ENERGY DEMAND & SUPPLY OUTLOOK

2017 - 2040

Contents

Message

Working towards the goal of President Rodrigo Roa Duterte for a stronger Philippines, the Department of Energy (DOE), now more than ever, is aggressively and consistently ascertaining the stability of the country's energy supply and systems, forging to address comprehensively the requirements from all sectors of the economy.

The DOE believes that the best solution to maintain a stable and robust energy industry is through a technology-neutral and competitive business environment. Using reliable data coupled with adequate industry analysis, the DOE is dedicated to adhere to the "point of view" and sentiments of the consumers in addressing the challenges of the dynamic energy sector, particularly in its policy and decision-making initiatives.

The DOE also persistently unifies with government partners, while also tightening its relationship with the private sector. Meeting the country's electricity and fuel requirements through improvements in the energy market, simplification of government procedures, promotion of resiliency in energy systems and infrastructures and the enhancements of the consumers' power of choice are paramount musts in the DOE's agenda.

All these are carefully planned and outlined in the Philippine Energy Plan (PEP). It is the energy sector's blueprint and bible in fulfilling the government's AmBisyon Natin 2040, which aspires for an equitable life for all Filipinos by 2040. Its guiding principles are also consistent with the Dutertenomics' Build Build Build program intended for sustained socio-economic development.

The PEP's energy demand and supply outlook considers the targets and assumptions of the energy sector with reference to the demand profile in ensuring the supply source's availability. The DOE is mandated and tasked after all to promote the use of efficient energy structures and technologies, indigenous and environment-friendly energy sources and carrying out new and existing policies, programs and measures within the energy sector.

In addition, the PEP is supported by data-driven sectoral plans and roadmaps to fulfill the message of empowering the consumers and stakeholders for global competition. Through the PEP, the DOE is confident that the government is presenting a harmonious and unified direction, to support a sturdy, stable and secure economic growth for the years ahead.

Para sa mga Filipino. Mabuhay!

ALFONSO G. CUSI
Secretary

Tables // Figures

LIST OF TABLES

LIST OF FIGURES

1 ENERGY SUPPLY AND DEMAND SITUATIONER

Total Final Energy Consumption

In 2016, the country's total final energy consumption (TFEC) reached 33.1 million tons of oil equivalent (MTOE), up by 8.4 percent from its 2015 level of 30.5 MTOE (Figure 1). All economic sectors increased their energy consumption during the period.

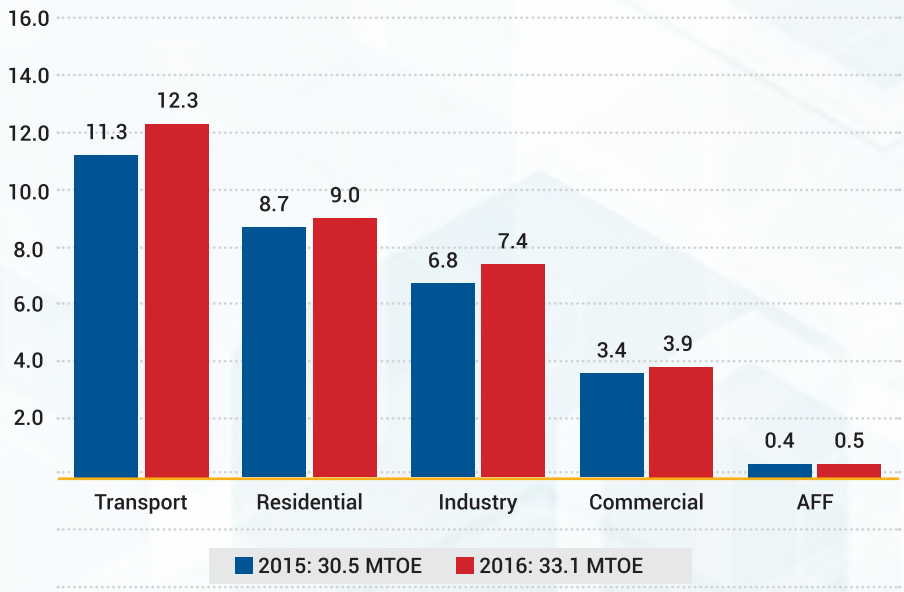

FIGURE 1. TOTAL FINAL ENERGY CONSUMPTION BY SECTOR IN MTOE (2015 VS. 2016)

The transport sector, accounting for more than one-third (37.2 percent) of total energy consumption was the biggest contributor to the demand mix. Its aggregate energy demand levels reached 12.3 MTOE, 9.1 percent higher from last year's 11.3 MTOE (Figure 2). This was attributed to increased utilization of gasoline and diesel for road transport. The economic expansion in the service sector, such as banking, retail, IT, consulting, telecommunication and the like, resulted in a double digit growth of 14.7 percent in its energy consumption, the fastest among end-use sectors, combined with an 11.7 percent share to TFEC. Likewise, the agriculture, fishery and forestry (AFF) sector registered a 12.4 percent hike in energy use despite a meager share of 1.4 percent to total demand. Higher production output from the industrial sector, particularly in the food processing and cement manufacturing industries, resulted to a 10.3 percent upsurge in the sector's collective energy requirements, corresponding to a 22.5 percent share to TFEC. On the other hand, the residential sector, in spite its status as the second biggest user of energy with a share of more than one-fourth (27.3 percent) of the country's total energy consumption during the period, registered a moderate increase of 3.5 percent in energy utilization.

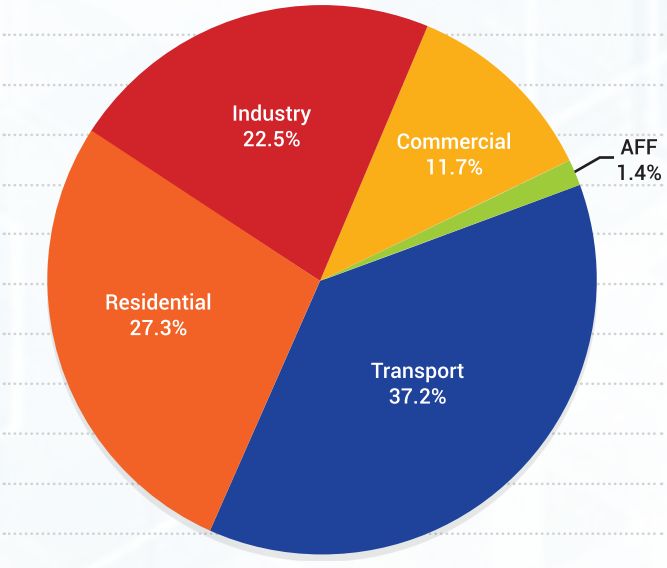

FIGURE 2. TOTAL FINAL ENERGY CONSUMPTION BY SECTOR (2016), % SHARES

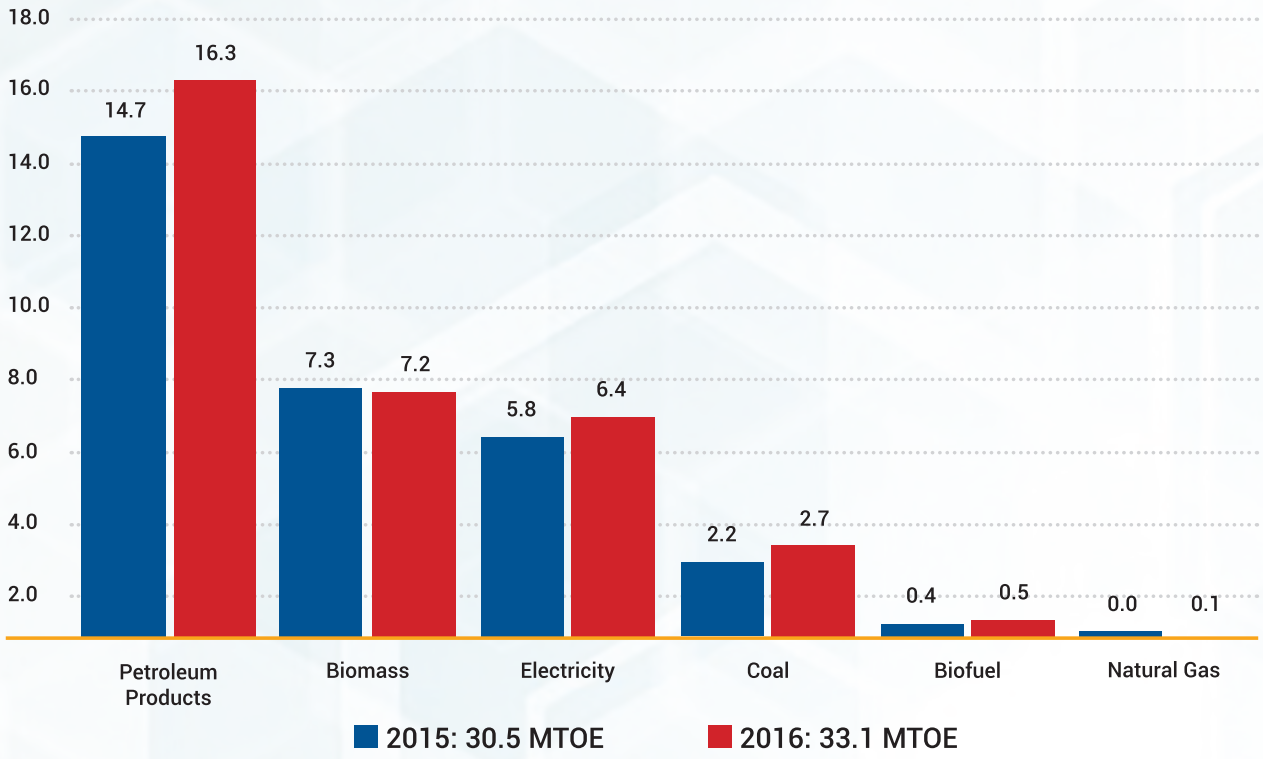

FIGURE 3. TOTAL FINAL ENERGY CONSUMPTION BY FUEL TYPE (2015 VS. 2016), MTOE
Note: 2015 natural gas consumption was 49.8 kTOE, while 2016 is 64.8 kTOE

Petroleum products garnered the bulk of the country's total final energy consumption with 49.3 percent share, as its demand levels jumped by 10.9 percent, from last year's level of 14.7 MTOE to 16.3 MTOE in 2016 (Figure 3). Generally stable domestic oil prices that prevailed last year encouraged the consumption of gasoline and diesel, as levels went up by 12.1 percent and 8.4 percent, respectively, bringing in a combined share of 79.7 percent to the total petroleum consumption.

Biomass was the second most consumed fuel in 2016 with 21.8 percent share to the total final consumption (Figure 4), despite posting a reduction of 1.1 percent in its consumption during the period. Bulk of the demand for biomass was consumed by the household sector, though its utilization dropped by 1.6 percent. Meanwhile, the industry and commercial sectors increased their biomass use by 1.0 percent each.

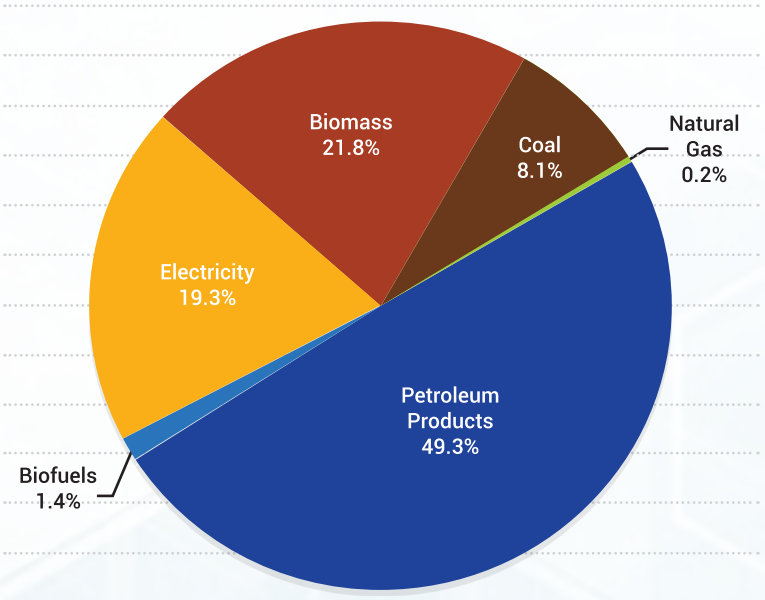

FIGURE 4. TOTAL FINAL ENERGY CONSUMPTION BY FUEL SHARES (2016)

Electricity demand level came in third after oil and biomass, with a share of 19.3 percent to TFEC in 2016. During the period, electricity posted a 9.4 percent growth to reach 6.4 MTOE level from last

year's 5.8 MTOE. Both the industrial and residential sectors registered close to one-third shares in the total electricity demand, while 29.4 percent was used in the commercial sector.

Meanwhile, coal consumption increased significantly by 20.6 percent at 2.7 MTOE in 2016, from last year's 2.2 MTOE. The upturn is attributed to the increased production output of coal-using industries, particularly food processing and cement manufacturing.

Consumption of biofuels, coco methyl ester (CME) and ethanol, went up by 9.2 percent, as their combined levels reached 467.4 thousand tons of oil equivalent (KTOE) in 2016, from 428.1 KTOE in 2015. This was mainly due to the strict compliance of oil companies to the mandated biofuel blend as fully implemented by the government.

Meanwhile, higher natural gas consumption for industrial purposes was reported during the period. Natural gas for non-power application registered the fastest growth of 30.2 percent among other fuels, as its levels increased to 64.8 kTOE in 2016, despite a meager share of 0.2 percent to the TFEC.

Total Final Energy Consumption, by Sector

Transport

The transport sector remained the most energy intensive sector in 2016 with a total share of 37.2 percent (Figure 2) in the final energy demand. Its demand level reached 12.3 MTOE during the period, which was 9.1 percent higher than its previous year's level of 11.3 MTOE (Figure 1).

Bulk of this increase came from the 10.8 percent hike in road transport demand, as car industry sales hit an all-time high of 417,356 units sold in 2016[1]. Road transport demand is equivalent to 88.2 percent of the entire sector's energy demand (Figure 5). Domestic air transport, owning 4.8 percent share in the sector's energy demand, posted a remarkable 33.1 percent increase in consumption as domestic tourism was boosted due to decrease in fuel prices resulting in more affordable air tickets, which in turn contributed to higher domestic tourism expenditures[2]. On the other hand, the energy consumption for rail transport increased by 5.9 percent in 2016 from the previous year's

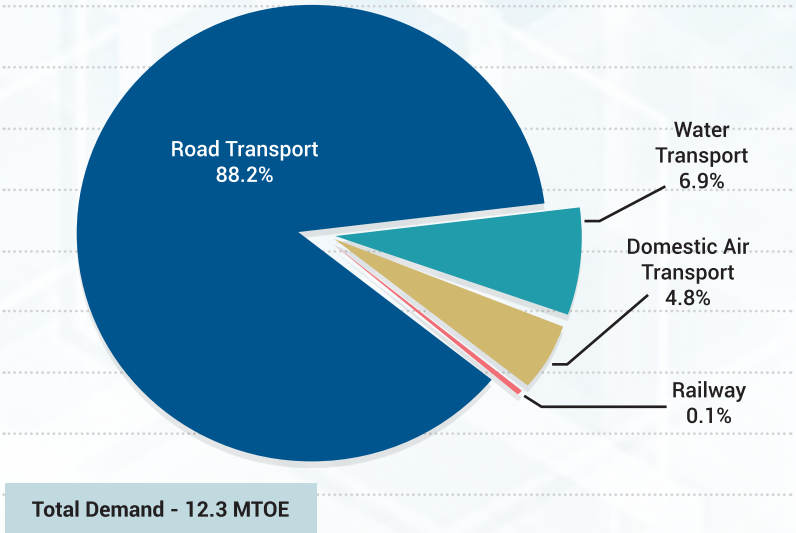

FIGURE 5. TRANSPORT FINAL ENERGY CONSUMPTION BY SUB-SECTOR (2016), percent

[1] Data from the Chamber of Automotive Manufacturers of the Philippines, Inc. (CAMPI) http://www.campiauto.org/ and Association of Vehicle Importers and Manufacturers (AVID) http://www.avid-inc.com.ph/
[2] Philippine Statistics Authority (https://www.psa.gov.ph/tourism-satellite-accounts-press-releases)

level of 10.1 KTOE, as more trains were made available in line with the efforts of the Department of Transportation (DOTr) to improve services in the Metro Rail Transit (MRT) and Light Rail Transit System (LRT). On the other hand, fuel consumption for water transport dropped by 17.0 percent from 2015 reaching 846.6 KTOE in 2016.

Petroleum products continued to be the sector's primary fuel, representing the bulk share of 96.4 percent to the total energy demand of the sector during the period (Figure 6). Diesel and gasoline, as main fuels utilized in road transport, put in an aggregate share of 89.9 percent in the overall demand mix of the sector. In terms of growth rate, gasoline and diesel increased by 12.2 percent and 5.4 percent, respectively. Fuel oil consumption increased by 10.8 percent during the period, while biofuels usage in the sector, such as biodiesel and ethanol, increased by 4.0 percent and 9.7 percent, respectively corresponding to the increase in consumption of diesel and gasoline of the sector. On the other hand, as safety issues and other concerns hampered the implementation of the auto-LPG program resulting in the decline in the number of taxis running on LPG in 2016[3] , its consumption in the transport sector likewise dropped by 54.6 percent.

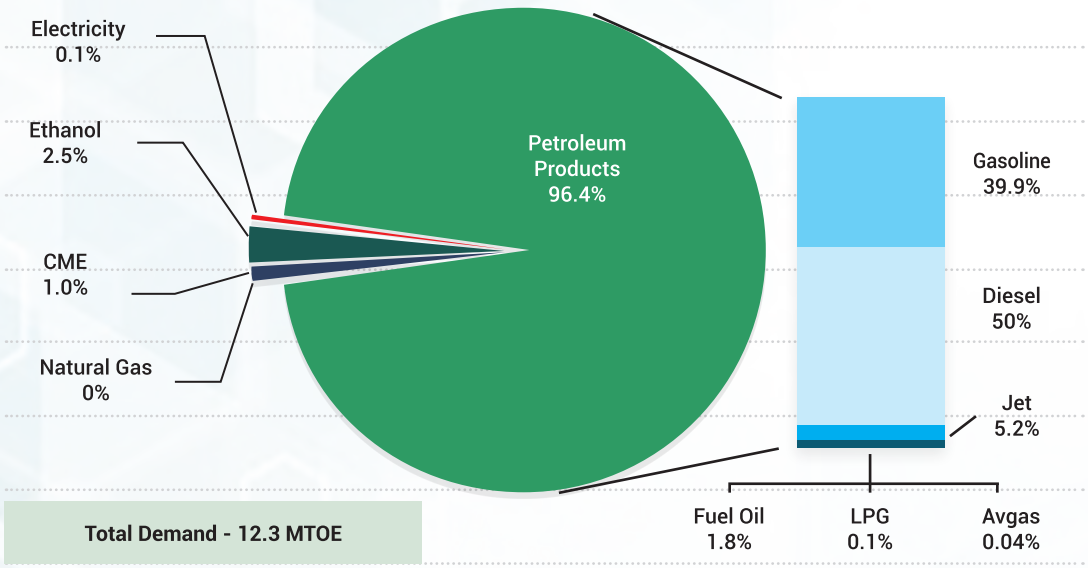

FIGURE 6. ENERGY CONSUMPTION OF THE TRANSPORT SECTOR BY FUEL (2016), percent

Residential

Total energy consumption of the residential sector grew by 3.5 percent from its 2015 level of 8.7 MTOE to 9.0 MTOE in 2016. This was attributed to the increased utilization of electricity and LPG in the sector during the period.

Biomass continued to be the most preferred fuel among households because of its abundance, accessibility and affordability, particularly in the rural areas (Figure 7). It accounted for the biggest chunk of the sector's energy consumption with 63.2 percent share, despite declining by 1.6 percent from its year-ago level of 5.8 MTOE.

[3] 9,718 auto-LPG taxis in 2015 vis-a-vis 8,415 units in 2016; Source: DOE Energy Sector Accomplishment Report (ESAR), 2016

Household electricity consumption, which accounted for 24.4 percent share in the sector's energy demand, increased by 12.7 percent from its 2015 level of 2.0 MTOE to 2.2 MTOE in 2016. As of December 2016, around 20.6 million households already have access to electricity[4]. This level of household electrification (90.7 percent), coupled with improved living standards due to increasing incomes[5], contributed to the higher demand for electricity. On the other hand, stable prices of petroleum products during the period in review resulted in a 17.5 percent jump in LPG consumption.

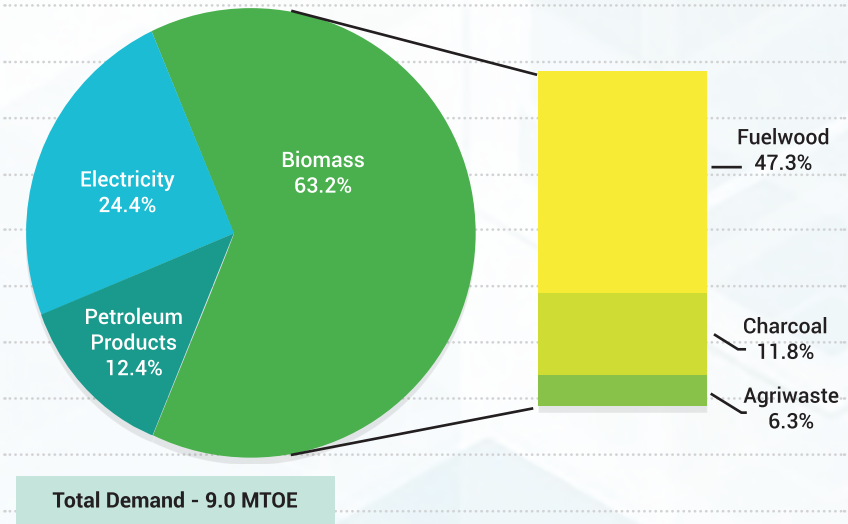

FIGURE 7. ENERGY CONSUMPTION OF THE RESIDENTIAL SECTOR BY FUEL (2016),Percent

Industry

The industry sector as the third biggest consumer of energy after transport and residential sectors, recorded its energy demand level at 7.4 MTOE in 2016, 10.3 percent higher than its year-ago level of 6.8 MTOE.

The manufacturing sub-sector continued to dominate the total demand mix of the sector, accounting for a substantial share of 93.1 percent (Figure 8). Of this share, energy intensive[6] industries took a share of 81.9 percent of the sub-sector's total energy demand. Energy consumption in the mining sub-sector went down by 18.5 percent, while contributing a share of 4.0 percent. This can be attributed to the slowdown in mining operations due to uncertainties posed by the government's extended ban on new mines and review of current mine permits. On the other hand, energy consumption of the construction sub-sector increased remarkably by 43.1 percent, in line with the implementation of the government's aggressive infrastructure roadmap that kicked-off in 2016.

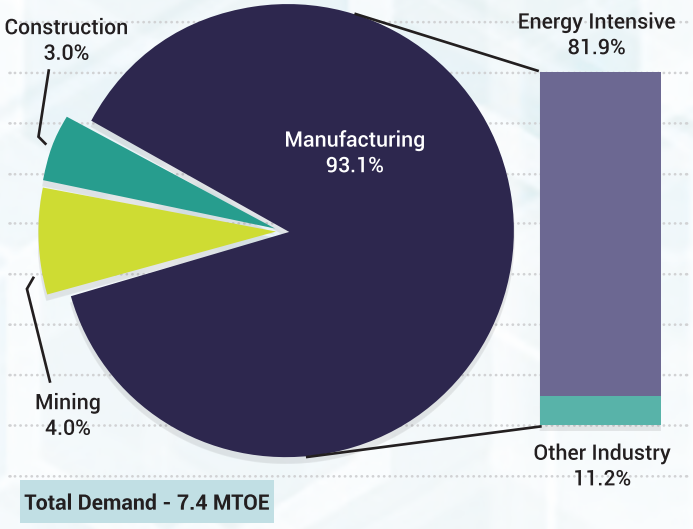

FIGURE 8. ENERGY CONSUMPTION OF THE INDUSTRY SECTOR BY SUB-SECTOR (2016), Percent

Coal, electricity, petroleum products, and biomass are the major fuels for industrial processes (Figure 9). Coal registered 35.9 percent share in the demand mix of the sector, coupled with

[4] DOE Energy Sector Accomplishment Report (ESAR), 2016
[5] Provides the motivation for households to acquire power intensive appliances and equipment, communication gadgets and other technologies
[6] Food processing, cement production, paper production and printing, chemicals, basic metals and machineries

a 20.6 percent hike in its consumption for cement manufacturing in 2016. This was attributed to the 6.6 percent boost in cement sales[7] to match the continued uptrend in public and private infrastructure spending due to confidence in the Philippine government. Meanwhile, electricity as the second most important fuel of the sector, accounted for 27.8 percent share of the total sector's demand with a utilization level of 2.1 MTOE or an increase level of 7.1 percent from 2015 to 2016.

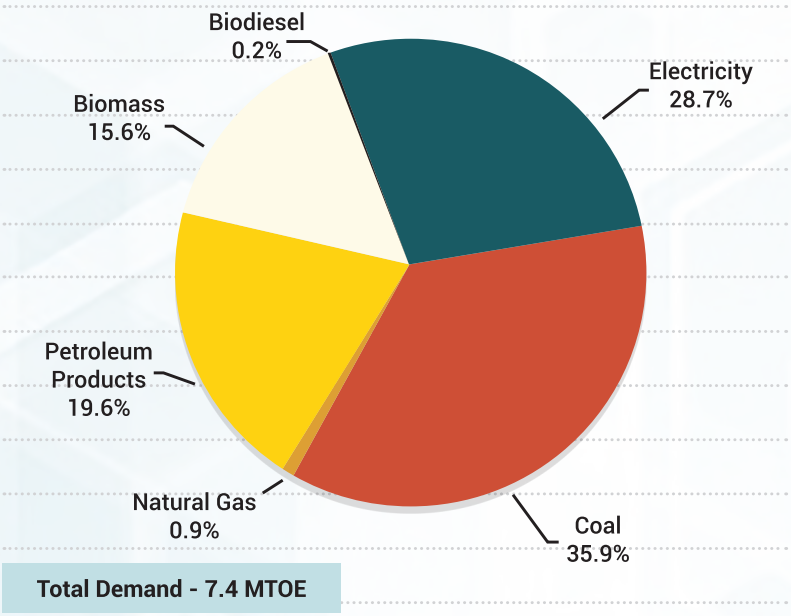

FIGURE 9. ENERGY CONSUMPTION OF THE INDUSTRY SECTOR BY FUEL (2016), Percent

The total consumption of petroleum products put in an additional 1.5 MTOE (or 19.6 percent share) to the industry's energy demand during the period. Among petroleum products, fuel oil and diesel were the most consumed, posting a combined growth of 6.9 percent between 2015 and 2016. Meanwhile, biomass, as a notable fuel in the industry sector and extensively used in food processing and sugar production, accounted for a share of 15.6 percent to the total demand with a utilization level of 1.2 MTOE, an increase of 1.0 percent in 2016. On the other hand, a small demand of natural gas (64.8 KTOE) for non-power application, and biodiesel (12.7 KTOE) contributed a combined share of 1.0 percent in the demand mix of the sector.

Commercial[8]

As the main driver of the country's GDP growth in 2016, the commercial (trade and services) sector's robust performance recorded its 7.7 percent increase in economic output. This level of economic activity was sustained by 3.9 MTOE of energy consumed during the same year, which reflected a double-digit growth of 14.7 percent from its 2015 level of 3.4 MTOE (Figure 10).

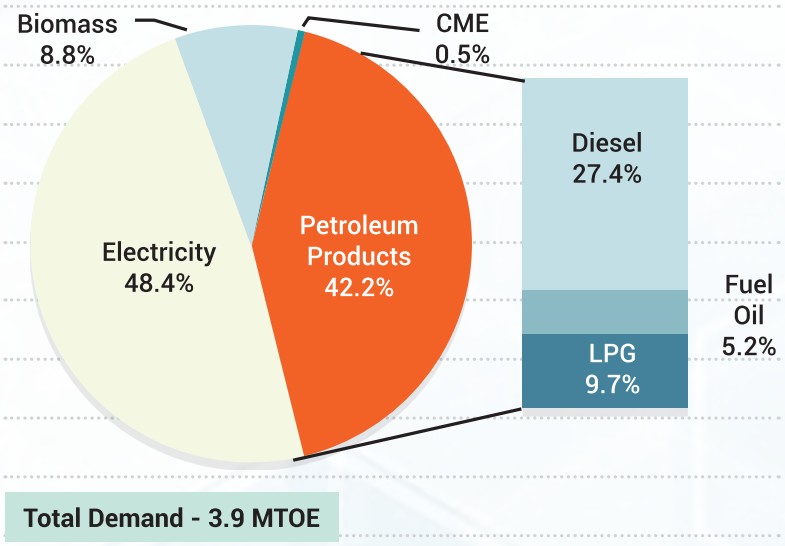

FIGURE 10. ENERGY CONSUMPTION OF THE COMMERCIAL SECTOR BY FUEL (2016), Percent

Electricity supplied almost half of the total energy demand of the sector,

[7] Data from the Cement Manufacturers Association of the Philippines (CeMAP) http://www.cemap.org.ph/
[8] Trade and services, excluding Transport

while its level increased by 8.4 percent. On the other hand, consumption of petroleum products, which accounted for the 42.2 percent of the sector's demand mix, went up by as much as 26.4 percent to reach 1.6 MTOE in 2016 based on last year's 1.3 MTOE level. All petroleum products registered higher consumption in 2016. Diesel demand stood at 1.1 MTOE in 2016, 25.4 percent higher than its year-ago level of 843.5 KTOE, while accounting for 27.4 percent share to the sector's demand mix. As a result of increased utilization of diesel, biodiesel use exhibited the fastest with 42.4 percent to reach 20.6 KTOE during the same period. Consumption of fuel oil improved by as much as half (45.0 percent) of its 2015 level of 138.4 KTOE to reach 200.7 KTOE. Utilization of LPG, mostly as cooking fuel by establishments engaged in food services business, accelerated by 20.6 percent with a utilization level of 373.8 KTOE. Commercial establishments slightly upped their biomass consumption by 1.0 percent, an increase from 336.6 KTOE in 2015 to 339.9 KTOE in 2016.

Agriculture, Fishery and Forestry (AFF)

The AFF sector indicated an increase in their utilization level by 12.4 percent from its 2015 level of 400.6 kTOE to 450.4 kTOE in 2016 (Table 1). The sector required more energy to counter the ill-effects of the El Nino phenomenon and typhoons that plagued the country in 2016.

Table 1. AFF ENERGY CONSUMPTION BY SUBSECTOR

Subsector	2015	2016	Growth Rate %
Agri-Industry	213.2	233.2	9.4
- Agri-Crops Product	71.3	74.2	4.0
- Livestock/Poultry	135.1	151.5	12.1
- Agri Services	6.7	7.5	11.6
Forestry	0.8	0.8	4.0
Fishery	186.6	216.5	16.0
Total	**400.5**	**450.4**	**12.4**

To prevent further decline in production of tilapia, skipjack, seaweeds and other species, mostly in Isabela, Cagayan, South Cotabato, Quezon and Palawan[9] due to Typhoons Karen and Lawin, the fishery sub-sector increased its energy requirements by 16.0 percent. Meanwhile, as major crops, such as palay and corn, suffered from reduction in harvested area, farmers were prompted to increase their economic activities and consume more energy to achieve favourable production output. Thus, the agri-crops product subsector's energy consumption went up by 4.0 percent during the period. On the other hand, the livestock and poultry subsector recorded a 12.1 percent hike in energy consumption as producers responded to the high demand for carabeef, meat, dairy products, as well as chicken and duck meat in Ilocos Region, Central Luzon and Northern Mindanao[10] .

[9] 2016 Performance of the Philippine Agriculture, PSA
[10] Ibid

Consumption of petroleum products, which contributed 50.8 percent share to the total demand of the sector, were up by 18.1 percent to 288.6 KTOE in 2016 led by diesel as it registered a 16.4 percent hike in demand. Electricity reflected an increase of 7.1 percent to reach 217.7 KTOE in 2016, while contributing almost half (48.3 percent) of the sector's energy demand (Figure 11).

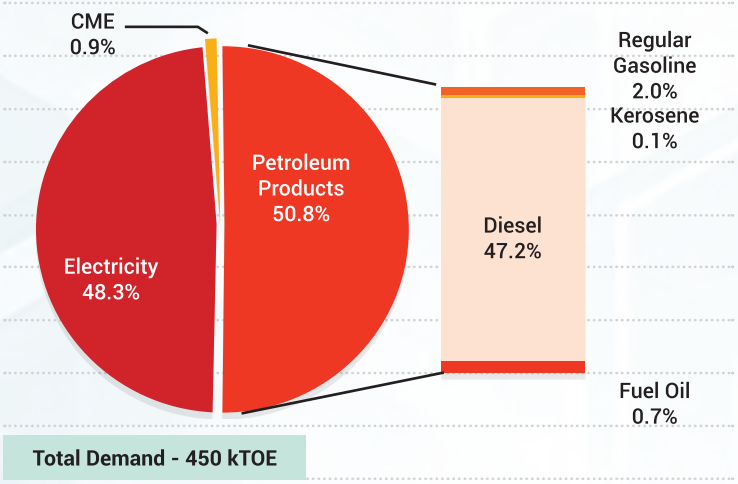

FIGURE 11. ENERGY CONSUMPTION OF THE AFF SECTOR BY FUEL (2016), Percent

Transformation

Oil Refining

There are two existing refineries in the Philippines namely, Petron Bataan Refinery in Limay, Bataan and the Pilipinas Shell Oil Refinery located in Tabangao, Batangas City. These refineries have a combined capacity of 285,000 barrels/day (bbl/d).

For the year 2016, refining output reached 79,016 thousand barrels (MB) (10.6 MTOE), from 77,853 MB (10.5 MTOE) in 2015. Consequently, the total level of marketable refined petroleum products increased by 2.8 percent, from 9.7 MTOE in 2015 to 9.9 MTOE in 2016 (Figure 12). The total marketable products[11] in 2016 were comprised mainly of diesel (39.5 percent share), gasoline (23.5 percent share) and fuel oil (7.5 percent share). The rest of the products were aviation fuel (10.1 percent), LPG (5.0 percent), kerosene (0.7 percent), and naphtha and other products (11.0 percent).

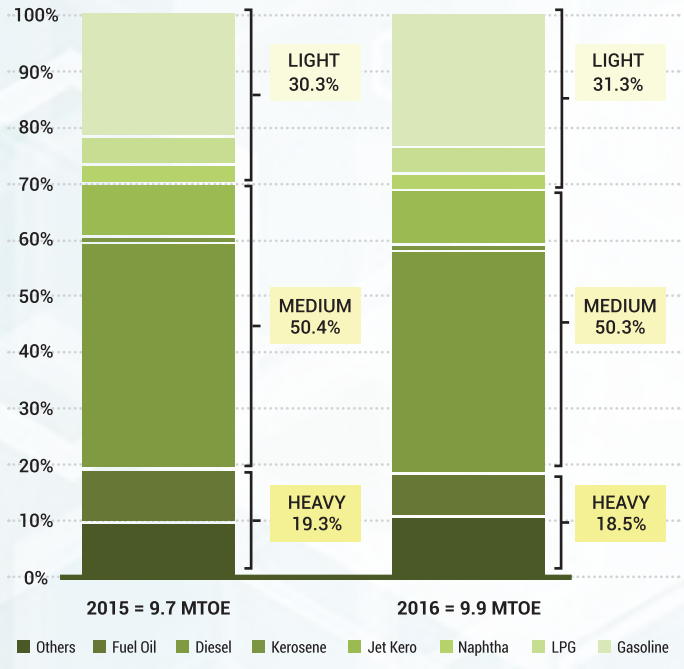

FIGURE 12. REFINERY PRODUCTION (2015-2016), Percent

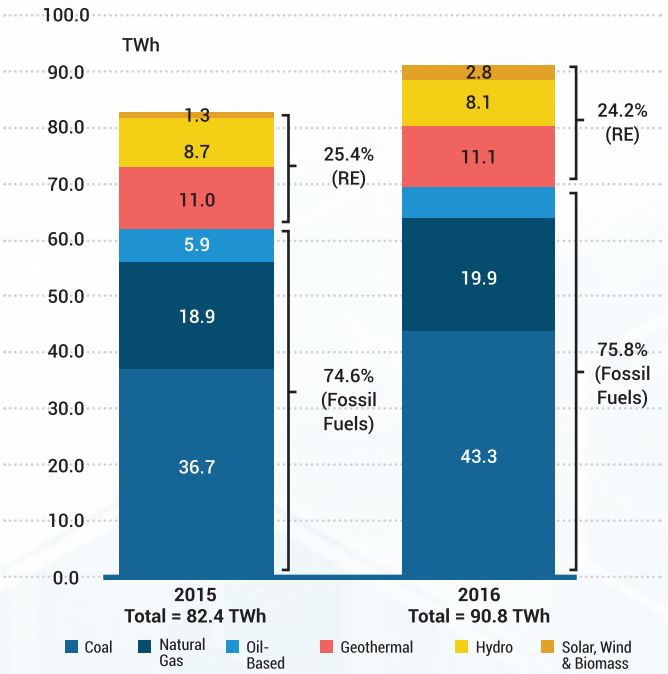

FIGURE 13. ELECTRICITY GENERATION BY FUEL TYE (2015-2016), TWH

[11] Finished marketable products refers to refining output that are ready for distribution to the various depots and market.

Power Generation

Power generation output increased by 10.2 percent from 82.4 TWh in 2015 to 90.8 TWh in 2016. Bulk of the country's power generation requirement was being sourced from coal with a share of around 47.7 percent to the total power mix. This was followed by natural gas and geothermal with the shares of 21.9 percent and 12.2 percent, respectively.

The total fuel requirements for power generation grew by 5.2 percent in 2016. RE contributed close to half of the total fuel input (45.2 percent) mainly due to high contribution of geothermal in power generation.

Coal demand (fuel input) for power generation reached 10.2 MTOE in 2016 from 9.3 MTOE in 2015. This level yielded a total generation output of 43.3 TWh, 18.0 percent higher than its 2015 level of 36.7 TWh (Figure 13). On the other hand, natural gas continued to contribute a significant share in the total power mix of the country with a 5.2 percent increase in generation output, while its input increased by 14.3 percent from 2015 to 2016. Meanwhile, oil also played an important role in augmenting supply of electricity particularly during peak demand, despite accounting for the lowest contribution among the fossil fuel sources for power generation at 6.2 percent share to the total power mix, albeit declining by 3.8 percent during the same period. This was likewise reflected in the 12.6 percent reduction of oil demand as fuel input in power generation during the period.

Total Primary Energy Supply

For 2016, the country's total primary energy supply (TPES) reached 53.2 MTOE, 3.7 percent higher from its 2015 level of 51.3 MTOE. This was due to the 9.4 percent increase in aggregate indigenous energy resources from 26.9 MTOE in 2015 to 29.4 MTOE in 2016, offsetting the 2.5 percent reduction in net energy importations. Higher domestic production from coal, natural gas, and renewable energy (RE), particularly that of biofuels and solar and wind, were reported during the same period (Figure 14).

Oil continued to provide for the bulk of the country's energy requirement accounting for 34.9 percent of the primary energy supply mix, followed by coal and geothermal with 22.0 percent and 17.9 percent share, respectively. In terms of growth, natural gas production from Malampaya Well registered a 14.6 percent hike in levels during the same period. Similarly, large increase was also seen in the

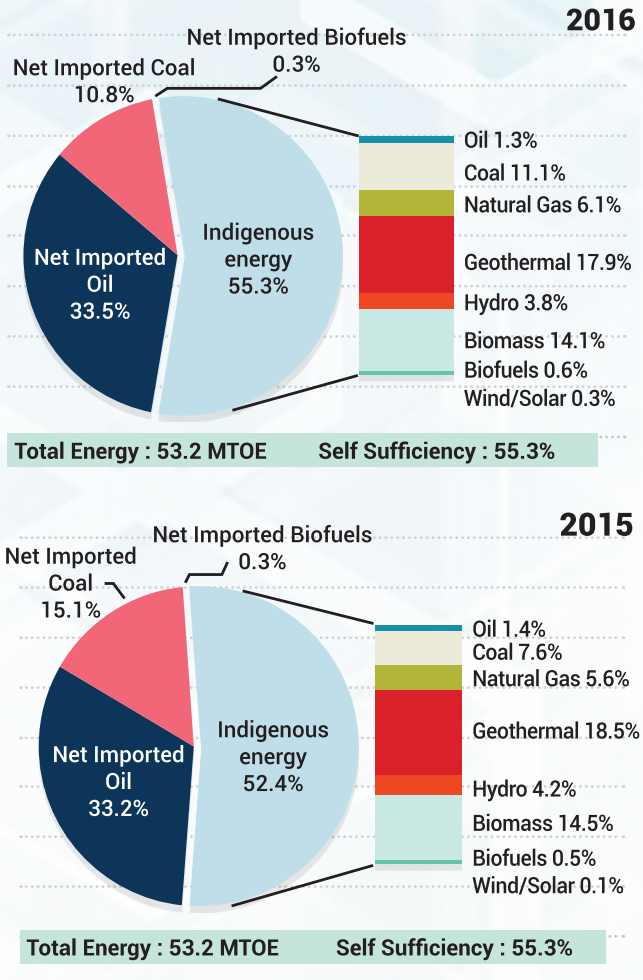

FIGURE 14. TOTAL PRIMARY ENERGY MIX BY FUEL (2015-2016), % SHARE

total primary oil supply increasing by 7.8 percent from 17.2 MTOE in 2015 to 18.5 MTOE in 2016 which was due to the increase in net importations.

Meanwhile, total primary coal supply grew considerably lower at a rate of 0.6 percent to reach 11.7 MTOE in 2016 from its previous level of 11.6 MTOE. The same trend is exhibited by aggregate renewable energy sources , which recorded a sluggish 0.5 percent increase in production level between 2016 and 2015.

From among the renewable supply, combined solar and wind energy grew by 133.6 percent, biofuels and geothermal production increased by 18.1 percent and 0.2 percent, respectively. On the other hand, hydro energy production was lower by 6.4 percent in 2016 vis-à-vis 2015.

The country's energy self-sufficiency improved to 55.3 percent, 2.9 percentage points more than the 2015 level of 52.4 percent.

Indigenous Energy

Total indigenous energy production went up by 9.4 percent from 26.9 MTOE in 2015 to reach 29.4 MTOE in 2016. Notable upsurges were reported for solar (691.9 percent), coal (52.0 percent), wind (30.3 percent), biofuels (18.1 percent) and natural gas (14.6 percent) coupled with modest growths from geothermal (0.2 percent) and biomass (0.9 percent). These energy resources augmented the country's domestic energy supply to be able to meet the total energy requirements during the period despite lower domestic production for oil (1.8 percent) and hydro (6.4 percent) during the same period.

Fossil Fuels

Oil. The country's aggregate oil production, including condensate, dropped by 1.8 percent, from 715.0 kTOE level in 2015 to 702.4 kTOE in 2016, while its contribution to total indigenous energy supply stood at 1.3 percent share. The reduction is attributable to the lower production output reported in Nido and Galoc oil fields during the same period.

Coal. The country's indigenous coal supply, with a share of 11.1 percent to total domestic energy production, accelerated by 52.0 percent to 5.9 MTOE in 2016 from 3.9 MTOE a year-ago. Bulk of the hike in production came from the country's major coal producer, the Semirara Mining and Power Corporation (SMPC), which accounts for 98.9 percent share in the total coal production of the country. SMPC's 2016 production set a new record high of 12,087 million metric tons (MMMT) run-of mine (ROM), 54.6 percent higher via-a-vis 2015. Private coal mines in Cebu likewise recorded a 20.9 percent increase in aggregate production. On the other hand, coal mines in Bicol, Surigao, Zamboanga and small-scale mines located in parts of the country, with combined contribution of 0.8 percent share to the country's total coal production, suffered cutbacks of almost half their 2015 levels.

Natural Gas. As of end 2016, Malampaya, the country's lone producing natural gas field, produced 3.3 MTOE of natural gas, equivalent to 6.1 percent share in the overall total indigenous

energy production during the year. This level translated to a double-digit growth of 14.6 percent compared with the 2015 level of production at 2.9 MTOE as the Malampaya gas field recovered from its maintenance shutdown in the previous year. It's domestic production supplies 100 percent of the country's natural gas requirements.

Renewable Energy

Geothermal. For 2016, the share of geothermal energy in the total indigenous energy supply reached 32.4 percent (equivalent to 17.9 percent share to the TPES). Geothermal production posted a minimal increase of 0.2 percent from its 2015 level of 9.5 MTOE. The minimal increase may be attributed to the newly rehabilitated 6 MW binary plant in Macban.

Hydro. The country's hydropower production contributed 6.9 percent share to the total indigenous energy supply in 2016 (equivalent to 3.8 percent share to the TPES). Hydropower production has been on decline since 2013, and further aggravated by the strong El Niño (drought) during the first half of the year (January to May 2016) which adversely affected the water level in Lake Lanao resulting in a 6.4 percent decline in hydropower generation from around 2.2 MTOE in 2015 to 2.0 MTOE in 2016. The country experienced the most severe El Niño phenomenon (drought) on record that started from late 2015 until June 2016.

Solar. Solar energy production went up by about nine-folds its 2015 level of 11.9 kTOE to reach 94.3 KTOE level in 2016, accounting for 0.2 percent share to the total energy mix in 2016. The robust increase was brought about by the massive addition to solar installed capacity - from 146.3 MW last 2015 to 4,118 MW in 2016. The country can look forward to solar's significant contribution to the energy mix in the future as 166 solar projects, with potential capacities totalling 4,081 MW, were awarded in 2016.

Wind. Production of wind energy stood at 83.9 MTOE, 30.3 percent more than its 2015 level of 64.4 kTOE, albeit a marginal contribution of 0.2 percent to the TPES. As of December 2016, 58 wind projects were awarded which would bring in a total of 1,039 MW additional capacities.

Biomass. Biomass continued to account for around one-fourth (25.5 percent) of the indigenous energy supply in 2016, increasing by 0.9 percent from its year-ago level of 7.4 MTOE.

The sluggish growth is attributed to the declining popularity of biomass as a conventional fuel in the household sector for cooking and heating, despite being a substitute fuel for more expensive sources of energy in the industry and commercial sectors.

On the other hand, biomass gradually stepped up its contribution to the power sector as its level of fuel input to electricity generation increased by as much as twice (101.6 percent) its 2015 level to reach 281.9 KTOE in 2016. The heightened promotion on the use of RE resulted in a total of 67 biomass projects awarded as of end 2016, with an additional aggregate capacity of more than 300 MW.

Biofuels. For 2016, the country's aggregate biofuels supply recorded a double-digit growth of 18.1 percent from its 2015 level of 258.4 KTOE to 305.1 KTOE in 2016, for a combined share of 1.0 percent out of the total indigenous energy supply during the period.

Ethanol production grew by 34.7 percent from 94.1 KTOE in 2015 to 126.8 KTOE in 2016. The entry of two additional ethanol boosted the continuous operation of the eight (8) existing ethanol facilities during the year. These production facilities yielded total sales of 226.9 million liters in 2016.

On the other hand, the existing 11 biodiesel producers put in a combined sales of about 217.7 million liters in 2016, translating to 178.3 kTOE, for an 8.5 percent increase in domestic supply of coco methyl ester (CME) from its 2015 level of 164.3 kTOE.

Net Energy Imports[12]

Net energy imports accounted for 44.7 percent of the total energy supply, posting a 2.5 percent decline to reach 23.8 MTOE in 2016 vis-à-vis 24.4 MTOE a year-ago. It is comprised of 75.0 percent oil and oil products; 24.3 percent coal, and 0.7 percent biofuels. Bulk of the decline was due to the reduction in net coal importation of 25.3 percent from 7.7 MTOE in 2015 to 5.8 MTOE in 2016 (Figure 15).

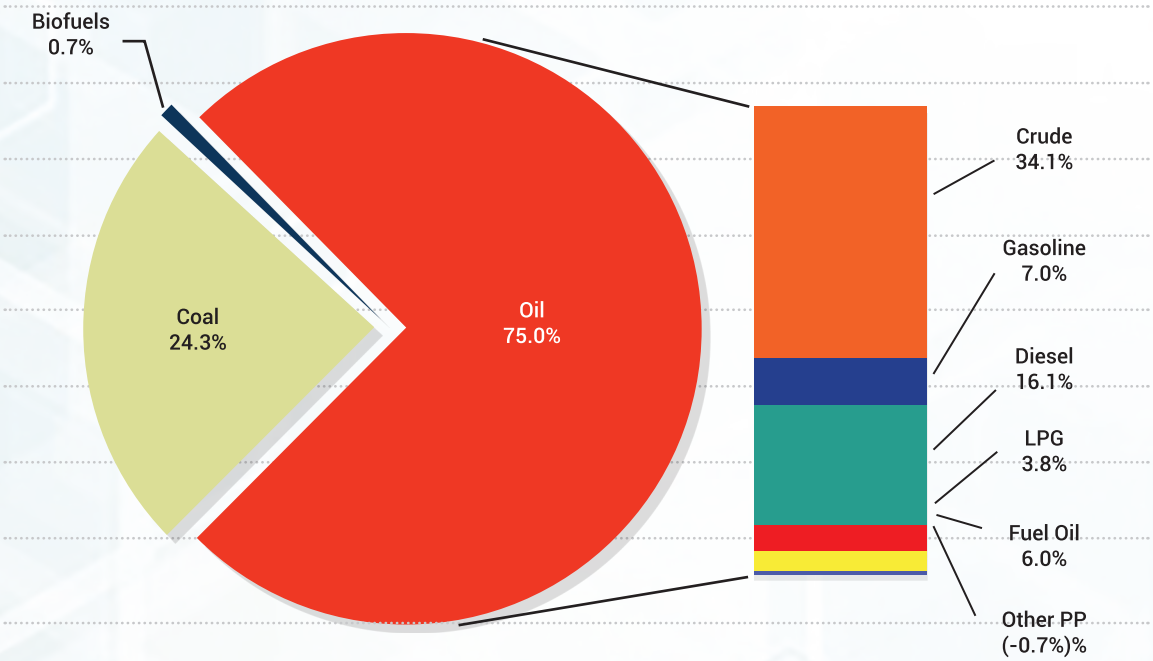

FIGURE 15. NET ENERGY IMPORTS (2016), Percent

[12] This is derived as total primary energy supply (TPES) less indigenous production. Alternatively, it can also be calculated as the sum of imports and stock change (+/-) less exports and international bunkers (aviation and marine)

Lower crude oil prices that prevailed in the international market in 2016 vis-à-vis 2015[13] , combined with a robust domestic demand for finished petroleum products, may have driven the increase in oil importation. Oil imports comprised 49.3 percent crudes and 50.7 percent petroleum products. The Middle East remain as the country's major source of imported crude oil, supplying 87.2 percent of the total crude imports. On the other hand, Russia and nearby ASEAN countries[14] supplied 6.7 percent share and 6.2 percent share, respectively, of the country's total crude oil importation. Similarly, the import volume of finished petroleum products went up by 10.0 percent to 10.9 MTOE in 2016, from 9.9 MTOE in 2015.

On the other hand, exports of finished petroleum products dropped by 5.7 percent to 1.2 MTOE in 2016, from the previous year's level of 1.3 MTOE, with Korea, Singapore and Taiwan as top export markets. There was also a 26.1 percent reduction in export volume of crude oil from the Galoc field, which offset the 10.4 percent gain of condensate from Malampaya.

In order to meet the increasing demand for coal in the power generation sector, import volume went up by 15.9 percent to 10.6 MTOE in 2016. Indonesia remains as the country's biggest source of imported coal garnering 89.8 percent share, while the remaining portion was supplied by Australia, Vietnam, Russia and South Korea.

Coal exports likewise reached an all-time high of 3.6 MTOE, more than twice its 2015 level of 1.6 MTOE as higher domestic production encouraged exportation. China's demand for Philippine coal, which accounted for 96.1 percent of the total export market, increased by as much as three times its volume in 2015 to reach 6.6 MMMT.

Meanwhile, ethanol imports declined by 14.3 percent to reach 145.1 kTOE, from its 2015 level of 169.2 kTOE as local production supplied most of the requirements of oil companies in compliance of the blending schedule mandated under the Biofuel Law.

Environmental Impact

The total GHG emission from energy related activities has increased by 10.3 percent to reach 109.8 million ton of CO_2 equivalent ($MTCO_2e$) in 2016 from 99.5 $MTCO_2e$ the previous year. The growth is due to increased activities in all sectors, notably in the industry sector (an energy intensive sector) resulting in the robust growth of the economy during the period. As such, GHG emission from industry grew the fastest at 15.8 percent. On the other hand, electricity production continues to contribute the biggest share in the total GHG emission notwithstanding the slight decrease of 0.7 percent from 47.1 percent share in 2015 to 46.4 percent share in 2016 (Table 2).

[13] Dubai crude oil price per barrel for 2015 was US$50.91, while for 2016 it was US$42.16
[14] Includes Korea, Malaysia, Indonesia and Brunei

Table 2. GHG INVENTORY FOR THE ENERGY SECTOR BY SECTOR (2015-2016)							
Sector	CO_2 Emission ($MtCO_2e$)		NonCO_2 Emission ($MtCO_2e$)		Total GHG Emission ($MtCO_2e$)		Percent Change in Total GHG Emission (%)
	2015	2016	2015	2016	2015	2016	2015-2016
Power Generation	46.7	50.7	0.1	0.1	46.9	50.9	8.7
Transport	31.6	34.4	0.0	0.0	31.8	34.7	9.1
Industry	12.9	15.0	0.0	0.0	13.0	15.0	15.8
Other	6.9	8.4	0.0	0.0	7.0	8.5	21.7
Energy	0.9	0.6	0.0	0.0	0.9	0.6	-30.6
Total	**99.0**	**109.2**	**0.1**	**0.1**	**99.5**	**109.8**	**10.3**
% Distribution							**Change in Distribution**
Power Generation	47.2	46.5	51.3	50.2	47.1	46.4	-0.7
Transport	31.9	31.5	27.8	27.8	31.9	31.6	-0.3
Industry	13.0	13.7	14.7	15.5	13.1	13.7	0.7
Other	7.0	7.7	5.7	6.3	7.0	7.7	0.7
Energy	0.9	0.6	0.6	0.3	0.9	0.6	-0.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	

Aside from electricity production (power generation), GHG from the transport and industry sectors contributed 31.6 percent and 13.7 percent shares to the total, respectively. The rest came from other sectors such as AFF and commercial (7.7 percent share), and other energy sector's activities (e.g. oil refining) (0.6 percent share).

The considerable increase in GHG emission is mainly brought about by the continued increased utilization of oil in the transport sector and coal for power generation (Table 3).

Table 3. GHG INVENTORY FOR THE ENERGY SECTOR BY FUEL (2015-2016)							
Sector	CO_2 Emission ($MtCO_2e$)		$NonCO_2$ Emission ($MtCO_2e$)		Total GHG Emission ($MtCO_2e$)		Percent Change in Total GHG Emission (%)
	2015	2016	2015	2016	2015	2016	2015-2016
Oil	47.8	51.4	0.3	0.3	48.0	51.7	7.7
Coal	44.6	50.1	0.2	0.3	44.8	50.4	12.4
Gas	6.7	7.6	0.0	0.0	6.7	7.7	14.6
Total	**99.0**	**109.2**	**0.5**	**0.6**	**99.5**	**109.8**	**10.3**
% Distribution							**Change in Distribution**
Oil	48.2	47.1	52.4	51.8	48.3	47.1	-1.1
Coal	45.0	45.9	46.3	46.9	45.0	45.9	0.9
Gas	6.7	7.0	1.3	1.3	6.7	7.0	0.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	

TABLE 4. CO_2 AVOIDANCE FROM THE MITIGATION MEASURES (IN KTCO2E)			
GHG Reduction Measures	2015	2016	%Change
Demand side	***7,883.7***	***8,004.6***	***1.5***
Efficiency in Electricity Consumption (EEC)	2,007.0	1,982.7	(1.2)
Efficiency in Fossil Fuel Consumption (EEF)	4,314.1	4,314.4	0.1
Biofuel	1,562.6	1,707.5	9.3
CNG/NG	0.04	0.05	30.6
Supply side			
Fuel Diversification in Power Generation @ 2000 GDP & EF	6,400.7	8,770.7	37.0
Total Avoidance *(Demand + Supply - EEC)*	**14,284.5**	**16,775.4**	**17.4**
Actual GHG Emission	**99,514.5**	**109,752.0**	**10.3**
Hypothetical GHG Emission (Actual + Total Avoidance)	**113,800.0**	**126,527.3**	
% Reduction	**12.6**	**13.3**	**5.6**

Figure 16 and Table 4 show the avoidance vis-a-vis mitigation measures in the Energy Sector. For 2016, the combined effect of demand-side mitigation measures, i.e., efficient use of fossil fuel and electricity, biofuels blending and natural gas contributed 8.0 $MTCO_2e$ net GHG reductions, bringing down the GHG emission level in 2016 by 6.3 percent of the total hypothetical GHG emission (actual plus total avoidance). On the other hand, fuel diversification in power generation through the use of RE and natural gas contributed 6.9 percent (of the hypothetical GHG emission) further reduction in GHG emission during the same period. With the above-stated mitigation measures, the energy sector has avoided a total of 16,775 $kTCO_2e$ or 13.3 percent of total GHG emission in 2016. This level translates to a 17.4 percent improvement from 2015's total avoidance of 14,284.5 $kTCO_2e$.

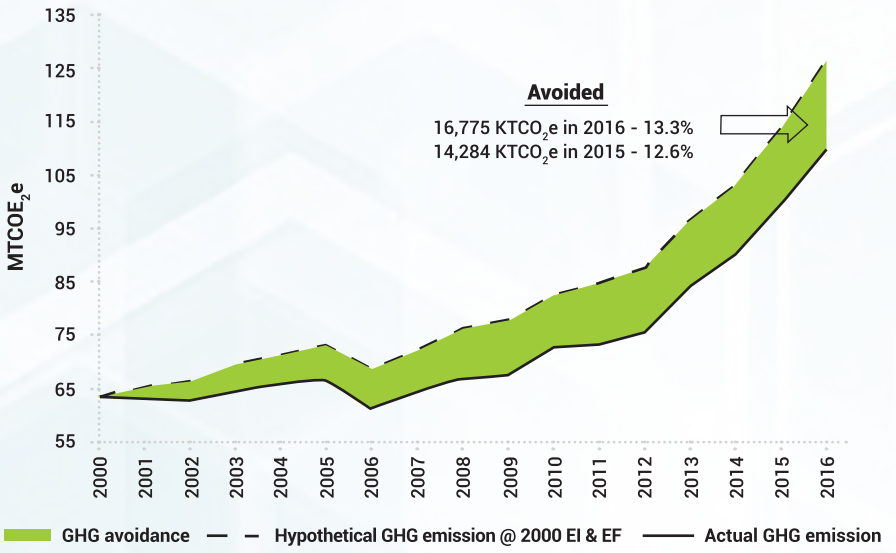

FIGURE 16. ACTUAL GHG EMISSION, GHG EMISSION AVOIDANCE HYPOTHETICAL GHG EMISSION (2000-2016)

Note: Hypothetical GHG Emission is equivalent to Actual GHG Emission plus GHG Emission Avoidance; GHG Base year is CY 2000 GHG Emission Level

Higher energy consumption particularly that of fossil fuels, translates to higher GHG levels. To curb this, the government continues to implement mitigation measures such as the intensive promotion on the use of RE in the power generation sector, adoption of energy conservation and energy efficient technologies in the demand side, mandatory blending of biofuels in gasoline and diesel, the use of alternative fuels in the transport sector, and others.

Energy – Economy and Environmental Indicators[15]

The country's total economic output, measured in terms of real GDP, rose faster at 6.9 percent in 2016 than the previous year's 6.1 percent. The services sector, which accounted for close to 60.0 percent of real GDP, remains as the main driver of growth. The combined effects of a robust domestic trade, coupled with heightened activity in other services sub-sectors[16] helped push the aggregate value-added in the services sector by 7.4 percent in 2016. Similarly, the industry sector grew resiliently by 8.4 percent vis-à-vis its previous year's growth of 6.4 percent, and contributing one-third (33.9 percent) to country's economic output during the period. This was caused by the higher production output from the manufacturing and construction sub-sectors. The AFF sector,

[15] GDP figures as based on the PSA-NSCB's National Accounts of the Philippines (NAP), as of May 2017
[16] Recreational, cultural and sporting activities, Hotels and Restaurants, Education Health & Social Work and Other Service Activities

which had the least contribution to real GDP at 8.7 percent share, suffered reduction in GVA of 1.3 percent due to lower production output of major crops and fishery due to combined effects of the tail-end of El Niño and typhoons in the last quarter of 2016. On the demand side, consumer and government spending coupled with higher investments contributed to over-all economic gains during the period.

Energy Intensity

The country's economy-wide energy intensity level remained at 6.7 tonnes of oil equivalent per million pesos of real GDP (TOE/MPhp) in 2016. Similarly, oil intensity was constant at 1.8 barrel per P100,000, and while that of electricity increased by 3.0 percent to 11.2 watt-hour/peso. Heightened efforts in energy efficiency across all economic sectors contributed to the generally unchanged intensity levels for all energy, including oil. On the other hand, strong electricity demand in 2016, the fastest growth recorded in recent years, contributed in higher intensity levels for the fuel (Figure 17).

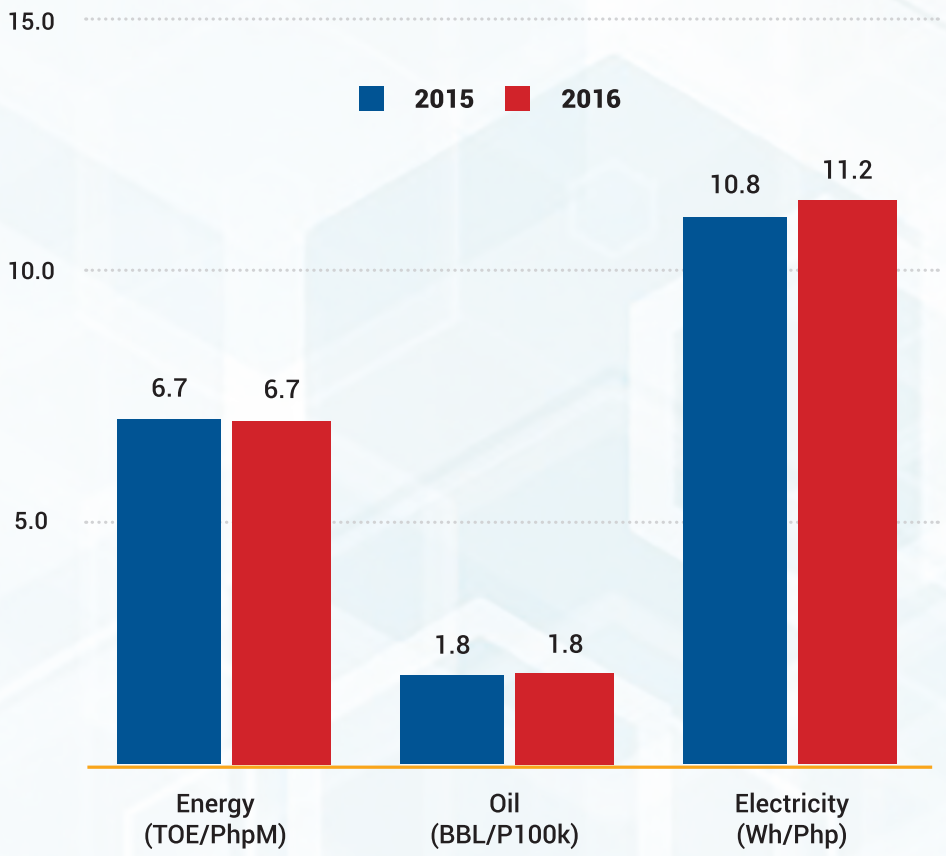

FIGURE 17. ENERGY INTENSITIES (2015 VS. 2016)

In the industry sector, energy use per unit of industrial output went up by 2.0 percent in 2016 to 0.30 TOE/Php100,000 as more energy was utilized in production processes in the manufacturing sub-sector. Meanwhile, the services sector posted energy intensity level of 0.37TOE/Php100,000, 2.8 percent higher than its year-ago level due to increased energy consumption in the transport sector and commercial establishments. On the other hand, energy intensity in the AFF sector increased by 13.9 percent at 0.063TOE/Php100,000 as farm output required more energy to help lessen the effects of the El Niño phenomenon that persisted until the second half of 2016, as well as the devastating effects of typhoons during the fourth quarter of 2016.

Energy Elasticity

The energy-to-GDP elasticity was reported at 0.92 units in 2016, while oil and electricity registered slightly higher elasticity values of 1.1 and 1.5, respectively. As all values are all positive, it implies the higher sensitivity of primary energy demand[17] to change proportionately with the changes of the economic output (Figure 18).

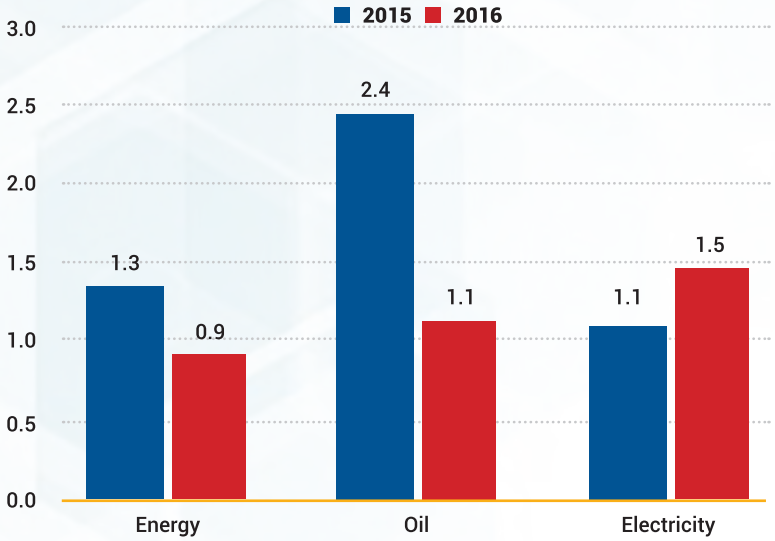

FIGURE 18. ENERGY ELASTICITIES (2015 VS. 2016)

Energy Per Capita

Energy per capita level went up by 4.6 percent to 0.53 TOE/person in 2016, from last year's 0.50 TOE/person. Similarly, oil and electricity per capita posted 6.1 percent and 8.4 percent growths, respectively, during the same period. The higher per capita levels in 2016 reflects increased consumption of energy resources, particularly of oil and electricity due to favorable domestic oil prices and intensified electrification programs during the same period. It also indicates improved accessibility of the country's populace to energy services due to ongoing efforts of the government and stakeholders in the energy sector (Figure 19).

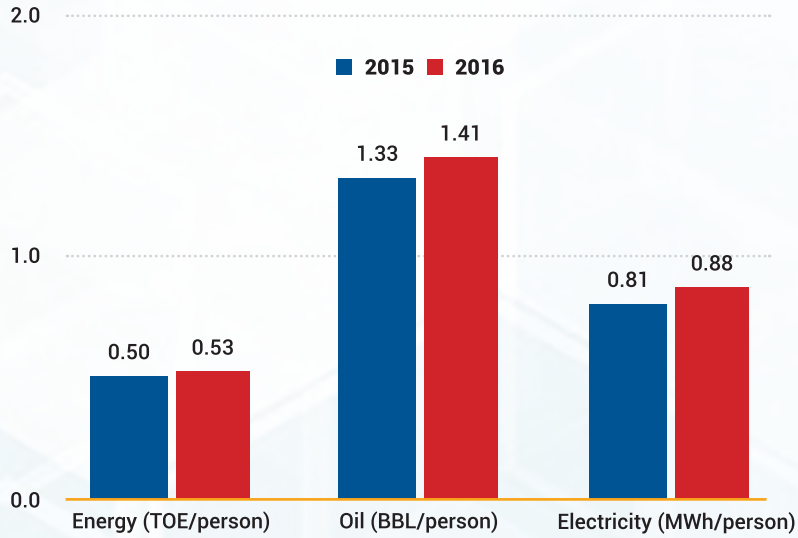

FIGURE 19. ENERGY PER CAPITA (2015 VS. 2016)

[17] Includes total final energy consumption net of electricity, fuel input to power generation, energy own-use and loss (net of electricity); 2016 total primary demand increased by 6.3 percent vis-à-vis real GDP growth of 6.9 percent.

GHG Emission

For 2016, total GHG emission for every Php 100,000 of the country's economic output (measured in terms of real GDP) stood at 1.45 tons of CO_2 equivalent (tCO_2e), 3.8 percent higher than the previous year's level of 1.40 tCO_2e (Figure 20). This was attributable to the heightened activities of all end-use sectors which requires more energy, particularly the industry sector, as their aggregate GHG emission levels went up by 15.8 percent during the period in review. The same trend was likewise reflected in the 9.2 percent hike in the amount of GHG per capita to 1.2 tCO_2e/person from 1.1 tCO_2e/person a year-ago. Similarly, with fossil fuels garnering 63.0 percent share in the energy mix, the GHG intensity of the TPES was 2.1 tCO_2e/TOE, 6.3 percent more than its 2015 level of 1.9 tCO_2e/TOE, while GHG emisision per TOE of oil consumption registered a 3.5 percent growth to reach 2.2 tCO_2e from 2.1 tCO_2e in 2015. On the other hand, as generation output of renewable energy power plants and other low emission fossil-fuel (natural gas) increased in 2016, GHG emission per megawatt-hr (MWh) of electricity generation dropped by 1.4 percent to 0.56 tCO_2e in the same period.

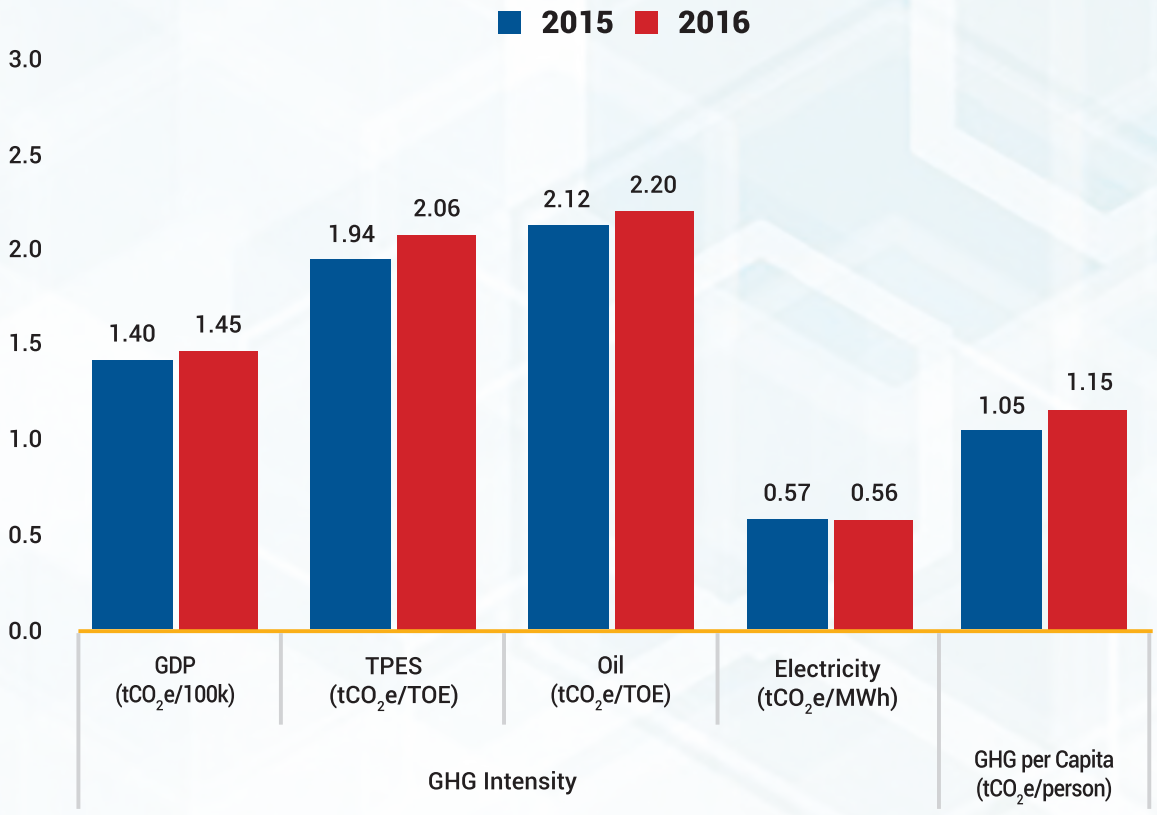

FIGURE 20. ENVIRONMENTAL EMISSION INDICATORS (2015 VS. 2016)

2 ENERGY SUPPLY AND DEMAND OUTLOOK

Key Assumptions, Parameters and Methodologies

The projection for Philippine Energy Outlook 2017-2040 considered the targets and assumptions of the energy sector in promoting the use of environmental friendly and benign energy sources and efficient end-use technologies (Table 5). The demand-side projections takes into account new and existing policy programs and measures within the energy sector which are currently being implemented and will be pursued within the timeframe of the Plan, as well as the impact of each end-use economic sector's targets and roadmaps. On the other hand, model building for energy supply requirements which are driven by projected demand established two scenarios for the 2017-2040 Energy Outlook. The first scenario, the Business as Usual Scenario (BAU), simulates how the future supply of energy will evolve without further government policy intervention and as the most likely to happen scenario. Meanwhile, the Clean Energy Scenario (CES) considers the impact of aggressive implementation of the plans, programs and policies of the government for the energy supply side, considering higher penetration of RE and natural gas in power generation combined with higher transmission efficiency. On the demand-side, energy savings in all sectors for electricity and petroleum products and increased utilization of alternative fuels for transport were likewise considered.

Consistent with the global call to combat and/or reduce the effects of climate change while supporting economic growth and development, the Plan adheres to the commitment on international energy intensity reduction particularly, the Asia-Pacific Economic Cooperation's (APEC) target to reduce aggregate energy intensity (energy demand per unit of gross domestic product - GDP) of APEC economies by 25.0 percent in 2030 to 45.0 percent by 2035 with 2005 as the base year period.

The base year used for the projections is 2016, and supply and demand targets/parameters are summarized in Table 5.

TABLE 5. SUPPLY AND DEMAND TARGETS FOR ENERGY OUTLOOK (2017-2040)

SCENARIO	ASSUMPTIONS	
	SUPPLY	DEMAND
Business as Usual (BAU) *(Reference Scenario)*	• Continuation of present development trends and strategies • Completion of all committed power projects • Inclusion of planned interconnection of Min-Vis by 2020 • RE development as planned (based of NREP) • Rehabilitation of existing RE capacity to extend economic life • 25.0 percent reserve margin	• Energy savings on all sectors for electricity of at least 10.0 percent by 2040 • 24.0 percent cumulative increase in number of vehicles using alternative fuels (CNG & electricity) in the Transport sector • 2.0 percent biodiesel and 10.0 percent bioethanol blend by 2040
Clean Energy Scenario (CES) *(Alternative Scenario)*	• Assumptions under the BAU with the addition of increased RE and LNG utilization, and entry of other of technologies with aggregate capacity of 10,000 MW for power generation	

The following are the general assumptions on the trends of major factors affecting the demand for various energy products:

Economic Growth

The average annual growth rate of the country's real GDP for the last decade (2006-2016) is 5.6 percent, with industry[18] and services[19] , both energy-intensive sectors, as main drivers of economic growth. Energy consumption in industry and services sectors increased, on the average, by 4.0 percent and 4.9 percent, respectively, for the past 10 years[20].

The Philippine Development Plan 2017-2022, the blueprint of the country's economic aspirations in the medium-term, expects a stronger and more inclusive[21] growth in GDP of 7.0 to 8.0 percent in the medium term (2017-2020)[22] . This serves as the impetus for the country to achieve its economic momentum, maintaining an 8.0 percent growth until 2030, after which, growth slightly slows down to an average of 7.5 percent between 2031 and 2040[23].

Population

The Outlook assumes that population shall increase from 103 million persons in 2016 to 148 million persons in 2040, equivalent to a yearly increase of 1.5 percent which is aligned with the population projections of the Philippine Statistics Authority (PSA).

Oil Prices

Crude oil price assumptions in the Outlook are based on the Organization of Petroleum Exporting Countries (OPEC) average crude import price, a proxy for international oil prices, in its World Oil Outlook (WOO) 2016-2040. It is assumed to increase from US$51/barrel in 2016[24] to around US$80/barrel in 2020 to US$123/barrel by 2030, and more than US$160/barrel by 2040.

Methodology Used for the Energy Outlook 2017-2040

In formulating the Energy Outlook, various energy modeling methodologies and tools were used by the Department to come up with the energy demand and supply projections for 2017 to 2040.

[18] Includes manufacturing, construction, mining and quarrying, electricity & water
[19] Includes trade, transport, communication & storage, finance, real estate, private and government services
[20] National Accounts of the Philippines (NAP), Philippine Statistics Authority (PSA) – As of May 2017
[21] Lower poverty rate and incidence
[22] National Economic Development Authority (NEDA) and Development Budget Coordinating Committee (DBCC) per Budget of Expenditures and Sources of Financing (BESF) 2017
[23] DOE internal estimate
[24] Actual 2016 FY price, DOE-Oil Industry Management Bureau

Energy demand was projected using Simple Econometric Simulation System, Expanded (Simple E^2), which is an integrated simulation system expanded from econometric simulation tool. This tool is an add-in application for Microsoft Excel 2000-2007 which was developed by the Institute of Energy Economics, Japan (IEEJ). On the other hand, final electricity consumption forecast adopts the peak demand projections from the Power Development Plan (PDP) 2017-2040. To account for the fuel supply from power generation, the generation mix is projected using the Model for Energy Supply Strategies and their General Environmental Impacts (MESSAGE) tool. MESSAGE model is a dynamic optimization tool from the International Atomic Energy Agency (IAEA) for electricity system planning that determines the least-cost generating system expansion plan to meet the demand for electric power. Energy demand and generation mix projections are then consolidated into the Long-range Energy Alternatives Planning System (LEAP) software to come up with the entire Energy Outlook. LEAP is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute.

To further improve the energy demand forecasts in Simple E^2, sectoral roadmaps, as well as relevant factors and information that impact on the energy consumption by sector were considered in the simulation, specifically:

- Demand levels for **Transport**, which is the most energy-intensive sector. The demand levels were derived separately for each of the four (4) modes of transportation – road, rail, air and water. For road transport, related indicators used as independent variables to project the demand include number of vehicles per type of fuel use, fuel efficiency and mileage, fuel conversion, and Gross Value-Added (GVA). Energy demand projection for rail transport used the number of passengers for the Philippine National Railways and MRT/LRT lines and population. On the other hand, for water and air transport, indicators such as the number of passengers, kilometer/ton-kilometer flown, cargo throughput and sub-sectoral value-added were used in energy demand projection. In general, the Outlook also incorporates future plans and programs of the Department of Transportation (DOTr), with the foreseen development in other related sectors, notably local tourism.

- The **Industry** sector's aggregate demand was divided into energy intensive and less-energy intensive industries. Included under the energy intensive industries are food processing, sugar, paper and pulp industries, cement manufacturing, chemicals, basic metal and machinery and equipment. Meanwhile, other manufacturing activities, as well as mining and construction fall under the less-energy intensive industries. Variables such as GVA, commodity prices, production targets and population were used as indicators for energy demand model of these sub-sectors. Sectoral roadmaps were likewise considered in modeling energy consumption.

- For the **Residential** sector, socio-economic indicators such as household final consumption expenditure (HFCE) and household population were considered in projecting energy consumption. Both data were sourced from the PSA. In addition, the results of the 2011 Household Energy Consumption Survey (HECS) were used extensively in the projection of the sector's energy consumption, particularly in determining the level of biomass demand.

- For **Commercial** and **Agriculture Fishery and Forestry (AFF)** sectors, GVA for trade and services, and agriculture, fishery and forestry were used, respectively.

Total Final Energy Demand

The country's Total Final Energy Consumption (TFEC) is expected to increase at an average rate of 4.3 percent annually, from 33.1 million tons of oil equivalent (MTOE) in 2016 to 91.0 MTOE in 2040 (Figure 21).

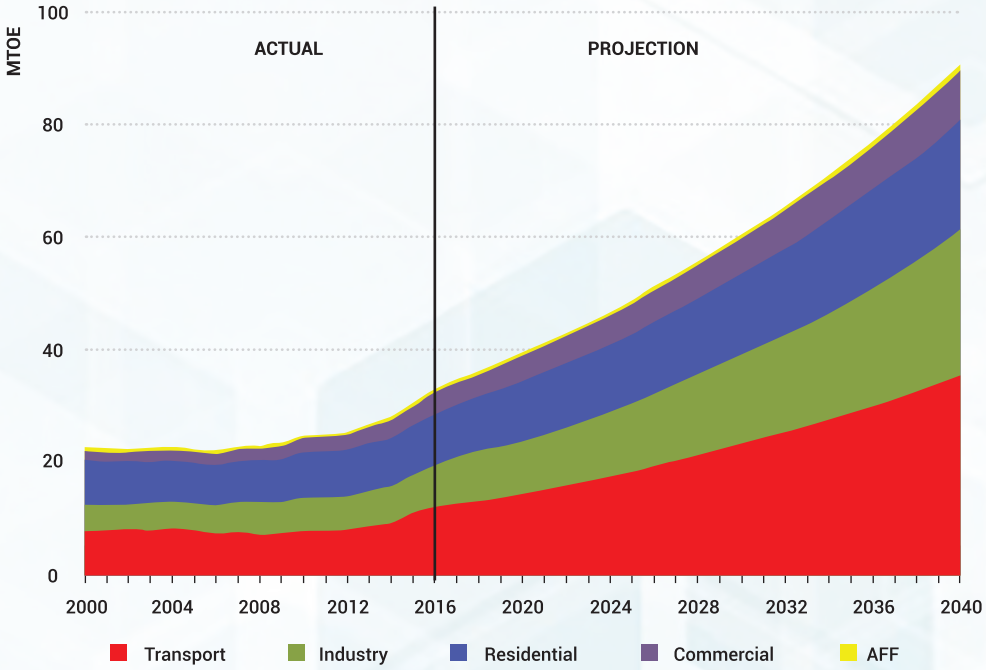

FIGURE 21. TOTAL FINAL ENERGY CONSUMPTION, BY SECTOR (2000-2040)

The transport sector will continue as the biggest energy consuming sector with 38.2 percent average share across the entire planning horizon. Both the transport and industry sectors account for bulk in terms of contribution to the increase in TFEC levels between 2016 and 2040. The industry will contribute 25.8 percent average share to TFEC across the planning horizon. Meanwhile, the residential sector will account for 24.2 percent average share to TFEC, followed by the commercial sector with 10.7 percent share. On the other hand, AFF sector will remain to be the least energy user with 1.1 percent average share of the total energy demand (Figure 22).

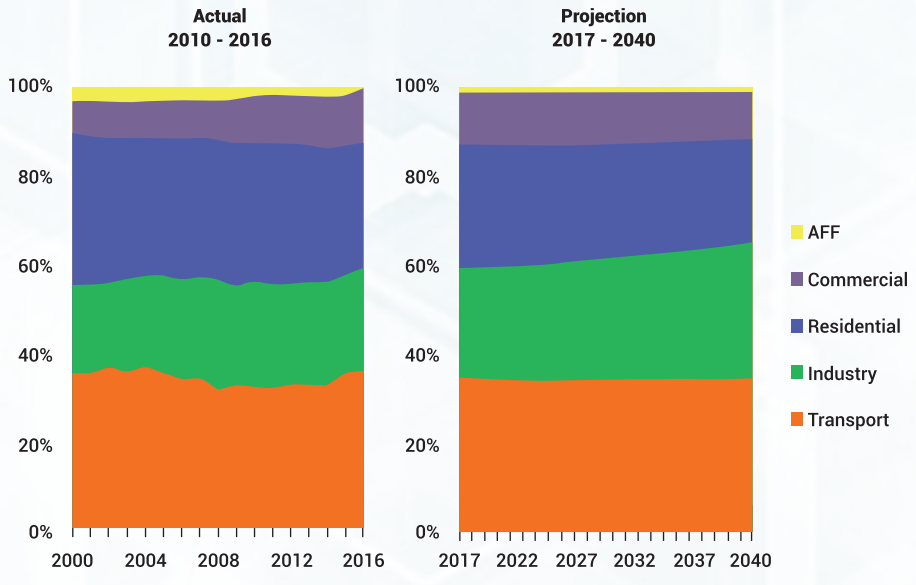

FIGURE 22: TOTAL FINAL ENERGY CONSUMPTION, BY SECTORAL SHARE (ACTUAL 2000-2016), CLEAN ENERGY SCENARIO (2017-2040)

Energy use in the industry sector will grow the fastest at an annual average of 5.4 percent. This is consistent with the anticipated increase in the energy utilization level of

the sector due to the implementation of government programs aimed to boost the development in the manufacturing sector. The transport and commercial sectors will post yearly increases of 4.5 percent and 3.5 percent, respectively. The AFF sector, despite its meager share to TFEC, will register an increase in energy utilization rate of 3.4 percent per year. On the other hand, energy consumption in the residential sector will grow at a rate of 3.3 percent yearly during the planning period.

Petroleum products will continue to account for the bulk of TFEC, with an average share of 50.5 percent in the demand mix (Figure 23). Despite the volatility of oil prices in the international market, demand for petroleum products will increase by an average of 4.5 percent per year from 2016 to 2040. Diesel and gasoline will continue to be the most widely-used petroleum products, with average shares of 44.0 percent and 34.8 percent in the total oil demand, respectively. Transport will remain as the major petroleum consuming sector with an average share of 71.9 percent in the total oil demand for the entire planning period.

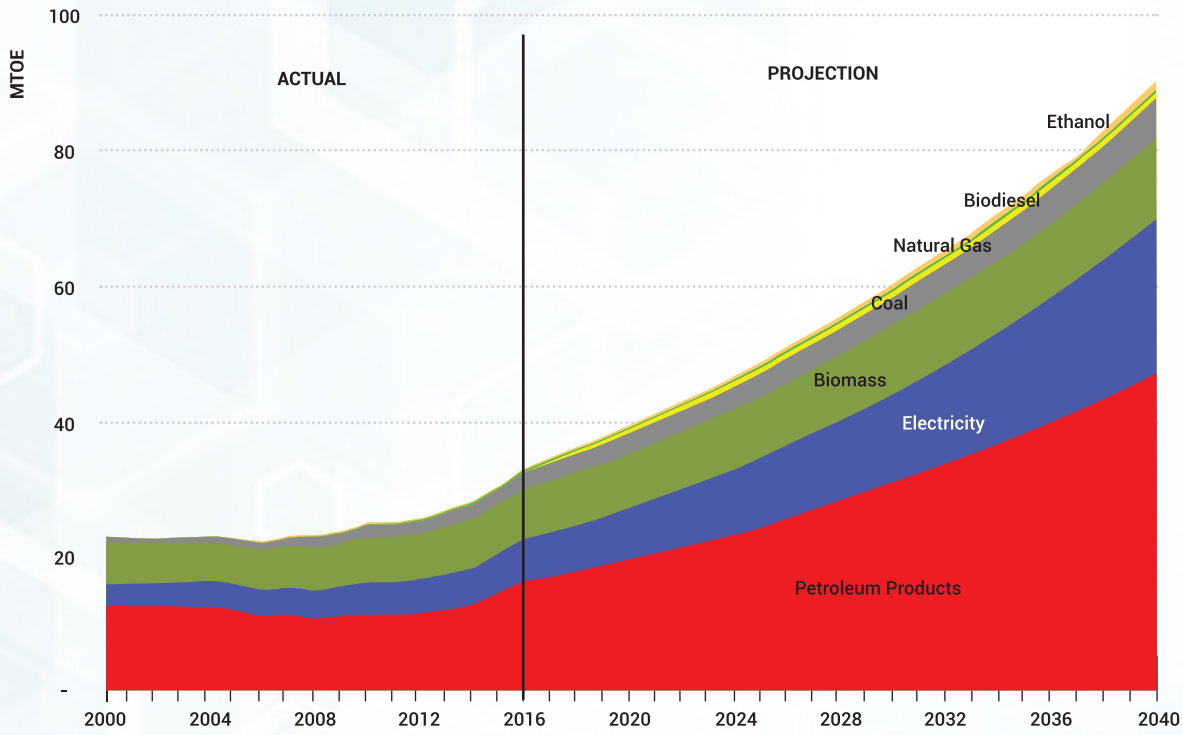

FIGURE 23: FINAL ENERGY CONSUMPTION, BY FUEL (2000-2040) IN MTOE

Electricity will contribute an average of 21.8 percent share to the final energy demand across the entire planning horizon, making it the second-most consumed fuel after oil. Electricity consumption is projected to grow by an average of 5.5 percent annually over the entire planning horizon. Its utilization in the transport sector is seen to expand by more than 20 times its 2016 level of 9 kTOE to 240 kTOE in 2040 due to the government's intensified plans of expanding mass rail systems (MRT and LRT), possible development of mass transit systems in major urban areas in the regions, including the significant penetration of electric vehicles in the road transport system. The industry

sector will constitute the largest portion of electricity demand at 36.4 percent average share, while household consumption of electricity will account for 34.6 percent share (Figure 24).

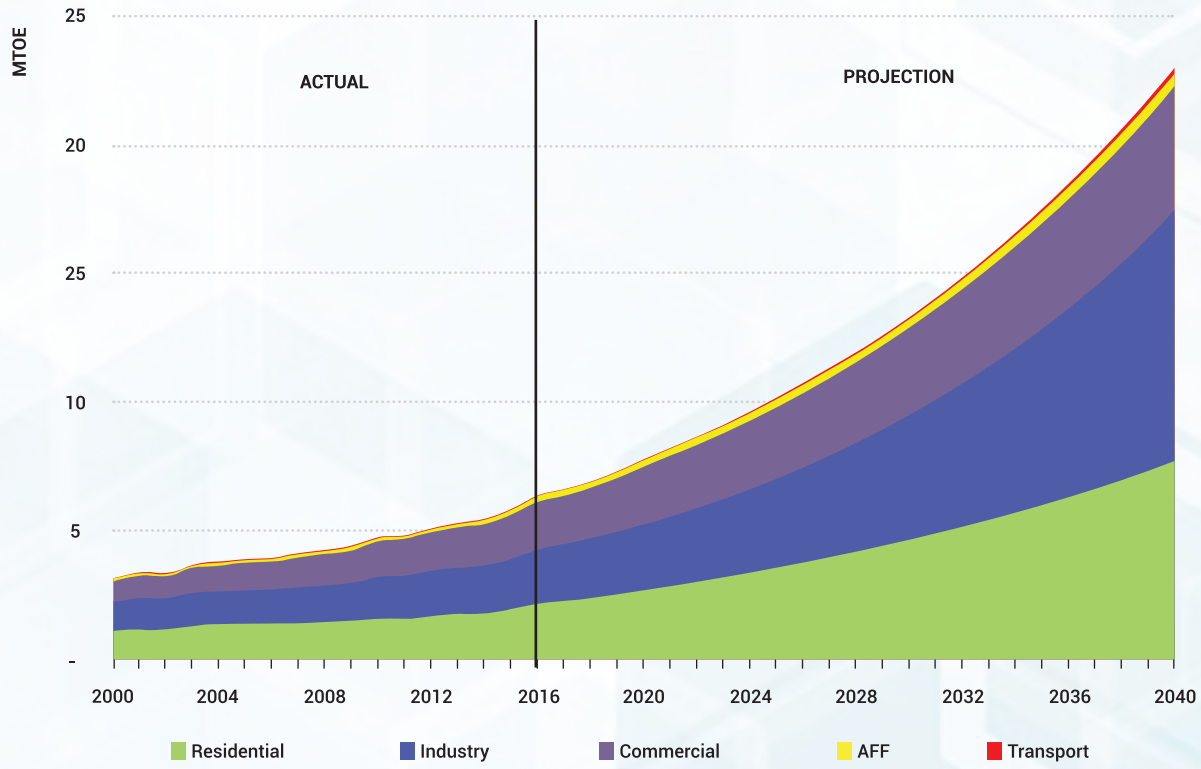

FIGURE 24: TOTAL ELECTRICITY CONSUMPTION, BY SECTOR (2000-2040) IN MTOE

Meanwhile, end-use biomass consumption is projected to maintain a steady 2.1 percent average growth for the next two and a half decades as improvement in living standards and rising income will encourage preference for more efficient technologies, particularly for households. However, it will remain as the third most consumed fuel next to oil and electricity, with 17.4 percent average share to TFEC for the planning period. The residential sector, as the major user of biomass, is seen to significantly contribute to over-all biomass demand, as its usage will increase steadily by an average of 1.4 percent per year from 5.7 MTOE in 2015 to 8.0 MTOE in 2040. On the other hand, there will be a noticeable increase of 4.7 percent in industrial biomass usage during the planning period, particularly from the sugar manufacturing sub-sector.

End-use demand (non-power application) for coal is expected to increase by 3.5 percent on the average, owning a 7.2 percent share to the final energy demand across the entire planning period. Its consumption will increase from 2.7 MTOE in 2016 to 6.0 MTOE in 2040. The rise in coal consumption is expected to support the increasing production of cement and basic metals as primary construction materials for public and private sector infrastructures.

The continuous implementation of the mandated biofuels blend for gasoline and diesel products will hike up total biofuel demand from 0.5 MTOE in 2016 to 1.8 MTOE in 2040. This translates to a 3.5 percent and 6.7 percent increase in the demand for biodiesel and bioethanol, respectively.

Meanwhile, non-power demand for natural gas will expand by 11.5 percent per year due to growing requirements from the transport, industry and commercial sectors. The CNG-fueled vehicles are expected to penetrate the road transport sector across the entire planning horizon. Natural gas is also expected to figure prominently as a fuel in emerging ecozones, industrial parks and commercial establishments.

Total Final Energy Consumption By Sector

Transport

In line with the government's "Build, Build, Build initiative"[25], we expect an aggressive transport infrastructure climate with the construction of more railways, urban mass transport, airports and seaports, bridges and roads. As such, the transport sector will continue to dominate the country's total energy demand, with an annual average share of 38.2 percent in the TFEC. Its energy requirement is projected to grow at a yearly rate of 4.5 percent, from its demand level of 12.3 MTOE in 2016 to 35.5 MTOE in 2040. The bulk of the sector's energy demand will be used for land transport, as about 80.0 percent of domestic traffic and 60.0 percent of freight traffic is by land[26].

With the implementation of EO 82 or the *Comprehensive Automotive Resurgence Program* (CARS) aimed at improving the automotive industry to sustain the robust growth in domestic automotive sales and strengthen local production[27], it is anticipated that the Philippines will become a regional automotive manufacturing hub in the Southeast Asia by 2020. With these developments, the transport sector will continue to rely on oil as its major fuel, constituting the bulk (95.2 percent) of the sector's total energy requirement for the next 25 years. Gasoline demand, particularly for passenger cars, will account for an average share of 48.3 percent of the sector's total oil demand, posting yearly increments of 5.7 percent, on the average, to reach 18.5 MTOE in 2040. However, the entry of electric vehicles (including e-trikes and hybrid vehicles) and consistent bioethanol blend is expected to limit the rise in gasoline consumption. On the other hand, as a significant portion of diesel consumption will be displaced with the projected penetration of additional CNG-fueled buses and higher biodiesel target blend, its demand level will still increase by a modest 3.3 percent to reach 13.4 MTOE by 2040 with an average share of 45.8 percent to the total (Figure 25).

Putting premium on sustainable development and ensuring energy security, as well as being able to withstand shocks to international oil prices, the DOE will continue to push for the utilization of cleaner alternative fuels in the transport sector. As such, the demand for bioethanol will expand by 6.7 percent per year on the average, reaching 1.5 MTOE by the end of the planning period. Meanwhile, demand for biodiesel is seen to increase by 3.3 percent per year for the next 25 years.

Further developments in the country's light railway systems, specifically: the capacity expansion and modernization of Line 1; Line 2 East and West route expansion; NAIA rail link and North &

[25] http://www.build.gov.ph/Home/BuildPresentation
[26] ADB-ASEAN Regional Road Safety Program Country Report: Philippines (CR7 PHL) p.5
[27] http://industry.gov.ph/cars-program/

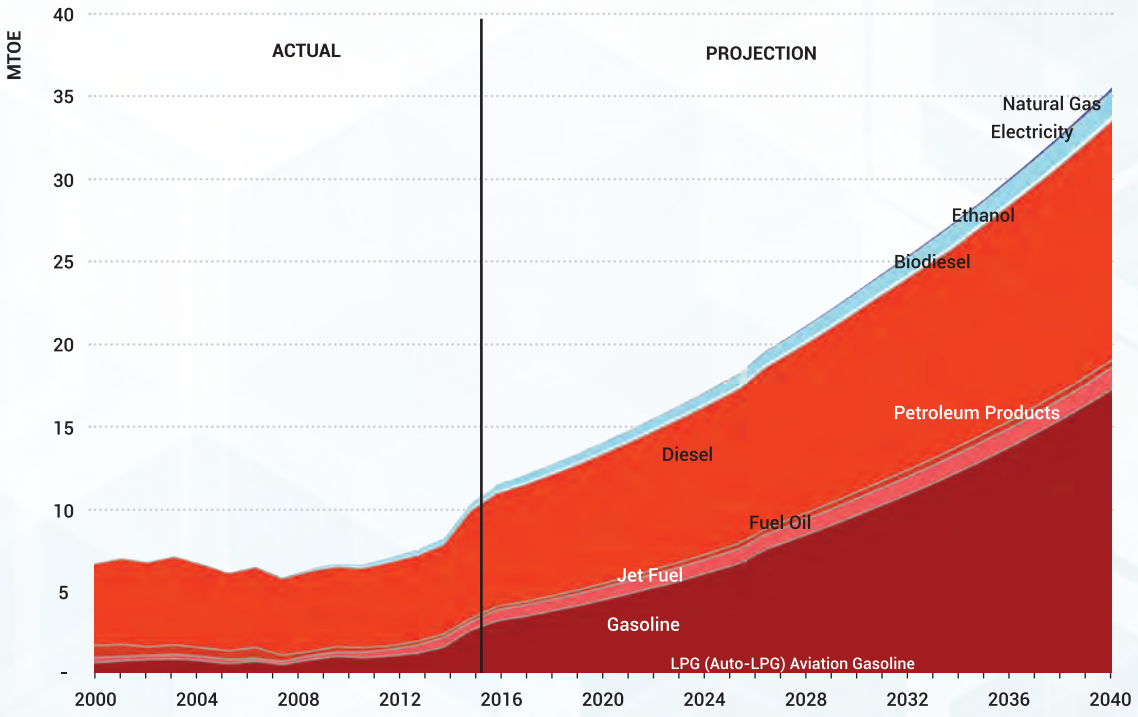

FIGURE 25: TRANSPORT ENERGY DEMAND, BY FUEL (2000-2040) IN MTOE

Cavite route expansion projects[28]; planned addition of LRT lines 4, 5 and 6; on-going construction of the Manila MRT Line 7 traversing Quezon City, Caloocan and Bulacan; the proposed Mega Manila Subway envisioned to be the first underground rapid transit in the Philippines; the expansion of mass railway transits in regional areas, specifically that of Mindanao; combined with the expected entry of e-trikes and other e-vehicles, electricity demand in the transport sector will expand to reach 240 kTOE by 2040, from 9 kTOE in 2016.

With the targeted commercialization of CNG-vehicles nationwide by 2040, natural gas use in the transport sector will reach 27 kTOE in 2040, from a nil value in 2016.

Industry

The government's Manufacturing Resurgence Program[29] envisions creating a globally competitive manufacturing industry with strong forward and backward linkages to serve as hubs[30] in the regional and international production networks of automotive, electronics, garments and food and supported by well-managed supply chains. With this, the Philippines aims to become the next manufacturing hub in Asia, resulting to higher value added and increased employment opportunities that will further strengthen the sector's role as the country's primary engine of economic growth. With this, energy use for industrial processes is expected to intensify for the next 25 years. From its 2016 level of 7.4 MTOE, it is projected to grow at 5.4 percent while contributing an average share of 25.8 percent in the country's TFEC across

[28] LRTA Website (@lrta.gov.ph)
[29] NEDA: The Philippine Economy: Recent Performance and Long-Term Outlook (2016) (www.neda.gov.ph)
[30] http://industry.gov.ph/category/manufacturing/

the entire planning horizon. This will translate to demand levels going up by almost four times its 2016 level to reach 26.1 MTOE in 2040 (Figure 26).

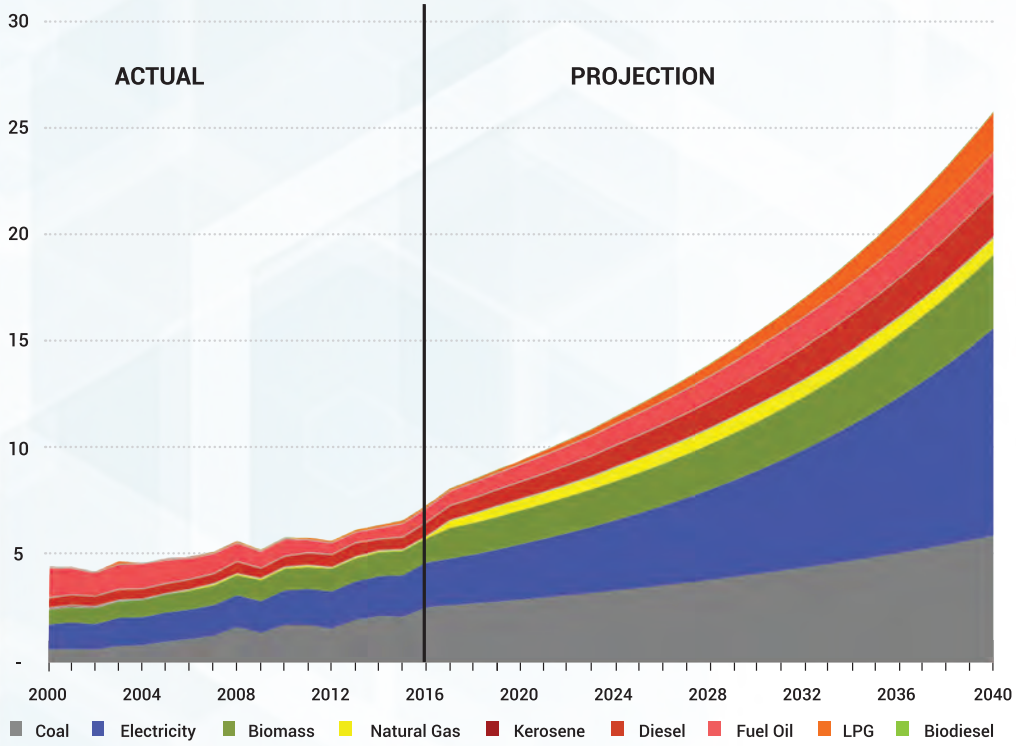

FIGURE 26. INDUSTRY ENERGY DEMAND, BY FUEL (2000-2040) IN MTOE

Industry will remain as the major end-use consumer of coal, with an average share of 27.9 percent of the sector's energy requirement over the entire planning horizon. Higher consumption for coal will emanate from cement, petrochemical and basic metals as these industries gear up for the anticipated demand of building materials for public and private infrastructure, which are expected to benefit from the bright economic prospects in the next decades. Likewise, coal demand in paper production, beverages and other food production is also projected to increase during the planning horizon. With these, coal consumption in industry is seen to expand by an average rate of 3.5 percent per year, to reach 6.0 MTOE in 2040 from 2.7 MTOE in 2016.

Meanwhile, electricity will take up an average share of 30.9 percent of the sector's total energy demand. Machinery/equipment and basic metal production are the top industrial electricity consumers, followed by textile/apparel and other food production. Total electricity demand of the sector is projected to grow by an average of 6.7 percent, reaching 9.8 MTOE in 2040 from 2.1 MTOE in 2016.

Despite its vulnerability to price shocks in the international market, oil will continue to play an important role in fueling the activities of the industry sector, accounting for an average of 21.5 percent share of the sector's total energy demand between 2016 and 2040. It will increase at an average rate of 6.0 percent per year, to reach 5.9 MTOE in 2040 from 1.5 MTOE in 2016. Diesel and fuel oil will constitute the bulk of oil demand, registering an average yearly increase of 5.0

percent and 4.4 percent, respectively, while consumption levels of LPG will increase by as much as 11.9 percent due to higher demand of food processing industries.

As increasing production volume necessitates more energy, the industry players would most likely pursue the utilization of other energy sources, such as biomass. Biomass will remain as an important fuel for the sector, particularly in sugar production, food and other manufacturing industries. Total biomass consumption of industry is expected to increase to 3.5 MTOE in 2040, accounting for an average share of 15.2 percent of the total industry energy demand over the planning period. Natural gas will also figure prominently in the demand mix of the sector due to its utilization in industrial parks, with levels increasing by 10.9 percent per year to reach 782 kTOE in 2040.

Residential

The residential sector is expected to contribute an average share of 24.2 percent in the country's total energy consumption during the planning period. As the total number of households expected to reach 35.1 million in 2040 at 1.7 percent increase per annum, energy demand level of households will increase by 3.3 percent per year, from 9.0 MTOE in 2016 to 19.6 MTOE in 2040. The increased utilization of more efficient fuels, such as electricity and LPG, is a contributing factor to the changing energy demand mix of households, which consequently result to the slowdown in the sector's demand for conventional fuels such as biomass and kerosene (Figure 27).

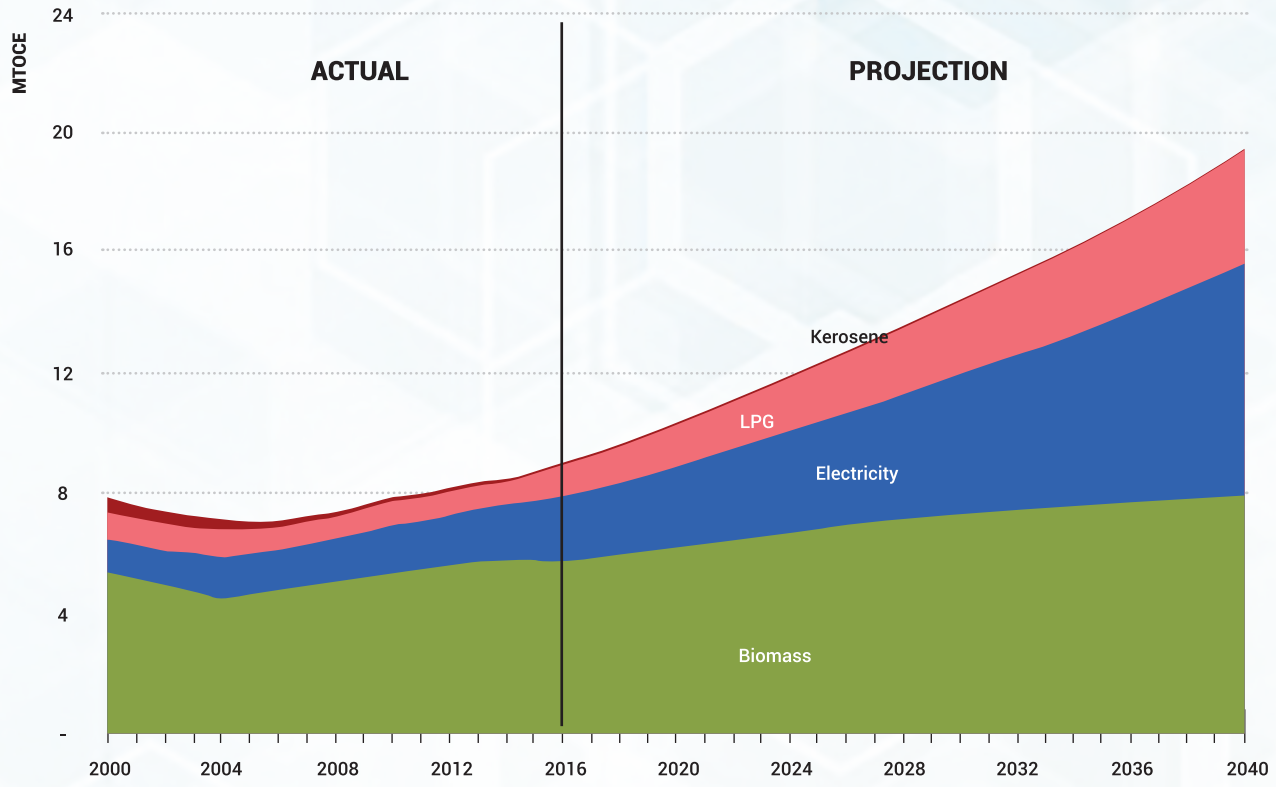

FIGURE 27. RESIDENTIAL ENERGY DEMAND, BY FUEL (2000-2040) IN MTOE

The sluggish growth in biomass demand of 1.4 percent per year across the entire planning horizon, will result to a reduction of its share to total household energy consumption by close to one-fourth of its 2016 share of 63.2 percent, to 40.7 percent share in 2040, as its consumption level is expected to reach 8.0 MTOE in 2040, from 5.7 MTOE in 2016.

Consistent with government's goal of promoting greater energy access thru its 100 percent household electrification target by 2020, electricity demand in the residential sector will increase by more than three times its 2016 level of 2.2 MTOE to 7.8 MTOE in 2040 while posting average yearly increases of 5.4 percent. LPG consumption is also expected to follow the same trend of increase, with a 5.2 percent growth per year across the entire planning horizon. Improvement in living standards and higher incomes will likely contribute to changing patterns of fuel preference among consumers for household activities such as cooking and heating, encouraging the shift to more efficient and convenient fuels and energy sources such as LPG and electricity. With these, kerosene is expected to decline by as much as 4.0 percent per year between 2016 and 2040.

Commercial

The commercial/services sector, supported by the consistent and resilient growth of trade, financial intermediation, and real estate and other business activities, including the booming business process outsourcing (BPO) industry, is expected to sustain its robust development trend in the long-term. This could also be attributed to higher foreign investor confidence and optimism brought about by the improved political stability in the country. Likewise, as the country's labor market attract more international BPOs to establish their headquarters domestically, this will result to increased demand for major investment properties such as office, retail and hotel as well as residential property. With these considerations, the commercial sector's aggregate energy requirement will increase at an average rate of 3.5 percent - from 3.9 MTOE in 2016 to 8.8 MTOE in 2040.

As the primary energy source for lighting and cooling office spaces and establishments, electricity will remain as the most in-demand fuel in the sector constituting more than half (52.5 percent on the average) of the total commercial demand, and will increase at an annual rate of 4.1 percent throughout the planning period (Figure 28).

The sector's oil demand will post yearly increments of 3.0 percent during the entire planning period. To sustain the upsurge in output of establishments engaged in food and other related services, demand for diesel, fuel oil and LPG is expected to increase annually by 3.3 percent, 2.0 percent, and 2.2 percent, respectively. The sector's biodiesel demand, correspondingly, will increase from 21 kTOE in 2016 to 46 kTOE in 2040.

Meanwhile, the consumption of biomass in the commercial sector, particularly fuel wood and charcoal, will still be prevalent among food establishments and restaurants mainly for commercial

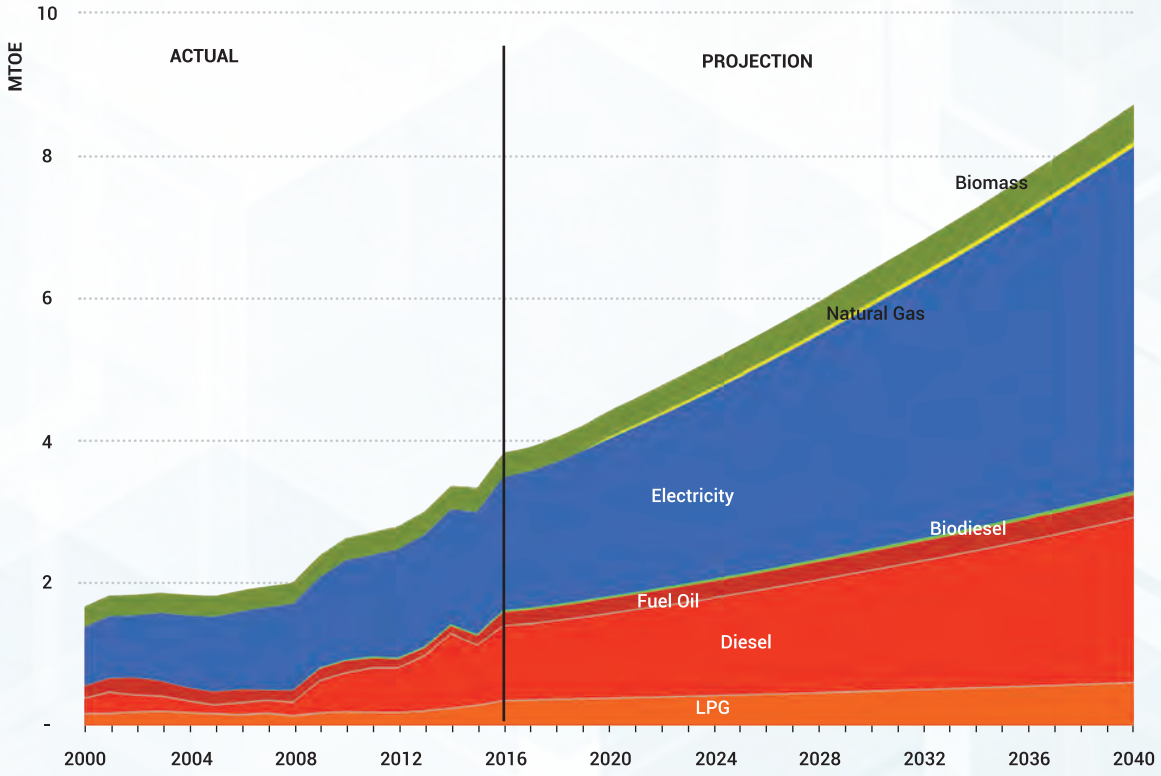

FIGURE 28. COMMERCIAL ENERGY DEMAND, BY FUEL (2000 – 2040) IN MTOE

cooking and heating. Its levels will grow modestly by 1.9 percent per annum within the planning period from 340 kTOE in 2016 to 531 kTOE by 2040. Natural gas is also expected to figure in the commercial sector's demand mix at 68 kTOE by 2040.

Agriculture, Fishery and Forestry (AFF)

The country's AFF sector will continue to be the least energy-intensive among the economic sectors accounting for a meager share of 1.1 percent in the total energy demand. The sector's energy demand levels will improve from 450 kTOE in 2016 to 1 MTOE in 2040, or an average yearly growth of 3.4 percent.

Energy demand in the AFF sector is comprised of: (1) petroleum products, used mainly for farm equipment, crop production and fishery; (2) electricity, largely used in the livestock and poultry sub-sector; and, (3) biodiesel which is a mandatory input to diesel categorized under petroleum products used for farm machineries and implements. Electricity will account for close to half (49.9 percent) of the sector's energy demand, followed by petroleum products, which will take up as much as 49.2 percent share, and biodiesel with 0.9 percent share.

The demand levels of both fuels will increase at average annual growth rates of 3.2 percent and 3.6 percent, respectively. Diesel consumption will increase from 212 kTOE in 2016 to 494 kTOE in 2040, while electricity will reach 466 kTOE in 2040 due to the continuous improvement in design, development and application of technologies on postharvest and modernization. Farmers try to

adopt new agricultural machineries and technologies that are fueled by electricity. The sector's demand for biodiesel will increase more than twice its 2016 level of 4 kTOE to 10 kTOE in 2040 (Figure 29).

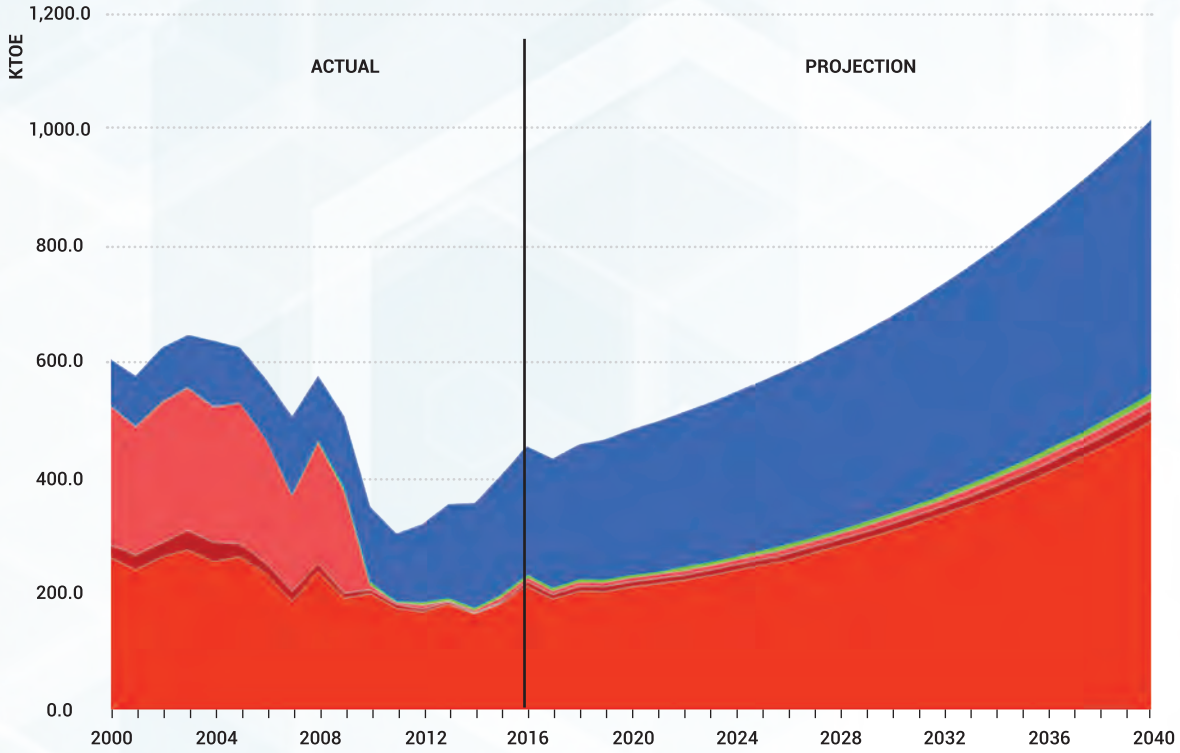

FIGURE 29. AFF ENERGY DEMAND, BY FUEL (2000-2040) IN MTOE

GHG Emission

Given the dynamics of energy demand under the BAU scenario, total GHG emission from fossil fuels (oil, coal and natural gas) is foreseen to increase at 5.5 percent per year across the planning period from 109.8 million tons of CO_2 equivalent ($MtCO_2e$) in 2016 to 396.9 $MtCO_2e$ in 2040. Emission from the consumption of coal fuels shall account for an annual average rate of 52.4 percent of the total GHG emission, while those from oil-based fuels will account for an annual average share of 42.4 percent, with natural gas contributing 5.2 percent share (Figure 30). With the entry of cleaner fuels and efficient technologies such as clean coal technologies (CCT) and that of LNG, combined with higher share of RE in the CES, total GHG emission under the CES scenario will drop to 345.5 $MtCO_2e$ in 2040 as growth slightly slows down at an annual average rate of 4.9 percent across the planning horizon.

Under the BAU, more than half or 51.4 percent of the total emission will come from the transformation sector, specifically from electricity generation. Meanwhile, from among the energy end-use sectors, transport will account for the biggest share of the total GHG emission with an annual average share of 28.7 percent, followed by industry comprising 13.2 percent, while 6.6 percent

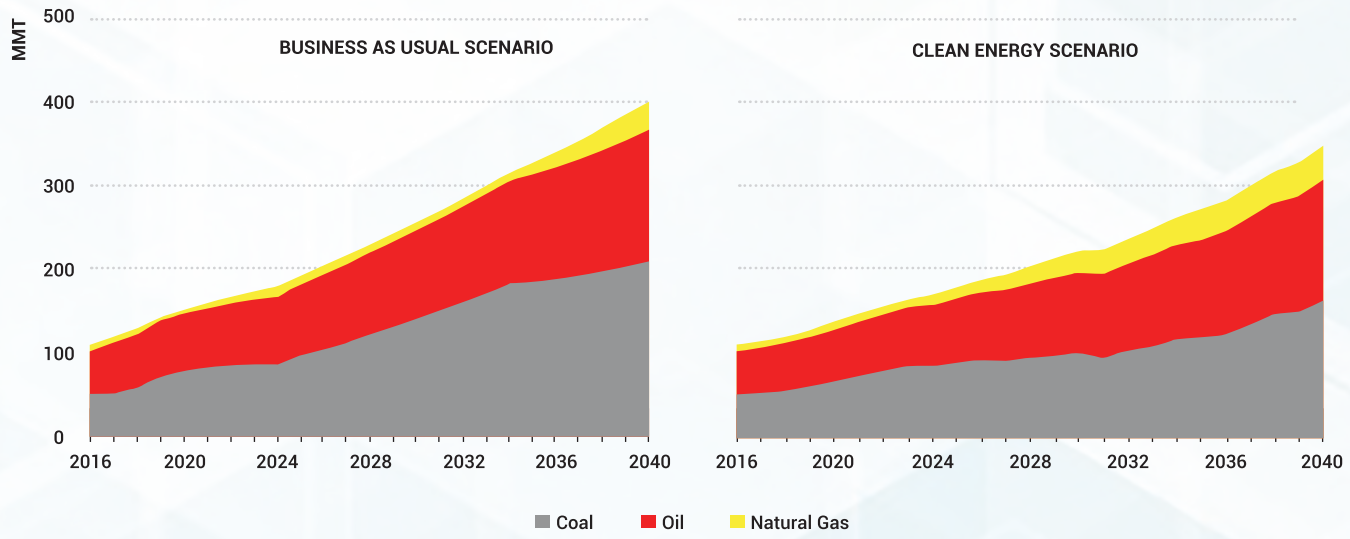

FIGURE 30. GHG EMISSION, BY FUEL, CLEAN ENERGY VS. BAU (2016 – 2040)

shares will come from other sectors such as commercial, residential and agriculture. For CES, bulk of the reduction in GHG emission vis-à-vis BAU will come from the electricity generation sector (Figure 31).

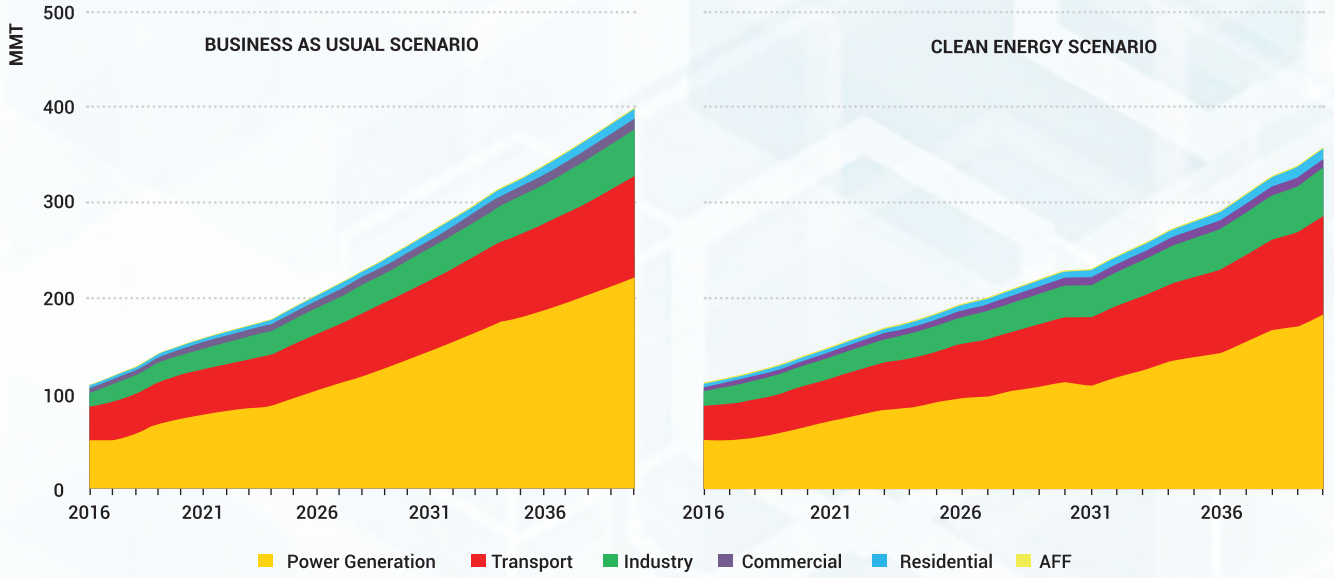

FIGURE 31: GHG EMISSION, BY SECTOR, CLEAN ENERGY VS. BAU (2016 – 2040)

Total Primary Energy Supply (TPES)

The country's TPES under the BAU scenario will grow at an annual average rate of 4.4 percent to reach 148.1 MTOE in 2040, from 53.2 MTOE in 2016. Throughout the planning period, coal and oil will dominate the supply mix, as both fuels account for combined share of 67.1 percent of the TPES. On the other hand, major sources of RE such as geothermal, biomass and hydro are expected to contribute in the TPES at the average shares of 11.8 percent, 11.1 percent and 3.0 percent, respectively (Figure 32).

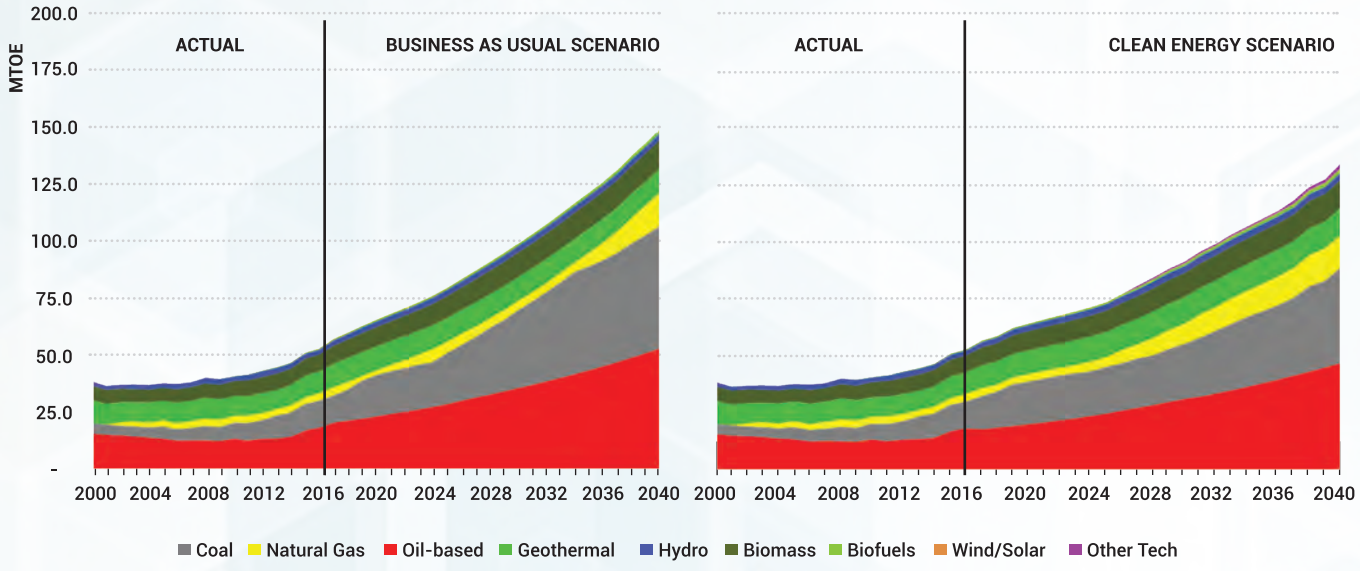

FIGURE 32. TOTAL PRIMARY ENERGY SUPPLY, BY FUEL TYPE, CES VS. BAU (2000-2040)

Meanwhile, TPES under the CES will reach 137.8 MTOE in 2040, 7.0 percent lower than the BAU for the same year, as growth slows down to 4.0 percent per year. The difference is due to the expected reduction in the contribution of fossil fuels to the TPES, particularly oil and coal, in anticipation of the increasing production of RE for power generation, particularly geothermal energy and combined solar and wind across the planning horizon.

This slightly reduces the aggregate share of coal and oil in the TPES to an annual average of 60.4 percent under the CES scenario. Moreover, the anticipated share of RE sources under the CES across the planning horizon will be at 29.2 percent on the average as its level will grow up to 29.2 MTOE in 2040 from its 2016 level of 19.7 MTOE. On the other hand, other technologies that will penetrate under the CES, particularly that of nuclear, are also expected to contribute to TPES at 2.0 MTOE by 2040.

Oil

The country's total primary oil supply is expected to grow by 4.5 percent per year on average in the BAU scenario, from 18.5 MTOE in 2016 to 53.1 MTOE in 2040. It will continue to contribute significantly to the country's total energy mix, with an average share of 36.0 percent across the entire planning horizon.

Meanwhile, with the penetration of alternative fuels (biofuels, CNG and electricity) for transport from BAU scenario to CES, the country's dependence on oil is expected to decline at an average of 8.8 percent across the entire planning period. Oil's annual average share to the TPES will likewise be lower at 34.7 percent, as the total oil supply under CES will grow at a slower rate of 4.1 percent per year to 48.8 MTOE in 2040 (Figure 33).

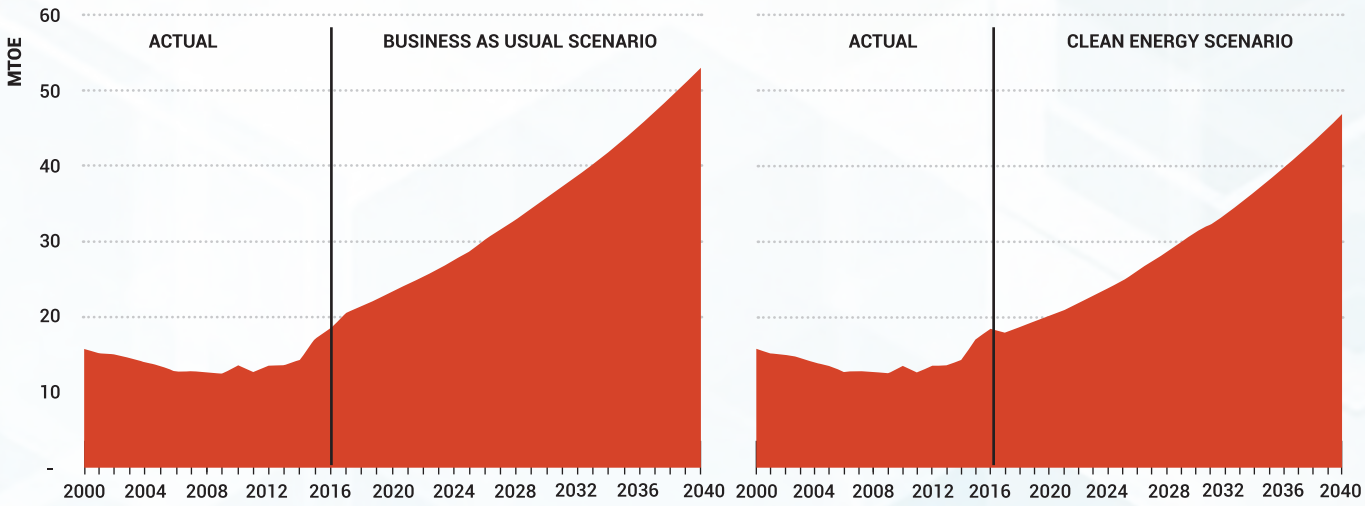

FIGURE 33. TOTAL OIL SUPPLY - ACTUAL, CES AND BAU (2000-2040)

Coal

Under the BAU, total coal supply will increase at a faster rate of 6.4 percent annually, rising by more than five times from its 2016 level of 11.7 MTOE to 51.3 MTOE in 2040, translating to an average share to TPES of 31.1 percent across the planning period. This is to provide for the increasing requirement of coal in the power sector, as well as additional requirements from the industry sector, specifically for cement and basic metals production (Figure 34).

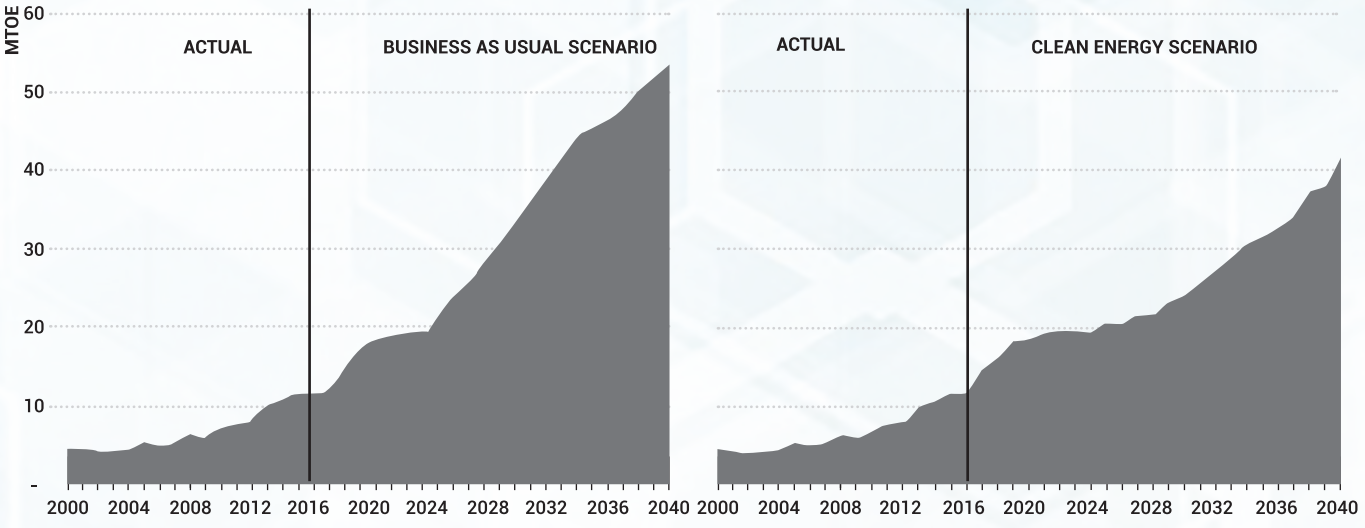

FIGURE 34. COAL SUPPLY - ACTUAL, CES AND BAU (2000-2040)

On the other hand, coal supply under the CES will increase at a slower rate of 5.3 percent to reach 40.7 MTOE level in 2040, coupled with a reduction in its average share to TPES of 5.7 percentage points from the BAU.

Natural Gas

Under the BAU, natural gas is projected to increase at a rate of 6.7 percent per year across the entire planning horizon - from 3.3 MTOE in 2016 to 15.7 MTOE in 2040 (Figure 35). The country's gas supply outlook will still be largely hinged on the production of the Malampaya field, including additional gas (uncontracted gas) until 2025. Aside from the Libertad Gas Field in Cebu which started its commercial production in 2010, potential gas fields foreseen to produce commercially within the next 20 years include San Martin by 2015, Sultan sa Barongis and Sampaguita by 2023, Sulu Sea by 2025, among others.

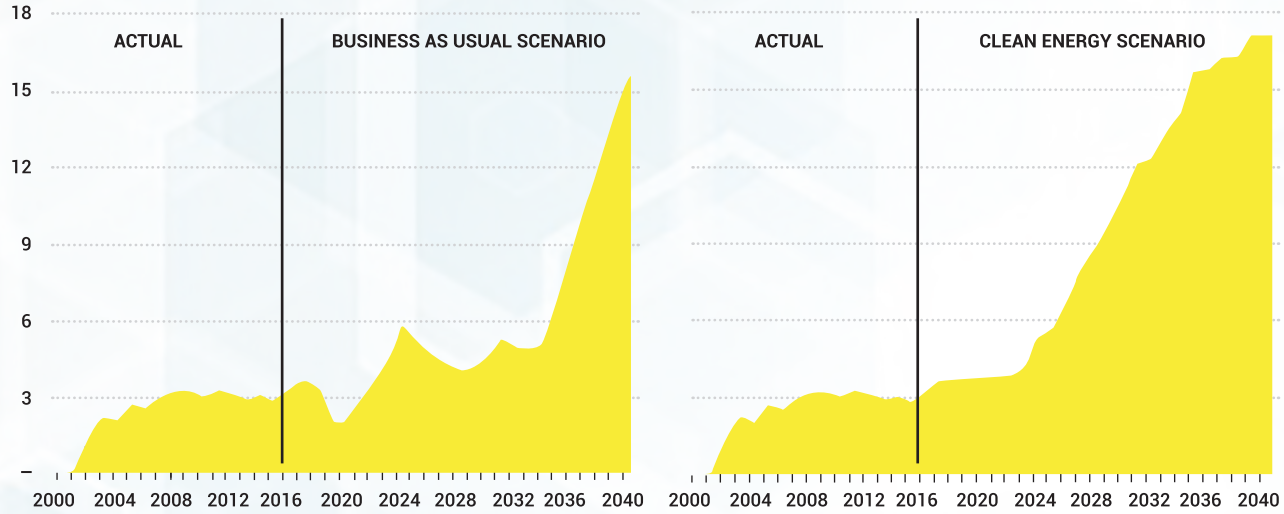

FIGURE 35. NATURAL GAS SUPPLY - ACTUAL, CES AND BAU (2000-2040)

Meanwhile, natural gas supply will post steady increments under the CES at 7.1 percent per year to reach 17.1 MTOE in 2040. Assuming the realization of production targets, the growth will also be largely due to the government's effort to promote the utilization of green fuel[31] for power generation and cater to the emerging market for liquefied natural gas (LNG) technologies.

Renewable Energy

Aggregate RE will account for an annual average share of 27.1 percent across the planning period under the BAU, increasing at an average rate of 1.5 percent per year, from 19.7 MTOE in 2016 to 28.2 MTOE in 2040. Under the CES, its contribution to TPES will improve to around 30 percent, and will reach 29.1 MTOE in 2040, equivalent to an annual average growth rate of 1.6 percent for the entire planning horizon (Figure 36). Geothermal and biomass will account for the biggest share to RE under both the BAU and the CES.

Geothermal energy will continue to be the country's major RE resource accounting for an average of 43.3 percent of the total RE under the BAU Scenario. Geothermal energy production will reach 10.5 MTOE in 2040 from 9.5 MTOE in 2016, which translates to a sluggish growth of 0.4

[31] RE and Natural Gas

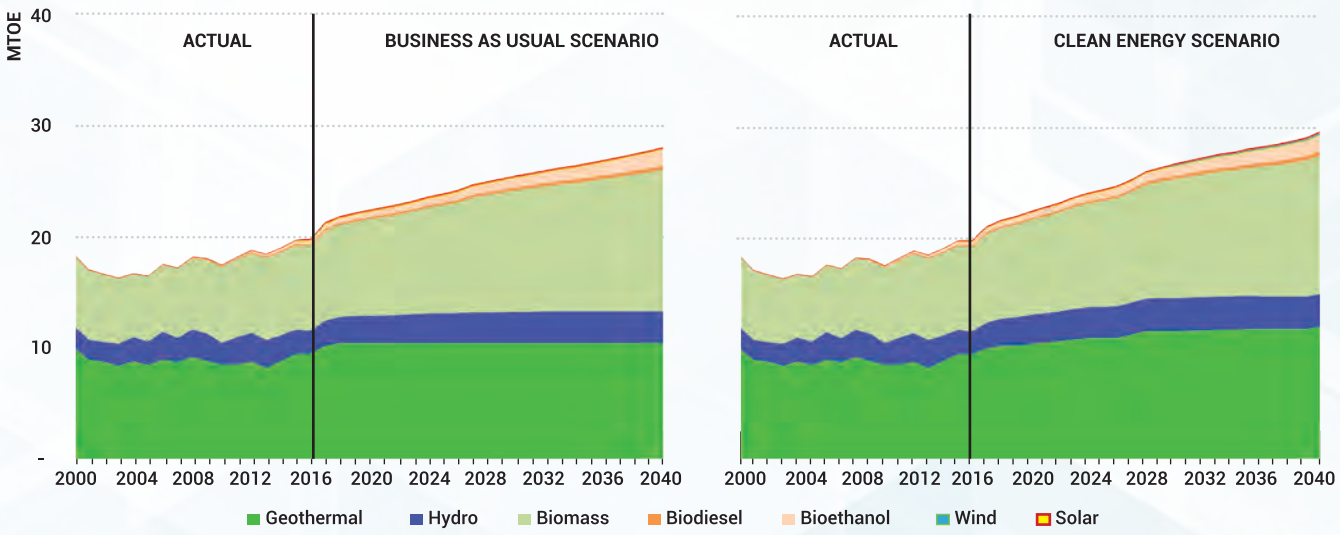

FIGURE 36. TOTAL RE SUPPLY - ACTUAL, CES AND BAU (2000-2040)

percent across the entire planning period. On the other hand, supply of geothermal energy in CES will be slightly higher at 11.7 MTOE in 2040, and will increase at a rate of 0.9 percent from its 2016 level. It will account for an average share of 44.3 percent to total RE across the planning period under CES. A total of 213 MW of additional geothermal power capacities[32] will be online within the next 25 years on top of its 1,916 MW existing installed capacity as of 2016.

Hydropower supply will register an average annual growth rate of 1.9 percent, from 2.0 MTOE in 2016 to 3.1 MTOE in 2040, and contribute an annual average share of around 3.0 percent to the TPES. The commissioning of hydro power projects within the planning period will be bringing an additional installed capacity of 4,792 MW[33]. Meanwhile, under the CES, hydropower will increase its supply levels to reach 2.9 MTOE in 2040 at an annual average rate of 1.5 percent.

Combined supply level of **solar and wind** under the BAU is projected to increase slowly by 0.2 percent per year to reach 0.2 MTOE in 2040. On the other hand, the CES will potentially bring the supply level of solar and wind to 0.4 MTOE by 2040 translating to yearly increases of 3.5 percent on the average. Committed and indicative solar and wind power plants are expected to put in 5,100 MW of additional capacity between 2016 and 2040[34].

On the other hand, **biomass** as an energy source will contribute 11.1 percent share to TPES under the BAU, posting yearly increments of 2.2 percent to reach 12.5 MTOE by 2040. It is expected to gradually step up its contribution to the power sector with the entry of 460 MW[35] additional capacities from its 2016 level of 233 MW. Under the CES, biomass supply will reach 12.3 MTOE by 2040, corresponding to 2.1 percent annual growth per year, and accounting for an average share of 11.7 percent to TPES.

[32] Committed: 93 MW, Indicative: 120 MW – Private Sector Initiated Power Projects (as of June 2017)
[33] Committed: 196 MW; Indicative: 4,596 MW – Private Sector Initiated Power Projects (as of June 2017)
[34] Committed: 110 MW; Indicative: 4,991 MW - Private Sector Initiated Power Projects (as of June 2017)
[35] Committed: 241 MW; Indicative: 218 MW - Private Sector Initiated Power Projects (as of June 2017)

Biodiesel supply for the entire planning period will contribute 0.3 percent to total TPES, as levels rise by 3.4 percent per annum to reach 0.4 MTOE in 2040. On the other hand, **bioethanol** production will increase by 6.7 percent per year – from 0.3 MTOE in 2016 to 1.5 MTOE in 2040. It is expected to contribute an average of 0.8 percent share to TPES.

Policy Implications and Recommendations

The emerging results of this Outlook merit several policy implications and recommendations:

1. Energy-economy indicators across the entire planning show significant trends, such as:

    - The decline in energy intensity (including oil and electricity) is expected due to the foreseen structural changes (such as emergence of more non-energy intensive industries/processes) in the domestic economy, as well as improvements in energy efficiency. Thus, the growth in economic output outpaces the gradual increase in energy demand across the planning period. In this Outlook, economy-wide energy intensity drops by as much as 56.0 percent in 2040 from its 2016 level which is well beyond the target set among APEC economies.

    - Energy use per capita is increasing; more energy is made available on a per person basis. Notably, electricity per person rises more rapidly than that of oil and energy, as a consequence of the intensified electrification campaign being carried out at the barangay/sitio level, making electricity more accessible to an ever-increasing number of households, particularly in rural and far-flung areas of the country. Fast-tracking the Mindanao-Visayas Interconnection Project by 2020 and other interconnection projects by 2019, in support of the country's goal of a One-Grid Philippines, will likely contribute to the achievement of this scenario.

2. As the Philippines is poised to become one of the fastest growing economy in Southeast Asia[36]. Backed by industrialization and urbanization targets, it is expected to require larger supply of energy to sustain its economic growth. Under the BAU scenario, such projection of economic growth creates a significant increase in fossil fuel requirement which will produce larger emissions in the future. With the CES, the increasing production of RE for power generation, particularly geothermal energy and combined solar and wind across the planning horizon signals the shift towards lower emission technologies, including that of natural gas, and other technologies over the medium to long term planning period. The inclusion of these resources is consistent with the vision of achieving a low carbon future anchored on a technology-neutral policy that will potentially increase supply reliability and make energy more affordable to consumers. Expectedly, this policy move will require considerable investments in the energy sector.

3. Sustained implementation of EO 30 to build appropriate portfolio for required additional capacities in energy projects particularly in power generation.

[36] 2015 OECD Economic Outlook for Southeast Asia

4. To be able to support the achievements stated under the CES, the following should be considered:

   - Heightened government support towards a nationwide implementation of alternative fuels for the transport sector such as the promotion of E-Vehicle and NGV programs.

   - Revisit the target mandated blending schedule of biofuels (bioethanol and biodiesel) under the Biofuels Act to meet the higher demand for clean fuel.

   - The Marginal Abatement Cost Curve (MACC) analysis shows that energy efficiency activities of the government are the most cost effective measures to mitigate the GHG. Thus, it is imperative to fast-track the passage of the Energy Efficiency and Conservation (Enercon) Bill to institutionalize EE&C programs, impose strict implementation and monitoring of EE&C projects, and provide incentives towards greater participation of private sector. With the Enercon Bill, energy savings target of more than 10.0 percent across all economic sectors is attainable. It will also provide the impetus to intensify the current EE&C campaign activities, as well as introduction of new approaches in EE&C. In anticipation of the passage of this bill, DOE Department Circular No. 2016-04-0005 was put in place declaring the compliance of importers, manufacturers, distributors and dealers of electrical appliances and other energy-consuming products with the Philippine Energy Standards and Labelling Program (PESLP). Said DC provides the rules and procedures on applications, approval, enforcement, monitoring, verification, labelling, inspection and adjudication relative to the PESLP as well as the imposition of corresponding sanctions and penalties for violations of these guidelines.

   - Hasten the issuance of the Philippine Natural Gas Policy Framework to fully implement the development of an integrated Liquefied Natural Gas (LNG) receiving and distributing facility with a reserve initial power plant capacity of 200 MW. To prepare the natural gas industry with the eventual passage of this bill, DOE Department Circular No. 2017-11-0012 or the "Philippine Natural Gas Regulation (PDNGR)" was issued to establish the rules and regulations relating to siting, design, construction, expansion, rehabilitation, modification, operation and maintenance of the Philippine Downstream Natural Gas Industry (PDNGI).

   - Maximize the technical assistance extended by the International Atomic Energy Agency (IAEA) and other international energy organizations to conduct a comprehensive study on the entry of nuclear power and come up with a firm National Policy in order to embark on a full-scale nuclear power program (NPP). With this policy, we shall tap nuclear power to provide for our baseload requirements, and contribute to our goal of a low-carbon future since it is a clean, reliable and sustainable energy source.

5. Energy self-sufficiency can be maintained at 60.0 percent through reduction in the country's dependence on imported energy, specifically fossil fuels. The government should intensify efforts on the following:

- Promote indigenous energy development and utilization

  → Expedite energy projects and explorations on oil, natural gas and coal in the Philippine Exclusive Economic Zone (EEZ) under the Philippine Conventional Energy Contracting Program (PCECP)

- Harnessing the country's full RE development

  → Increase RE capacity from its 2010 level of 5,000 MW to 20,000 MW by 2040

  → Strengthen RE policy mechanisms under the Renewable Energy (RE) Law to attract new investments in the sector

6. In general, this Outlook recommends the full implementation and realization of sectoral roadmaps and targets under this PEP to achieve the optimal energy scenario in the medium and long term.

DEPARTMENT OF ENERGY

Energy Center, Rizal Drive, Bonifacio Global City (BGC)
Taguig City, Philippines 1632
Tel. Nos.: 840-1780; 479-2900 local 288, 328

www.doe.gov.ph facebook.com/doe.gov.ph twitter.com/doe_ph