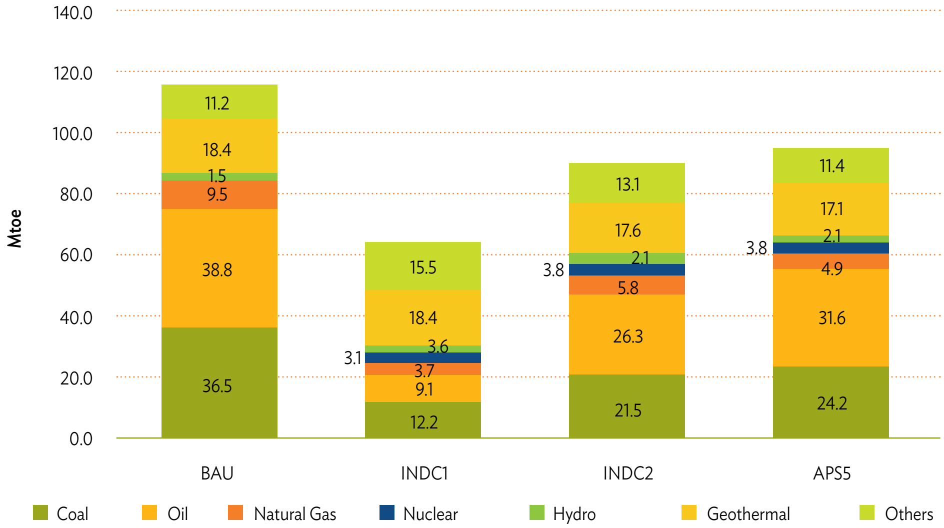
Source: Author's calculations.

3.3 Intended Nationally Determined Contributions Scenario

Aside from the assumptions set forth under the APSs, the country's commitment to international environmental agreements in terms of its INDC was likewise studied. Two simulations were done for this purpose: INDC1 seeks to determine the effect of a 70% reduction in CO_2 emissions by 2030 from BAU, while INDC2 looks into more considerable CO_2 emissions reduction targets by 2040. In INDC1, to be able to reduce CO_2 emissions by 70% in 2030, fuel substitution, such as from fossil fuels to electricity and biomass, was assumed from 2025 to 2035 in the demand sectors. On the other hand, more considerable assumptions were made in INDC2, such as 25%–30% energy efficiency target from 2025 to 2035 and 10% electricity use in the transport, industry, and services sectors to substitute gasoline and diesel demand. For INDC2 power generation, it was assumed that all additional capacities from coal and natural gas power plants by 2022 until 2040 will be of highly efficient technologies and more contribution of RE generation output to compensate for the significant increase in electricity demand. At the end, the energy savings potential of INDC2 at 25.5 Mtoe is higher by 4 percentage points compared with APS5 (20.8 Mtoe) but with much higher CO_2 reduction from the BAU scenario by 38.2% in 2040 compared with APS5 with 29.6% CO_2 reduction at the same period.

3.3.1 TPES

Figure 14.13: Comparison of Total Primary Energy Supply in 2040 (BAU, INDC, and APS5)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, INDC = Intended Nationally Determined Contributions, Mtoe = million tons of oil equivalent.

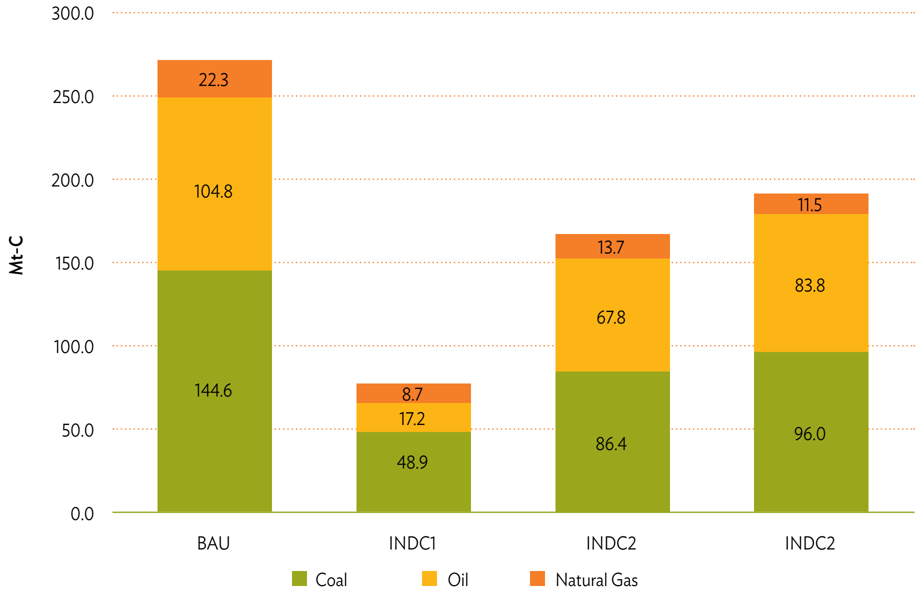
Source: Author's calculations.

INDC1 yields a TPES level of 64.5 Mtoe, 44.3% (51.3 Mtoe) less than that of the BAU scenario. Under INDC1, supply of fossil fuels will significantly decline by 70.6% from the BAU level. On the other hand, the reduction on INDC2 supply level compared with the BAU scenario is projected at 22%. Comparing also the supply level between INDC2 and the APS, the difference is only 4.8 Mtoe, with INDC2 lower by 5% at the 90.3 Mtoe level of energy supply. Despite the significant reduction in the aggregate supply of fossil fuels in INDC2 at 37%, this was compensated by the higher production of RE compared with the BAU scenario and APS5.

3.3.2 Total CO_2 Emissions

INDC1 will produce the least amount of CO_2 emissions at 74.7 Mt-C amongst the four scenarios. This will reflect 70% reduction of CO_2 emissions by 2030 and 72.5 CO2 emission by 2040 from BAU. On the other hand, INDC2's CO_2 emissions reduction at 167.9 Mt-C in 2040 is lesser by 55.4% compared with that of INDC1 during the period, while only 12.2% higher reduction from APS5. The CO_2 emissions reduction of INDC1, INDC2, and APS5 from the BAU scenario will register at 72.5%, 38.2%, and 29.6%, respectively, by 2040.

Figure 14.14: Comparison of Total CO_2 in 2040 (BAU, INDC, and APS5)



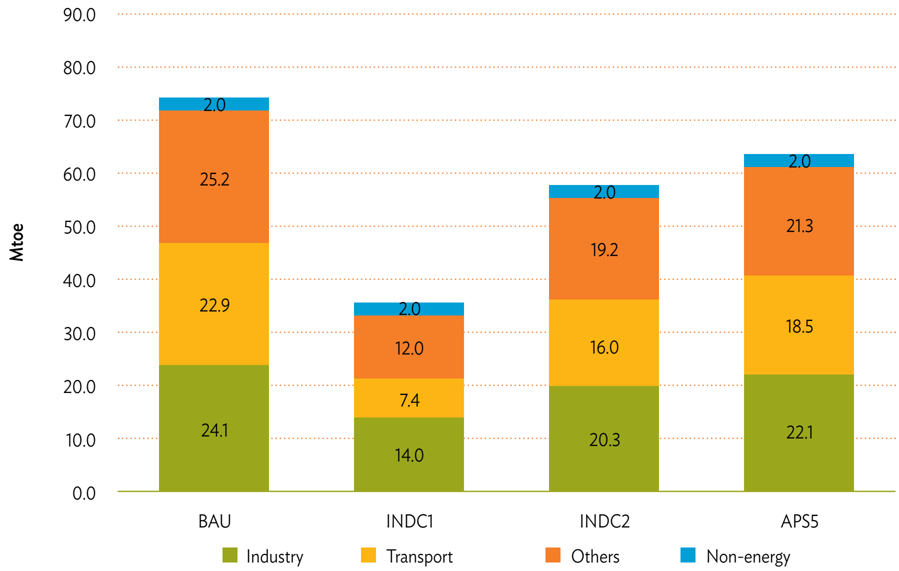
APS = Alternative Policy Scenario, BAU = Business-As-Usual, INDC = Intended Nationally Determined Contributions, Mt-C = million tons of carbon.

Source: Author's calculations.

3.3.3 Final energy demand

The CO_2 emissions reduction targets for both INDC1 and INDC2 put a cap on final energy demand, resulting in lower levels compared to APS5. However, energy demand in transport, which has been the primary source of CO_2 emissions amongst end-use sectors, has been reduced to 7.4 Mtoe under INDC1, which is considerably lower compared to the sector's historical consumption levels. This contributes to the halving of final energy demand for INDC1 at 35.4 Mtoe from the BAU scenario's 74.2 Mtoe. On the other hand, the demand mix of INDC2, which totals 57.6 Mtoe, is almost similar with the levels of each end-use sector from that of the BAU scenario and APS5.

Figure 14.15: Comparison of Final Energy Consumption by Sector in 2040 (BAU, INDC, and APS5)

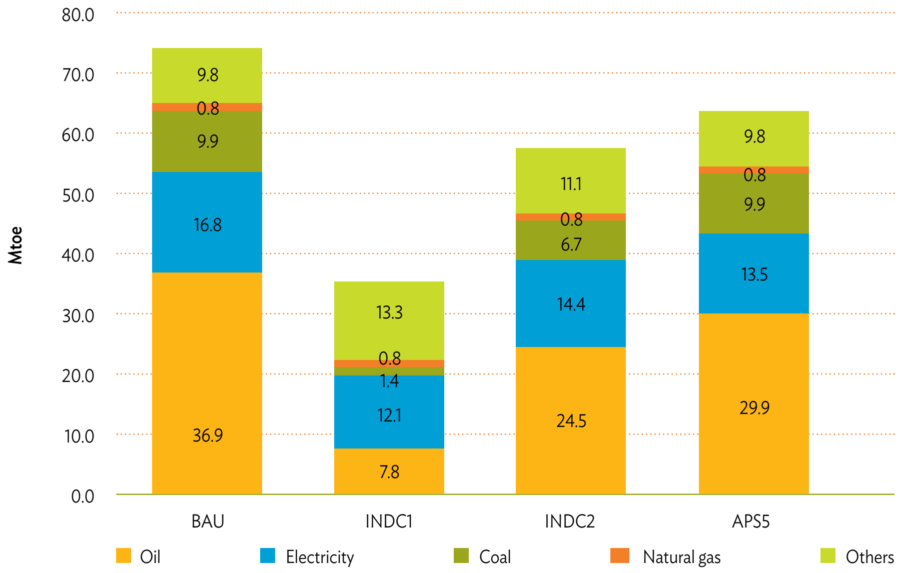


APS = Alternative Policy Scenario, BAU = Business-As-Usual, INDC = Intended Nationally Determined Contributions, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

In Figure 14.16, the effect of 70% CO_2 reduction in INDC1 will bring down the aggregate consumption of oil and coal by 80.3% from its BAU scenario level. The scenario may not be possible without other fuels to substitute this aggregate level of consumption of oil and coal. In particular, coal consumption in INDC1 will be reduced to a mere 1.4 Mtoe by 2040 or an almost sevenfold reduction from the BAU scenario, while oil will account for an almost fivefold reduction. For INDC2, an assumption to substitute smaller reduction of fossil fuels in the demand sectors will bring down the coal and oil demands by 32% to 33% from the BAU scenario. INDC2's electricity demand is higher by 6.5% compared with the APS5 level to compensate reduction in fossil-fuel demand. Meanwhile, oil demand in INDC2 will be reduced significantly compared with the BAU scenario and APS5 but will still be the most dominant fuel in the demand sector as could also be observed in the BAU scenario and APS5.

Figure 14.16: Comparison of Final Energy Consumption by Fuel Type in 2040 (BAU, INDC, and APS5)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, INDC = Intended Nationally Determined Contributions, Mtoe = million tons of oil equivalent.

Source: Authors' calculations.

4. Implications and Policy Recommendations

Amongst the fossil fuels under the BAU scenario, coal supply will register the fastest growth rate at 4.9% throughout the planning period. This is due to the significant contribution of coal in power generation, which corresponds to the increasing demand for electricity at 4.3% average annual rate. Towards 2040, coal supply level will almost be at equal level with the country's most dominant fuel, oil, that is mainly used in the transport sector. The aggregated share of RE at 26.8% is behind by 14.8% of the projected contribution of coal in the supply mix. The result of the study indicates that the significant use of coal during the planning period is inevitable. Given the current policy of the government to fully support the attainment of its development goals as envisioned in Ambisyon 2040, which covers the country's industrialisation and urbanisation goal within the framework of the long-term Philippine Development Plan, the DOE is focused on achieving security and reliability of energy supply in anticipation of the long-term economic development of the country. This is to support the vision of a low-carbon future and adopting a technology-neutral policy in coming up with an optimal energy mix. At this point, a reliable source of energy for power generation such as coal is indispensable; in fact, majority of the committed capacities from the private power projects are coal power projects (more than 70% of the committed capacities). Consistent with the results of the study, the share of coal in power generation by 2040 will account for almost half of the total generation output. Natural gas will comprise one-fourth of the generation output while the remaining shares will be sourced from oil and RE. Thus, it is important for the government to push for more diversification of energy sources in a feasible manner to achieve an ideal energy mix that would be consistent with the goal of the energy sector on energy security. Coal-fired power plants provide reliable baseload capacity given their dominant share in power generation, while avoiding or controlling their increased capacity in power generation will hamper the stability of electricity supply. The government still needs to safeguard the environment through policy interventions such as promoting the use of highly efficient and clean coal technologies in power generation and non-power industries. In fact, coal demand in the industry sector will be the third highest in utilisation level by 2040 after oil and electricity at 13.3% share of the total demand mix. However, there is an issue in implementing the policy, considering the power sector is a deregulated industry. Under this condition, the government has limited control in choosing the type of power plants to be built since the power industry is already deregulated and led by private investment. It can be addressed somehow by formulating a fuel mix policy for power generation to guide and inform investors and other key players of the industry on the preferred power mix of the country for long-term sustainability of the country's power sector. This policy might have been in conflict with technology-neutral policies. However, the role of the government here is only to provide a check-and-balance on the share of fuel types in the power mix. Each fuel should not be more than the required level that it could dictate the price of electricity and disrupt supply that will more likely cause a total power crisis.

On the demand side, oil will register the biggest share in the final energy consumption by almost half of the demand mix at the end of the planning period. This will happen despite the current effort of the government to promote the energy efficiency and conservation programme and alternative fuel and technology development. The results of the model indicate that the share of oil in the total demand is constantly at around 50% across different scenarios. It would be appropriate for the government to focus on the promotion of alternative fuels in the transport sector to substitute partly and directly the use of oil in the sector with the extended implementation of alternative fuels in the transport programme.

Moreover, the use of alternative technologies and fuels such as electric vehicles, compressed natural gas (CNG), autogas (LPG for transportation), and biofuels for transport will temper the utilisation of oil in the country in the future, thus, reducing the negative impacts of oil price volatility in the world market. The government's efforts in the promotion of alternative fuels in the transport sector will help not only in reducing the energy requirements but also in lessening GHG emissions that mostly come from the transport sector.

On the other hand, under the APS, energy and CO_2 intensity will continue to decline from 2015 to 2040, although CO_2 emissions per energy consumption will increase corresponding to the increased share of fossil fuels. In this regard, the government should strictly implement plans and/or programmes for energy efficiency and conservation that will address volatile oil prices and their inflationary effect on the prices of basic commodities, and change the economic structure of the country to rely more on its services sector rather than on energy-intensive industries. This is also consistent with the target of the Asia-Pacific Economic Cooperation (APEC) to reduce its aggregate energy intensity (energy demand per unit of GDP) by 45% by 2035, with 2005 as the base year. Improvement in the energy intensity of the Philippines is expected to be driven in part by the country's changing economic structure, relying more on its service sector than on energy-intensive industries.

In response to the results of this study, the government should pursue its programmes and projects that will further increase and enhance the use of indigenous, clean, and efficient alternative fuels. The full implementation of the Renewable Energy Act of 2008 to expand the utilisation and development of indigenous energy, such as geothermal, hydro, solar, wind, and other clean energy, will not only promote the use of sustainable energy but will also lessen the country's need for energy imports. FiT, RPS, and other policy mechanisms provided under the law will boost the use of RE.

Special attention should also be given to the industry sector since its energy demand is growing more than the transport sector and could have high potential energy savings. In fact, based on the study results, the demand of the industry sector will surpass that of the transport sector as early as 2035 across different scenarios.

Currently, the Philippines has a specific quantitative energy-saving requirement as provided under Administrative Order (AO) No. 110, Directing the Institutionalisation of a Government Energy Management Program. The AO requires the reduction of at least 10% in the cost of fuel and electricity consumption, amongst others, in the government. This can be duplicated or expanded to other sectors if an existing energy conservation law will require strict regulation and implementation.

In addition, there is a need to pass the Energy Conservation Law to realise the targets set by the government. The law will institutionalise energy conservation and enhance the efficient use of energy in the country.

Moreover, looking at the integration of all the scenarios, the result is effective in reducing the carbonisation ratio. This indicates that the government should set the enabling environment to ensure that policies will strictly be implemented.

Finally, it is important to ratify commitment to international environmental agreements like the INDC and Nationally Determined Contributions that will direct member countries to pursue reduction of CO_2 emissions under a certain framework. Based on the results of the study, nearly 35% could be a suitable level of CO_2 emissions reduction in the country by 2040.

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