

# Belize - Annual Energy Report



## 2016

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## Overview

Notably, all modern economies are energy dependent. The issue of energy transition is becoming ever more central to both national and global agendas. Belize's National Energy Policy (NEP, 2012) sets out the basic principles and strategies for integrating energy more deeply into Belize's development. An integral component of Belize's national development agenda is to develop strong sustainable energy policies and programmes that underpin the national economy.

Currently, Belize's power supply comes from hydropower, biomass, solar, fossil fuels (Diesel, Crude oil, Heavy and Light Fuel) and electricity imported from Mexico. Given Belize's efforts on greening its economy, renewable energy (RE) has become a focal area within its national energy landscape. Table 1 below presents General Information on Belize and Table 2 represents a summary of Belize's Energy Sector in 2016.

**Table 1.** General Information 2016.

| Indicator                     | Unit                   | Total     |
|-------------------------------|------------------------|-----------|
| Population                    | thousand inhab.        | 377,968   |
| Area                          | km <sup>2</sup>        | 22,970    |
| Population Density            | inhab./km <sup>2</sup> | 16        |
| Urban Population              | %                      | 44.71     |
| GDP USD (at Market Prices)    | MUSD                   | 1,384,822 |
| GDP per capita                | MUSD 2016/inhab.       | 7,327.72  |
| GDP Growth Rate               | %                      | -0.6      |
| Human Development Index (HDI) | HDI Value (UNDP)       | 0.709     |

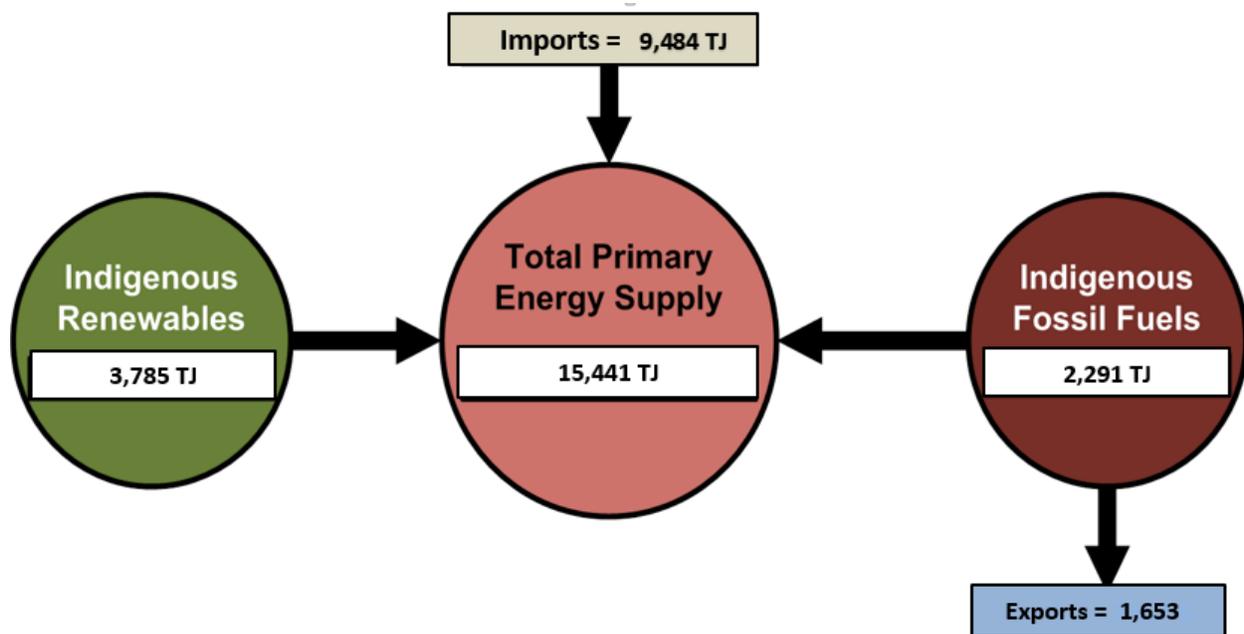
**Table 2.** Summary of Belize's Energy Sector in 2016.

| Parameters                                  | Volume for 2016           |
|---|---------------------------|
| Electricity - Production                    | 635,950.50 (MWh)          |
| Electricity - Consumption                   | 556,248.60 (MWh)          |
| Electricity - Importation (%)               | 230,138.20 (MWh) (36.19%) |
| Electricity - from fossil fuel (%)          | 58,851.43 (MWh) (8.31%)   |
| Electricity - from hydroelectric plants (%) | 270,580.68 (MWh) (42.55%) |
| Electricity - from renewables (%)           | 352,960.87 (MWh) (52.85%) |
| Crude Oil - Production (barrels/day)        | 986.92 barrels            |
| Refined Petroleum Products - Importation    | 53,272,662 US gallons     |

# Energy Supply

## Total Primary Energy Supply (TPES)

Figure 1 captures Belize's energy content of its Total Primary Energy Supply (TPES), including production and trade in energy. Total primary energy supplied in Belize for 2016 amounted to **15,441 Tera joules (TJ)**. Within Belize's TPES, Indigenous Fossil Fuels (Crude oil and Petroleum Gas) accounted for 2,291 TJ of which 1,653 TJ was exported as International Crude Oil sale. Indigenous Renewables accounted for 3,785 TJ of Belize's Total Primary Energy Supply. Domestic energy production accounted for 6,076 TJ of the TPES. On the other side of the trade account, 9,484 TJ of energy was imported in the form of refined petroleum products and electricity from Mexico's Comisión Federal de Electricidad (state-owned electric utility of Mexico, widely known as CFE).



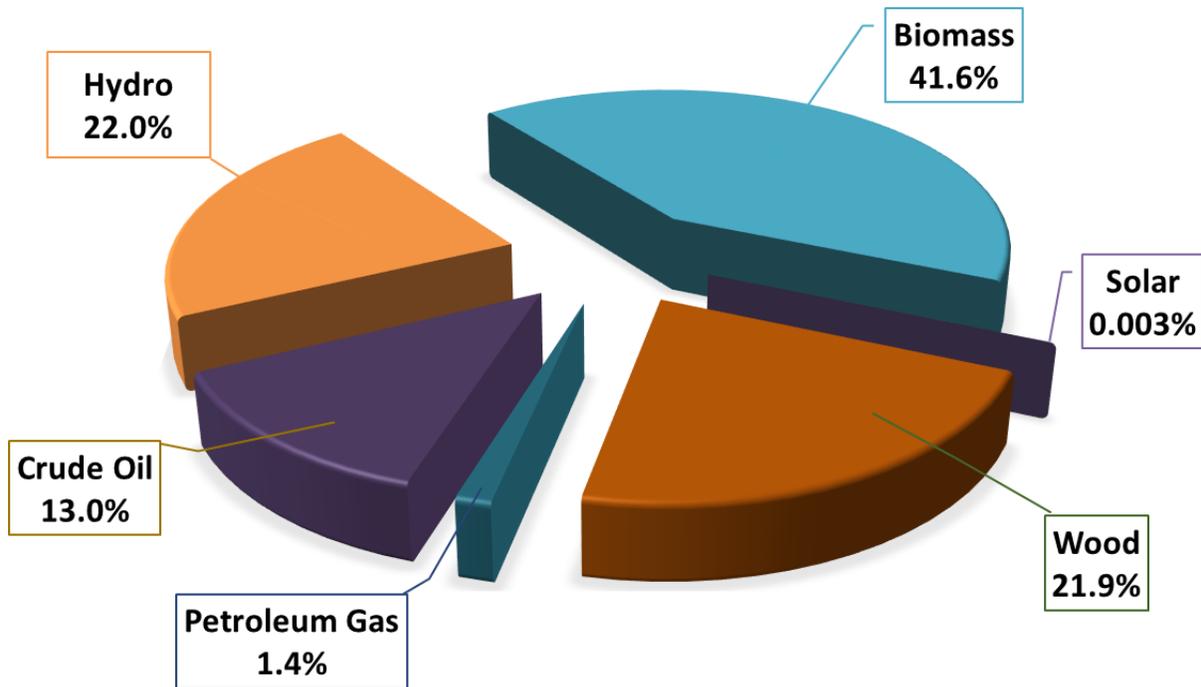
**Figure 1.** Total Primary Energy Supply for Belize 2016.

## Primary Energy Supply<sup>1</sup>

Figure 2 depicts the indigenous energy supply in Belize by primary energy content. In 2016, Crude Oil accounted for 13% (574.91 TJ) of indigenous energy production and Petroleum Gas accounted for 1.4% (62.93 TJ). Renewables made up the remaining 85.60% of primary energy supply,

<sup>1</sup> Primary energy refers to energy sources as found in their natural state.

consisting of Biomass at 41.6% (1,841.28 TJ), Solid Biofuel (firewood) at 21.9% (969.458 TJ), Hydro at 22% (974.09 TJ) and Solar<sup>2</sup> at 0.003% (0.15 TJ).



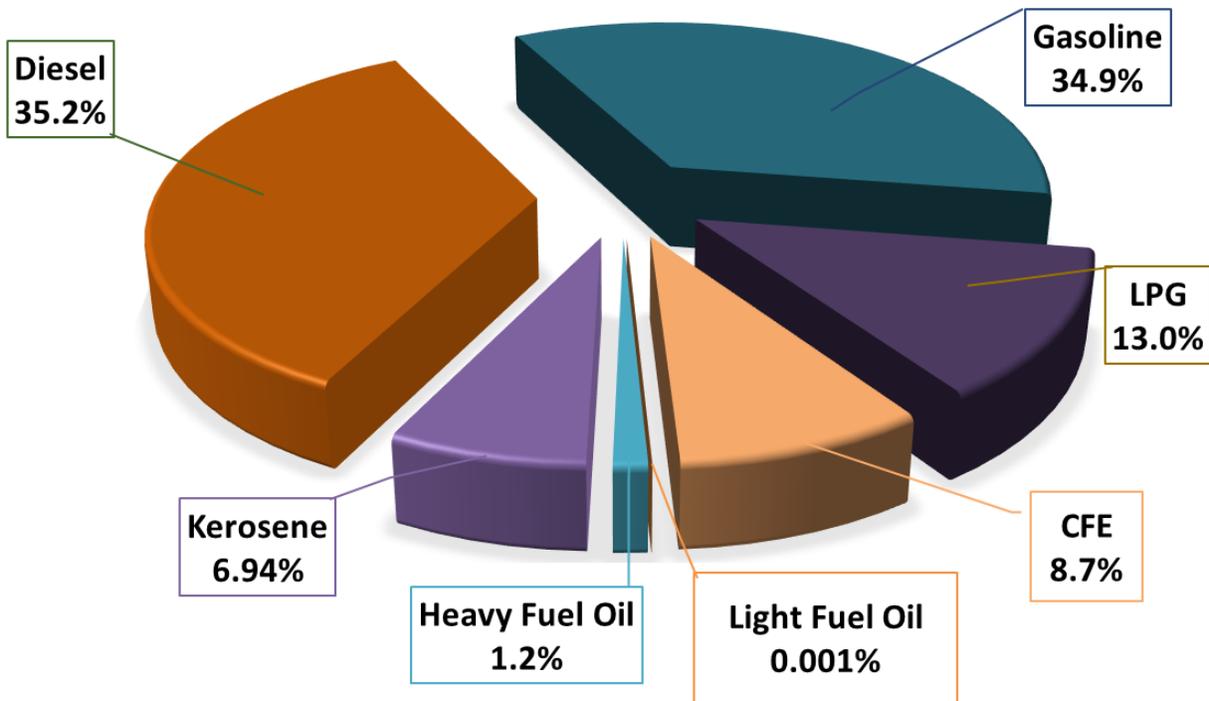
**Figure 2.** Belize's Indigenous Energy Production by Primary Energy Content in 2016.

### Secondary Energy Supply

Belize imports majority of the secondary energy that it consumes, including electricity from the interconnection with Mexico's CFE. Belize's secondary energy supply was evidently dominated by imported oil products (Figure 3). Diesel accounted for 35.2%, Gasoline (Premium and Regular) accounted for 34.9%, LPG accounted for 13%<sup>3</sup> and imported electricity accounted for 8.7% of the secondary energy supply. Other secondary energy supply sources imported included: Kerosene, Light Fuel Oil and Heavy Fuel Oil.

<sup>2</sup> There are a few small scale solar and wind energy installations across the country by private generators; however, the primary energy supplied is very negligible.

<sup>3</sup> It is also produced locally by Belize Natural Energy (BNE) from a mixture of butane and methane that is associated with the production of crude oil.



**Figure 3.** Belize’s Secondary Energy Supply in 2016.

## Electricity Sub-Sector

Under its license granted by the Public Utilities Commission (PUC), Belize Electricity Limited (BEL) is the sole entity responsible for generating, purchasing, transmitting and supplying electricity throughout the country of Belize. In 2016, *energy sales grew by 1.4%* to a total of *540.9 gigawatt hours (GWh)* in comparison to the previous year (2015). BEL served a growing customer base of approximately 96,635 accounts with a peak power demand of 96 megawatts (MW)<sup>4</sup> in 2016.

### Transmission and Distribution

All major load centers across Belize are connected to BEL’s national grid system. BEL operates a transmission line backbone running generally from the north to the south of Belize, being interconnected with the Mexican national electricity grid in the north as shown in Figure 4. Particularly, the 115 kV transmission line covers the entire northern and western zone of Belize with the southern half of Belize fed via a 69 kV transmission line. There are 34.5 kV circuits feeding-off the 115 kV backbone to Corozal, Orange walk and San Pedro.

<sup>4</sup> Belize Electricity Limited – Annual Report 2016:

[http://www.bel.com.bz/annual\\_reports/Annual%20Report%202016.pdf](http://www.bel.com.bz/annual_reports/Annual%20Report%202016.pdf)

Currently, Caye Caulker remains the lone isolated load center and its electricity generation needs are met from a diesel power plant. According to Belize Electricity Limited's 2016 Annual Report, 92% of the total households in the country are connected to an electricity supply. In other remote rural areas and cayes where there are no connections to the national grid, households, communities and other entities use a mix of diesel gensets, small scale photovoltaic systems or small scale wind turbines to supply electricity for their own needs.

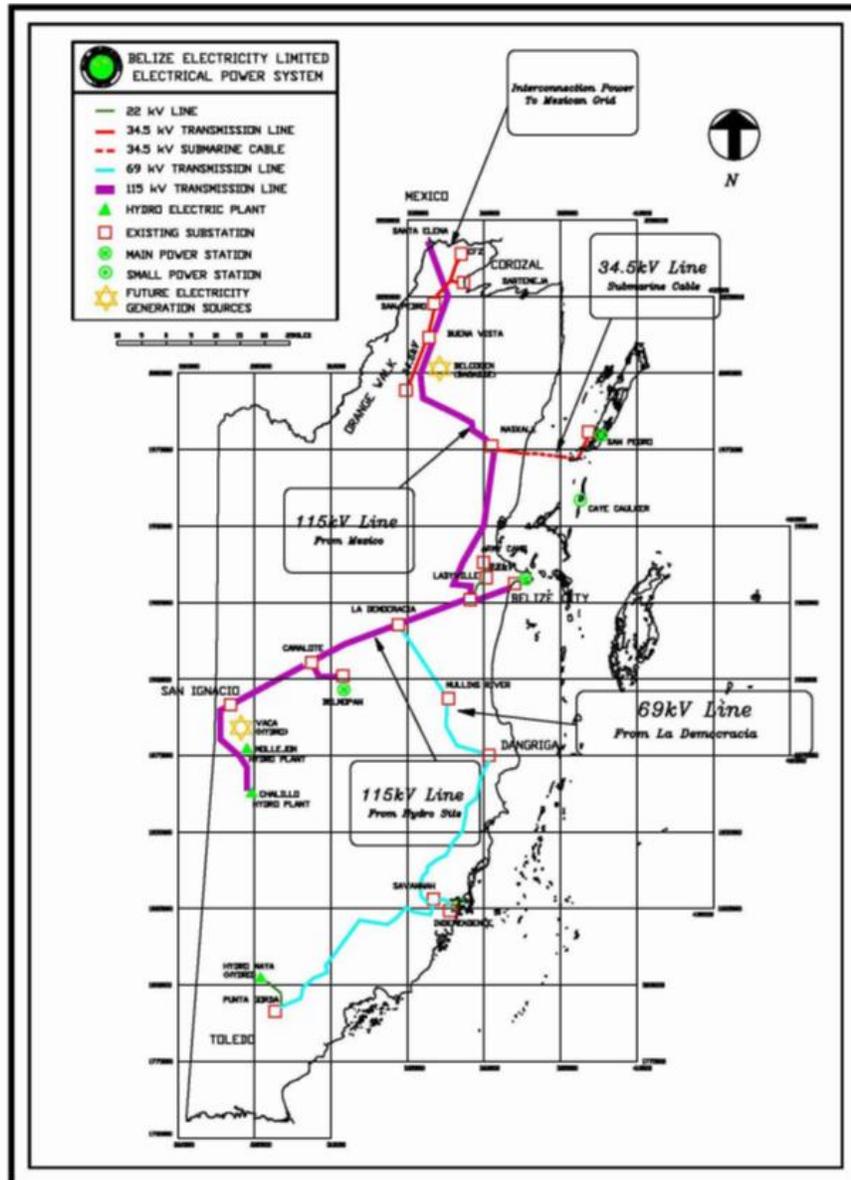


Figure 4. Belize Electricity Limited Transmission Network.

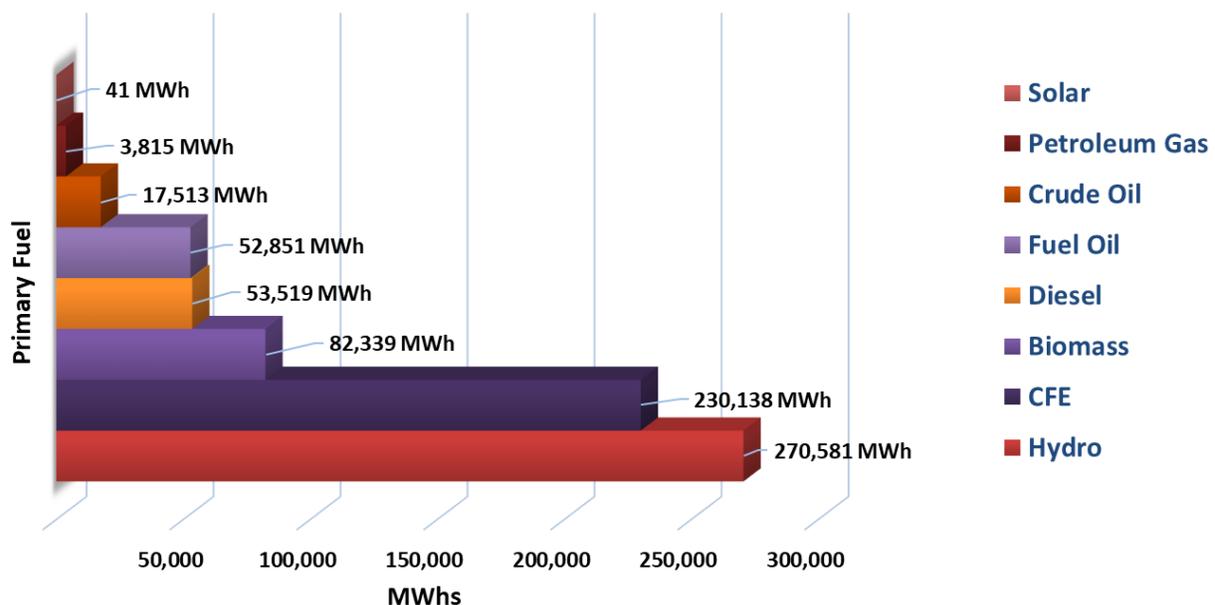
## Installed Capacity

In 2016, 25.1% (3,874.52 TJ) of Total Primary Energy Supply was converted into 614,669 MWh of electricity. The total installed capacity of licensed power producers was 111.98 MW in 2016, consisting of:

- Mollejon Hydroelectric Plant, equipped with 3 x 8.4 MW Francis turbines, located on the Macal River, having a typical output of 8 MW during dry season and 21 MW during wet season (**21MW**)
- Chalillo Hydroelectric Dam and Plant, with an installed capacity of 2 x 3.65 MW (**7.3 MW**);
- Vaca Hydroelectric Plant outfitted with 2 x 9.0 MW and 1 x 1.0 MW turbines (**20 MW**);
- Hydro Maya Limited (HML) has units of 1 x 2.4 MW and 1 x 0.6 MW housed in its run-of-the-river hydroelectric facility (**3 MW**);
- BEL owns a diesel-fired gas turbine rated at 22.5 MW, but its actual output is typically 20.0 MW. In addition the utility deploys 6 x 1.1 MW mobile high-speed diesel units at different nodes in their network (overall installed capacity of **24MW**);
- Belize Co-Generation Energy Limited (BELCOGEN) generates electricity burning bagasse and heavy fuel oil using two-(2) 90 ton/hr boilers (high-pressure steam @64bar/480°C) expanding into 1 x 12.5 MW (back-pressure) and 15 MW (condensing/extraction) turbines nominally exporting (**13.5 MW**) into the national grid;
- Belize Aquaculture Limited (BAL) owns a power plant that operates 3 x 7.5 MW Wartsila medium-speed diesel units. The facility was initially a self-generator for its aquaculture operations; but it's currently an IPP having contracted (**15MW**) on a standby arrangement to BEL;
- Farmer's Light Plant Corporation operates five (5) diesel generators with rated capacities of 2 x 2.2 MW and 3 x 1.1 MW that run on crude oil (**7.7 MW**);
- University of Belize Solar Farm- There is a solar installation at the University of Belize that has a rated capacity of (**.48 MW**). This system is connected to the National Grid.
- Belize Water Services has a 70 KW Solar Plant installed on their Caye Caulker, Reverse Osmosis Plant to reduce the amount of electricity they draw from the island grid.

## Electricity Generation

In 2016, a total of **635,950.50 MWh** of electricity was produced with a total of **556,248.60 MWh<sup>5</sup>** of electricity being consumed. Figure 5 illustrates the breakdown of gross electricity generation in Belize by fuel source in 2018. It can be seen that Hydro accounts for the majority of electricity generated in 2016 with 270,581 MWh of electricity produced. Hydro was closely followed by imported electricity from Mexico's CFE who was responsible for 230,138 MWh of electricity produced. Other fuel sources which contributed to electricity generation in Belize for 2016 included: Biomass (82,339 MWh), Diesel (53,519 MWh), Fuel Oil (52,851 MWh), Crude Oil (17,513 MWh), Petroleum Gas (3,815 MWh) and Solar PV (41 MWh). Overall, it is crucial to note the integral role that BECOL and CFE plays when it comes to sustainability and Belize's energy security within the electricity subsector.



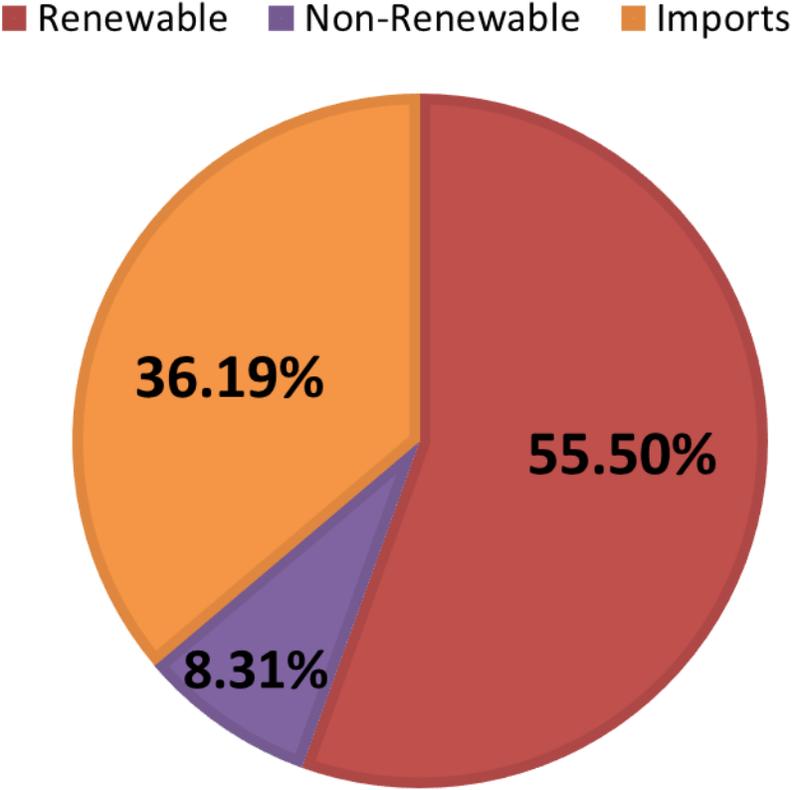
**Figure 5.** Belize's Gross Electricity Generation by Fuel Source in 2016.

## Electricity Generation by Energy Type

Within Belize's generation mix in 2016, RE was the dominant fuel source type, accounting for **55.50%** of electricity generation (Figure 6). RE fuel sources in Belize included: Hydro, Biomass, and Solar PV. Imported electricity accounted for **36.19%** while Non-renewable fuel sources such as Crude Oil and Diesel accounted for only **8.31%** of electricity generation. Belize's commitment to decreasing greenhouse gas emissions and combatting climate change has seen a steady

<sup>5</sup> This figure includes both electricity consumed on BEL's national grid and off-grid electricity generation (Farmers Light Plant Corporation (Spanish Lookout) and Caye Caulker Diesel Generators).

increase in employed RE technology over recent years. Importantly, not counting the imported electricity from Mexico’s CFE illustrates that Belize reached an **87.84% RE penetration** within its indigenous electricity production. As a result, Belize is leading the way among CARICOM member states in the transformational shift towards the use of clean energy solutions (RE) for electricity generation.



**Figure 6.** Electricity generation by Energy Type in 2016.

### Electricity Consumption by Sectors

Figure 7 highlights Belize’s electricity consumption across varying sectors in 2016. Electricity consumption was compared among 4 sectors, which comprised: Commercial, Industrial, Residential and Street Lighting Sector. The commercial and residential sector were responsible for majority of the electricity consumption in Belize by a significant margin compared to the other two sectors. The commercial sector equated to 281,892 MWh of electricity consumption whereas the residential sector was second with 199,843 MWh of electricity consumption. In stark contrast, the industrial sector only consumed 32,567 MWh of electricity while street lighting was only responsible for 26,619 MWh of electricity consumption. Street lighting is likely to decrease over the next few years due to BEL’s LED Street Light programme where by old inefficient street

lights are being replaced by new and efficient LED street lights. This will decrease the electricity consumption of street lights in Belize overtime.

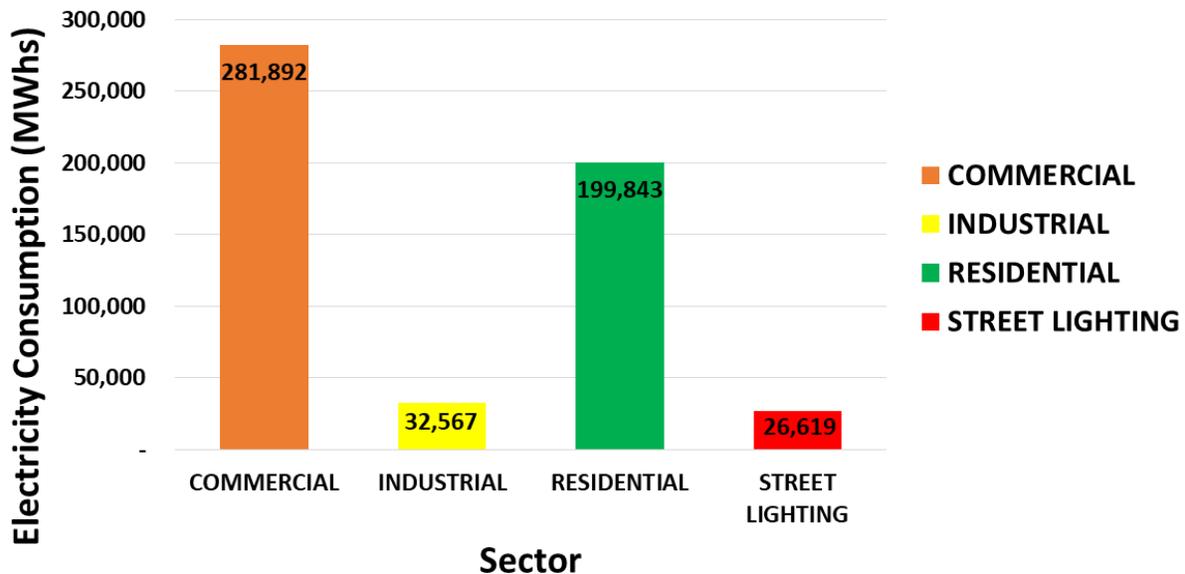


Figure 7. Sectoral Electricity Consumption in 2016.

## Hydrocarbon Sector

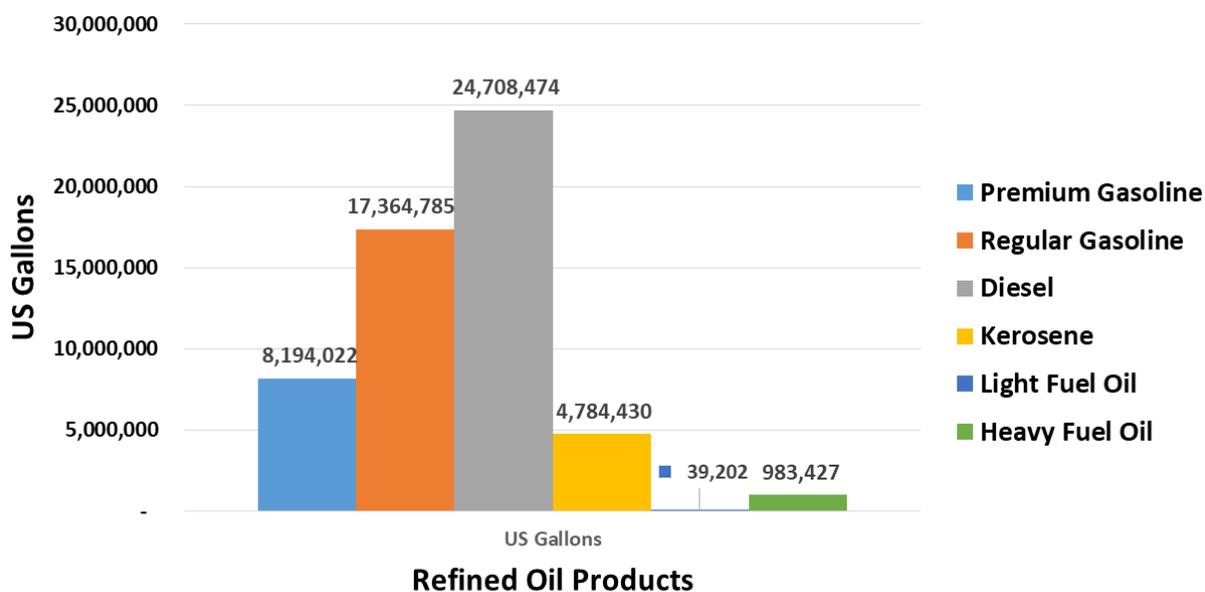
### Crude Oil and Gas Extraction

In Belize, Belize Natural energy (BNE) remains the sole oil producer in the country. BNE was extracting roughly 4,130 barrels of crude oil per day from its Spanish Lookout field in 2010; this has fallen to approximately **986.92** barrels per day in 2016. As far as can be determined, no local refining of crude oil is taking place.

The gas associated with crude oil extraction at the Spanish Lookout site is processed by BNE into three output streams: (i) a natural gas mixture of methane and ethane, (ii) LPG (propane and butane), and (iii) heavier hydro-carbons. Firstly, the natural gas mixture is used to fuel a 1 MW gas turbine that generates about 75% of BNE's electricity needs. Secondly, the LPG is stored and sold in the local market as cooking fuel. In 2016, a total of 2,087,316.45 **lbs** of LPG was sold on the local market in Belize. This only equates to a mere **3.72%** of current LPG consumption in Belize. Thirdly, the heavier hydrocarbons (occurring mainly as pentane, hexane, heptane and octane) are re-injected back into the crude oil production train.

## Refined Oil Products

Given the fact that there are no local refineries in Belize, all refined oil products are imported into the country via a sole importer, PUMA Energy Limited. Imported refined products include: Gasoline (Premium and Regular), Diesel, Kerosene, and Fuel Oil (Light and Heavy Fuel Oil). As shown in Figure 8, Gasoline (Premium and Regular) holds the largest share of imported oil product at 25,558,807 US gallons in 2016. Diesel also constitutes a large share of the imported oil products at 24,708,474 US gallons in 2016. Due to the volume of refined oil products entering the country, the transportation sector is responsible for a large share of Belize's energy use and greenhouse gas emissions.



**Figure 8.** Refined Fuel Products imported into Belize in 2016.

## Energy Balance 2016

The definition of the main activities and energy sources of Belize are presented in Belize's Energy Balance<sup>6</sup> (Table 3). In general, it is observed that Belize counts with indigenous non-renewable and renewable primary energy sources. In contrast, most of the secondary energy sources are imported, including electricity.

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<sup>6</sup> The energy balance calculated by the Energy Unit under the Ministry of Public Service, Energy and Public Utilities is available in Tera joules (TJ).

**Table 3.** Belize's 2016 Energy Balance.

| <b>SUMMARY ENERGY BALANCE - 2016 (in TJ)</b> |                  |                    |                  |              |             |                 |                    |                |
|--|------------------|--------------------|------------------|--------------|-------------|-----------------|--------------------|----------------|
|  | <b>Petroleum</b> | <b>Petro-fuels</b> | <b>Bio-fuels</b> | <b>Hydro</b> | <b>Wind</b> | <b>Other RE</b> | <b>Electricity</b> | <b>TOTAL</b>   |
| <b>Energy Supply</b>                         | 638              | 8,656              | 2,811            | 974          | 0           | 0               | 828                | <b>13,907</b>  |
| <i>Indigenous Supply</i>                     | 2,291            | 0                  | 2,811            | 974          | 0           | 0               | 0                  | <b>6,076</b>   |
| <i>Import</i>                                | 0                | 8,656              | 0                | 0            | 0           | 0               | 828                | <b>9,484</b>   |
| <i>Export</i>                                | -1,653           | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>-1,653</b>  |
| <i>Production Loss</i>                       | 0                | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>0</b>       |
| <b>Transformation Sector</b>                 | -145             | -60                | -1,841           | -974         | 0           | 0               | 828                | <b>-2,192</b>  |
| <b>Electricity Sector</b>                    | -114             | -60                | -1,841           | -974         | 0           | 0               | 828                | <b>-2,161</b>  |
| <i>Utilities</i>                             | 0                | -60                | 0                | 0            | 0           | 0               | 0                  | <b>-60</b>     |
| <i>IPPs</i>                                  | 0                | 0                  | -1,841           | -974         | 0           | 0               | 828                | <b>-1,987</b>  |
| <i>Self-Generators</i>                       | -114             | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>-114</b>    |
| <b>Petroleum Sector</b>                      | -31              | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>-31</b>     |
| <i>Oil Refineries</i>                        | 0                | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>0</b>       |
| <i>NGL Producers</i>                         | -31              | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>-31</b>     |
| <b>Distribution Loss</b>                     | 0                | 0                  | 0                | 0            | 0           | 0               | 0                  | <b>0</b>       |
|  |                  |                    |                  |              |             |                 |                    |                |
| <b>Electricity Output (MWh)</b>              | 21,328           | 36,007             | 82,339           | 270,581      | 0           | 41              | 230,138            | <b>640,434</b> |
| <i>Utilities</i>                             | 0                | 15,903             | 0                | 0            | 0           | 0               | 0                  | <b>15,903</b>  |
| <i>IPPs</i>                                  | 0                | 19,436             | 82,339           | 270,581      | 0           | 0               | 0                  | <b>372,356</b> |
| <i>Self-Generators</i>                       | 21,328           | 668                |                  | 0            | 0           | 0               | 0                  | <b>21,996</b>  |