Belize Annual Energy Report

2022 EDITION

MPUELE
MINISTRY OF PUBLIC UTILITIES, ENERGY, LOGISTICS & E-GOVERNANCE
"Building a green future via Service, Innovation & Transformation!"

ENERGY UNIT

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Report Designed by:

Bridget L. Rhys

Foreward

As we reflect on the energy landscape of Belize, it is my privilege to present the 2022 Belize Annual Energy Report, a comprehensive and informative account of our nation's energy sector, challenges, and accomplishments. This document serves as a testament to the collective efforts of our government, industry stakeholders, and the people of Belize in shaping a sustainable and resilient energy future.

In 2022, the globe was subjected to economic uncertainty, energy security concerns, rising energy costs, and the ever-increasing climate change constraints amounting to a complex blend of factors impacting the energy landscape. Even so, the global energy transition, pivotal to climate change mitigation and adaptation efforts, is well underway with calls for acceleration. Against the backdrop of the global energy crisis in 2022, our nation's prosperity and competitiveness are tied to achieving a successful transition to a low carbon future.

The Government of Belize and its energy sector partners are committed to continuing and accelerating the transition to a low-carbon energy system. Belize, a nation endowed with abundant natural resources for dispatchable, non-fossil fuel energy sources, has dedicated efforts to advance renewable energy sources. The 2022 Annual Energy Report showcases a momentous milestone – renewable energy accounting for an impressive 53% of our total gross electricity generation - equivalent to 90% of in-country electricity generation. This underscores Belize's dedication to increasing emission reduction action, diversification of production streams, and fostering sustainable economic development.

This report delves into Belize's energy journey beyond numbers and statistics, spotlighting initiatives that promote distributed energy resources, energy efficiency, and drive technological advancements. Still, we must remain keenly aware of the challenges and persistent obstacles that lie ahead. We must place emphasis on the redesign of the energy market through improved energy infrastructure, increase access to modern energy services for marginalized communities, and mobilize finances to meet the demands of a dynamic energy landscape.

As we unveil the 2022 Belize Annual Energy Report, we extend our gratitude to all stakeholders who continue to propel Belize towards a sustainable energy future and to those who played a key role in the production of this Annual Energy Report.

Let us seize the insights within these pages as an opportunity to review and reaffirm our commitment to climate and energy objectives that can act as levers to accelerate the energy transition.

Hon. Michel Chebat

HON. MICHEL CHEBAT, SC.
MINISTER, MINISTRY OF PUBLIC UTILITIES, ENERGY, LOGISTICS & E-GOVERNANCE

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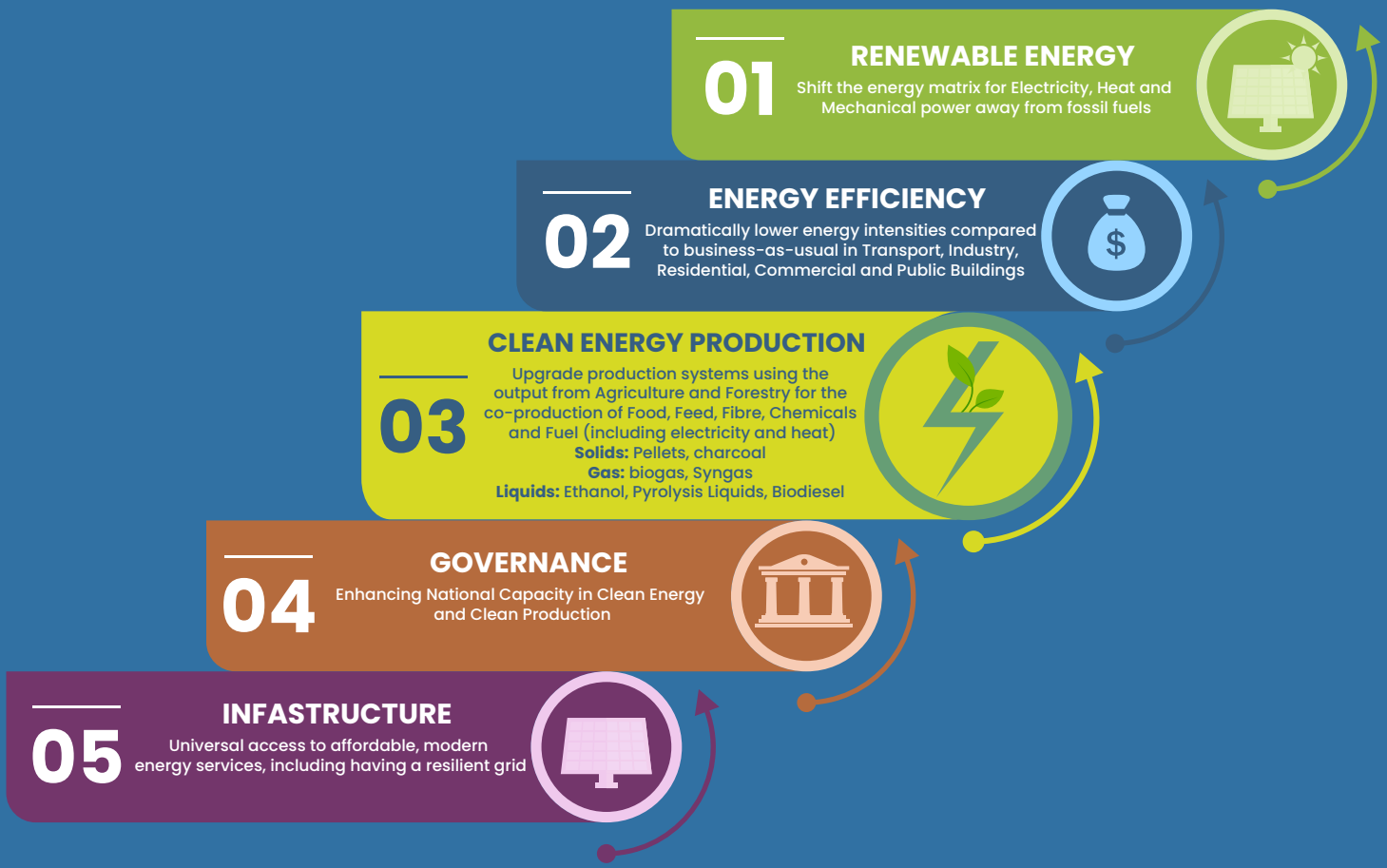
Mission Statement

To plan, promote and effectively manage the production, delivery and use of energy through Energy Efficiency, Renewable Energy, and Cleaner Production interventions for the sustainable development of Belize.

THE FIVE PILLARS

The foundation of the Energy Unit's work to enhance the energy sector and improve access to modern and sustainable energy is based on Five Pillars:



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Abbreviations

CARICOM	Caribbean Community
CCK	Caye Caulker
CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency
CFE	Comisión Federal de Electricidad (state-owned utility of Mexico)
CPP	Consolidated Project Plan
BAPCOL	Blair Athol Power Company Limited
BEL	Belize Electricity Limited
BELCOGEN	Belize Co-Generation Energy Limited
BNE	Belize Natural Energy Limited
FLPC	Farmer's Light Plant Corporation
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HDI	Human Development Index
IRES	International Recommendations for Energy Statistics
IPP	Independent Power Producer
LAC	Latin America and Caribbean
LED	Light-Emitting-Diode
LPG	Liquified Petroleum Gas
MER	Mean Electricity Rate
NDC	Nationally Determined Contribution
PPA	Power Purchasing Agreement
PUC	Public Utilities Commission
PUMA	Puma Energy Bahamas S.A.
PV	Photovoltaic
RE	Renewable Energy
SDG	Sustainable Development Goals
SIB	Statistical Institute of Belize
SIDS	Small Island Developing States
SSEL	Santander Sugar Energy Limited
TES	Total Energy Supply
UB	University of Belize
USD	United States Dollars

Glossary

Biomass:
Organic non-fossil material of biological origin constituting a renewable energy source.

Energy:
The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy).

Energy Access:
A household having reliable and affordable access to both clean cooking facilities and to electricity.

Energy Balance:
An accounting framework for compilation and reconciliation of data on all energy products entering, exiting, and used within a country or area during a reference period (in this publication, a year).

Energy Efficiency:
Refers to the use of technology to reduce the energy needed for a given purpose or service (a ratio of service provided to energy input). Unlike conservation, which involves some reduction of service, energy efficiency provides energy reductions without sacrifice of service.

Energy Indicators:
These are key statistic markers that offer a snapshot of the energy sector.

Energy Intensity:
A ratio of energy consumption to another metric, typically national gross domestic product in the case of a country's energy intensity.

Energy Security:
The uninterrupted availability of energy sources at an affordable price.

Fossil Fuel:
An energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are petroleum, coal, and natural gas.

Gross Electricity Production:
The sum of the electrical energy production by all generating units/installations concerned (including pumped storage) in one year, measured at the output terminals of the generators. (IRES)

Hydroelectric/Hydro Power:
The use of flowing water to produce electrical energy.

Independent Power Producer:
A corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for the generation of electricity for use primarily by the public and that is not an electric utility.

Indigenous Energy Production:
Any kind of extraction of energy products from natural sources within the national territory which results in conversion to a usable form.

Installed Capacity:
Sometimes termed peak installed capacity or rated capacity, means the capacity of the facility (expressed in MW) were it to be operated on a continual basis at the maximum capacity possible without causing damage to it (assuming any source of power used by it to generate electricity was available to it without interruption).

Mean Electricity Rate:
Annual average unit cost of power sold.

Nationally Determined Contributions:
These are national climate plans highlighting climate actions, including climate-related targets, policies, and measures governments aim to implement in response to climate change and as a contribution to global climate action.

Peak Load Demand:
The highest simultaneous demand for electricity satisfied during the year. Note that the electricity supply at the time of peak demand may include demand satisfied by imported electricity, or alternatively, the demand may include exports

of electricity. (IRES)

Primary Energy:
Energy sources as found in their natural state before any transformation to secondary or tertiary forms of energy.

Refined Petroleum Products:
Products obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Refined petroleum products include but are not limited to gasolines, kerosene, distillates (including No. 2 fuel oil), liquefied petroleum gas, asphalt, lubricating oils, diesel fuels, and residual fuels.

Renewable Energy Resources:
Energy resources that are naturally replenishing but flow limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action. (US EIA Glossary)

Secondary Energy:
Refers to the more convenient forms of energy which are transformed from other, primary, energy sources through energy conversion processes.

Solar Photovoltaic (PV):
These are arrays of cells containing a material that converts solar radiation into DC electricity.

Total Energy Supply:
Is defined as flows representing energy entering the national territory for the first time, energy removed from the national territory and stock changes. The entering flows consist of production of primary energy products and imports of both primary and secondary energy products. The flows removing energy from the national territory are exports of primary and secondary energy products and international bunkers.

2022 At A Glance

Key facts:

Total Primary Energy Supply: In 2022, Belize's total energy supply totalled 17,836.6 TJ, an increase of 4% compared to 2021.

Energy Trade Data: Belize's energy import share accounted for 64.3% of total primary energy supply, showcasing an increase of 8.3% in comparison to 2021.

- With a high percentage of energy imports (60%+), this indicates a greater reliance on foreign energy sources, which leaves Belize vulnerable to supply disruptions, geopolitical risks, and price volatility.
- Belize imported 323.3 gigawatt-hours (GWh) of electricity in 2022 from its neighbouring country of Mexico.

Energy Production: In 2022, primary energy production from renewables and fossil fuels amounted to 7,492 TJ of total energy supply, with 6,425 TJ from renewables and 1,067 TJ from fossil-fuel sources. Production of crude oil decreased by 1.1% while the production of natural gas increased by 38.9%.

Greenhouse Gas Emissions: total gross GHG emissions in Belize's energy sector equated to 845.9 Gg CO_2 eq in 2019, representing an increase of 20.3% in comparison to the previous reference year (2018).

- The transport sub-category represents the largest source of emissions by a sizable margin equating to 544.0 (Gg CO_2 eq) in 2019.

Electricity Generation: renewable sources accounts for 52.9% of total gross electricity generation – equivalent to 90% of in-country electricity generation.

- Utility-scale solar generation demonstrated 13.2% of growth in 2022.
- Non-renewable energy sources for electricity production in 2022 fell to a share of 6.1%, marking a 3.3% reduction.
- Belize's Nationally Determined Contributions stipulates a renewable energy target of achieving 75% of gross electricity generation from renewable energy sources by 2030.

Electricity Consumption: In 2022, a total of 619.1 GWh of electricity was consumed across various sectors.

- In Belize, the commercial and residential sectors collectively form a substantial portion of gross electricity consumption.

New Investments: Energy investments in Belize are needed! It is estimated that Belize's energy sector requires $624 MUSD up to 2030 to implement its Nationally Determined Contributions (Commonwealth Secretariat, 2021).

1. Introduction

1.1 The 2022 Annual Energy Report

The most prevalently used definition of 'energy' is 'the capacity to do work' (Merriam-Webster, Incorporated, 2023) (Encyclopaedia Britannica Inc., 2023). Oxford languages give a very useful description for the purposes of this publication: 'power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines' (Oxford University Press, 2023). This report makes much use of the technical parameters of energy: units, conversions, types, and flows. Regardless, energy and its surrounding issues cannot be more grounded, more immediate, or more crucial to the living standards and long-term development of any household, community, or country. Energy's connection to the concerns of climate change tend to take centre stage, considering the challenges now facing Belize, the region, and the world. Though, it is also important to keep in mind the impact that energy decisions have on everything from sustainable development and economic independence to environmental conditions and everyday living and business expenses.

The Annual Energy Report, published by the Energy Unit within the Ministry of Public Utilities, Energy, Logistics & E-Governance, intends to provide a holistic overview of Belize's energy sector for policy-makers, stakeholders, and the public. It tracks the national flows of energy at different stages: production, importation, refinement, distribution, and consumption. It highlights trends and changes that can shed light on key drivers and have important ramifications for the future of the sector. It discusses the cross-cutting issues of energy: greenhouse gases, climate change, conservation and mitigation, patterns of use, and consumption.

The key sections of the report are as follows:

- Overview – Energy Balance and Key Energy Indicators
- Energy Flows – Energy Supply across categories
- Electricity – Generation, Capacity, Distribution, Renewables
- Final Consumption – Insight into everyday usage driven by survey data
- Energy Prices – Trends and Updates for the consumer's pocket
- Environment and Climate Protection – Interconnections with Policy and Sustainable Development

1.2 Energy Sector Policy and Legislative Framework

Belize's policy landscape continues the expansion process mentioned in previous report publications – namely the updating of the National Energy Policy (NEP, 2012). This new National Energy Policy is currently at the draft stage, undergoing review by stakeholders and pending final approval by the Cabinet.

Whereas the 2015 Sustainable Energy Framework and the 2018 Consolidated Project Plan played important roles in broadening and deepening the scope of energy sector themes built out in the now decade-old NEP, the updated energy policy has the outlook to align government priorities with the most recent sector developments, while providing the platform for a new legal framework, which is being advanced in parallel to the updated energy policy. An update to the turn-of-the-century Electricity Act created and ratified two decades ago, the newly defined Energy Act is expected to delineate and define the roles of the key sector players, as well as lend legislative leverage to the mandate of the Department of Energy (currently the Energy Unit).

These policy and legislative tools will act as a foundation for new initiatives going forward and aid in attaining international financing support. Stable and coherent policies will create an enabling environment for private sector investment by providing consistent investment signals.

1.3 Changing Energy Landscape

Recent years have seen several innovative programs and initiatives unfold within the national energy sector, as the government, key stakeholders, and the public achieve greater cognizance of the technologies and strategies that are gaining traction at the global scale. With the intention of reducing emissions and building sustainable energy security, these tools are being tested in the water of Belize's public opinion, consumer base, and investment landscape. A brief overview of some notable programs is given here.

1.3.1 Electric Mobility

Belize has a long-established market for old used vehicles imported from the United States. As a result, the national fleet is now indicative of inefficient fleet characteristics, namely, large vehicles, many cylinders, high mileage, and high fuel consumption rates. Data collected at the Energy Unit shows that the Transportation sector is by far the largest fossil fuel consumer and the largest greenhouse gas emitter. Promoting electric vehicles is considered one of the primary emissions mitigation actions within the transport sector. The contemporary electric private vehicle remains out of the economic reach for most Belizeans. Hence, the Government of Belize and its development partners have set their sights on making inroads within the public transportation system with the implementation of the 'Towards Low Carbon Transport – Piloting E-mobility within Belize's Public Transport System' project, funded by the European Union, and implemented by the United Nations Development Programme (UNDP), alongside the Ministry of Public Utilities, Energy, Logistics, and E-Governance. The pilot will deploy electric buses within the public transport system across both inter-city and intra-city contexts and aims to demonstrate technical, economic, social, and environmental grounds for upscaling electric mobility in Belize.

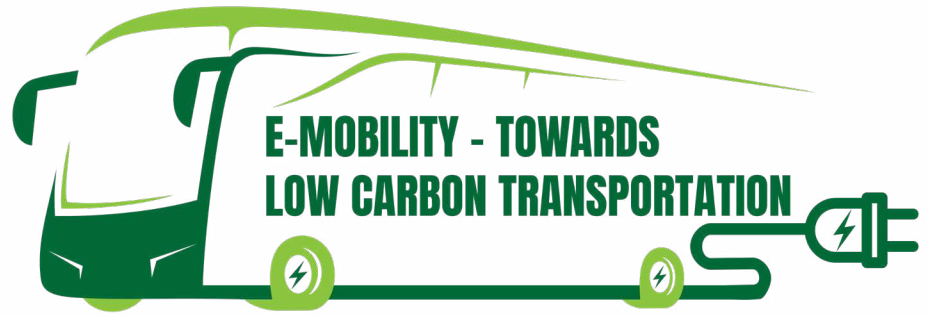


Figure 1: Piloting E-Mobility Project Logo

1.3.2 Distributed Energy Generation

Our reliance on imported energy in the form of refined fossil fuels, together with imported electricity from Mexico, has resulted in vulnerabilities in electricity supply and cost. There is local generation dependent on imported diesel and heavy fuel oil. Market volatility in both the global oil market supply and imported electricity trickles down to the cost of power in Belize. The rapidly changing energy landscape calls for redesigning the energy market in Belize to enable things like distributed energy-source integration, demand-side response, and more flexible power services.

Numerous Belizeans have sought to build energy resilience (and independence) within their own establishments by supplementing their grid supply with distributed Solar Photovoltaic systems. As there are currently no legal or regulatory systems in place to allow grid-connected proprietors to sell energy back to BEL, such systems are either standalone or 'grid-tied,' that is, supplying power in complement to BEL. The economic viability of a Solar PV system depends on many factors: income, solar potential, battery costs, and distance to the grid, among others. Careful analysis should be taken when considering investing in one. As the burgeoning business of enterprises like ProSolar and Solar Energy Solutions Belize (SESB) have shown, not only does a market for distributed solar exist in Belize, but it is growing.

It should also be noted that other types of distributed renewables, such as small-scale wind and organic waste, are areas with unexplored potential that may prove viable for some electricity consumers. Overall, individual consumers, organizations, and local authorities can take charge of their own energy portfolio.

1.3.3 Energy Efficiency

The importance of energy efficiency measures leads from the intuitive fact that less energy is to be produced, paid for, or combusted as emissions, if less energy is consumed by users. It also references the maximized usefulness of energy that is already produced and paid for. A key area for targeting electrical energy efficiency is within the most used or high consuming electrical appliances. Replacing existing refrigerators, washers, dryers, air conditioners, and lighting with higher-efficiency versions is a high-impact strategy for reducing the country's electrical expenditure. MPUELE, in collaboration with the Belize Bureau of Standards, is at the forefront of this effort through the development and implementation of the Energy Efficiency Labelling Scheme (EELS) project, launched in November 2022. This project aims to introduce efficiency labels and standards for refrigerators, air conditioning units, and lighting (through volunteering retailers in the first instance) that sensitize consumers to the energy performance of appliances while improving the efficiency of the appliance national stock through standards. Buyers will be able to weigh and decide what degree of energy efficiency they are willing to invest in and make choices to reduce their electrical consumption in an informed manner.

2. Overview

2.1 Energy Balance

Globally, energy balances are denoted as a key accounting instrument for the compilation and reconciliation of energy statistics. Energy balances allow users to analyse and understand the role of energy within the national territory of a given country, particularly the economy, during a reference period of one year (United Nations, 2017). Energy balances provide an overview of the effective functioning of energy markets and can act as a formulating mechanism for policy goals and a monitoring framework for energy policies. Furthermore, an energy balance table provides an essential foundation for the development and estimation of various high-level energy indicators (i.e., energy intensity, share of renewable energy, sectoral consumption of energy), highlighting the role of energy within a country's economy.

Table 1 presents the overall energy balance of Belize for 2022 and provides an overview of energy supply, transformation, energy consumption, and electricity output. Following up on the restructuring of the energy balance format in 2021 to align with the "International Recommendation for Energy Statistics, IRES" standards, the 2022 energy balance structure remains the same, with a focus now placed on data gaps, i.e., energy consumption. Thus, the methodology for creating the 2022 energy balance table, defining and grouping of energy products, as well as the statistical terminology employed, are harmonized with internationally established standards.

To ensure international comparability and support monitoring purposes, Belize's 2022 energy balance table is presented in a detailed format as recommended by IRES. The degree of detail presented was dependent on data and resource availability and the underlying classifications used in context with Belize's energy landscape. The energy balance is presented in a standard energy unit, Terajoules (TJ), and provides a standard energy balance table, where columns represent energy products (fuels), and the rows represent energy flows.

[1]Closely match the types of tables used by organizations like the International Energy Agency (IEA) and Eurostat.

Table 1. Belize 2022 Energy Balance Table.

Energy Flows \ Energy Products	Crude oil	Natural gas	Oil pr			
			Motor Gasoline[1]	Diesel Oil	Kerosene	Fuel Oil[1]
Indigenous Production	1,020.1	46.9	-	-	-	-
Imports	-	-	3,616.0	2,996.9	1,002.3	155.5
Exports	-110.3	-	-	-	-	-
International marine bunkers	-	-	-	-	-	-
International aviation bunkers	-	-	-	-	-	-
Stock changes (+/-)	67.4	-	-	-	-	-
Total Energy Supply (TES)	**977.2**	**46.9**	**3,616.0**	**2,996.9**	**1,002.3**	**155.5**
Statistical Difference	**107.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Transfers	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Transformation Processes	**-160.1**	**0.0**	**0.0**	**-245.4**	**0.0**	**-155.5**
Electricity plants	-	-	-	-245.4	-	-155.5
CHP plants	-160.1	-	-	-	-	-
Heat plants	-	-	-	-	-	-
Gas works (and other conversion to gases)	-	-	-	-	-	-
Natural Gas Blending Plants	-	-	-	-	-	-
Charcoal Plants	-	-	-	-	-	-
Other Transformation processes	-	-	-	-	-	-
Energy Industry Own Use	**25.9**	**0.0**	**0.0**	**4.9**	**0.0**	**0.0**
Losses	**0.0**	**-46.9**	**0.0**	**0.0**	**0.0**	**0.0**
Total Final Energy Consumption	**683.3**	**0.0**	**3,616.0**	**2,746.6**	**1,002.3**	**0.0**
Manufacturing, Construction, Non-fuel Mining Industrie	-	-	-	-	-	-
Non-metallic minerals	-	-	-	-	-	-
Machinery	-	-	-	-	-	-
Mining and quarrying	NR	-	-	-	-	-
Food and tobacco	159.5	-	-	NR	-	-
Paper, pulp and print	NR	-	-	NR	-	-
Wood and wood products	2.2	-	-	-	-	-
Construction	155.7	-	-	-	-	-
Not elswhere specified	284.0	-	-	-	-	-
TRANSPORT	-	-	-	-	-	-
Road	-	-	3,616.0	2,746.6	NR	-
Domestic Aviation	-	-	-	-	-	-
Domestic Marine Navigation	-	-	NR	-	-	-
Not elswhere specified	-	-	-	-	-	-
OTHER	-	-	-	-	-	-
Residential	-	-	NR	-	1,002.3	-
Commercial and public services	70.1	-	-	-	-	-
Agriculture/Forestry	11.8	-	-	NR	-	-
Fishing	-	-	-	-	-	-
Not elswhere specified	-	-	-	-	-	-
NON-ENERGY USE	-	-	-	-	-	-
in Industry/Transformation/energy	-	-	-	-	-	-
of which: feedstocks	-	-	-	-	-	-
in transport	-	-	-	-	-	-
in other	-	-	-	-	-	-
						Electricity a
Total Electricity Generated[5] - MWh	**17,154.6**	**0.0**	**0.0**	**15,396.5**	**0.0**	**15,003.3**
Electric Utility	-	-	-	15,100.8	-	-
Electricity plants (IPPs)	-	-	-	-	-	15,003.3
CHP plants (IPPs)	15,532.0	-	-	-	-	-
Electricity Autoproducers	1,622.7	-	-	295.7	-	-

Notations: - = Data Not Applicable, NR = Data Not Reported | Notes: 1 Motor Gasoline (Premium and Regular), Fue
distributed generation from renewable sources. 3 Firewood estimates based on calculation using Labour Force Sur
Classifications within Electricity Final Consumption. 5 Refers only to total electricity generated in country (excludes ir

roducts			Hydro	Solar[2]	Wind	Biofuels		Electricity[4]	Heat	Total
Aviation Fuel[1]	LPG	Non-Energy Oil Products				Bagasse	Firewood[3]			
-	-	-	860.2	19.0	-	4,874.2	671.6	-	-	7,492.0
1,190.4	1,345.0	NR		-	-	-	-	1,163.9	-	11,470.0
-	-	-	-	-	-	-	-	-	-	-110.3
-	-	-	-	-	-	-	-	-	-	0.0
-1,015.1	-	-	-	-	-	-	-	-	-	-1,015.1
-	-	-	-	-	-	300.6	-	-	-	368.1
175.3	**1,345.0**	**0.0**	**860.2**	**19.0**	**0.0**	**5,174.8**	**671.6**	**1,163.9**	**0.0**	**18,204.7**
0.0	**0.0**	**0.0**	**0.0**	**2.8**	**0.0**	**300.6**	**0.0**	**206.2**	**0.0**	
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
0.0	**0.0**	**0.0**	**-860.2**	**-16.3**	**0.0**	**-4,874.2**	**0.0**	**1,664.3**	**0.0**	**-4,647.4**
-	-	-	-860.2	-16.3	-	-	-	984.9	-	-292.6
-	-	-	-	-	-	-4,874.2	-	679.4	NR	-4,354.8
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	NR	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-84.2**	**0.0**	**-53.4**
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-299.9**	**0.0**	**-346.8**
175.3	**1,345.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**671.6**	**2,237.9**	**0.0**	**12,478.0**
-	-	-	-	-	-	-	-	154.2	-	154.2
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	NR	-	-	-	-	-	-	-	-	159.5
-	NR	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	2.2
-	-	-	-	-	-	-	-	-	-	155.7
-	-	-	-	-	-	-	-	-	-	284.0
-	-	-	-	-	-	-	-	-	-	0.0
-	NR	-	-	-	-	-	-	NR	-	6,362.7
175.3	-	-	-	-	-	-	-	-	-	175.3
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	1,345.0	-	-	-	-	-	671.6	878.9	-	3,897.7
-	NR	-	-	-	-	-	-	1,204.9	-	1,275.0
-	-	-	-	-	-	-	-	-	-	11.8
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	-	-	-	-	-	-	-	-	0.0
-	-	NR	-	-	-	-	-	-	-	0.0
-	-	NR	-	-	-	-	-	-	-	0.0
nd Heat Output										
0.0	**0.0**	**0.0**	**238,958.1**	**5,290.6**	**0.0**	**173,592.0**	**0.0**	**0.0**	**0.0**	**465,395.1**
-	-	-	-	-	-	-	-	-	-	15,100.8
-	-	-	238,958.1	5,290.6	-	-	-	-	-	259,252.0
-	-	-	-	-	-	173,592.0	-	-	-	189,124.0
-	-	-	-	-	-	-	-	-	-	1,918.3

l Oil (Heavy), Aviation Fuel (Aviation Gasoline and Jet Fuel Kerosene), LPG (Liquified Petroleum Gas). 2 Figures exclude
vey results from the Statistical Institute of Belize. 4 Estimates made for Farmers Light Plant Corporation Customer
mported electricity from CFE-Mexico, 380.2 GWh).

2.2 Energy Indicators

Given the scientifically forecasted looming climate crisis and the advent of the COVID-19 pandemic and its associated economic predicament, the call for governments and major energy stakeholders to ensure that the pathway ahead was based on building a secure and sustainable energy future has been reinforced twofold. Nonetheless, the global clean energy transition is known for its complexity, as its required actions lie in economic, technological, and demographic factors. With the global energy landscape's continual experience with rapid change and shifting priorities, it is crucial for decision and policymakers to gather insights into the future impacts of today's energy choices, setting the stage for the development and implementation of indicators for assessing progress toward nationally defined objectives and climatic targets.

In general, energy indicators play a pivotal role in the energy sector by providing a quantifiable way to track trends, assess performance, and make informed decisions. Given energy's role in improving social and economic well-being, energy indicators are key in understanding the sector's contribution to sustainable economic growth. Together these indicators may be used to retrospectively measure and monitor at the national level long-term trends of an energy system. These long-term trends can provide a snapshot of a country's energy scenario and allow for the tracking of progress toward nationally defined objectives, climatic targets, and sustainable development goals.

The proposed set of energy indicators builds upon general guidelines and methodologies in the development of national energy indicators in 2020 and for use in Belize's efforts to monitor the effects of energy policies on the social, economic, and environmental dimensions of sustainable development. In summary, energy indicators provide a factual platform for setting targets, measuring progress, and steering the energy sector toward a more secure and environmentally responsible future. The energy indicators presented below have been prepared in alignment with Belize's country-specific conditions, priorities, and capacities.

2.2.1 Energy Import as a Share of Total Primary Energy Supply (TPES)

Energy imports as a share of total primary energy supply (TPES) represents a critical metric in assessing Belize's energy self-sufficiency and external energy dependence. In 2022, Belize's energy import as a share of total primary energy supply equalled 64.3%, representing a 2.1% increase in share over the 2021 – 2022 reporting period. While an increase in energy import share was displayed in 2022, the energy import share was still below the threshold set by a few years pre-2021, as shown in Figure 2.

A core objective of any socio-economic development pathway is to sustain reliable energy supplies to satisfy the ever-increasing demand of market activities and its people. In parallel fashion to many nations around the globe, Belize also experienced an economic rebound in 2021, with a jolt in speed in 2022. With businesses reopening, tourists traveling to Belize once again, and a population ready to climb out of the depths of a pandemic, energy demand increased. In 2022, energy imports in Belize saw an 8.3% increase compared to 2021 figures, signalling a means by which energy supplies are linked to satisfy demand.

A high percentage of energy imports (60%+) indicates a greater reliance on foreign energy sources, leaving Belize vulnerable to supply disruptions, geopolitical risks, and price volatility. As a result, energy supply interruptions warrant a systemic risk to Belize's sustainable development agenda and should be addressed through targeted energy policy actions. The challenge lies in finding scalable, reliable, ecologically viable, and affordable ways to meet an increase in demand for energy. According to Belize Electricity Limited (2023), their Least Cost Expansion Plan (LCEP) aims "to increase in-country firm capacity and reduce reliance on imported energy to stabilize the cost of power."

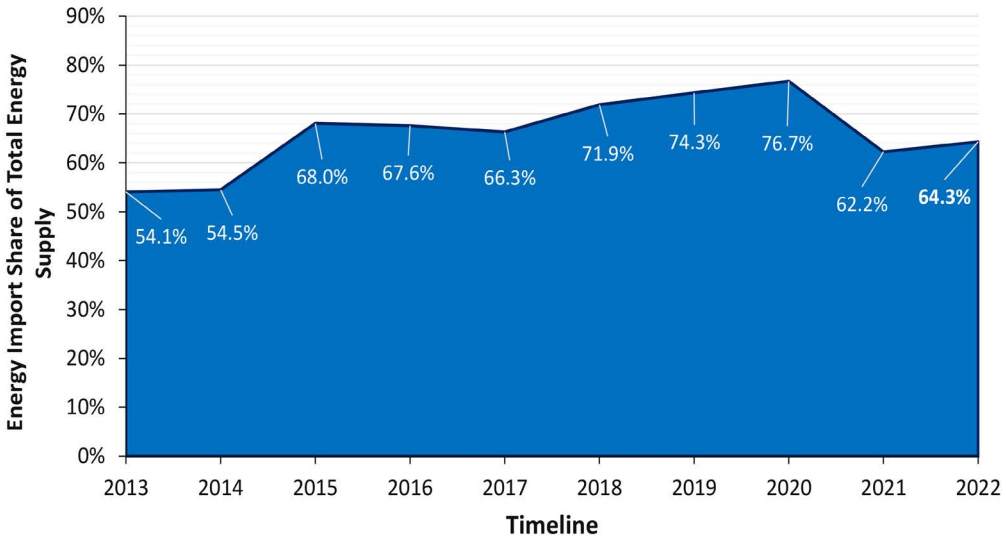


Figure 2 : Historical Timeline of Energy Import as a Share of Total Primary Energy Supply

2.2.2 Renewable Energy Share of Total Primary Energy Supply

The renewable energy share in total final energy supply is the percentage of total energy supplied that is derived from renewable resources. Renewable energy sources include wind power, solar power (thermal, photovoltaic, and concentrated), hydropower, tidal power, geothermal energy, ambient heat captured by heat pumps, biofuels, and the renewable part of waste. As governments around the globe commit to an energy transition that will lead their economies along a clean development pathway, increasing the share of renewable energy in the total primary energy supply is paramount due to its extensive benefits across a range of socio-economic and environmental parameters.

In 2022, Belize's total primary energy supply (TES) was 17,836.6 TJ, of which 36% or 6,425 TJ was produced from renewable energy sources (Figure 3). Belize's renewable energy sources include hydro, biofuels (bagasse and firewood), and solar photovoltaics. The share of renewables in 2022 was the highest recorded renewable energy share of TPES in the last decade, up by 1.3% over the 2021 – 2022 reporting period.

While it may be considered a minute increase in comparison to 2021 figures, increasing the renewable energy share in the TPES offers multifaceted benefits. Overall, it represents a strategic action towards a resilient and sustainable energy future and showcases Belize's progress towards contributing to global efforts to mitigate climate change and limit temperature rise. Belize is well placed for the re-design of the energy market to enable distributed energy source integration, demand-side response, and more flexible power services built upon modern and smart energy systems.

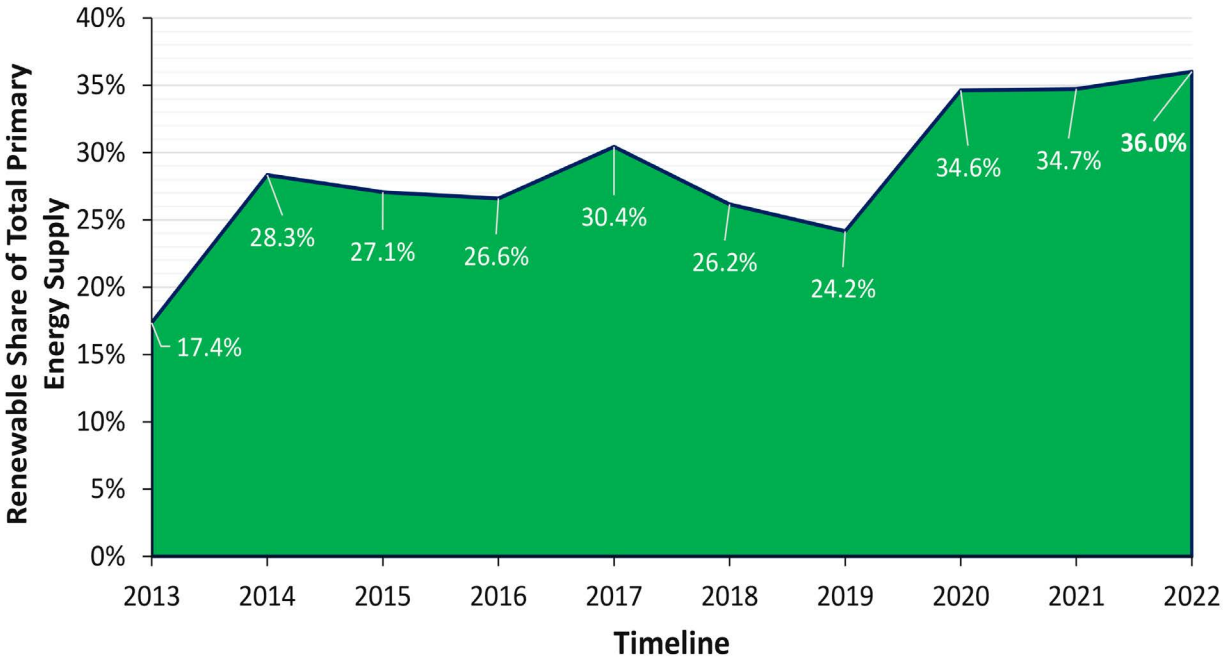


Figure 3: Historical timeline of Energy Import as a Share of Total Primary Energy Supply.

2.2.3 Percentage of Renewable Energy in Electricity Mix

This indicator measures the share of renewable energy used in the generation of electricity. The elements comprising this indicator are renewable resources, non-renewable resources, and electricity imports from Mexico (CFE). In Belize, renewables include electricity production from hydropower, solar photovoltaics, and biofuels (bagasse). In alignment with Belize's enhanced climatic targets, Belize's updated NDCs call for an achievement of 75% gross generation of electricity from renewable energy sources by 2030 (Government of Belize, 2021).

Figure 4 illustrates the evolution of renewable energy's role in the electricity mix over time. In 2022, renewable energy sources contributed a substantial 52.9% of total electricity generation. As displayed in Figure 4, the percentage of renewable energy in the electricity mix has fluctuated in recent years, triggered by compounding factors, including climate variation and its impacts on in-country renewable energy generation and the electricity demand-supply nexus, which is linked to imported electricity from Mexico.

Belize has emerged as a pioneering leader in integrating renewable energy sources into its electricity mix. Nevertheless, there is great opportunity to tap into mature technological advances in solar photovoltaics and wind to bridge the gap between current renewable energy achievement in the electricity mix and the climate targets set in Belize's international commitments. With renewable energy technologies at cost parity, the current investment cycle in the electricity sub-sector must be renewables led, buttressed by grid modernization.

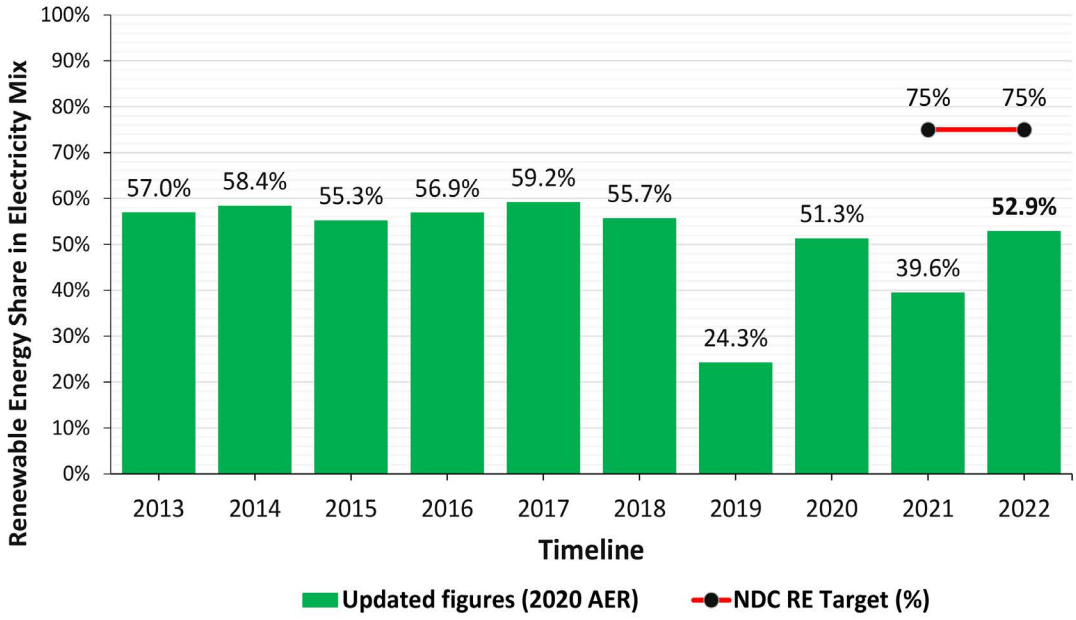


Figure 4: Historical Timeline of Renewable Energy Share in Electricity Mix

2.2.4 GHG Emissions from the Energy Sector

Belize's fourth National Greenhouse Gas (GHG) Inventory report is the most recent inventory report submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and covers reference years 2018 and 2019 (National Climate Change Office, 2021). The energy sector summary report that fed into Belize's fourth national GHG inventory report is the first energy sector-specific inventory prepared directly by the Energy Unit, within the Ministry of Public Utilities, Energy, Logistics, & E-Governance (MPUELE).

According to Belize's fourth national GHG inventory report (National Climate Change Office, 2021), Belize is currently acting as a net carbon sink for emissions. However, across all sub-sectors assessed for both reference years, there was a general increase in GHG emissions. As Figure 5 indicates, there was a decline in total gross GHG emissions in 2018, amounting to 674.6 Gg CO_2 eq which represents a decrease of 14.2% in comparison to the previous reference year. Following the decline in 2018, total gross GHG emissions in 2019 from Belize's energy sector rose sharply to 845.9 Gg CO_2 eq representing an increase of 20.3% compared to the previous reference year.

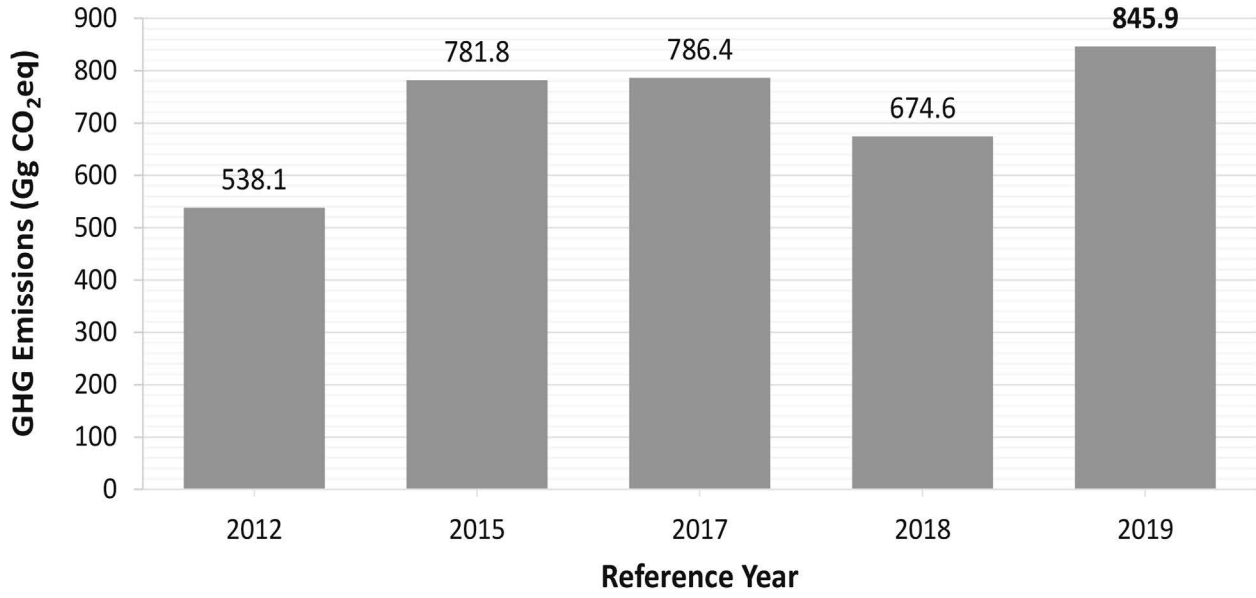


Figure 5: Total Annual GHG Emissions for the Energy Sector

Figure 6 indicates the proportion that each energy sub-sector contributed to Belize's gross emissions. Within the energy sector, the transport sub-category represents the largest source of emissions by a sizable margin of 460.7 and 544.0 (Gg CO2 eq) in 2018 and 2019, respectively. The transport sub-sector was followed by other sectors (residential and commercial activities), energy industries, and fugitive emissions. Energy was the sector with the largest contribution to Belize's GHG emissions in 2019. Therefore, the decarbonization of the energy sector is critical to the success of achieving Belize's ambitious climatic targets.

The next GHG inventory cycle has commenced and it is being led by the National Climate Change Office (NCCO), with the Energy Unit (MPUELE) tasked as the lead for the energy sector. The next GHG energy sector summary report will cover reference years 2020 – 2022 and is slated to be ready for submission in 2024.

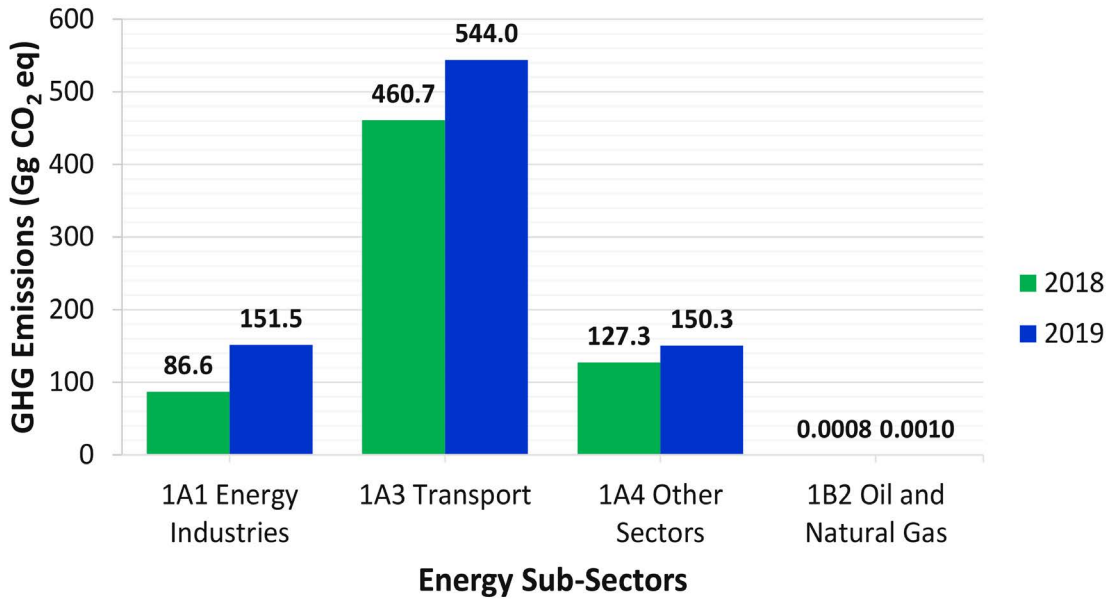


Figure 6: Annual GHG Emissions (CO2e) per Energy Sub-sector in 2018 & 2019

2.2.5 Energy Intensity Measure in Terms of Primary Energy and GDP

According to the United Nations Statistics Division (2021), energy intensity is defined as the energy supplied to the economy per unit value of economic output. Within the context of this report, this indicator refers to "total primary energy supply in tons of oil equivalent (toe) per thousand USD of GDP." The energy intensity measure in terms of Primary Energy and GDP for 2022 was not calculated; official GDP figures from the Statistical Institute of Belize (SIB) were not scheduled for release in alignment with the production timeline of this report. Potential GDP figures from other sources may have data that were treated differently and are not the authorized body for official statistics in Belize, like the SIB.

Nevertheless, for informational purposes, Figure 7 provides energy intensity information for Belize across a ten-year historical timeline. As shown in Figure 7, energy intensity in 2021 saw a slight decrease to 0.177 toe/$1000 USD compared to the previous year. This represented a 5.85% improvement in energy intensity (less energy input for economic output, GDP) over the 2020-2021 reporting period.

Like it is across world regions, energy intensity levels and energy efficiency trends and achievements will differ widely across sectors in Belize. While there are slight fluctuations across the historical timeline up to 2021, overall growth in Belize's energy intensity levels calls for further energy efficiency policy implementation across major economic sectors.

It is important to note that energy intensity can be affected by several factors, such as climate, economy structure, and the nature of economic activities, among other variables that are not necessarily linked to pure efficiency. Given the large number of factors that affect energy use, the ratio of total energy supply/use to GDP should not be used alone as an indicator of energy efficiency for policy-making purposes. Disaggregation of energy intensity, e.g., by final consumption sectors or end-uses, could provide further insights into progress towards energy efficiency.

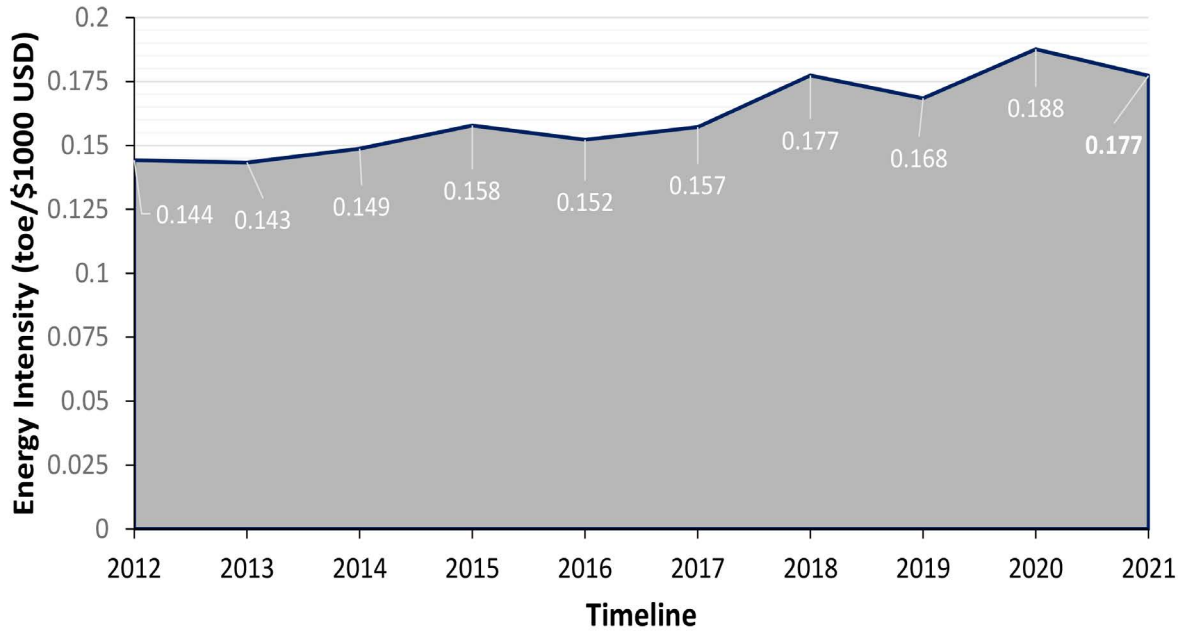


Figure 7: Historical Timeline of Energy Intensity in Belize

2.2.6 Energy Access and RE Generating Capacity per Capita

Modern energy services are a crucial component of improving social and economic well-being among people and their communities. Thus, measuring the share to which citizens of Belize have access to affordable, reliable, and modern energy services is an important socio-economic indicator. This indicator highlights not only energy infrastructure, but also the extent to which people have access to essential services and improved living conditions. Specifically, under the Sustainable Development Goal 7's Target 7.1, is indicator 7.1.1 "Access to Electricity" and under Target 7.b, is indicator 7.b.1 "Installed renewable energy-generating capacity in developing countries (in watts per capita).

According to the Tracking SDG7, The Energy Progress Report, "the global electricity access rate rosed markedly between 2010 and 2020, from 83% to 91%, with the need of 100 million new connections a year going forward to meet the 2030 target" (International Energy Agency, International Renewable Energy Agency, United Nations Statistics Division, World Bank, & World Health Organization, 2022). Although energy access for Belizean citizens is generally high, many rural and peri-urban communities still do not have access to reliable and affordable electricity.

Given the importance of access to modern energy services in Belize, an Energy Access and Indicator Workshop was held in November 2022 to constitute a unique forum that brought together diverse government ministries and departments, policymakers, development partners, and independent experts from Belize and the wider Caribbean region to discuss and share experiences on the development and implementation of energy access projects and the mainstreaming of energy indicators for benchmarking progress to obtain an understanding of the impacts and implications of various energy access programmes. The development of an institutionalized Energy Access indicator will play a significant role in energy planning as a statistical tool to communicate to stakeholders and decision-makers the need for energy services among underserved populations.

A renewable energy (RE) generating capacity per capita indicator holds significant importance and quantifies the capacity of clean and sustainable energy sources relative to Belize's population. Overall, this indicator aligns with climate change related objectives and showcases progress in the transition to a sustainable energy pathway, particularly local renewable energy adoption.

While these indicators are considered an essential component of energy planning, Belize still lacks a comprehensive framework for assessing how many people have access to reliable and affordable electricity service that is provided at a standardised level of service (such as the Multitier Framework established by the UN). The Government of Belize is optimistic that these indicators will be developed and implemented in the medium-term and can be used to guide policy makers to allocate resources effectively and target interventions where they are most needed.

3. Energy Flows

3.1 Total Energy Supply

This year's total energy supply (hereinafter, the TES) – that is, the total sum of all available in-country energy, both produced and imported – has significantly increased since last year (Figure 8). A difference of 745 TJ or a growth of 4% is put into perspective when considering that a single terajoule represents the energy equivalent of burning 7,600 gallons of automotive gasoline. Due to the natural growth of population and economic activities over time, it is generally expected that energy needs will also grow steadily as years pass. Economic and social shocks, however, disrupt this trend, as we have yet to regain the pre-COVID 2019 energy supply of 18,028 TJ.

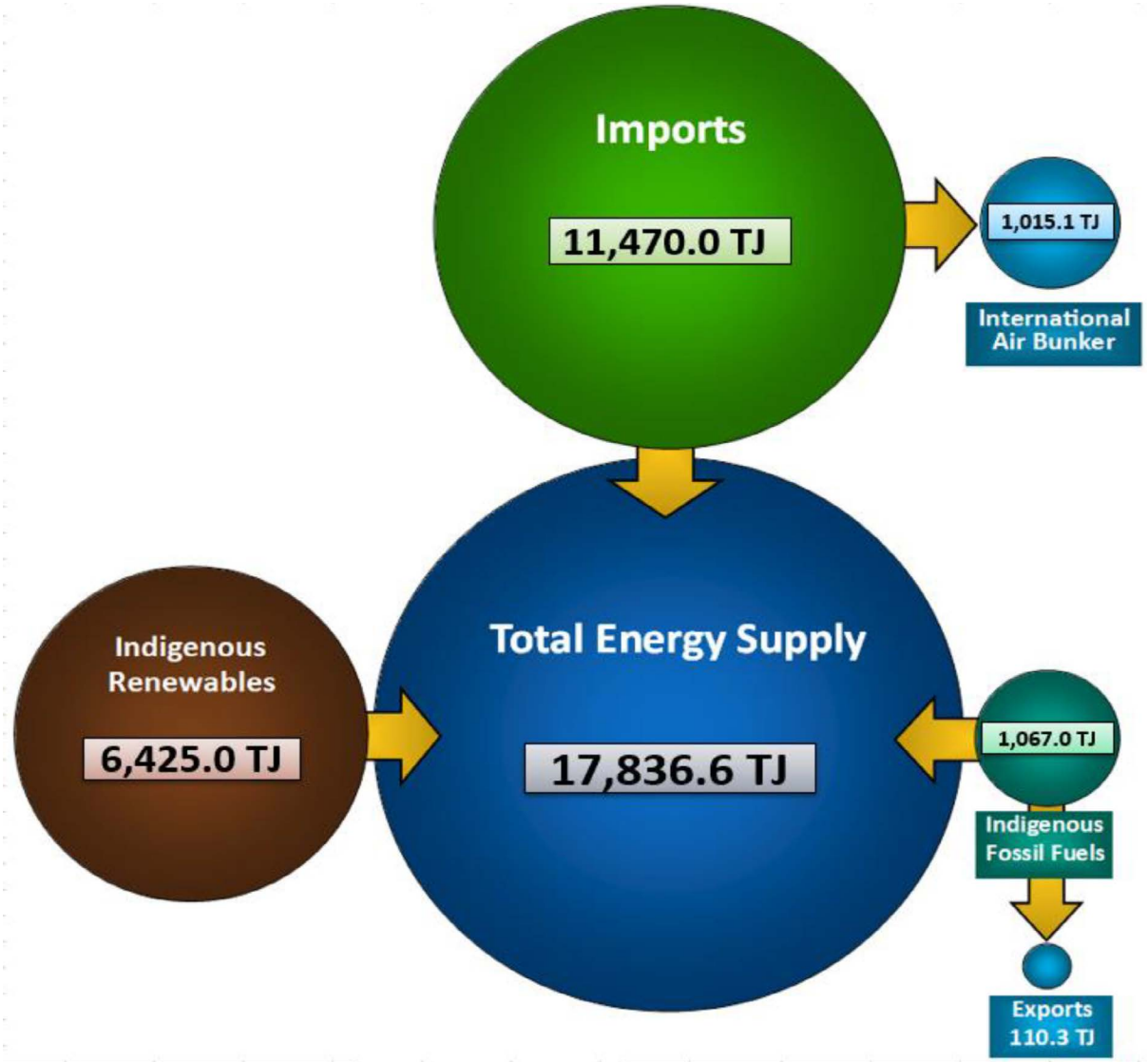


Figure 8: Primary Energy Flows within Belize's National Energy Sector in 2022.

3.2 Energy Trade Data

The stark comparison between Belize's energy imports and energy exports will only be exacerbated in the future, due to the contracting production and exportation of crude oil – the only energy product exported by Belize. Figure 9 below demonstrates the relative shares of imports and exports. At 110.3 TJ and 1%, a reduction of nearly two-thirds from last year, crude exports are outweighed by nearly a hundred times in energy imports, which comprises both the total volume of refined oil products such as gasolines, diesel, and kerosene, but also a significant portion of the country electricity supply in the form of imported electricity from Mexico: a total of 11,470 TJ, or 99%.

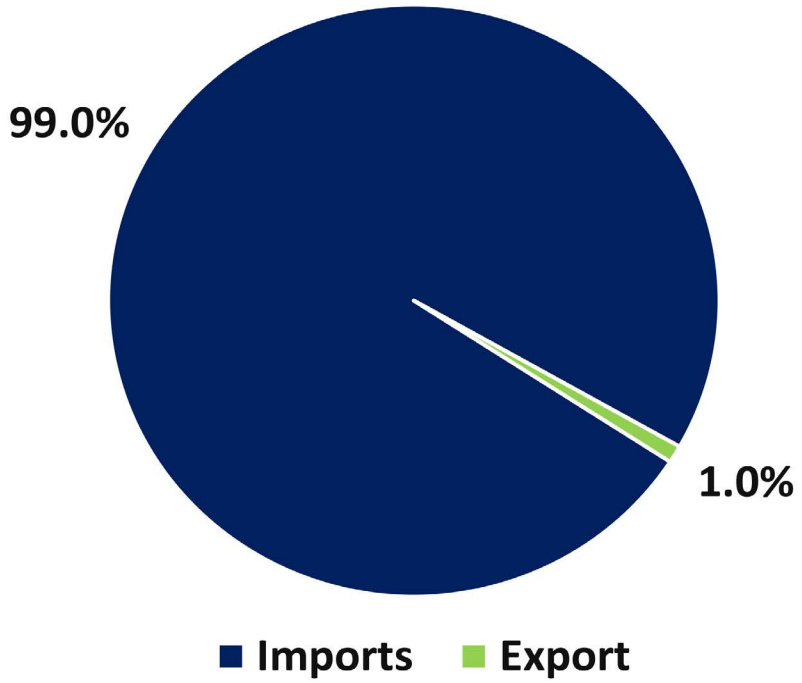


Figure 9: Proportion of Energy Trade Data for 2022

3.3 Primary Energy

3.3.1 Primary Energy Supply, by fuel type

Defined as the raw, unprocessed forms of energy within a country's borders, Belize's primary energy consists of local sources that accounted for a total of 7,489.3 TJ. It should be noted that while the sugar cane by-product bagasse makes up the largest share of primary energy – 65% as shown in Figure 10 below – only a portion of bagasse produced is typically consumed solely for electricity production. Crude Oil, hydropower, and firewood compose the next largest shares – 13.6%, 11.5%, and 9%, respectively.

Firewood quantities are based on yearly estimates calculated using data from the annual Labour Force Survey of the Statistical Institute of Belize (hereinafter, SIB) derived from the number of households dependent on firewood for lighting and cooking. It can also be noted that the small fraction of solar power represented consists solely of utility-scale contributions to the electric grid. The magnitude of distributed solar power remains a significant data gap for the energy sector in Belize.

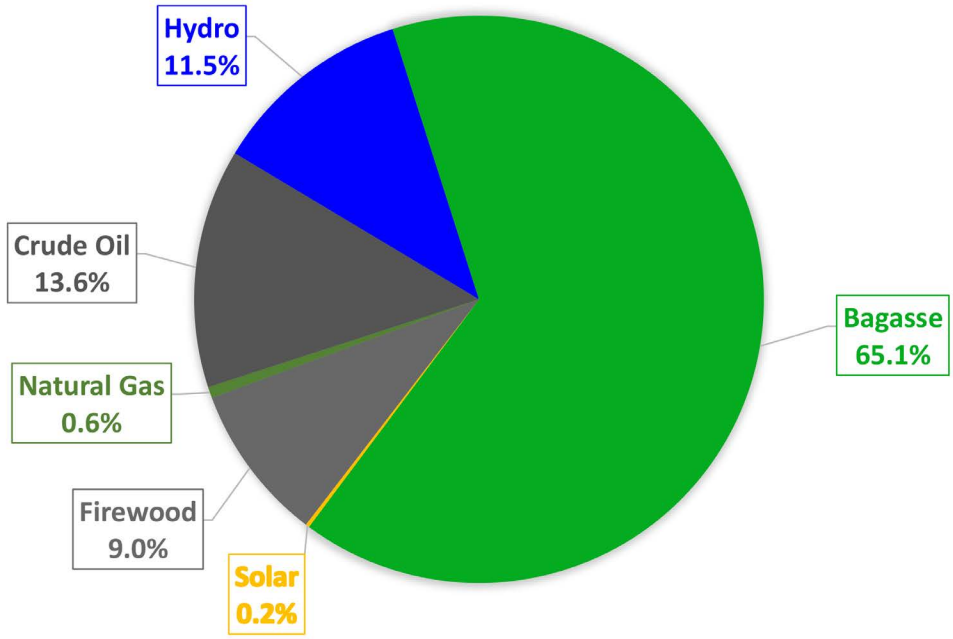


Figure 10: Belize's Primary Energy Supply in 2022 by Fuel Type Share

3.3.2 Renewable Energy – Supply by Energy Product

Figure 11 below shows the fluctuations in the primary supply of renewables over the past five years – separated by source type. These primary renewables add up to a total of 6,425.2 TJ in 2022. The chart shows that the primary driver behind the rising renewables supply is bagasse, production of which has rebounded and surged since the 2019 drought. Hydropower has also picked up from the 2019 drought, except for a discernible reduction in 2021, which can be attributed to climate variation in combination with maintenance-related downtime at the power plant. Notable is the consistency of firewood consumption, save for a visible increase in 2021 – possibly a reaction to rising LPG costs as a cooking fuel.

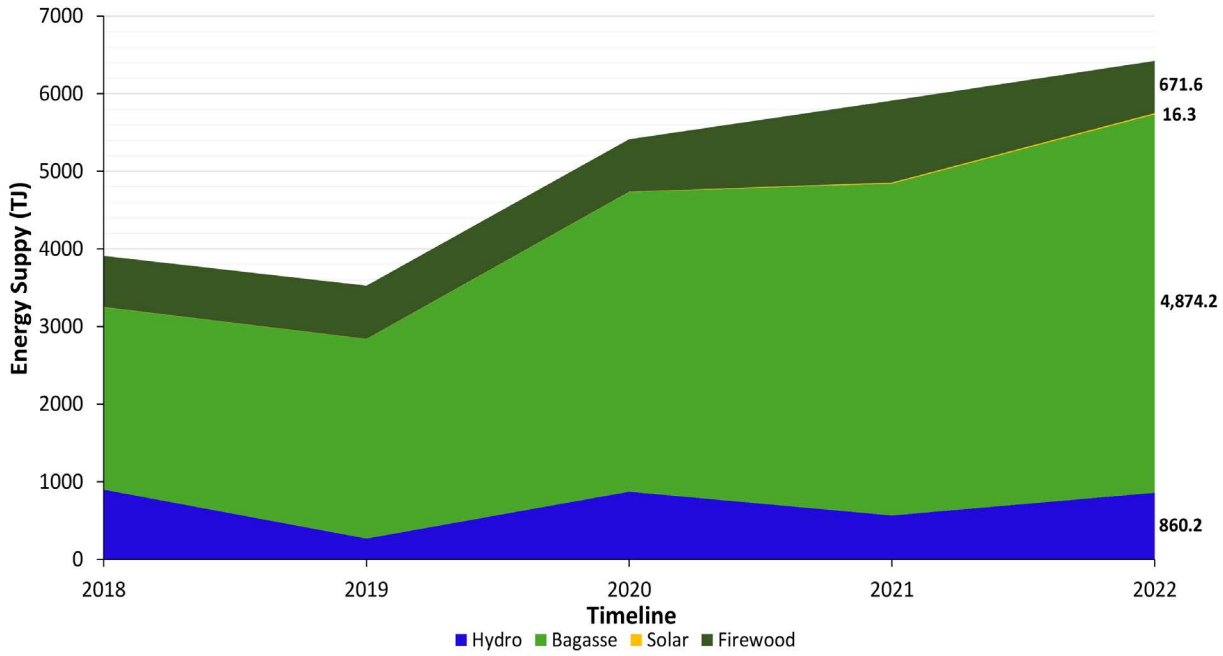


Figure 11: Historical timeline of Renewable Energy Supply by Energy Product

3.4 Secondary Energy

3.4.1 Secondary Energy Supply by Fuel Type

In opposition to primary energy, secondary energy comprises that which has been processed or refined in some way. Secondary energy sources not only make up the majority of Belize's liquid and gaseous fuels, but also include electricity imports from the Comisión Federal de Electricidad (CFE). It should be noted that electricity from hydro, wind, and solar, that is, dynamic sources, is considered primary, whereas electricity converted from any pre-existing fuel, particularly combustibles, is considered a secondary energy source. Belize's secondary energy supply added up to 11,470 TJ in 2022: a rise of 8% from 2021. As it is not known that we perform any refining activities in-country, this quantity coincides with that of imported energy seen in the TES flowchart above.

Figure 12 below shows the breakdown of secondary sources by shares. Apart from the 10.1% supply contributed by electricity imports – which constitutes 1,163.9 TJ – the majority shares are made up by CO2-emitting fossil fuels. The greater portions within these again are destined for the transportation sector: diesel, gasolines (both premium and regular), and aviation fuels. Liquid Petroleum Gas (LPG) constitutes a share of 11.7% of the whole, mostly attributed to cooking, but also has a growing market as a transportation fuel. One point of interest is yet another data gap: the final energy consumption of imported kerosene is not comprehensively known.

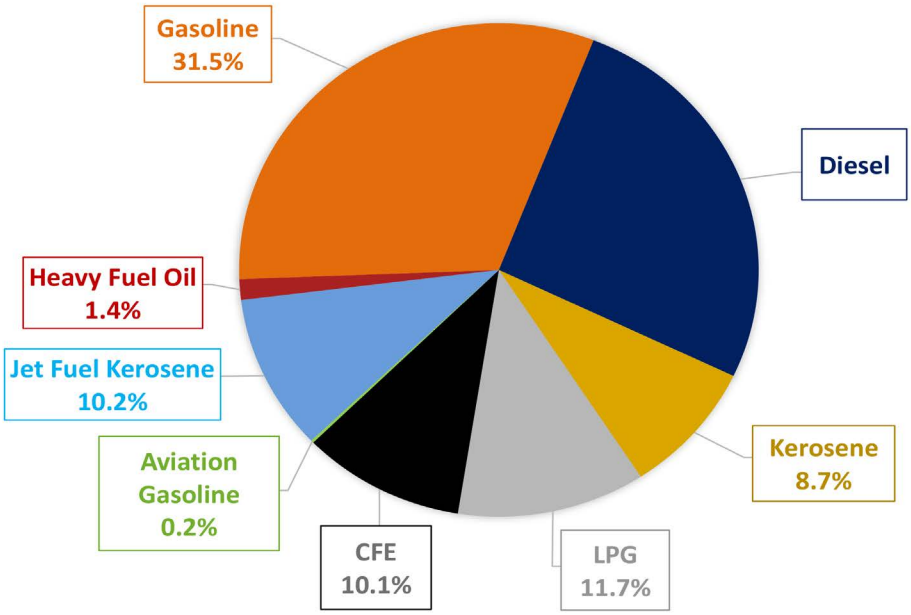


Figure 12. Belize's Secondary Energy Supply by Fuel Type in 2022

3.4.2 Supply of Secondary Energy: Refined Petroleum Products

The historical timeline chart below shows changes in the imported refined petroleum products' volumes over the past five years. This year, the total volume of imported liquid fuels achieved 64,298,000 US Gallons – equating to 8,961.2 TJ. This signifies an 8% increase in fuel volume since 2021, but a 12.5% increase in energy content.

Since the 2020 low point, when the pandemic lockdowns were at their height and transportation slowed, fuel imports have risen steadily, though not quite to the level witnessed in 2019. The apparent growth within jet fuel kerosene volumes is imputed to data reporting discrepancies, not actual increases in aviation activities. A complementary reduction of premium gasoline and a rise in regular gasoline in 2022 implies a switch in consumer choice, possibly a reaction to rising fuel costs.

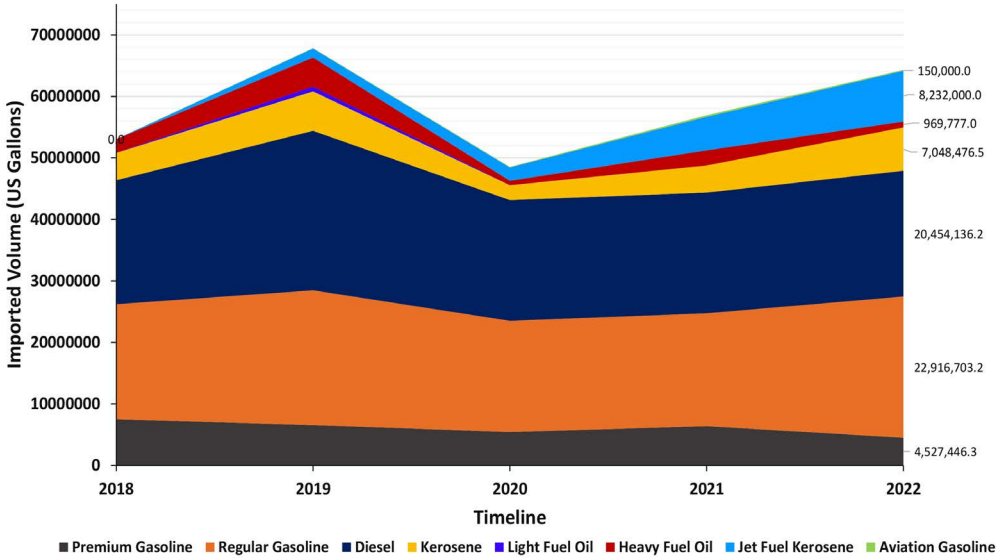


Figure 13. Historical Supply of Secondary Energy: Refined Petroleum Products

4 Electricity Sector

4.1 Installed Electricity Generation Capacity

The installed electricity generating capacity for Belize totalled 134.92 MW in 2022, with a change of 0.07 MW compared to the previous year. In Table 2, you will find a synopsis of the installed electricity generation capacity by power-producing facilities during the reporting period of 2021 to 2022. Of the total installed electricity generating capacity in 2022, renewable energy generating capacity equated to 80.5 MW, representing 59.7% of indigenous generating capacity. Hydropower accounted for the largest share of the total, with a capacity of 54.65 MW. In contrast, fossil-fuel powered generating capacity equated to 54.4 MW, representing 40.3% of Belize's indigenous generating capacity. Most of the electricity-producing plants in Belize are independent entities (Independent Power Producers) contracted to supply grid power through

Power Purchasing Agreements (PPAs) with the utility, Belize Electricity Limited. The total capacity figure of 134.92 MW does not include imported electricity from Mexico (CFE), which is included in the table below.

Table 2. Electricity Producing Plants in Belize in 2022

ON-GRID		2021	2022	2021-2022
Producer	**Type**	**Capacity (MW)**	**Capacity (MW)**	**Change (+/-)**
Hydro		**54.65**	**54.65**	**0**
Fortis Belize - Mollejon	Hydro	25.2	25.2	0
Fortis Belize - Challilo	Hydro	7	7	0
Fortis Belize - Vaca	Hydro	19	19	0
Hydro Maya	Hydro	3.45	3.45	0
Biomass		**21.5**	**21.5**	**0**
BELCOGEN	Biomass	13.5	13.5	0
Santander	Biomass	8	8	0
Solar PV		**4.40**	**4.37**	**-0.03**
UB - JICA	Solar	0.48	0.45	-0.03
Farmers Light Plant Corporation	Solar	3.04	3.04	0
PSF	Solar	0.88	0.88	0

Non-RE Thermal		**42.5**	**42.5**	**0**
BAPCOL	Fossil Fuel	22.5	22.5	0
Gas Turbine (BEL OWNED)	Fossil Fuel	20	20	0
OFF-GRID				
Producer	**Type**	**Capacity (MW)**	**Capacity (MW)**	**Change (+/-)**
Non-RE Thermal		**11.8**	**11.9**	**0.1**
CCK Plant (BEL owned)	Fossil Fuel	4	4.1	0.1
Farmers Light Plant Corporation*	Fossil Fuel	7.8	7.8	0
ENERGY IMPORTS				
Producer	**Type**	**Capacity (MW)**	**Capacity (MW)**	**Change (+/-)**
Imported Electricity from Mexico		**55**	**55**	**0**
CFE		55	55	0
TOTAL		**134.85**	**134.92**	**0.07**

4.2 Peak Electricity Demand

The highest level of electrical power consumption within a specific timeframe, usually a day, a season, or a year refers to peak electricity demand. According to Figure 14, Belize's peak electricity demand in 2022 exhibited a sizable increase over the 2021 – 2022 reporting period and marked the highest peak demand recorded over the last decade. Recent data has shown global electricity peak demand to be on the rise, with increasing energy needs driven by a multitude of factors such as population growth, climate variations, industrial activities, and the increasing use of electric technologies. The increase in Belize can also be linked to the continual rebound in the economy following the Covid-19 pandemic, with a large energy appetite within the tourism sector. As reported by Belize Electricity Limited (2023), Belize is not able to meet its electricity demand solely from the use of indigenous generation sources and must rely on the interconnection with Mexico (CFE) to meet that demand. As a result, governments, energy planners, and utilities are placing a critical focus on managing the supply of electricity during peak demand periods.

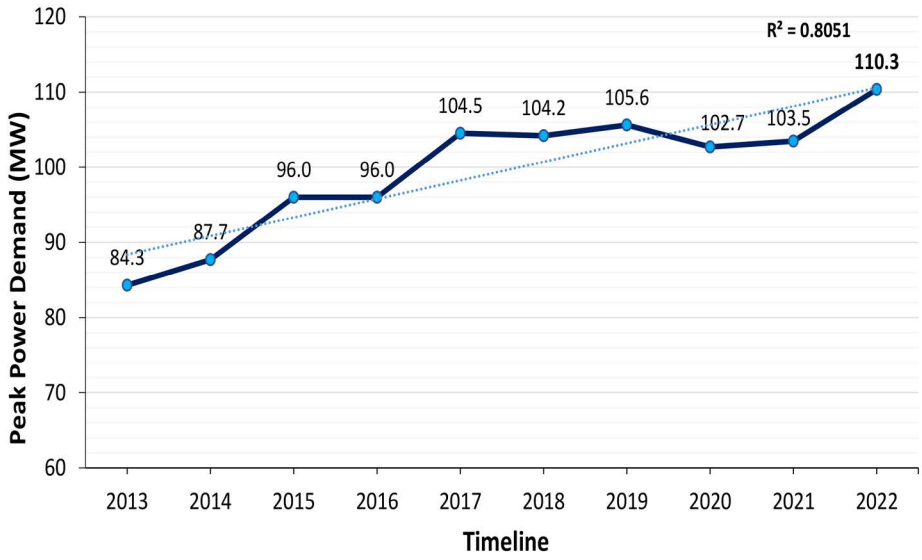


Figure 14 : Historical Timeline of Peak Power Demand in Belize

4.3 Gross Electricity Production

The annual gross electricity production figure serves as a vital indicator of a nation's energy prowess and consumption patterns. In 2022, 789.4 gigawatt hours (GWh) of electricity was generated in Belize, marking the most significant gross generation figure in the last decade. This represented a 5.6% increase over the 2021 – 2022

reporting period and encompasses a diverse mix of sources ranging from renewables, fossil fuels, and electricity imports. It clearly indicates the increasing energy use patterns in Belize and a gauge for Belize's self-sufficiency and wider energy policies. The forecasted increases in gross electricity production are in alignment with meeting surges in energy demand and bring the transition to a more sustainable energy landscape in Belize into greater focus.

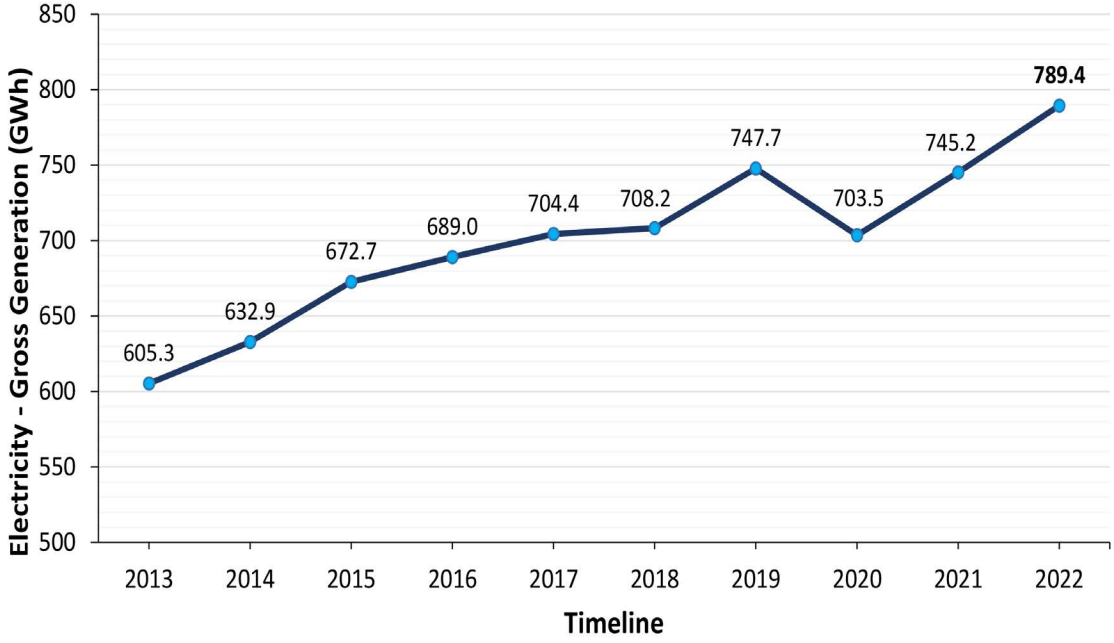


Figure 15 : Historical Timeline of Gross Electricity Production in Belize

4.4 Electricity Production by Fuel Type

Figure 16 showcases the composition of Belize's electricity generation by major energy sources, covering a five-year historical period (2018 – 2022). In 2022, the appetite for energy continued to grow following the release of restrictive measures endured over the pandemic period, especially in the tourism sector. Given BEL's reliance on CFE (Mexico) to supplement in-country generation, electricity imports played a large role in meeting Belize's electricity production needs and accounted for 323.3 gigawatt hours (GWh) of electricity produced in 2022. This represented a share of 40.9% of total electricity generated, down from a share of 51.1% in 2021. The decrease in electricity imports was triggered by increased in-country electricity generation from renewable sources. Similarly, in 2021, hydro constituted the second largest source of electricity behind energy imports at 239 GWh, registering a 51.6% increase in electricity generation compared to 2021. Electricity generation from biofuels (bagasse) again represented the third largest electricity generation by fuel type, at 173.6 GWh, registering a share of 22% (+30.4% compared to 2021). As it relates to solar PV, which saw the most significant increase in electricity in 2021, the trend continued, with solar PV generation now increasing to 5.3 GWh in 2022.

With considerable increases in in-country generation from renewable energy sources in 2022, electricity generation from fossil fuel-based power generation decreased to 48.2 GWh, contributing to a 30.8% decrease in generation share. Fossil fuel sources included Crude Oil (17.8 GWh), Diesel (15.4 GWh), and Fuel Oil (15GWh), with Petroleum Gas and LPG not in use for electricity generation as was the case in 2021.

The decrease in fossil fuel sources for electricity generation aligns closely with Belize's environmental and climate objectives, as higher renewable energy source generation signifies reduced greenhouse gas emissions, advancement towards resilience to energy supply disruptions, and decreased reliance on imported petroleum-based finite resources.

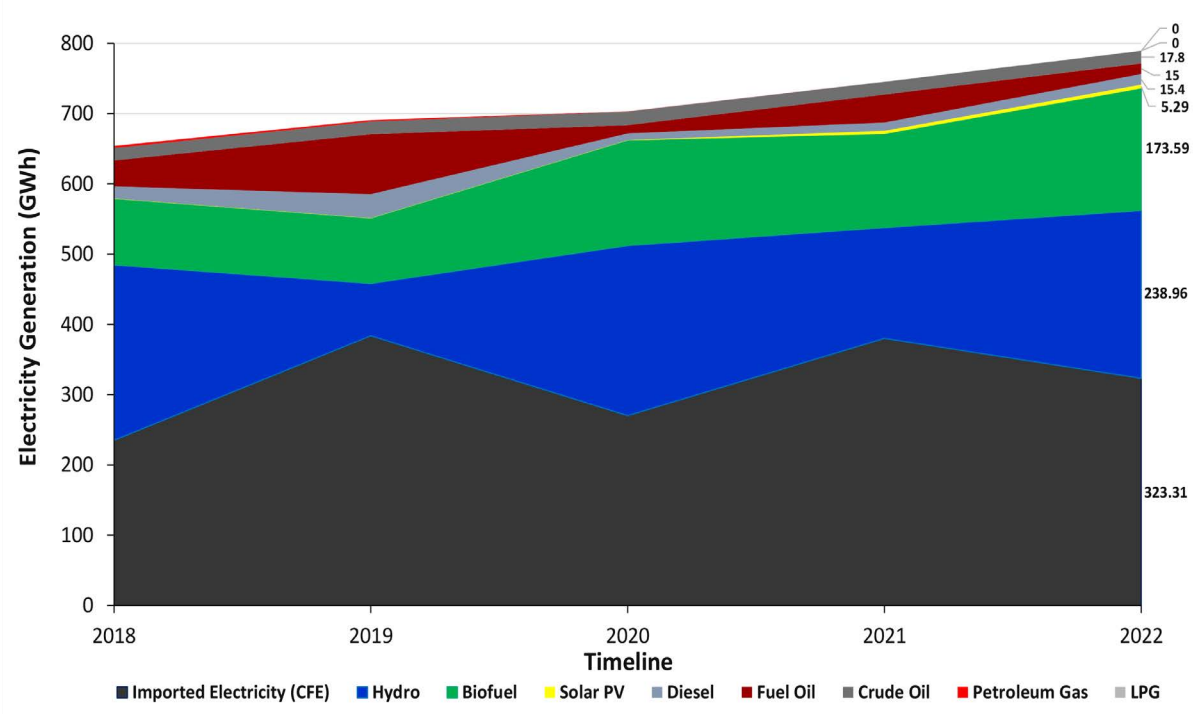


Figure 16 : Historical Timeline of Electricity Generation by Fuel Type

4.5 Electricity Production by Plant Type

Electricity production by plant type in 2022 was dominated by renewable energy electricity generating plants (Figure 17). This showcases the role and importance of renewable energy to Belize's energy sector and its commitment to limiting GHG emissions and contributing to global mitigation actions. The trend seen from last year repeats itself, with hydroelectric power plants representing the largest share of electricity production among producing plant types with a share of 51.3%, followed by combined heat and power (CHP) plants at a share of 37.2%. The CHP plants are based on the combustion of bagasse as a by-product of Belize's sugar milling process. Non-renewable thermal plants equated to a share of 10.3% in 2022, which represents a 30.8% decrease over the reporting period. Lastly, solar PV generating plants were the smallest power producing plant by share, at just 1.1%.

With the Government of Belize's commitment to accelerate renewable energy uptake across both utility-scale and distributed generation, there is a grand opportunity for the further development and expansion of renewable energy plants, given the improvement of cost parity to fossil fuel-based plants. In addition, solar PV power plants is said to be at the top of the list of fastest growing sources of electricity generation across the globe. Given Belize's low solar PV power plant share and the need to decrease reliance on Mexico for electricity imports, it's safe to say that there is an untapped potential for solar PV implementation in Belize going forward.

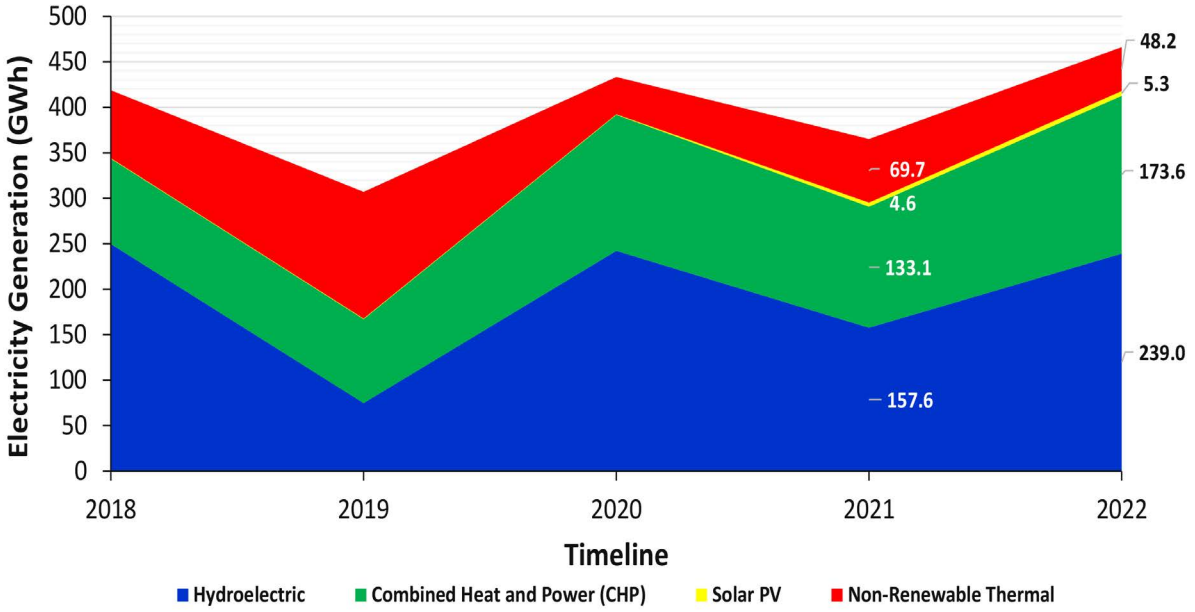


Figure 17 : Historical Timeline of Electricity Production by Plant Type in Belize

4.6 Share of Electricity Production by Source and Fuel Type

Figures 18 and 19 demonstrate a summary of the share of electricity production by source and fuel type in 2022. In 2022, renewable energy sources made up 52.9% of gross electricity production in Belize, representing a 13.3% increase compared to the previous year (39.6% in 2021). The growth in electricity generated from renewable energy sources during the 2021 – 2022 reporting period largely reflects an increase in hydroelectric and biofuel sources across power producing plants. With increases in renewable energy sources for electricity generation, there was a subsequent decrease in electricity imports from CFE (Mexico), equating to a share of 41% in 2022 (10.1% decline in comparison with 2021). Similar to electricity imports, non-renewable energy sources for electricity production in 2022 fell to a share of 6.1%, marking a 3.3% reduction in share over the 2021 – 2022 reporting period.

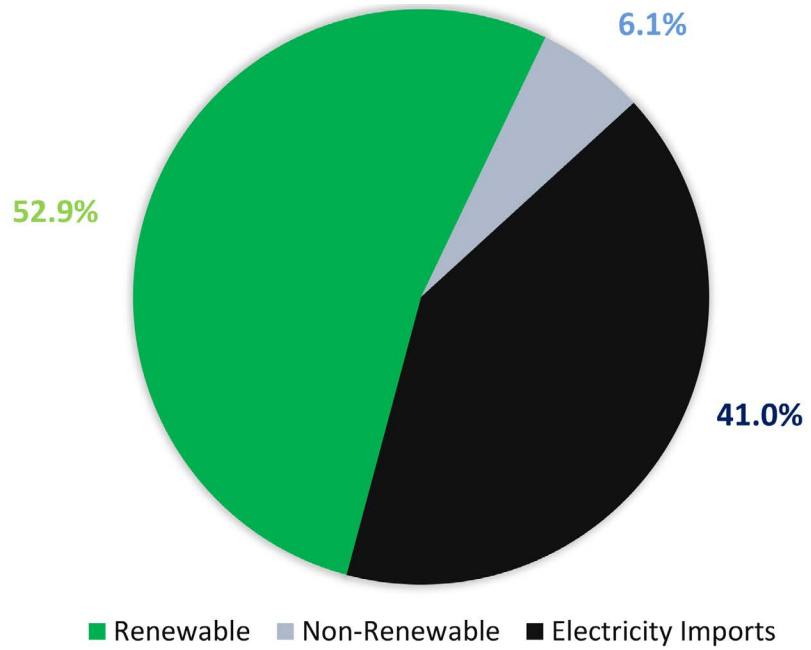


Figure 18 : Electricity Production Share by Source in 2022

Figure 19 illustrates overall electricity generation in Belize in 2022 disaggregated by proportion of fuel type within the electricity mix. A disaggregation of Figure 18 above, renewable energy sources dominated Belize's electricity mix in 2022 and is comprised of hydro, biofuel (bagasse) and solar PV. Hydro amounted to a share of 30.3%, while biofuel (bagasse) followed with a share of 22.7%, and solar PV with a mere percentage of 0.7%. Notably, hydroelectric power saw the largest share increase from year to year and plays a prominent role, harnessing Belize's water resources to generate clean and reliable electricity. While solar continues to gain traction, it is still not on the same level as its renewable energy counterparts, which are responsible for the majority of renewable's growth in electricity production.

In addition to renewables, Belize also employs non-renewable energy sources comprising diesel, fuel oil, and crude oil, with shares of 2%, 1.9%, and 2.3%, respectively. Diesel demonstrated a minimal increase of 0.4%, while fuel oil and crude oil decreased in share over the 2021 – 2022 reporting period. While these non-renewable resources continue to play a role (backup and stability) to ensure consistent supply in the electricity mix, the Government of Belize has established its commitment to reduce the reliance on non-renewable sources through targeted investments in infrastructure changes and technology adoption.

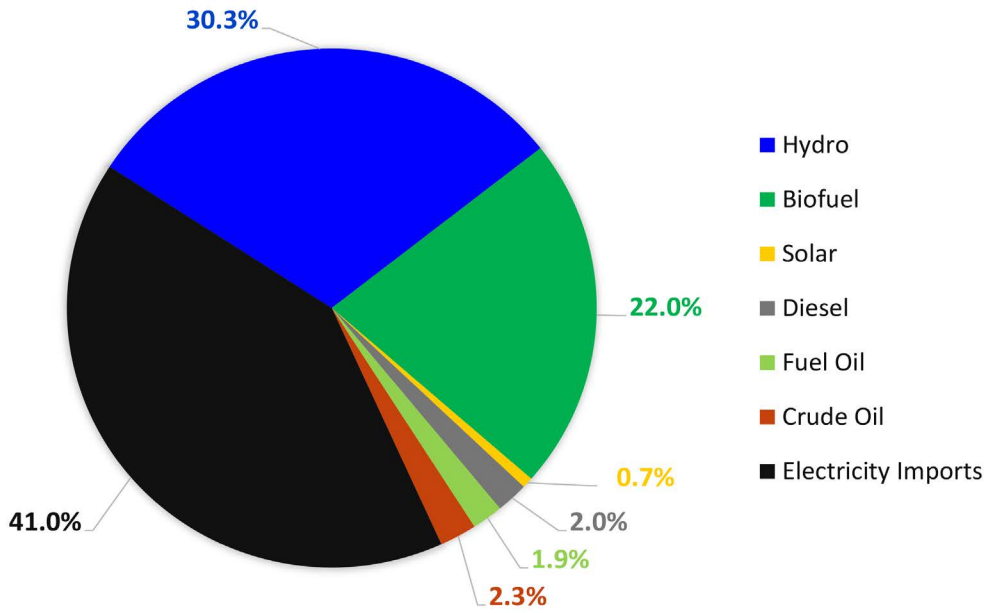


Figure 19 : Electricity Production Share by Fuel Type in 2022

4.7 Net Import of Electricity

Figure 20 showcases the historical timeline of electricity imports in Belize. Belize imported 323.3 gigawatt-hours (GWh) of electricity in 2022 from its neighbouring country of Mexico. Between 2021 and 2022, electricity imports decreased by 15%, from 380.2 gigawatt-hours (GWh) to 323.3 gigawatt-hours (GWh). Over the last decade, electricity imports peaked at 383.7 gigawatt-hours in 2019, when renewable energy sources were severely impacted by climate variability that year. Considering the rapid increase in energy demand, the last four years have displayed a significant increase in electricity imports compared to the years pre-2019, where imports remained constant from year to year.

Given Belize's reliance on imported electricity as a core component of maintaining a stable supply of energy to its people, energy security should be an issue of national concern. Greater utilization of domestic renewable energy and its associated technologies can help to mitigate the risks related to supply disruptions, and further emphasis on resource self-sufficiency is necessary.

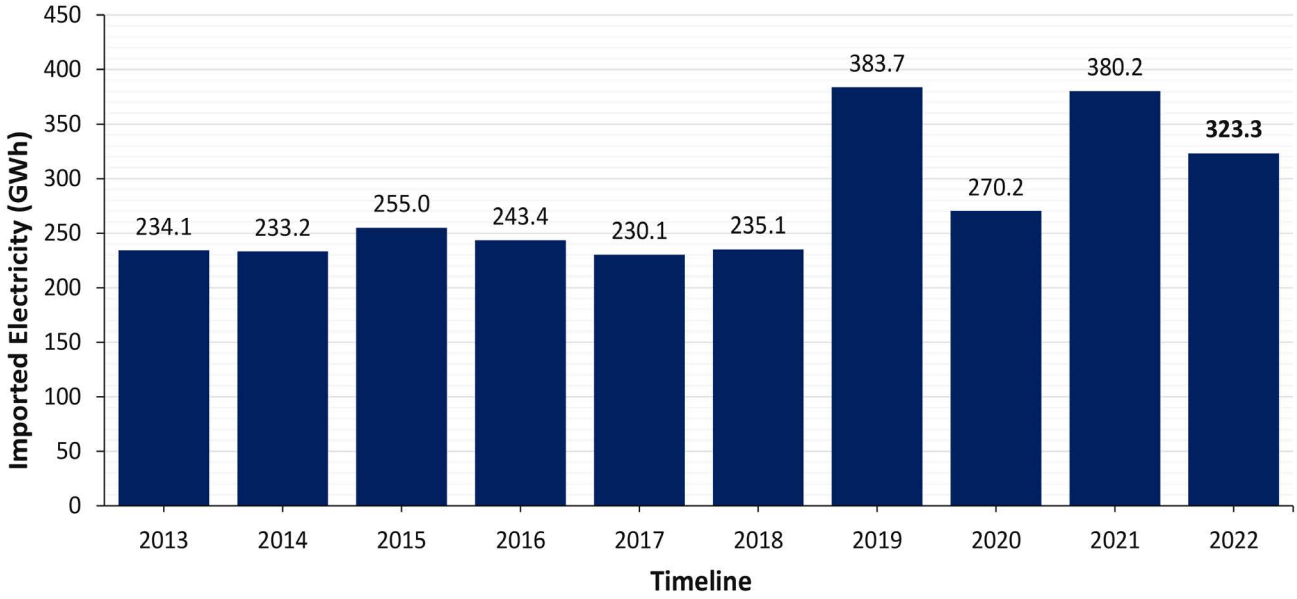


Figure 20: Historical Timeline of Net Electricity Imports in Belize

4.8 Gross Electricity Consumption by Sector

Gross electricity consumption, disaggregated by various sectors, offers great insight into energy utilization patterns in Belize (Figure 21). It should be noted that the following breakdown does not apply to any electricity being generated independently of the national grid, such as any rural mini-grids or Farmers Light Plant's grid in Spanish Lookout. Electricity consumption is disaggregated into four main customer groupings, which include: Commercial, Industrial, Residential, and Street Lighting. In Belize, the commercial and residential sectors collectively form a significant portion of gross electricity consumption. Following its trend over the past decade, the commercial sector continues with the largest electricity consumption at 299.2 GWh, displaying an increase of 34.2 GWh compared to 2021. The increase in consumption is linked to the continued rebound in the economy following the Covid-19 pandemic, as retail and public spaces began to operate at full capacity. Secondly, the residential sector exhibited a reduction in sector electricity consumption, similarly seen in 2019, equating to 239.9 GWh. BEL states that the reduction of residential sectoral electrical consumption is the effect of the population returning to office spaces and retail places (commercial sector) in contrast to the established remote working arrangements that were necessary in 2021.

The industrial sector is typically known for accounting for a substantial share of electricity consumption as the main driver of economic activity. However, this is not the case in Belize given the nation's lack of major manufacturing industries and/or the way in which the customer class is defined in Belize, with the possibility of some manufacturing activities being captured under the commercial class. Nevertheless, industrial sector electricity consumption in 2022 more than doubled to 37.9 GWh. Lastly, the street lighting sector's electricity consumption remained the same in 2022 as in 2021 at 24.9 GWh, with little to no variance in the historical timeline. Overall, effective implementation of energy efficient practices, adoption of smart technologies, and education to encourage changes in energy-related behaviour can limit further growth in consumption patterns and facilitate sustainable energy use.

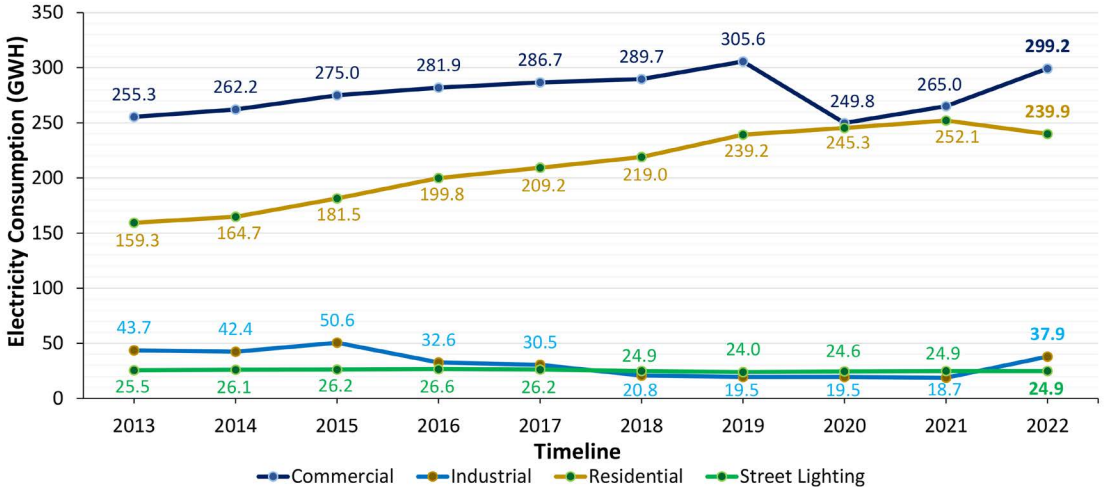


Figure 21: Historical Timeline of Electricity Consumption by Sector

4.9 Electricity Purchase, Sales, and Losses by Distribution Utility

Under its license granted by the Public Utilities Commission (hereinafter, PUC), BEL is the primary entity responsible for purchasing, transmitting, and distributing electricity throughout Belize. According to BEL (2023), electricity sales grew 7.3% in 2022, hitting a record high of 601.9 gigawatt-hours. BEL served a customer base of over 108,000 accounts in 2022 (BEL 2022 Annual Energy Report). Total electricity purchased by BEL from IPPs and CFE (Mexico) in 2022 equated to 685.3 GWh, including net generation by the electric utility. The total electricity purchased in 2022 is placed against electricity sales of 601.9 GWh. BEL's corresponding transmission and distribution losses were recorded at 11.9% for 2022, equating to 81.4 GWh. Providing electrical power to the Spanish Lookout community in western Belize, the Farmers Light Plant Corporation (FLPC) operates their own generation system and distribution network outside of the national electricity grid. In 2022, FLPC had aggregated energy sales of 17.2 GWh.

Belize's updated Nationally Determined Contributions (NDC, 2021) sets out an energy-specific action for the "Reduction in transmission and distribution losses from 12% to 10% by 2030, resulting in reduced electricity demand and better quality of supply". In 2022, BEL's corresponding transmission and distribution losses were recorded at 11.9% for 2022, equating to 81.4 GWh. This represented a significant decrease in losses (0.9%) over the 2021 – 2022 reporting period, aligning with the losses trend exhibited in the historical timeline (Figure 22).

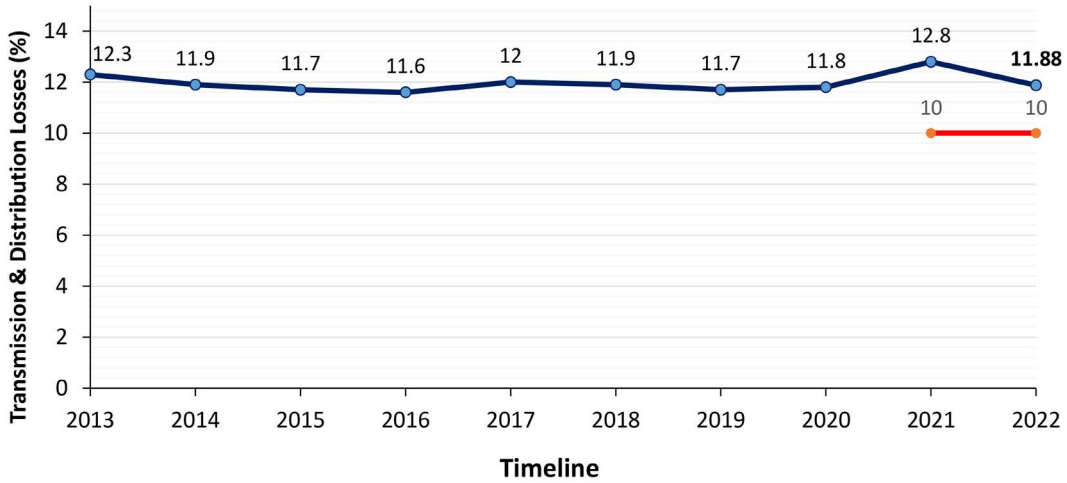


Figure 22: Historical Timeline of Transmission and Distribution Losses

5. Final Energy Consumption

5.1 Overview of ERCAP: Scope, Goals, Nature of Results, Breakdown of Results

This section presents a selection of notable data results from the End-Use Energy Consumption Survey conducted under the Energy Resilience for Climate Adaptation Project (ERCAP). The Energy Unit's role as beneficiary of the ERCAP took place throughout 2019 – 2022. Its objective was primarily to build in-house capacity in the areas of Energy Planning & Energy Modelling, while also providing data support for those processes, namely end-use or final energy consumption data. The country-wide survey was conducted in 2022 through MRC Consultants and Transaction Advisers and targeted three main sectors of national consumption sectors: Residential, Commercial, and Transportation. These sectors were sampled within the following scope:

1. Among the six districts of Belize, 2,500 residential households were targeted for interviews and 87% responded. This sample was patterned after the size of SIB's Labour Force Survey and is considered to be strongly representative, statistically.
2. One hundred seventeen businesses were interviewed, distributed across the six districts of Belize, of which 91% responded. Initially intended to target around a thousand commercial entities, low response rates and poor representativeness make this dataset statistically the weakest of the three sectors, and each result should be viewed with a cautious awareness of significant population biases.
3. The owners of 262 public road transportation vehicles were interviewed, for which the response rate was about 75%.

It should be noted that these data results should not be considered in any way comprehensive of Belize's entire energy consumption. Apart from the uncertainties inherent in any sample survey, these three sectors represent some of the high-consuming areas. Limitations in logistics and resources meant that sectors such as Agriculture or Public Buildings were not afforded specific focus.

5.2 Residential Survey

Within the residential sector, penetration of cooling technologies was defined through either the possession of an air-conditioning unit or a fan. The sample yielded a penetration percentage of 67%, which was lower than expected, as it would have been believed that most, if not all, Belizean households would own either a standing or ceiling fan. Regardless, what is nearly certain is that demand for both types of cooling units will increase with time alongside the intensity of climate change impacts.

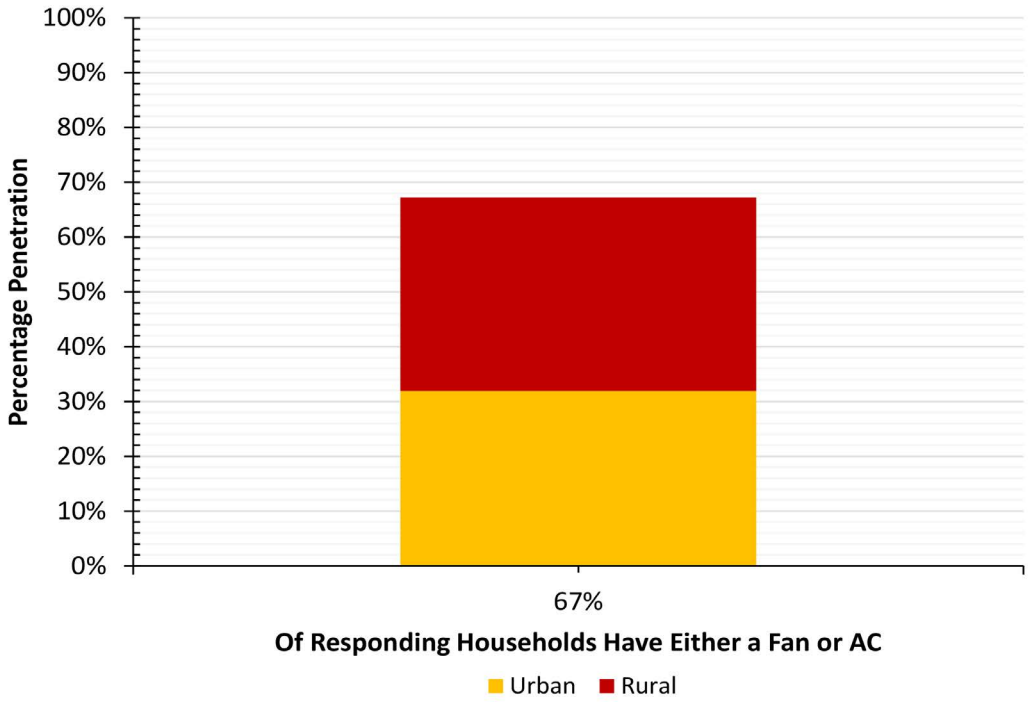


Figure 23 : Penetration of Cooling Technologies within the Residential Sector

Among households that utilized electricity as a lighting source, the different types of lighting fixture technologies were counted. It was notable that the most efficient fixture type: LED lamps, were already the most prevalent, and the least efficient, incandescent lamps, were already on their way to being phased out. Where lighting technologies are concerned, the transition towards energy efficient technologies can be considered underway.

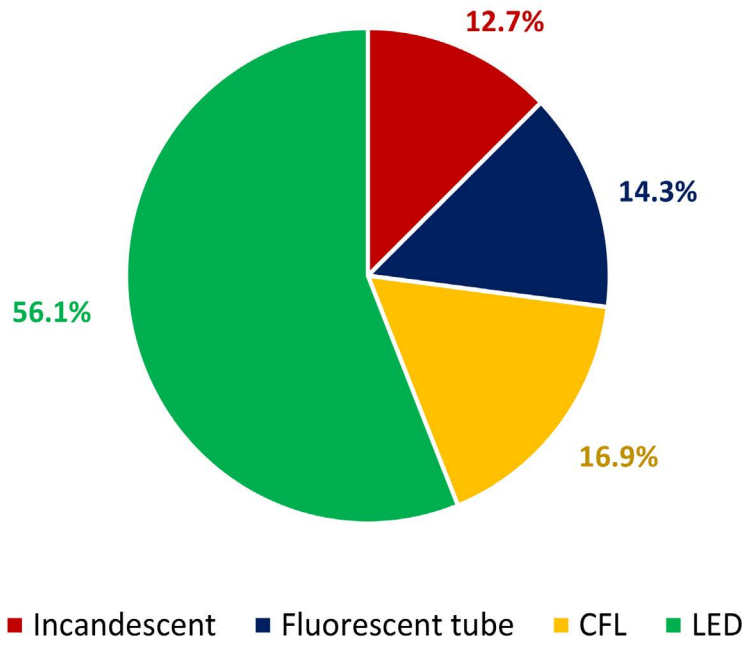


Figure 24 : Penetration of Lighting Fixture Technologies in Residential Sector

Considering the mitigation potential for energy efficiency and energy conservation measures, Figure 25 below shows the electricity uses that ranked highest in consumption (Consumption was derived from the rating of appliances and estimated time of usage, both provided by survey respondents). Refrigeration consumes the most electricity by far, but cooling, laundry and lighting also make up significant portions of the whole. Therefore, energy efficiency measures and technologies centered around these uses can be concluded as having the greatest impact. Examples include technology-replacements like inverter-type refrigerators and smart lighting, as well as behaviour-based mitigations, such as waiting until you have a full load before washing as many laundry loads as possible in succession rather than incidentally.

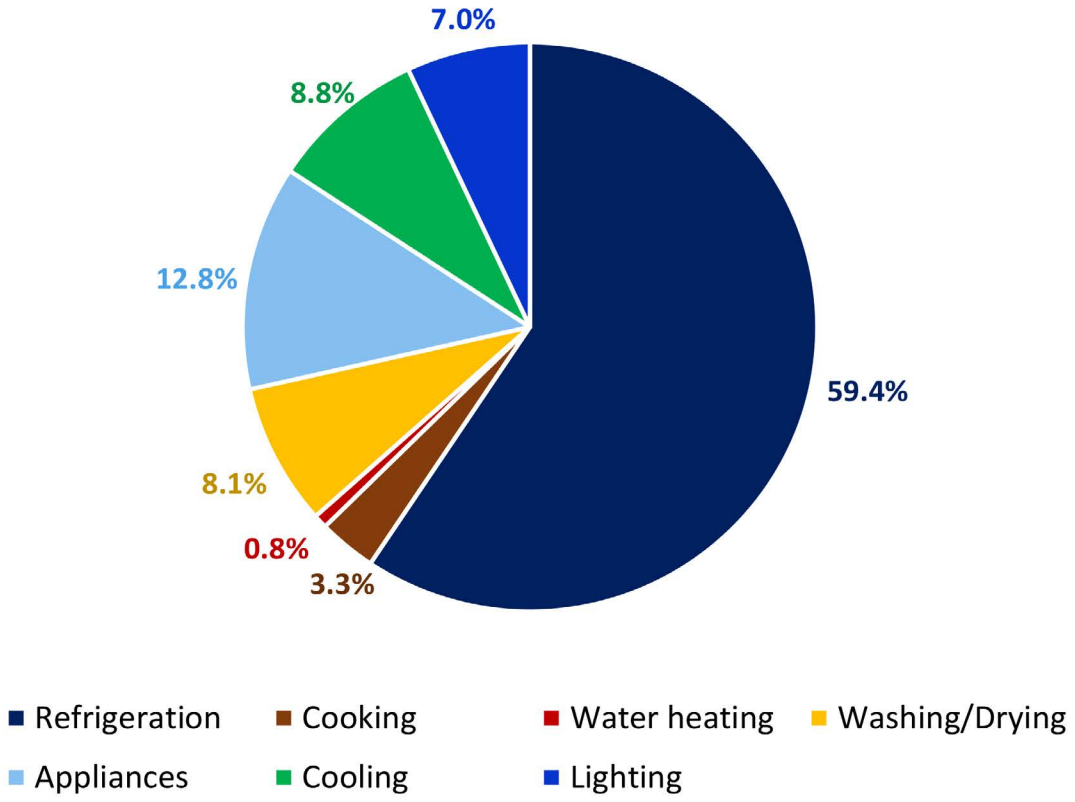


Figure 25: Share of Electricity Consumed in Residential Sector per Use

5.3 Enterprises/Commercial Survey

Compared to the residential sector survey, the commercial survey had a drastically reduced sample size and would be considered significantly less reliable. Within the sample set, 68% of businesses made use of air conditioning, while 26% did not. Still, this small sample showed what would be expected regarding air conditioning penetration, since a typical business would be more expected to have an AC unit than a typical household. Again, the worsening impacts of climate change imply an increase in cooling demand within all sectors, including commerce, making air conditioning one of the prime areas for energy efficiency and management going into the future.

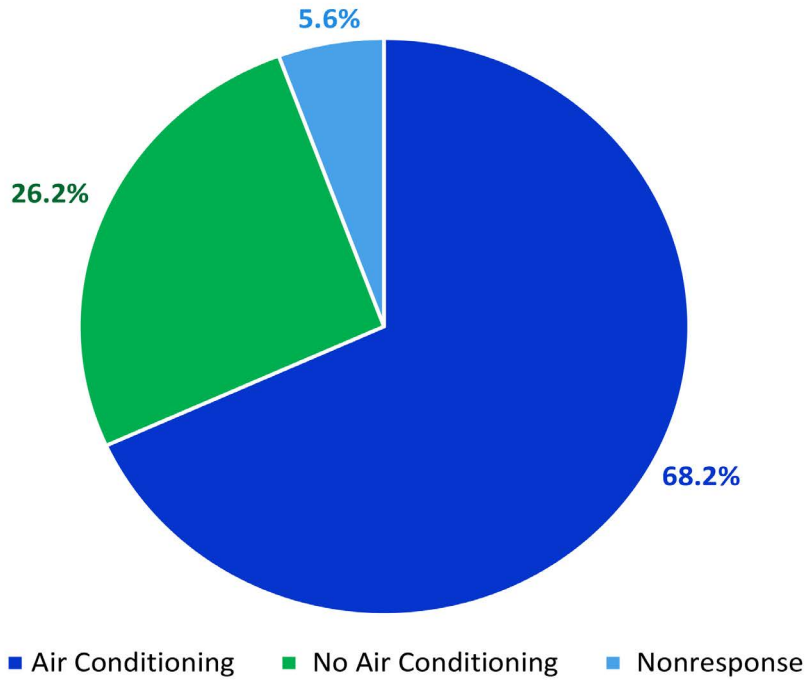


Figure 26 : Penetration of ACs within Commercial Sector Sample

Just as in the residential sector, but in more extreme proportions, Figure 27 below shows that LED lighting fixtures are the most prevalent at 81%, while the non-efficient incandescent fixtures are the least occurring at 3%. It is an interesting observation on the economic pressures of energy efficiency: the energy and cost savings become more worthwhile at larger scales. Put another way, the larger your bill, the more incentive you have to reduce consumption. Energy efficiency measures may see greater traction and impact among commercial proprietors where they can be brought on board.

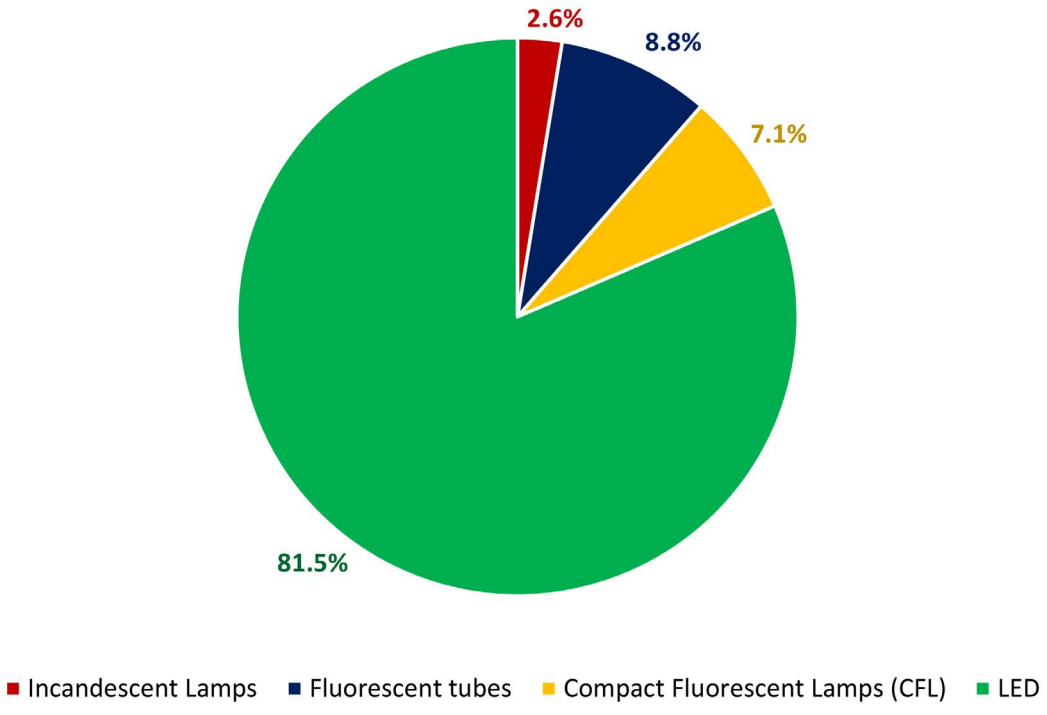


Figure 27 : Penetration of Lighting Fixture Technologies within Commercial Sector Sample

5.4 Transportation Survey

The results shown here focus on the public road transportation section of the survey. It shows the percentage breakdown of fuels by the type of vehicle/service. The inner ring shows the percentage of vehicle/service types within the public transportation sample. The outer ring shows which fuels can be attributed to each. It would be expected that all buses in the sample use diesel and that most taxis use gasoline. What is interesting to note, however, is the encroachment of cheaper fuels in the form of LPG and diesel among the taxis and busitos[2]. This creates an overall picture where 60% of surveyed public transportation respondents use gasoline, but 22% use diesel, and nearly 18% use LPG. Proprietors are cognizant of the importance of both cost and energy savings to their business models. These services can have evident potential for energy efficiency in fuel-switching (to LPG, natural gas, or electricity) or fuel-efficiency (replacement by more efficient vehicle types).

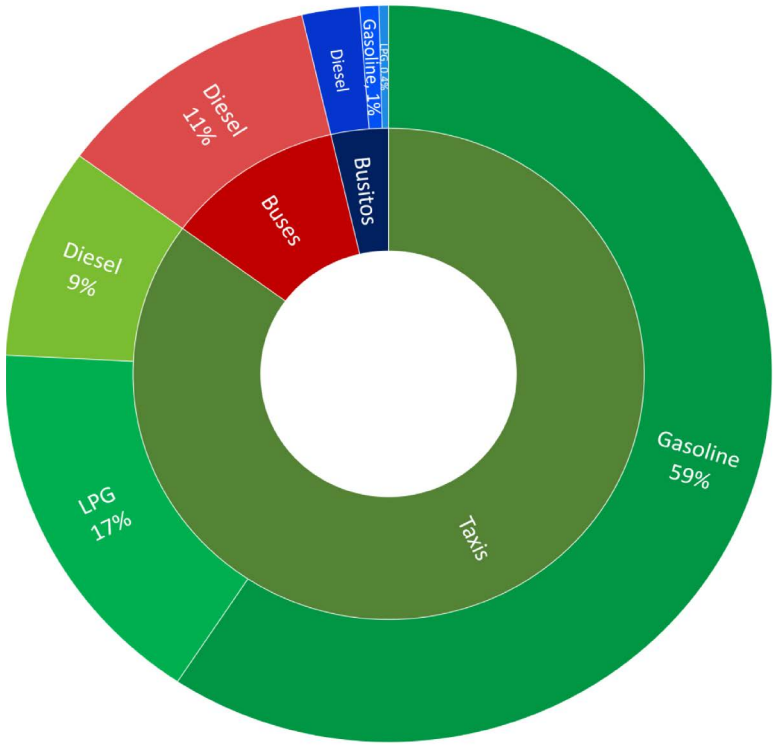


Figure 28 : Shares of Fuel Consumed within Public Transportation by Vehicle Type

5.5 Conclusion & Next Steps

While the final consumption survey yielded several results that fit within expected parameters, some outcomes made the researchers unsure whether there were errors in the survey or in existing assumptions. In addition, as the first data collection project of its kind, this survey could not provide any insight as to where these consumption patterns are moving. To compile a trend, several data points are needed. The only solution to both these issues, as well as that of holistic sector coverage, is to carry out similar surveys going forward. Even sample surveys of reduced scale require significant resources to carry out. However, as the data outputs have usefulness across public and private sectors, it is worthwhile to consider innovative routes to support them.

[2] Small vans used for taxing persons at shorter distances in comparison to buses.

6. Energy Prices

BEL publishes its Mean Electricity Rate (MER) as part of its annual reports. The MER is considered a gauge of what power costs for the average consumer and of the country's progress towards making electricity more affordable. It should be noted that the MER is an overall indicator and is not reflective of which specific tariff is being applied to a given customer at any point in time. What it does show, is that Belize's national electricity rates have remained notably resilient throughout the past few years, despite the combined economic shocks of reduced local generation in 2019 and 2021, as well as reduced demand during the lockdown period of 2020 and 2021. This resiliency can be attributed in part to the regulatory framework that equalizes the PUC's requirements with the policies of BEL. 2022 has seen a slight reduction of $0.007 from 2021, less than a cent, which is in keeping with the recent trend.

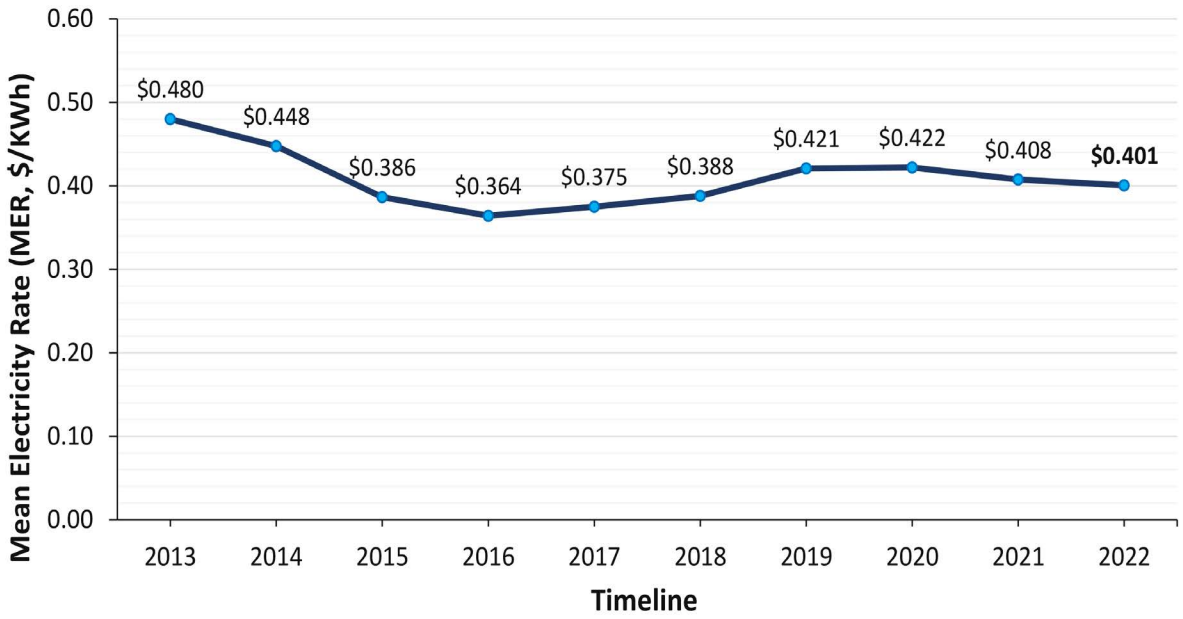


Figure 29: Historical Timeline of Mean Electricity Rate (MER, BZD$/KWh)

For more information, visit BEL's website to help you understand your electricity bill[3].

[3]Tariff Categories: https://www.bel.com.bz/Rate_Schedule.aspx, Bill Calculator: https://www.bel.com.bz/Customer-BillCalculator/

6.2 Average Pump Price for Conventional Refined-Petroleum Fuels

It doesn't take a government-released analysis to know that the pump price of road transportation fuels has seen steady increases in the past year. Every consumer sector has felt its effects. Since 2021, premium gasoline has seen the largest increase: $3.87 per gallon – a 33% rise. Diesel follows with a 26% increase of $2.71 per gallon. Regular Gasoline saw the least increments with $2.11 – still quite significant – of 19%. These rises are generally attributed to instabilities within global markets, driven by inconsistencies in supply and demand, shifts in geopolitical policies, and the risks of regional conflicts. They also increase the incentive for fuel conservation and efficiency measures. It is more prudent than ever to reduce trips, use less AC, and take every opportunity to carpool.

Figure 30: Average Annual Pump Price of Refined Petroleum Fuels for Transportation

6.3 Annual Average Price for Liquified Petroleum Gas (LPG)

The Government of Belize has maintained controlled prices of retailed LPG, considering it an essential commodity for consumers. In October of 2021, the Supplies Control Unit, and with it, control of LPG prices, was relocated from the Belize Bureau of Standards to the Ministry of Agriculture, Food Security and Enterprise. These prices for the past two years are presented in Figure 31 below as averages by yearly quarters because there are no predetermined intervals to the setting of effective prices. It is clear that while 2022 has seen a notable trend in prices decreasing, it has yet to supersede the steady rise that has been consistent with other commodities in recent years. The highest average price seen for 2022 was $1.52 per pound, while the lowest was $1.35 per pound, which was still higher than the lowest price for the previous year: $1.15 per pound.

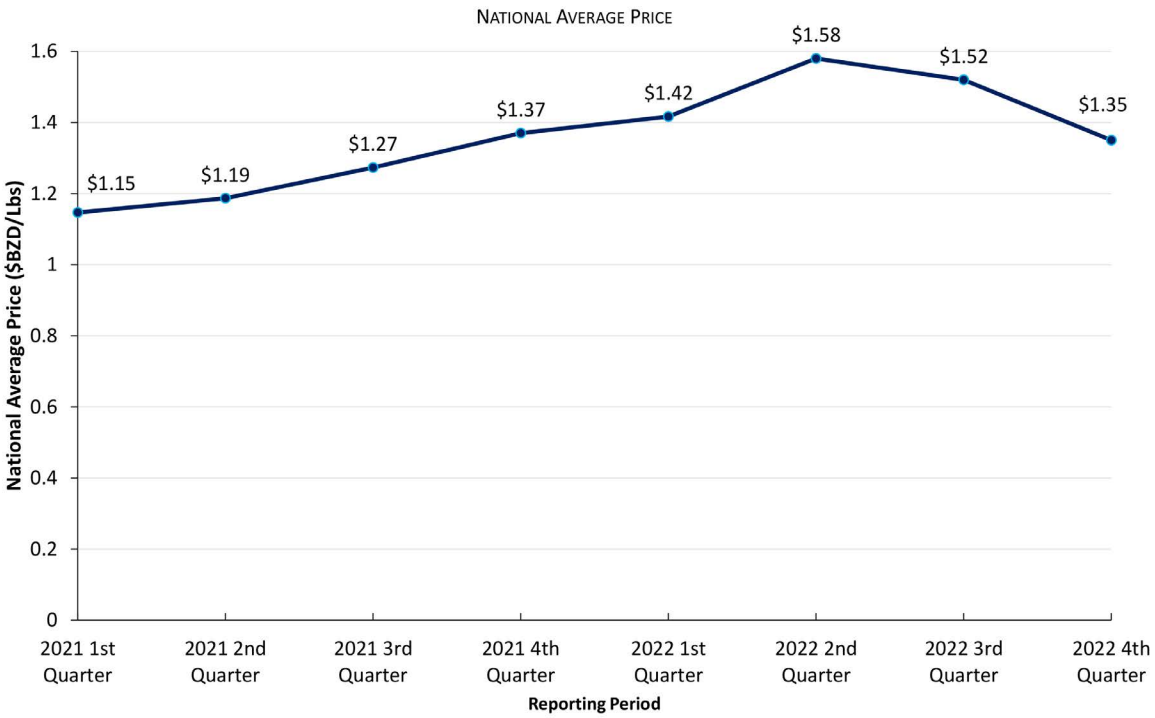


Figure 31: Historical Trend for Average Price of LPG: Quarterly Breakdown

Figure 32 below shows that the yearly average price of LPG has risen steadily over the past three years, whatever the incidental variances in prices were within those years. For the last month of 2022, the average LPG price per pound was BZD $1.35 across both urban and rural areas. Regardless, the yearly average for 2022 was BZD $1.47 per pound – 12 cents higher. Consumers should consider that whatever the immediate price of 'butane' is, conservation practices like tracking leaks, using low heat where possible, switching off flame, and proper maintenance of your stove continue to make pragmatic sense in the long term.
To stay abreast of the controlled LPG prices, consumers can follow the Government's official press releases on Facebook.

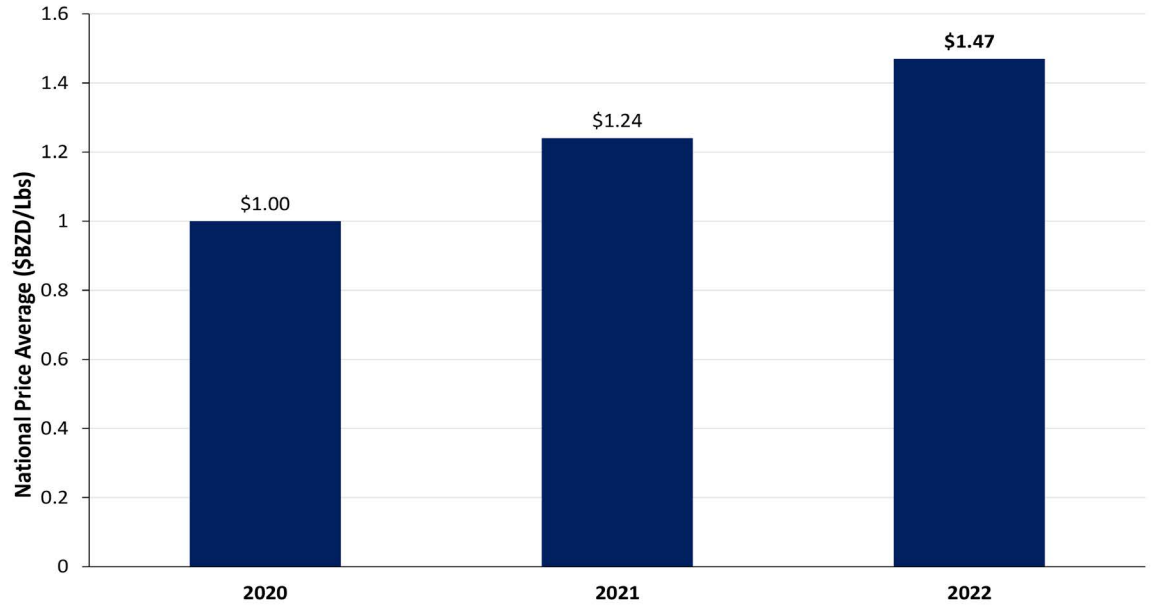


Figure 32: Historical Trend for Average Price of LPG: Yearly Breakdown

7. Environment and Climate Protection

"Sustainable energy for climate change mitigation and adaptation"

Climate and Sustainability Goals

The message has been very clear: the window for which to impose meaningful alterations to prevent the worst impacts and risks associated with climate change is closing fast (Intergovernmental Panel on Climate Change, 2022). A climate crisis is far-reaching, which threatens and impacts the natural environment, the well-being of people and their communities, and the well-being of future generations to come. The climate urgency and sustainable development perspective must be underpinned by a swift transformation of the energy sector, with its defining role in combating climate change being more pivotal than ever. Many nations have embraced the responsibility to their natural environment and their people, to develop a low-carbon future, grounded in innovation, environmental stewardship, and social progress. This requires countries around the globe to rethink their energy strategies and recognize how the actions within their energy sector profoundly shape their nation's and the planet's future.

With the signing of the Paris Agreement, the stage was set for a paradigm shift where both developed and developing countries pledged to reduce greenhouse gas emissions and adapt to the impacts of climate change (low-carbon and climate-resilient pathway). The overall goal of the Paris Agreement is to "limit global warming to well below 2° Celsius, preferably to 1.5° Celsius, compared to pre-industrial levels" (United Nations Framework Convention on Climate Change, 2021).

At the heart of this energy transformation are ambitious climate and sustainability goals. These goals, along with their associated indicators, serve as a directional guide to the transformative pathway toward a low-carbon and resilient energy sector. Belize, like many other nations, has anchored climate commitments in legally binding frameworks that can enforce long-term implementation of national priorities and withstand political cycles. Overall, climate and sustainability goals in the energy sector transcend numerical targets and reflect social and economic dimensions towards a greener energy future.

7.1. Sustainable Development Goal 7

In 2015, the 2030 Agenda for Sustainable Development was adopted by the United Nations General Assembly. At the core of the agenda lies its Sustainable Development Goals (hereinafter, SDGs), which outline a set of targets and indicators to guide global efforts to end poverty and ensure prosperity for all people while tackling climate change and working to preserve our environment (United Nations, 2017). Of the 17 SDGs created, a dedicated and stand-alone goal on Energy is SDG 7 – Affordable and Clean Energy. SDG 7 aims to "ensure access to affordable, reliable, sustainable, and modern energy for all." Under SDG 7, there are five energy-related targets (Table 3).

Title	Target
7.1	By 2030, ensure universal access to affordable, reliable, and modern energy services.
7.2	By 2030, increase substantially the share of renewable energy in the global energy mix.
7.3	By 2030, double the global rate of improvement in energy efficiency.

7.A	By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.
7.B	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support.

7.2 Belize Sustainable Energy Strategy and Action Plan

The strategy and action plan, which was created in 2015, identified energy efficiency and renewable energy potential for Belize and formed the blueprint for realizing Belize's sustainable energy goals within the electricity sub-sector. The report highlighted Belize's potential and targets based on a Business-as-usual scenario (BAU) versus a national sustainable energy strategy (NSES) scenario for Belize. Table 4 lists energy-related targets found within the Belize Sustainable Energy Strategy and Action Plan.

Table 4. Targets Established by the Belize Sustainable Energy Strategy and Action Plan

Category	Target
Renewable Energy	Renewable energy could represent 89% of supply by 2033.
Energy Efficiency	Improve Energy Efficiency and Conservation by at least 28% by 2033.

7.3 Nationally Determined Contributions (NDCs)

Belize as a signatory to the Paris Agreement, is required to prepare, communicate and maintain successive NDCs that it intends to achieve. As such, following Belize's submission of its first NDC in 2016, it submitted its updated NDC in September 2021 following a consultative development process. According to Belize's updated NDC, "Belize has committed to increasing emissions reduction ambition in this updated NDC, including through the use of nature-based solutions in the FOLU sector intended to increase removals, whilst underpinning the NDC development process with more robust and realistic data and projections in all sectors" (Government of Belize, 2021).

Overall, the Belize updated NDC represents a 5% increase in overall commitments with the addition of sectoral adaptation actions aimed at building resilience and development capacity. In relation to the Energy Sector, Belize's commitment to enhancing its climate ambition is showcased in Table 5 through the following energy sector targets and actions:

Table 5. Belize's Updated NDC Energy Sector Commitments: Targets and Actions

Type	Commitment	SDG Linkages
Target	**Avoid emissions from the power sector equivalent to 19 KtCO2e per year through system and consumption efficiency measures amounting to at least 100 GWh/year by 2030.**	**SDG 7, 13**
Action	Reduction in transmission and distribution losses from 12% to 10% by 2030 resulting in reduced electricity demand and better quality of supply	SDG 7, 13
Action	Improve energy efficiency and conservation by at least 10% by 2030 compared to a BAU baseline projection, including through an increase of appliance efficiency in buildings and implementation of building codes, appliance standards and labels and promotion of energy efficient technology in the tourism sector	SDG 7, 13
Target	**Avoid 44 KtCO2e in the national electricity supply by 2030 through the introduction of expanded capacity from renewable energy sources**	**SDG 7, 13**
Action	Achieve 75% gross generation of electricity from renewable energy sources by 2030 through the implementation of hydropower, solar, wind and biomass, including in the tourism sector.	SDG 7, 13
Action	Reduce emissions from high carbon electricity sources including taking 2MW diesel generation offline by 2022 and converting new LPG generation to CNG by 2026.	SDG 7, 13
Action	Install 40 MW utility-scale solar power by 2025.	SDG 7, 13
Action	Implement an interconnection policy and regulatory framework to facilitate distributed renewable power generation by 2022.	SDG 7
Action	Expand the use of biomass, including bagasse, for electricity generation.	SDG 2, 7, 13

[4] Small Paris Agreement, Article 4, Paragraph 2.

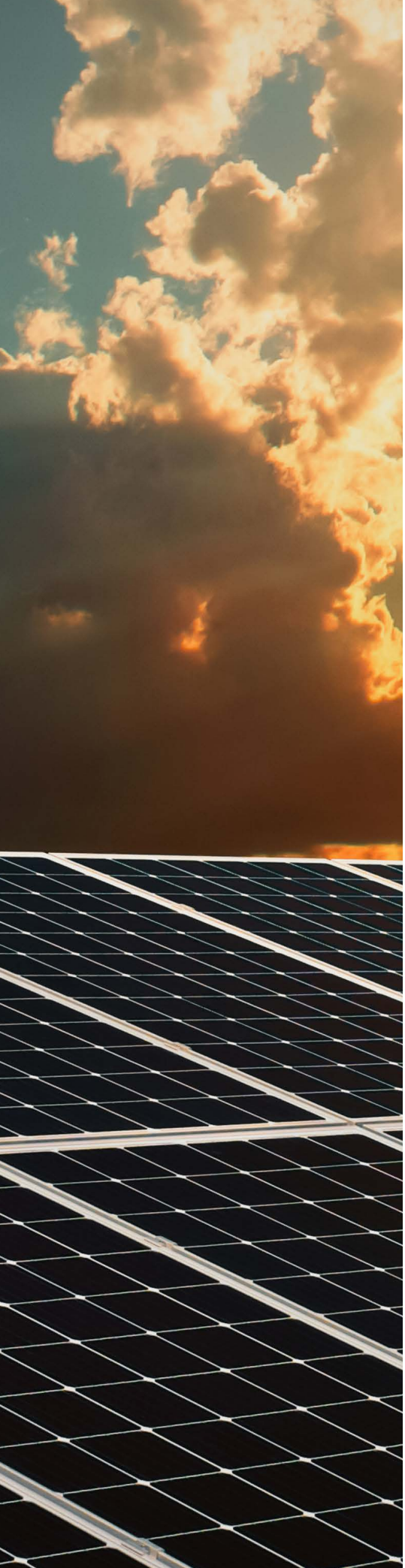
Action	Explore the feasibility of onshore wind power generation and flexible storage technologies to complement high levels of variable renewable power sources	SDG 7, 13
Target	**Avoid 117 KtCO2e/year from the transport sector by 2030 through a 15% reduction in conventional transportation fuel use and achieve 15% efficiency per passenger- and tonne-kilometre through appropriate policies and investments**	**SDG 7, 13**
Action	Improve efficiency in the public transit system through the deployment of 77 hybrid and electric buses by 2030 (17 by 2025)	SDG 7, 11, 13
Action	Implement a policy framework to promote more efficient vehicles and alternative fuels/blends through incorporation of fuel economy labels; emissions testing; fuel economy standards, limitations and emissions-based taxes/feebates for imported vehicles by 2025	SDG 7, 11, 13
Action	Facilitate adoption of electric vehicles in the passenger fleet by conducting a feasibility study for EV penetration, including assessment of potential incentives, and investing in EV charging infrastructure	SDG 7, 11, 13

Given the risks and impacts associated with the global climate challenge, energy negotiations and polices in the current context have been focused on the importance of decarbonizing the energy system and the transition to net zero status. Belize is committed to the global effort to combat climate change while developing its economy sustainably through the pursuit of its NDC targets and actions. Embracing a multi-faceted approach, various strategic initiatives and projects are underway to propel the nation toward a more sustainable and climate-resilient future..

The electric utility continues its work to proactively embark on a journey to enhance its resilience and operational efficiency in times of increased extreme weather events and external factors. Belize aims to empower energy efficiency through ambitious initiatives. Energy-efficient lighting has gained traction, and the Ministry of Public Utilities, Energy, Logistics, and E-Governance, with support from the European Union, has implemented an energy management program for public buildings to identify areas for energy efficiency improvements and provide technical assistance and support. Additionally, energy efficiency labels and standards have been developed in collaboration with the Belize Bureau of Standards to have empowered citizens make informed decisions while increasing energy efficiency.

Belize's resounding commitment to achieve 75% gross generation of electricity from renewable energy sources by 2030 showcases a momentous milestone in 2022 – renewable energy accounting for an impressive 53% of our total gross electricity generation - equivalent to 90% of in-country electricity generation. Recognizing the crucial role of decarbonization in the transport sector, Belize has begun the transition from conventional vehicles to electric vehicles, with the start of electric charging station installations happening around the country through the electric utility, Belize Electricity Limited. Additionally, MPUELE, with funding from the European Union, has embarked on the first-of-its-kind electric bus pilot project in Belize aimed at facilitating the transformation within Belize's Transportation Sector by enabling low-carbon means of transportation.

In conclusion, Belize's energy sector maintains commendable advances toward its Nationally Determined Contribution targets and actions to navigate the challenges of climate change with unwavering resolve.



Reference

Asghar, Z. (2008). Energy-GDP Relationship: A Casual Analysis for the Five Countries of South Asia. Applied Econometrics and International Development, 8(1). Retrieved from https://www.usc.gal/economet/reviews/aeid8114.pdf

Beare, M. (2018, November). The Importance of Energy Security. Retrieved from Oxford Policy Management Limited: https://www.opml.co.uk/blog/importance-energy-security

Belize Electricity Limited. (2020). 2019 Annual Report. Belize City: Belize Electricity Limited. Retrieved from https://www.bel.com.bz/annual_reports/Annual%20Report%202019.pdf

Belize Electricity Limited. (2022). 2021 Annual Report. Belize City: Belize Electricity Limited. Retrieved from https://www.bel.com.bz/annual_reports/Annual%20Report%202021.pdf

Belize Electricity Limited. (2023). BEL 2022 Annual Report . Belize City: Belize Electricity Limited.

Bunker, K., Torbert, R., & al., e. (2018). Belize Consolidated Project Plan. Rocky Mountain Institute.

Commonwealth Secretariat. (2021). National Climate Finance Strategy of Belize 2021 - 2026. Belize: Commonwealth Secretariat.

Encyclopaedia Britannica Inc. (2023). Britannica - Energy, physics. Retrieved from Encyclopedia Britannaica: https://www.britannica.com/science/velocity

Energy Unit. (2021). 2020 Belize Energy Balance. Belmopan: Ministry of Public Utilities, Energy and Logistics.

European Environment Agency. (2022, March 4). Indicators: Share of energy consumption from renewable sources in Europe. Retrieved from European Environment Agency: https://www.eea.europa.eu/ims/share-of-energy-consumption-from

Geology and Petroleum Department. (2020). Petroleum Companies Operating in Belize. Retrieved from Ministry of Economic Development: https://med.gov.bz/petroleum-companies-operating-in-belize/

Geology and Petroleum Department. (2021, March 23). Belize Petroleum Industry. Retrieved from Ministry of Economic Development and Petroleum: https://med.gov.bz/belize-petroleum-industry/

Government of Belize. (2016). Belize Nationally Determined Contributions. Belmopan: Government of Belize. Retrieved from https://unfccc.int/files/focus/ndc_registry/application/pdf/belize_ndc.pdf.

Government of Belize. (2021). Updated Nationally Determined Contributions. Belmopan: Government of Belize.

Intergovernmental Panel on Climate Change. (2022). Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the IPCC. Cambridge, UK, and New York, USA: Cambridge University Press.

International Energy Agency . (2021). Climate Change. Retrieved from International Energy Agency: https://www.iea.org/topics/climate-change

International Energy Agency. (2022). Climate Change. Retrieved from International Energy Agency: https://www.iea.org/topics/climate-change

International Energy Agency. (2022, March). Global Energy Review: CO2 Emissions in 2021. Paris: International Energy Agency. Retrieved from https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2

International Energy Agency, International Renewable Energy Agency, United Nations Statistics Division, World Bank, & World Health Organization. (2022). Tracking SDG 7: The Energy Progress Report. Washington, DC.: World Bank. Retrieved from https://trackingsdg7.esmap.org/data/files/download-documents/sdg7-report2022-full_report.pdf

Masson, M., Ehrhardt, D., & Lizzio, V. (2020). Sustainable Energy Paths for the Caribbean. Washington: Inter-American Development Bank. doi:10.18235/0002236

Merriam-Webster, Incorporated. (2023). Merriam-Webster: Energy definition. Retrieved from Merriam-Webster: https://www.merriam-webster.com/dictionary/energy

National Climate Change Office. (2021). Belize's Fourth National Greenhouse Gas Inventory Report. Belmopan, Belize.: Government of Belize. Retrieved from https://unfccc.int/sites/default/files/resource/Fourth%20National%20GHG%20Inventory%20rev%20Aug42020.pdf

Oxford University Press. (2023). Oxford Languages. Retrieved from https://languages.oup.com/

PUMA Energy Bahamas S.A . (2021). Where we operate: Belize. Retrieved from Puma Energy: https://pumaenergy.com/en/whoweare/whereweoperate/detailspage?countryName=Belize&region=2

Secretariat, C. (2021). National Climate Finance Strategy of Belize 2021 - 2026. Belize. : Commonwealth Secretariat.

South Trinidad Chamber of Industry and Commerce. (2009). Assessment of the Energy Service Sector in the Caribbean . San Fernando: South Trinidad Chamber of Industry and Commerce.

Statistical Institute of Belize. (2019). Belize National Housing Characteristics (Statistics Poster). Belmopan, Belize. Retrieved from http://sib.org.bz/wp-content/uploads/HouseholdCharacteristics_2019-04.pdf

United Nations. (2017). The Sustainable Development Goals Report. New York: United Nations.

United Nations Framework Convention on Climate Change. (2021). The Paris Agreement. Retrieved from United Nations Framework Convenment on Climate Change: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

United Nations Statistics Division. (2021, February). SDG Indicators: Metadata Repository. Retrieved from Sustainable Development Goal Indicators: https://unstats.un.org/sdgs/metadata/?Text=&Goal=7&Target=

Vivid Economics. (2021). Low Emissions Development Strategy and Action Plan: Belize. Belmopan: National Climate Change Office (Government of Belize).

World Meteorological Organization. (2021, October 31). State of Climate in 2021: Extreme events and major impacts. Retrieved from World Meteorological Organization: https://public.wmo.int/en/media/press-release/state-of-climate-2021-extreme-events-and-major-impacts

Annex

Methodological Notes

The information presented below is dedicated to the elucidation of any issues in data quality, coverage, management, methodological treatments, and/or other areas to ensure transparency and visibility for data users. Methodological notes are described below:

Section 2.1 Energy Balance:

Belize's 2022 energy balance table is presented in a detailed format as recommended by IRES. The degree of detail presented was dependent on data and resource availability and the underlying classifications used in context with Belize's energy landscape. The detailed definition of energy products and energy flows in the development of Belize's 2021 Energy Balance Table can be found within the IRES document (Chapter 3, D. Definition of Energy Products & Chapter 8, C. Structure of Energy Balance). Prerequisite energy data on final consumption by sectors in Belize is currently underreported/not available in some cases.
Biofuels (bagasse): the FORECAST.ETS excel function was employed for the calculation of steam production data for Belcogen in 2022, using data from the previous 5 years (2017 – 2021). The excel function returns a statistical value as a result of time series forecasting for steam production.

Section 2.2 Energy Indicators:

Energy Intensity: the unit of measure of tons of oil equivalent per $1000 USD of GDP as stipulated by the International Energy Agency and the International Atomic Energy Agency (2005) remains. Updated and official GDP statistics were unavailable during the production of this report. Hence, once data becomes available the 2022 energy intensity parameter will be calculated and published.

Energy Import Share of Total Primary Energy Supply (TPES): Total Primary Energy Supply was recalculated, resulting in changes to energy import share over the historical timeline.

Renewable Energy Share of Total Primary Energy Supply: Total Primary Energy Supply was recalculated, resulting in changes to renewable energy share over the historical timeline.

Annual GHG Emission from the Energy Sector: For the national GHG inventory report, the IPCC Inventory Software was utilized as GHG inventory software with the goal of implementing default tier methodologies according to the 2006 IPCC guidelines. The IPCC inventory software enables parties to prepare national GHG inventories in line with the established guidelines and provides standardized formats for reporting tables and worksheets.

[5] IPCC Inventory Software (Version 2.691 of January 23, 2020). Produced by IPCC Task Force on National Greenhouse Gas Inventories.

All energy sector activity data were disaggregated by reference year and source categories, converted to energy units, and inputted into the IPCC Inventory Software. No country-specific or plant-specific emissions or emission factors (EFs) were available; hence, emissions were calculated by combining activity data (fuel consumption) with default emission factors from the 2006 IPCC Guidelines/Inventory Software. In addition to emission factors, default global warming potentials were used to calculate carbon dioxide (CO2) equivalents. CO2 equivalent is a measure of how much a gas contributes to global warming, relative to CO2 (GWP = 1). Global warming potentials (100-year time horizon) from IPCC's Fourth Assessment Report (2007) was used to calculate carbon dioxide (CO2) equivalents.

Section 3.3 Primary Energy:

The energy supply represented by Belize's consumption of fuelwood or firewood, for 2022 as well as earlier annual energy reports, is not quantified by direct measurement or monitoring, but is instead derived from yearly estimates based on population and labour force survey data published by the Statistical Institute of Belize, for which the baseline is the 2010 national census.

Section 3.3.1 Primary Energy Supply, by fuel type:

The energy supply represented by fossil fuel production within Belize would typically include petroleum gas flared on-site, along with the unrefined products natural gas and crude oil, according to international energy reporting standards. However, that aspect of fossil fuel energy flows is not reported here.

Section 4.1 Installed Electricity Generation Capacity

Installed electricity Generation Capacity included changes reported from year to year. The variation reported for UB – JICA Solar and Caye Caulker Plant (CCK) was due to an error in the data reported the electric utility, and the installed capacity in 2022 should be denoted a revision.

Section 4.2 Peak Electricity Demand

Of several historical trends presented throughout this report, the Peak Electricity Demand is the only one assigned a regression value. This is because while peak demand values are incidental, the increase in national electricity demand over time is considered an important driver in energy sector development. The peak demand serves as a proxy for national demand and its progression is notable to highlight.

Section 4.5 Electricity Production by Plant Type

The data in related to electricity production required the classification of independent power producers to showcase the disaggregation of power plant types in Belize producing electricity and the shares provided to power production. Plants were then classified as: Hydroelectric, Combined Power and Heat (CHP), Solar PV and Non-Renewable Thermal plants. This may be subject to change upon further review of classification types in the future.

Section 4.8 Gross Electricity Consumption by Sectors:

The breakdown of gross electricity consumption by economic sectors is defined by the customer tariff groupings as stipulated by Belize Electricity Limited. Therefore, its coverage is limited to national grid-connected customers and does not include microgrid or mini-grid systems, which are present in Belize. It also excludes coverage of privately generated electricity or electricity sourced from distributed generation.

It should also be noted that while BEL utilizes five tariff groupings: residential, social, commercial, industrial, and street lighting. For the purposes of this report, we have aggregated the social and residential groupings, resulting in four main groups.

Section 6.3 Annual Average Price for Liquified Petroleum Gas (LPG)

Prices for LPG are based on the Belize Bureau of Standard's publications of controlled prices. With each new publication designating that new prices are in effect over existing ones, the values are 'effective' prices and go into effect at irregular time intervals. However, they are presented here in quarterly averages to smoothen their presentation over time. Due to this treatment, it may be noted that, as there were no effective price updates in the first quarter of 2020, the average for 2019 Q4 was used since that would represent the prices in effect at the time. Additionally, the average price of LPG on an annual basis for available data was also presented.

Measurement/Conversion Units

A summary of units used throughout the 2022 Annual Energy Report composes this section, along with their definitions and derivations (Table 6 and 7). Included are some conversions to the metric system of units. Though Belize has historically made use of both Imperial and American units, recent movements towards an internationally recognized standard has prompted us to incorporate metric-derived systems.

Economics

All dollars and cents that appear in this report are in Belize dollars (hereinafter, BZD) unless stated otherwise. Each Belize dollar is exchanged at the rate of approximately 0.5 to 1 US dollar. Gross Domestic Product (hereinafter, GDP) is measured in Belize dollars, while GDP per capita is measured in Belize dollars per person (BZD/person).

Area

Spatial area, which is used to quantify land and land uses, is measured in km^2.

Volume

Instead of the corresponding SI unit of cubic metres (m3)/kilolitres (kL) for volume, barrels (bbl) and US Gallons (US Gal), equivalent to 159 litres and 3.8 litres, respectively, are used for the volumetric measurement of liquid fuels such as gasoline and diesel. For purely gaseous fuels such as natural gas, thousand cubic feet (Mcf) are used.

Mass

For most solid fuel masses, the SI unit kilotons (kt) or thousand tonnes (103 t) are standard.
In Belize, the imports and retail of gaseous fuels such as Liquid Petroleum Gas (hereinafter, LPG) are carried out in pounds (lbs), which is equivalent to 0.5 SI kilograms (kg).
Quantities of fuels, regardless of their material state, may often be expressed in energy units, as seen below.

Energy/Power

The standard SI unit of energy, the joule, is key to this report, along with its common multiples, the Terajoule (TJ) and Gigajoule (GJ). Also important is the Watt-hour, which measures energy in the context of electricity, and its multiples, the Kilowatt-hour (KWh), Megawatt-hour (MWh) and Gigawatt-hour (GWh). One (1) KWh is equivalent to 0.0036 GJ. Barrels-of-oil-equivalent (boe) are also used to measure energy. Each boe corresponds to 0.00581 TJ. Similarly, tons-of-oil-equivalent (toe), equivalent to 0.04184 TJ, is used.

Power is measured here in Watts and its multiples: Kilowatts, Megawatts, and Gigawatts. Electric potential, used to denote the charge-carrying capacity of electric power lines, is measured in kilovolts (kV), an SI unit.

Table 6. Multiples of Energy Units

Common Multiple	Base Unit Equivalent
Electricity	
Kilowatt	1,000 Watts
Megawatt	1,000,000 Watts
Gigawatt	1,000, 000, 000 Watts
Terawatt	1,000, 000, 000, 000 Watts
Energy	
Kilowatt-hour	1,000 Watt-hours
Megawatt-hour	1,000,000 Watts-hours
Gigawatt-hour	1,000, 000, 000 Watts-hours
Terawatt-hour	1,000, 000, 000, 000 Watts-hours
Kilojoule	1,000 Joules
Megajoule	1,000,000 Joules
Gigajoule	1,000,000,000 Joules
Terajoule	1,000,000,000,000 Joules

Table 7. Conversion Table for Units Used in this Publication

Common Unit	Standard/SI Unit
Currency	
1 Belize Dollar	0.5 US Dollars
Volume	
1 Barrel	159 Litres
1 US Gallon	3.8 Litres
Million Cubic Meters	109 Litres
Thousand Cubic Feet	28,317 Litres
Mass	
1 Pound	0.5 Kilograms
1 Metric Kiloton/thousand tonnes	1,000,000 kilograms
Energy	
1 Kilowatt-hour	3.6 x 10-6 Terajoules
1 Barrels-of-Oil-Equivalent	0.00581 Terajoules
1 Tons-of-Oil-Equivalent	0.04184 Terajoules

Belize Annual **Energy** Report

2022 EDITION

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