

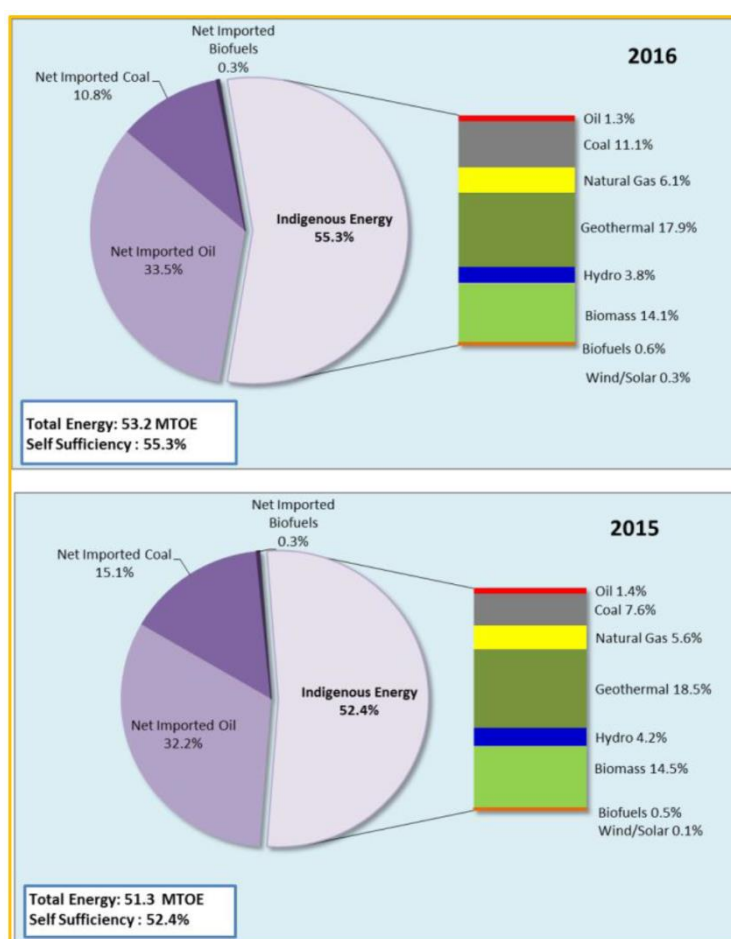
1.3 Philippines

1.3.1. Philippine Energy Demand and Supply Situation, 2016

a. Total Primary Energy Supply

The country's total primary energy supply (TPES) reached 53.2 million tonnes of oil equivalent (Mtoe) in 2016, 3.7% higher from its 2015 level of 51.3 Mtoe. This was due to the 9.4% increase in aggregate indigenous energy resources from 26.9 Mtoe in 2015 to 29.4 Mtoe in 2016, offsetting the 2.5% reduction in net energy importations. Higher domestic production from coal, natural gas, and renewable energy, particularly biofuels, solar, and wind, was reported during the same period (Figure 2.1.3-1).

Figure 2.1.3-1. Total Primary Energy Mix in the Philippines by Fuel Shares, 2015–2016



Mtoe = million tonnes of oil equivalent.

Source: Philippine Energy Plan 2016-2030.

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

in the total primary oil supply, by 7.8% from 17.2 Mtoe in 2015 to 18.5 Mtoe in 2016. This was due to the increase in net importations.

Meanwhile, the total primary coal supply grew considerably slower at a rate of 0.6% 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% increase in production level between 2015 and 2016. From amongst the renewable supply, combined solar and wind energy grew by 133.6%; biofuels and geothermal production increased by 18.1% and 0.2%, respectively. On the other hand, hydro energy production was lower by 6.4% in 2016 vis-à-vis 2015.

The country's energy self-sufficiency reached 55.3%, 2.9 percentage points higher than the 2015 level of 52.4%.

b. Indigenous Energy

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

c. Fossil Fuels

Oil

The country's combined oil production, including condensate, dropped by 1.8%, from 715.0 kilotonnes of oil equivalent (ktoe) in 2015 to 702.4 ktoe in 2016, while its share in the contribution to total indigenous energy supply stood at 1.3%. 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% to total domestic energy production, accelerated by 52.0% to 5.9 Mtoe in 2016 from 3.9 Mtoe in the previous year. The bulk of the hike in production came from the country's major coal producer, Semirara Mining and Power Corporation (SMPC), which accounts for a 98.9% share in the total coal production of the country. SMPC's 2016 production set a new record high of 12,087 million metric tonnes run-of-mine coal, which was 54.6% higher vis-à-vis 2015. Private coal mines in Cebu likewise recorded a 20.9% increase in aggregate production. On the other hand, coal mines in Bicol, Surigao, and Zamboanga, as well as small-scale mines located throughout parts of the country, with a combined share of 0.8% to the country's total coal production, suffered cuts of almost half their 2015 levels.

Natural Gas

As of the end of 2016, Malampaya, the country's lone producing natural gas field, produced 3.3 Mtoe of natural gas, equivalent to a 6.1% share in the overall total indigenous energy production during the year. This level translated to double-digit growth of 14.6% 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. Its domestic production supplies 100% of the country's natural gas requirements.

d. Renewable Energy

Geothermal

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

Hydro

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

Solar

Solar energy production increased about nine times its 2015 level of 11.9 ktoe to reach 94.3 ktoe in 2016, accounting for a 0.2% share in the total energy mix in 2016. The robust increase – from 146.3 MW in 2015 to 4,118 MW in 2016 – was brought about by the massive addition to solar installed capacity. The country can look forward to solar's significant contribution to the energy mix in the future as 166 solar projects, with a total potential capacity of 4,081 MW, were awarded in 2016.

Wind

Production of wind energy stood at 83.9 Mtoe, 30.3% more than its 2015 level of 64.4 ktoe, albeit a marginal contribution of 0.2% to TPES. As of December 2016, 58 wind projects were awarded, which would bring in total additional capacity of 1,039 MW.

Biomass

Biomass continued to account for around one-fourth (25.5%) of the indigenous energy supply in 2016, increasing by 0.9% from its 2015 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 remaining a ready and substitute fuel for more expensive sources of energy in the industry and commercial sectors.

On the other hand, the contribution of biomass to the power sector gradually increased, as its level of fuel input to electricity generation grew more than twofold (101.6%) its 2015 level to reach 281.9 ktoe in 2016. The heightened promotion of the use of renewable energy resulted in

a total of 67 biomass projects awarded as of the end of 2016, with an additional aggregate capacity of more than 300 MW.

1.3.2. Current Status of Transportation Fuel Supply

Oil

Inventory

Actual crudes and petroleum products inventory in December 2016 closed at 20,742 MB (thousand barrels) or an equivalent of 51-day supply – 37 days for crude oil and products in country stocks and 14 days in transit. This was higher by 15.2% from the financial year (FY) 2015 level of 18,005 MB. For the financial year ending December 2016, the average inventory was recorded at 47 days – 38 days in country stock and 9 days in transit.

The government continued to enforce the Minimum Inventory Requirement given the continuing risks faced by the downstream oil industry sector, such as geopolitical instability and supply delivery problems to areas affected by calamities (e.g. typhoon, flood, earthquake).

As such, updates on the status of oil supply to areas heavily affected by typhoons were provided to the National Disaster Risk Reduction and Management Council to ensure continuous supply.

The current Minimum Inventory Requirement for refiners is in-country stocks equivalent to 30 days, while a supply equivalent to 15 days stock is required for bulk marketers and 7 days for liquefied petroleum gas (LPG) players.

Crude Oil Supply

The country imported various types of crude oil in 2016 and reached 78,772 MB, a slight increase of 0.9% from 78,060 MB in 2015.

Eighty-seven percent of the total crude mix (68,537 MB) was sourced from the Middle East, of which 36.1% (28,438 MB) came from Saudi Arabia, the top supplier of crude oil to the country. This is followed by Kuwait with a 33.6% share of the total crude mix and the United Arab Emirates with a 13.3% share. On the other hand, 6.7% (5,256 MB) of crude oil was imported from the Russian Federation. The remaining 6.3% was sourced from the Association of Southeast Asian Nations (4,980 MB) and from local production (135 MB).

Petroleum Products and Ethanol Imports

FY 2016 petroleum product imports totalled 86,108 MB, an increase of 12.9% from 76,276 MB in 2015.

In terms of volume, diesel oil import grew by 24.6% compared with the 2015 import. Kerosene/avturbo, LPG, and gasoline imports also rose by 19.9, 19.7, and 3.7%, respectively. On the other hand, fuel oil import dropped by 15.3%.

The other industry players accounted for a majority of the product imports with 73.5% of the total import volume, up by 8.9% to 63,319 MB from 58,132 MB in 2015. The oil majors (Petron,

Chevron, and Pilipinas Shell) accounted for the remaining 26.5%, which increased by 25.6% from 18,144 MB in the previous year to 22,789 MB.

The local refiners (Petron and Pilipinas Shell) accounted for 16.0% of the total product imports, which included blending stocks, as against a 84.0% share by direct importers.

The product import mix comprised mostly of diesel oil at 41.0%, gasoline at 18.2%, LPG at 13.5%, fuel oil at 8.3, kerosene/avturbo at 8.2%, and other products at 10.7%.

Total gasoline imports reached 43.5% of gasoline demand, while diesel oil imports reached 54.5% of diesel demand. LPG imports, on the other hand, reached 68.6% of LPG demand. Total product import was 55.4% of the total product demand.

The import share of the oil majors in the total demand was 14.7%, while the other players' share was 40.7%. As for the refiners, their import share in the total demand was 8.9%, while 46.5% was attributed to direct importers.

Meanwhile, a total of 1,632 MB of ethanol was imported for fuel use during the year, which dropped by 14.3% from 1,904 MB of 2015. Republic Act No. 9367 or the Biofuels Act of 2006 mandated that all gasoline to be sold in the country should be E10 (gasoline with 10% bioethanol content).

Moreover, petroleum coke for smelting plants (400 megatonnes) was also imported during the year as well as butane in canisters (208 megatonnes).

Crude Run and Refinery Production

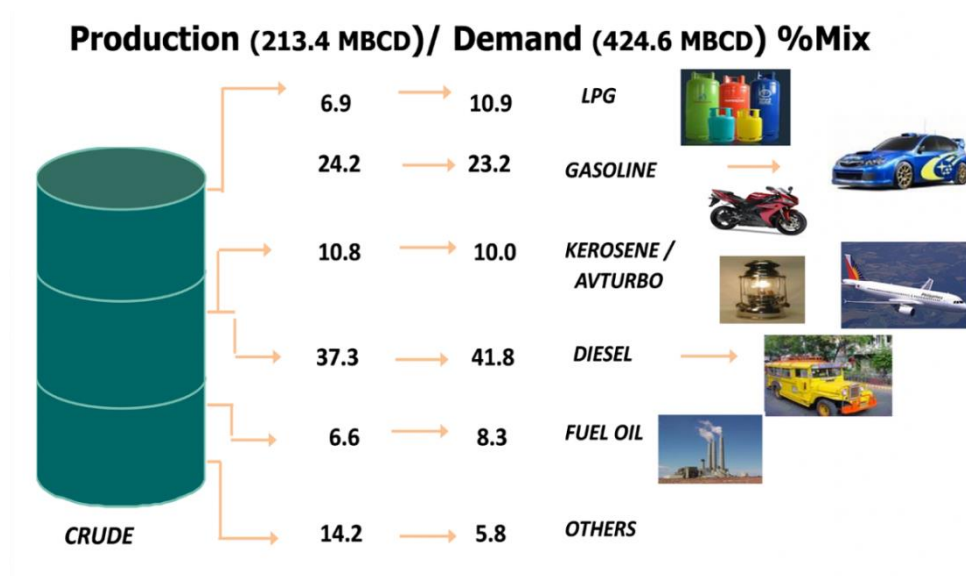
The country's current maximum working crude distillation capacity is 285 MB per stream day.

Total crude processed as of the end of 2016 was up by 2.0% from 77,478 MB in 2015 to 79,016 MB. Refinery utilisation during the period also increased by 1.7% from 74.4% in the previous year to 75.7% in 2016.

Consequently, local petroleum refinery production output also grew by 3.1% from 75,751 MB to 78,113 MB. The FY 2016 average refining output was 213.4 MB per day.

Compared with FY 2015, gasoline output posted an increase of 10.8%, which may be attributed to the expanded refinery of one local refiner, now capable of producing more white petroleum products. Kerosene and avturbo output also rose by 10.2%. Similarly, LPG and diesel oil rose by 1.1 and 0.6%, respectively. However, fuel oil output dropped by 18.4%.

Figure 2.1.3-2 Production and Demand Mix in the Philippines in Fiscal Year 2016



LPG = liquefied petroleum gas, MBCD = thousand barrels of oil per calendar day.
Source: Philippine Energy Plan 2016-2030.

Diesel oil continued to dominate the production mix with a share of 37.3%, followed by gasoline and kerosene/avturbo with 24.2% and 10.8% shares, respectively. Meanwhile, LPG and fuel oil had 6.9% and 6.6% shares, respectively (Figure 2.1.3-2).

Petroleum Product Demand

The year-to-date (YTD) December 2016 total demand of finished petroleum products grew by 8.5% to 155,414 MB from 143,226 MB in YTD December 2015. This can be translated to an average daily requirement of 424.6 MB compared with the previous year's level of 392.4 MB.

Compared with YTD December 2015 figures, diesel oil demand posted an increase of 10.5%. LPG, kerosene/avturbo, and gasoline demand were also up by 14.0%, 12.7%, and 10.0%, respectively. Likewise, naphtha rose by 22.6% vis-à-vis the previous year. However, fuel oil demand decreased by 11.7%.

The total product demand mix comprised mostly diesel oil at 41.8%, gasoline at 23.23%, LPG at 10.9%, kerosene/avturbo at 10.0%, fuel oil at 8.3%, and naphtha and other products at 5.8% (Fig. 2.1.3-2).

Petroleum Product Exports

The country's total petroleum product exports as of the end of 2016 dropped by 1.5% from 13,988 MB in 2015 to 13,771 MB.

Compared with the previous year, condensate, the top exported products for the period, registered an increase of 5.3%. Likewise, exports of propylene, pygas, and gasoline rose by 46.2%, 10.3%, and 8.2%, respectively. However, fuel oil and naphtha exports were down by

46.4% and 13.1%, respectively. Other petrochemical products such as mixed xylene and benzene dropped by 7.0% and 21.5%, respectively.

The total export mix comprised of condensate (28.8%), naphtha (11.8%), gasoline (13.2%), fuel oil (11.5%), propylene (10.8%), pygas (9.7%), mixed xylene (5.1%), mixed C4 (3.4%), toluene (3.1%), benzene (1.2%), and reformat (1.1%).

The oil refiners' exports accounted for 58.0% of the total export mix, while the export of other players accounted for the remaining 42.0%.

Crude Oil Exports

A total of 1,804 MB crude oil from Galoc (Palawan Light) was exported during 2016, a decrease by 26.1% from 2,441 MB in 2015.

Total Petroleum Products

The major oil companies (Petron Corp., Chevron Philippines Inc., and Pilipinas Shell Petroleum Corporation) had a 57.8% market share of the total demand, while the other industry players (including PTT Philippine Corp. (PTTPC), Total Phils., Seaoil Phil. Inc., TWA Inc., Phoenix, Liquigaz, Petronas, Prycegas, Micro Dragon, Unioil, Isla Gas, Jetti, Eastern Petroleum, JS Union, JS Phils. Corp., Petrotrade, South Pacific, Marubeni, SL Harbour, Perdido, and Filoil Logistics Corp.) as well as the end users who imported directly most of their requirement captured 42.2% of the market.

Meanwhile, the local refiners (Petron Corporation and Pilipinas Shell) captured 51.0% of the total market demand, while 49.0% was credited to direct importers and end users.

Liquefied Petroleum Gas

The other players' market share, with the inclusion of South Pacific in early 2016, increased to 63.4%. The remaining 36.6% was credited to the oil refiners. Amongst the other LPG players, Liquigaz had the biggest market share with 23.3%, followed by Pryce Gases with a share of 12.7% and Isla Gas with a share of 12.66%.

The FY 2016 estimated total oil import bill amounting to \$7,451.9 million was 13.5% lower than in FY 2015 when it was \$8,612.0 million. This was attributed to lower import cost (for both crude and petroleum products) despite an increase in the petroleum product import volume. The total oil import cost consisted of 55.4% finished products and 44.6% crude oil.

Total import of crude oil amounted to \$3,321.0 million, down 17.9% from \$4,043.1 million in FY 2015 due to the lower cost, insurance, and freight (CIF) price per barrel of \$42.159/bbl compared to \$51.795/bbl in 2015.

Meanwhile, the total product import cost went down by 9.6% to \$4,130.9 million at an average CIF cost of \$47.973/bbl, whereas in 2015 it was \$4,568.9 million at an average CIF cost of \$59.899/bbl. The average dollar rate for 2016 was \$47.5 compared to \$44.36 in 2015.

On the other hand, the country's petroleum export earnings for the period fell by 23.2% from \$878.7 million in 2015 to \$675.0 million in 2016. This was due to the decreased volume of crude exported for the period and lower free on board (FOB) price per barrel vis-à-vis 2015 figures.

Overall, the country's 2016 net oil import bill amounting to \$6,776.8 million was down by 12.4% from \$7,733.3 million in 2015.

Natural Gas

The Philippines had 3,772 billion cubic feet (BCF) of proved natural gas reserves and 109 million barrels (MMB) of condensate, which can be found mostly in the basins of Northwest Palawan and Cagayan. Potential resources for natural gas stand at 68 BCF, while undiscovered mapped resources from the 14 sedimentary basins all over the country will reach 8,303 BCF of natural gas.

From 2012 to 2015, production of natural gas from Malampaya Field was recorded at 515.05 BCF with associate condensate of 16.57 MMB during the same period. Additional production of 73.67 BCF of natural gas and 2.19 MMB of condensate was also realised during the first half of 2016.

In 2013, the Department of Energy (DOE) in partnership with the World Bank completed the Natural Gas Master Plan Update, which included the objective to establish a natural gas investment and transactional framework focusing on liquefied natural gas (LNG). Likewise, in 2014, the DOE commissioned the Philippine National Oil Company to engage the Public–Private Partnership (PPP) Center to conduct a feasibility study on the 105-kilometre Batangas–Manila Natural Gas Pipeline (BatMan 1) to supplement the study by the Japan International Cooperation Agency on the technical aspect for the LNG entire chain (LNG facilities, regasification, pipeline, and offtake facilities) including a social and environmental impact study. Further, to open the country to the LNG market, in 2015 the DOE granted an extension of about 12 months to the provisional permit issued for the imminent completion of the country's first LNG Terminal Hub and merchant power plant in Pagbilao, Quezon owned by Energy World Corporation (EWC).

As of the end of 2015, natural gas posted a total actual production of 126,192 million standard cubic feet (MMSCF), with a shortfall of about 3.2% as compared to the previous year when it was 130,351 MMSCF. Similarly, natural gas consumption also decreased by 6.1% from a total of 125,611 MMSCF in 2014 to 117,926 MMSCF in 2015. Such decreases can be attributed to the implementation of planned and unplanned shutdown activities both in the facilities of Malampaya as well as on the customer side such as the gas-fired power plants and refinery. As of the second semester of 2016, fuel production recorded a total of 73,665 MMSCF, while total consumption was at 70,534 MMSCF.

Power generation accounts for 97.7% of the total annual consumption, while the industry sector accounts for about 2.3% (Table 2.1.3-1). Transportation sector consumption, however, is greatly affected by the deferment of the commercial operation of the 31 compressed natural gas (CNG) buses under the DOE's Natural Gas Vehicle Program for Public Transport (NGVPPT) due to the suspended operation of the existing CNG daughter refilling station in Mamplasan, Biñan, Laguna.

Currently, the only source of natural gas in the country is the Malampaya gas field, which has an average production of 380 MMSCF per day. Apparently, two projects will be implemented to ensure a stable supply of natural gas for the Luzon Electricity Grid, Malampaya Phases 2 and 3.

In 2013, Malampaya Phase 2 was completed upon the successful installation of two production wells. On the other hand, Malampaya Phase 3 involves design, fabrication, and installation of a new depletion compression platform and is expected to commence operation in 2016. It will also allow additional volumes of natural gas to be committed to new customers.

In 2015, the main consumers of natural gas in the country were still the three natural gas-fired power plants in Luzon, which consumed around 115,788.1 MMSCF of gas, and the Pilipinas Shell Petroleum Corporation refinery, which consumed around 2,137.7 MMSCF of gas. Additional market participation in terms of power generation is expected in the gas industry by 2016 through the entry of the 100 MW Avion Gas Power Plant and the additional 450 MW San Gabriel Power Plant.

Furthermore, to ensure sustainability of the natural gas supply, the DOE is considering the importation of LNG as a major option to meet the demand of the industry. At present, the DOE is entertaining proposals from various private parties that will bring LNG into the country.

Table 2.1.3-1 Natural Gas Production and Consumption in the Philippines
(million standard cubic feet, mmcfs)

Production	Consumption			Total
	Power (1994–2016)	Industry (2005– 2016)	Transportation (2008–2014)	
1,803,550	1,705,616	31,675	184	1,737,475

Source: Philippine Energy Plan 2016-2030.

1.3.3. Current Status of Biofuel Supply in the Transportation Sector

The country embraces the development of biofuels with the anticipation of achieving energy security, augmenting farmers' income, generating rural employment, and reducing greenhouse gas (GHG) emissions that can contribute to mitigating the effects of climate change. In 2007, the passage of Republic Act 9367, otherwise known as the Biofuels Act of 2006, together with Department Circular No. 2007-05-0006, or its Implementing Rules and Regulations, mandated the use of biofuels and established the National Biofuels Program to ensure a sustained investment climate for production, distribution, and utilisation of biodiesel and bioethanol. Since then, the government has been constant in promoting the use of biofuels as an alternative and clean fuel in the transportation sector.

As a result, the total number of biofuel producers has increased continuously, from 11 producers in 2011 to a total of 16 in 2014. At present, the country already has 21 biofuel producers located nationwide, 10 of which are bioethanol producers with registered total annual capacity of 282.12 million litres (Table 2.1.3-2) and 11 are biodiesel producers with total registered annual capacity of about 574.90 million litres (Table 2.1.3-3).

Three more bioethanol production plants with a combined capacity of 120.5 million litres will be added by the third quarter of 2018, bringing the total production capacity to 402.62 million litres (Table 2.1.3-2).

Table 2.1.3-2 List of Accredited Bioethanol Producers and Registered Bioethanol in the Philippines

BIOETHANOL				
	NAME OF PRODUCERS	REGISTERED CAPACITY (million liter/yr)	FEEDSTOCK	REMARKS
Accredited				
1	San Carlos Bioenergy, Inc.	40	Sugarcane	Operational
2	Leyte Agri Corporation	9	Molasses	Operational
3	Roxol Bioenergy Corporation	30	Molasses	Operational
4	Green Future Innovations, Inc.	54	Sugarcane	Operational
5	Balayan Distillery, Inc.	30	Molasses	Operational
6	Far East Alcohol Corp.	15	Molasses	Operational
7	Kooll Company	14.12	Molasses	Operational
8	Universal Robina Corp.	30	Molasses	Operational
9	Absolute Distillers Inc	30	Molasses	Operational
10	Progreen Agri Corp (formerly EI)	30	Molasses	Operational
Total		282.12		
Registered with Notice to Proceed Construction				
1	Cavite Biofuels Producers, Inc.	38	Sugarcane	Target Commissioning: September 2018
2	Canlaon Alcogreen Agro Industr	45	Sugarcane	seeking financial closure
3	Emperador Distillers, Inc,	66	Sugar/Molasses	Target Commissioning: 1st Quarter 2018
4	NSEBIO Ltd. Phil. Branch pilot	2 wet tons bagasse	Wet Bagasse	Operational
5	Victorias Milling Corporation	16.5	Molasses	Target Commissioning: March 2018
Total		165.5		

Source: Renewable Energy Management Bureau, Department of Energy, Philippines.

Table 2.1.3-3 List of Accredited Biodiesel Producers and Registered Biodiesel Projects in the Philippines

BODIESEL				
	NAME OF PRODUCERS	REGISTERED CAPACITY (million liter/yr)	FEEDSTOCK	REMARKS
Accredited				
1	Phil. Biochem Products, Inc.	40	CNO	Operational
2	Chemrez Technologies, Inc.	90	CNO	Operational
3	Mt. Holly Coco Industrial, Inc.	60	CNO/Copra	Operational
4	Tantuco Enterprises, Inc.	90	CNO/Copra	Operational
5	JNJ Oleochemicals, Inc.	63.3	CNO/Copra	Operational
6	Pure Essence International, Inc.	72	CNO	Operational
7	Golden Asian Oil International, Inc.	60	CNO	Operational
8	Bioenergy 8 Corporation	30	CNO	Operational
9	Freyvonne Milling Services	15.6	CNO	Operational
10	Phoenix Petroleum Philippines, Inc.	24	CNO	Operational
11	Econergy Corporation	30	Cochin Coconut Oil	Operational
Total		574.9		
Registered with Notice to Proceed Construction				
1	Bio Renewable Energy Ventures, Inc.	150	CNO	Ongoing Permitting
2	Archemicals Corporation	15	CNO	Ongoing Construction
Total		165		
Pending Application				
1	Greentech Biodiesel Inc.	100	CNO/Copra	in-process

Source: Renewable Energy Management Bureau, Department of Energy, Philippines.

In 2016, the total production of biodiesel was 225.87 million litres, while total sales were 217.70 million litres. As of the end of 2017, the total biodiesel production stood at 222.13 million litres, while total sales were 203.48 million litres.

The total actual production of bioethanol in 2016 stood at 230.18 million litres with total sales of 226.88 million litres. Production and sales increased significantly by 37.11% and 34.71%, respectively, as compared to 167.87 million litres and 168.42 million litres in 2015. As of 2017, total production was pegged at 234.65 million litres and total sales at 234.90 million litres (Table 2.1.3-4).

Table 2.1.3-4 Biodiesel and Bioethanol Production and Sales in the Philippines, 2016-2017

	Accredited		2016 (million litres)		2017 (million litres)	
	# of projects	Annual capacity	Production	Sales	Production	Sales
Biodiesel	11	574.9	225.87	217.70	222.13	203.48
Bioethanol	10	282.12	230.18	226.88	234.65	234.90

Source: Renewable Energy Management Bureau, Department of Energy, Philippines.

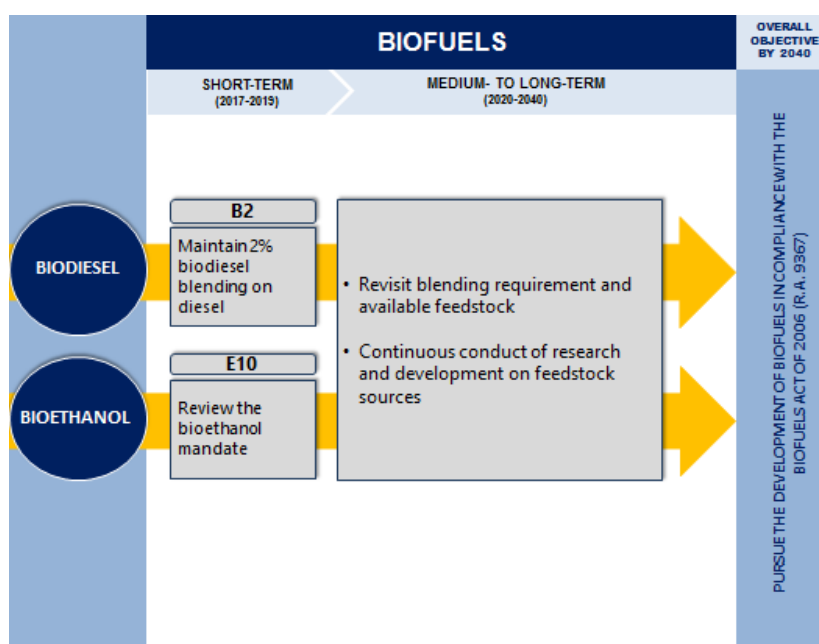
1.3.4. Research and Development Support

In terms of research and development (R&D), the DOE initiated a partnership with the academe to implement biofuel projects using alternative feedstocks such as sweet sorghum, cassava, macro-algae, and nipa sap. As such, from 2012 to 2015, four projects were implemented to introduce and develop alternative feedstocks of biofuels in the country: (1) Village Scale Production of Hydrous Ethanol as Feedstock for R&D in Biofuel Trials and Anhydrous Ethanol Production, implemented by Mariano Marcos State University; (2) Bioethanol Production from Macro-algae and Socio-ecological Implications, implemented by the University of the Philippines-Visayas Foundation Inc. (UP-VFI); and (3) Bioethanol Production Potential of Different Cassava Varieties under Northern Mindanao Condition and Development of a Pilot-Scale Cassava Bioethanol Plant, implemented by Xavier University, which are already completed; and (4) Establishment of a Community-Based Bioethanol Industry and Continued Research and Development on the Feasibility of Hydrous Bioethanol as Biofuel Blend Using Nipa Sap, which started implementation in 2016 and also is being undertaken by Mariano Marcos State University.

1.3.5. Road Map

The DOE has come up with a road map that will facilitate the implementation of the scheduled blending of biofuels from 2017 to 2040 in compliance with the Biofuels Act of 2006 (Figure 2.1.3-3).

Figure 2.1.3-3 2017–2040 Road Map of Biofuels in the Philippines



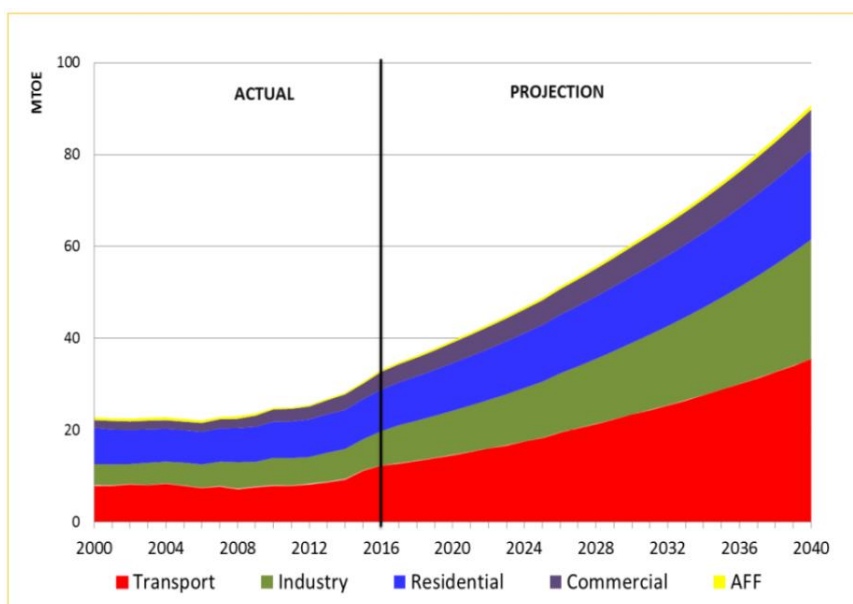
Source: Philippine Energy Plan 2017–2040.

Accordingly, under the road map, for the short term (2017–2019), biodiesel will maintain the current 2% blending level, while that of bioethanol will be at 10%. For the medium- to long-term planning period, the DOE together with the National Biofuels Board will embark on revisiting or re-evaluating the blending requirement with due consideration of the availability of feedstock. Furthermore, continuous R&D of biofuel feedstock sources will be implemented.

Fuel Demand and Biofuel Supply Outlook Based on the Philippine Energy Plan 2017–2040

The country’s total final energy consumption (TFEC) is expected to increase at an average rate of 4.3% annually, from 33.1 Mtoe in 2016 to 91.0 Mtoe in 2040 (Figure 2.1.3-4).

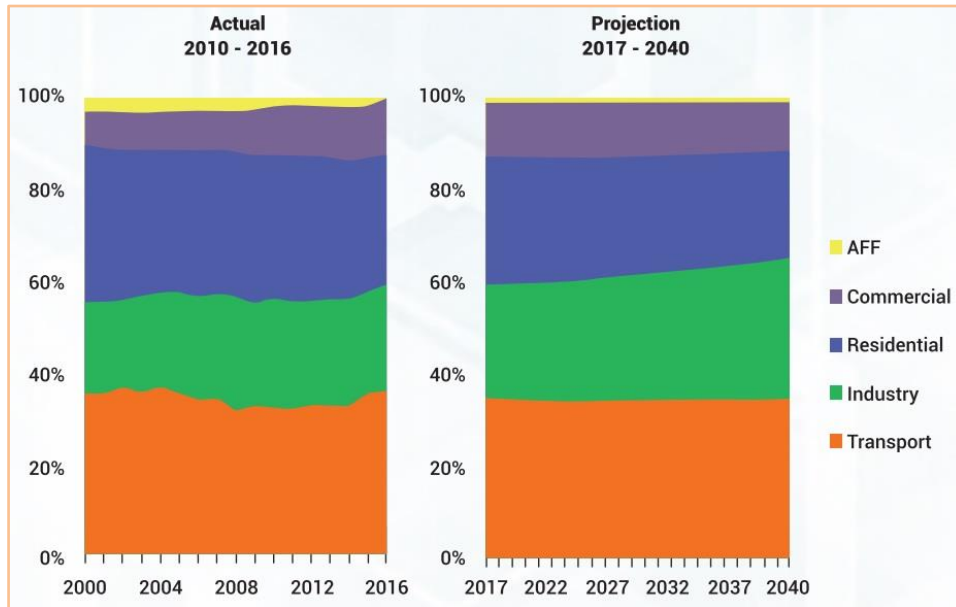
Figure 2.1.3-4 Total Final Energy Consumption in the Philippines by Sector, 2000–2040



Source: Philippine Energy Plan 2017–2040.

The transportation sector will continue as the biggest energy-consuming sector with a 38.2% average share across the entire planning horizon. Both the transportation and industry sectors account for the bulk in terms of contribution to the increase in TFEC levels between 2016 and 2040 (Figure 2.1.3-5).

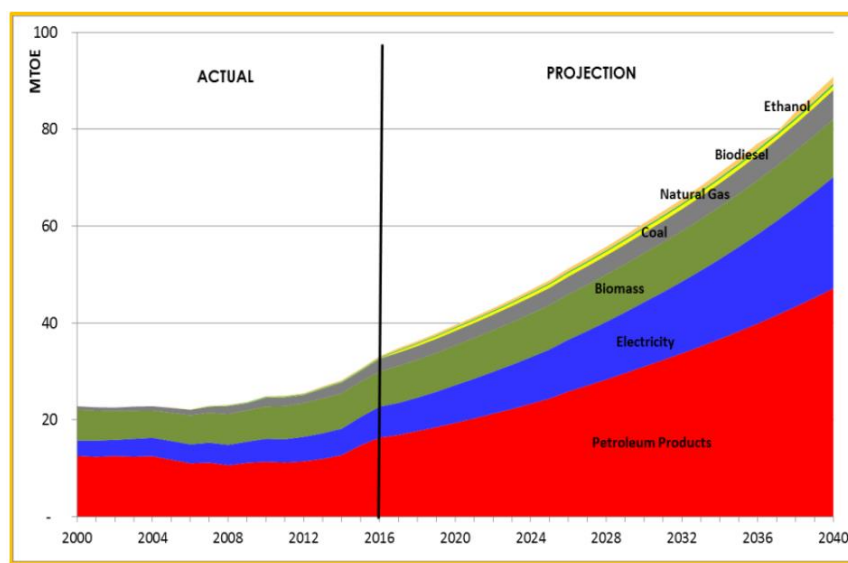
**Figure 2.1.3-5 Total Final Energy Consumption in the Philippines by Sectoral Share
(Actual 2000–2016, Clean Energy Scenario 2017–2040)**



Source: Philippine Energy Plan 2017–2040.

Petroleum products will continue to account for the bulk of TFEC, with an average share of 50.5% in the demand mix (Figure 2.1.3-6). Despite the volatility of oil prices in the international market, demand for petroleum products will increase by an average of 4.5% 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% and 34.8% in the total oil demand, respectively. Transportation will remain the major petroleum-consuming sector with an average share of 71.9% in the total oil demand for the entire planning period.

Figure 2.1.3-6 Final Energy Consumption in the Philippines by Fuel, 2000–2040



Mtoe = million tonnes of oil equivalent.
Source: Philippine Energy Plan 2017–2040.

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% and 6.7% increase in the demand for biodiesel and bioethanol, respectively.

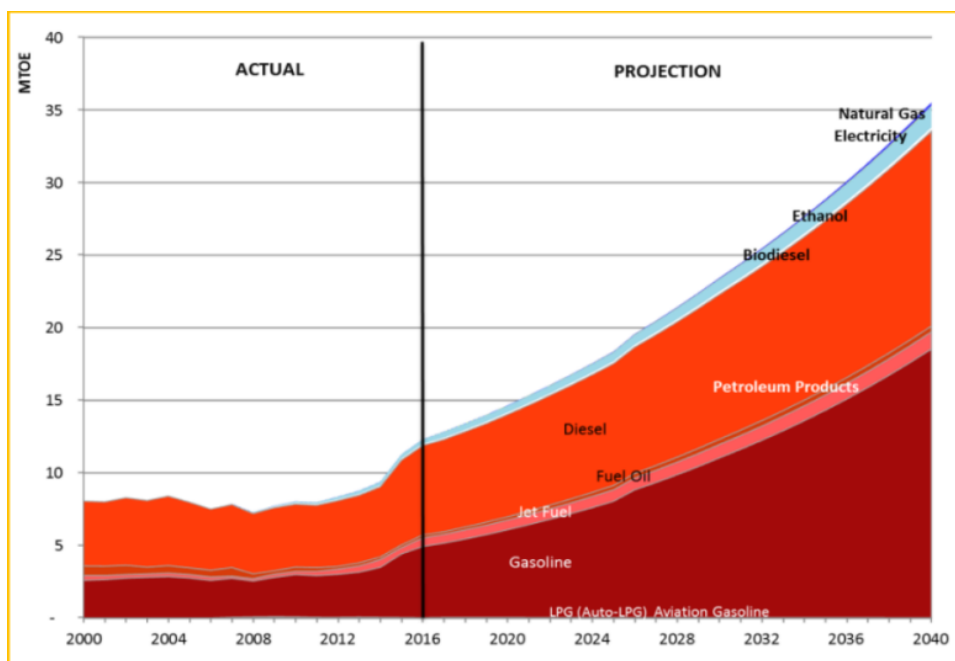
In line with the government’s ‘Build, Build, Build’ initiative, we expect an aggressive transportation infrastructure climate with the construction of more railways, urban mass transport, airports, seaports, bridges, and roads. As such, the transportation sector will continue to dominate the country’s total energy demand, with an annual average share of 38.2% in TFEC. The sector’s energy requirement is projected to grow at a yearly rate of 4.5%, from its demand level of 12.3 Mtoe in 2016 to 35.5 Mtoe in 2040. The bulk of this energy demand will be used for land transport, which covers about 80.0% of domestic traffic and 60.0% of freight traffic.

With the implementation of Executive Order 82, or the Comprehensive Automotive Resurgence Program, aimed at improving the automotive industry to sustain the robust growth in domestic automotive sales and strengthen local production, it is anticipated that the Philippines will become a regional automotive manufacturing hub in Southeast Asia by 2020. With these developments, the transportation sector will continue to rely on oil as its major fuel, constituting the bulk (95.2%) 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% of the sector’s total oil demand, posting average yearly increments of 5.7% to reach 18.5 Mtoe in 2040. However, the entry of electric vehicles (including e-trikes and hybrid vehicles) and use of a consistent bioethanol blend are expected to limit the rise in gasoline consumption. On the other hand, as a significant portion of diesel consumption will be displaced by the projected penetration of additional CNG-fuelled buses and higher biodiesel target blend, its demand level will still

increase by a modest 3.3% to reach 13.4 Mtoe by 2040 with an average share of 45.8% of the total (Figure 2.1.3-7).

The biodiesel supply for the entire planning period will contribute 0.3% to TPES, as levels rise by 3.4% per year to reach 0.4 Mtoe in 2040. On the other hand, bioethanol production will increase by 6.7% per year – from 0.3 Mtoe in 2016 to 1.5 Mtoe in 2040. It is expected to contribute an average 0.8% share in TPES.

Figure 2.1.3-7. Transport Energy Demand in the Philippines by Fuel, 2000–2040



Mtoe = million tonnes of oil equivalent.
Source: Philippine Energy Plan 2017–2040.

Table 2.1.3-5 Biodiesel Demand Outlook of the Philippines, 2018–2040

Year	Diesel demand (million litres)	% blend target	Supply requirement (million litres)
2018	10,365.72	2	207.31
2019	10,730.13	2	214.60
2020	11,149.34	5	557.47
2025	13,812.06	5	690.60
2030	16,575.44	5	828.77
2035	19,502.28	5	975.11
2040	22,804.11	5	1,140.21

Source: Renewable Energy Management Bureau, Department of Energy, Philippines.

Table 2.1.3-6 Bioethanol Demand Outlook of the Philippines, 2018–2040

Year	Gasoline demand, (million litres)	% blend target	Supply requirement, (million litres)
2018	7,573.11	10	757.31
2019	7,999.54	10	799.95
2020	8,476.11	10	847.61
2025	11,266.27	10	1,126.63
2030	15,518.58	10	1,551.86
2035	20,185.21	10	2,018.52
2040	26,163.83	10	2,616.38

Source: Renewable Energy Management Bureau, Department of Energy, Philippines.

Tables 2.1.3-5 and 2.1.3-6 show the biodiesel and bioethanol supply requirement, respectively, which would reach 1,140 million litres and 2,616 million litres by 2040.

1.3.6. Current National Plans for Reduction of Energy Consumption

The government has continuously implemented the National Energy Efficiency and Conservation Program (NEECP), launched in 2004, as the banner programme for on the various initiatives on energy efficiency and conservation initiatives. This programme includes the following:

- Energy Efficiency Standards and Labelling Program
- Government Energy Management Program
- Energy Management Services/Energy Audits
- Fuel Conservation and Efficiency in Road Transport
- Power Conservation and Demand Management (Power Patrol).

The DOE approved the implementation of the Energy Efficiency and Conservation Roadmap in July 2014, which specifies a direction towards an energy-efficient economy by 2040. The road map identifies short-, medium-, and long-term action plans across key energy-consuming sectors. The road map will provide more sustainable and long-term policy directions on energy efficiency and conservation.

The DOE has pursued the accreditation of energy service companies to promote emerging business industries in the economy. As of 2015, there were 15 accredited energy service companies to help accelerate the implementation of energy efficiency and conservation measures in the private sector. The DOE also offers audit services to manufacturing plants, commercial buildings, and other energy-intensive companies to evaluate the energy utilisation efficiencies of equipment, processes, and operations and to recommend energy conservation measures for adoption by these companies.

The DOE has also implemented the Philippine Industrial Energy Efficiency Project in partnership with the United Nations Industrial Development Organization and the Department of Trade and Industry with the Global Environmental Fund providing the project funding. The project will introduce the application of ISO 50001 to select industry sectors, such as chemicals, food and beverage, iron and steel, and pulp and paper. The project could generate about 2 million megawatt-hours (MWh) of energy savings.

1.3.7. Current National Plans for Alternative Fuel Introduction

To pursue diversified low-cost transport fuel in the country and to contribute to mitigating the adverse effects of climate change, the government is implementing programmes such as the NGVPPT, Auto-LPG, and the Market Transformation through the Introduction of Energy Efficient Electric Vehicles Project. These projects intend to reduce the country's dependence on imported oil as well as provide people a cheaper and more environment-friendly fuel that will serve as an alternative to fossil fuels.

a. Natural Gas Vehicle Program for Public Transport – Compressed Natural Gas (Buses)

The government is extending the NGVPPT's pilot phase implementation of 200 CNG buses until 2018. Moreover, the successful introduction of CNG utilisation for transport is dependent on the competitive pricing of CNG against the diesel price. With the current pump price of diesel hovering around ₱21.00–₱25.00, the NGVPPT will require a form of government incentive until the programme moves to the commercial phase, where the number of CNG buses will be sufficient to make CNG more competitive with diesel.

Moreover, the DOE will continuously coordinate with the legislative body, academe, and concerned national government agencies for the provision of incentives, capacity-building activities, policies and guidelines, establishment of a CNG tank requalification facility, and development of emergency response protocols for CNG vehicles to support the deployment of CNG buses under the programme. In addition, a continuous information, education, and communication campaign and other promotional activities will be regularly conducted throughout the planning horizon to sustain awareness about the programme.

b. Auto-Liquefied Petroleum Gas Programme

The DOE in its effort to pursue the auto-LPG programme has come up with an action plan that will facilitate the formulation and establishment of necessary support to mainstream the use of auto-LPG in the transportation sector:

- R&D on the expanded applications of LPG in other sectors, including agriculture (farming and fishing subsectors)
- Lobby for the legislation providing incentives for the importation and/or manufacturing of original manufactured LPG-fuelled vehicles

- Development of rules and guidelines to encourage the establishment of support infrastructure such as auto-LPG refilling stations, after-sales services, and manufacture of parts.

c. Market Transformation through Introduction of Energy Efficient Electric Vehicles Project

In partnership with the Asian Development Bank and the Clean Technology Fund, the DOE has implemented the Market Transformation through Introduction of Efficient Electric Vehicles Project, or E-Trike Project, to promote energy efficiency and clean technologies in the transportation sector. It aims to reduce the sector's annual petroleum consumption by 2.8% (based on 20 MMB annual consumption in 2010) and to avoid CO₂ emissions of estimated 259,008 tonnes annually by shifting to 100,000 electric tricycles (e-trikes).

The project has procured 3,000 e-trikes, but difficulty in securing commitments from the local government units decelerated the programme. The DOE has come up with a medium-term action plan that will assist the electric vehicles (EV) industry to take off, which includes (1) a campaign for the passage of bills that will bring down the cost of EV acquisition, either through importation for the initial market penetration or sourcing out locally in the medium term; and (2) continuation of EV promotional activities.

1.3.8. Electric and Hybrid Vehicles – Non-Project Grant Aid for the Introduction of Japanese Advanced Products and Its System (Next-Generation Vehicle Package)

In 2013, the Government of Japan coordinated with the Department of Foreign Affairs and DOE for the Japan Non-Project Grant Aid for the Introduction of Japanese Advanced Products and Its System (Next-Generation Vehicle Package) for the Philippines.

Under the terms of the grant aid, next-generation vehicles such as hybrid vehicles, plug-in hybrid EVs, and EVs, including charging stations, will be procured in Japan through the Japan International Cooperation System. The grant covers the procurement and delivery of vehicles to agreed destinations. However, all taxes shall be shouldered by the government as its counterpart as well as the corresponding maintenance and other operating expenses for the distribution and deployment of the vehicles.

Target beneficiaries of said grant aid include Philippine National Police stations in the provinces of Leyte and Samar, which were devastated by typhoon Haiyan (known locally as Yolanda); national government agency regional offices in Region 8 that are instrumental to emergency response operations and rehabilitation; and national government agencies that could assist in the conduct of research, performance testing, and promotion of alternative fuel vehicles were also allotted with vehicles for promotional purposes. The distribution of hybrid vehicles was already completed in 2017. Meanwhile, eight units of plug-in hybrid EVs had already been delivered, while the charging station was inaugurated in December 2017.

1.3.9. Other Energy Technologies

The DOE shall continuously monitor emerging and mature energy technologies in other countries that can be adopted for domestic application. As such, thorough evaluation, testing, and validation will be done for domestic applications, specifically in the transportation sector. In the medium term, the DOE will embark on the following identified energy technologies for evaluation and validation:

- cellulosic biomass feedstock for bioethanol production and woodchips production of efficient domestic cook stove using wood chips;
- fuel derived from petroleum-based waste materials such as plastics and rubbers;
- efficient biomass-based stoves for domestic cooking; and
- micro-energy harvesting technologies.

Once the technologies are assessed and approved to be locally applicable, the programme for performance testing and demonstration for said technologies will be developed for possible commercialisation.

The long-term goal of the government is to deploy efficient and applicable alternative fuel energy technologies for transport and non-transport purposes. It envisions that by 2040, alternative fuel vehicles will be mainstreamed in the country's transportation sector.

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