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BELIZE'S FIRST BIENNIAL UPDATE REPORT

TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

NATIONAL CLIMATE CHANGE OFFICE

Ministry of Forestry, Fisheries, the Environment and Sustainable Development

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National Climate Change Office
Ministry of Fisheries, Forestry, the Environment and Sustainable Development
Old Lands Building, Market Square
City of Belmopan, Belize

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FOREWORD

Statement from the Hon. Omar Figueroa, Minister of State, Ministry of Fisheries, Forestry, the Environment and Sustainable Development

Climate change is a cross-sectoral issue that affects Belize's long-term development. Belize is already familiar with the impacts of climate change such as rises in temperature, droughts, and ocean acidification. Our geographic location provides greater negative impacts of climate change due to the country's reliance on climate-sensitive sectors. It puts Belize at risk for economic crises such as declines in the agriculture sector, increase in natural disaster recovery costs and increase in human health conditions such as vector-borne illnesses and heat stress.

Despite being a minute contributor to global greenhouse gas (GHG) emissions, Belize is committed to reducing its emissions in an effort to contribute to the Paris Agreement's goal of keeping global temperature below 1.5° to 2° C above pre-industrial levels. For instance, Belize aims to achieve its renewable energy and energy efficiency potential with an intention to reduce its consumption of fossil fuels while working toward sustainable development. In spite of Belize's minimal GHG emissions, its international commitments and the opportunities and benefits that results from combatting climate change gives rise to the nation to include climate change in development plans.

Having signed unto the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), Belize has several commitments that must be fulfilled. This includes the submission of Belize's First Biennial Update Report (BUR) to the UNFCCC. The BUR provides updated information on Belize's national circumstance and GHG Inventory. It also discusses the actions taken toward reducing Belize's emissions along with the needs and support that the country has received to do so. The GHG Inventory in the BUR records emissions and removals and has revealed that Belize is a net carbon sink and despite this, our country continues to work towards decarbonizing and achieving low carbon development.

Belize is committed to transparently share its ambitious actions and progress via the BUR and joining other nations around the world who share the same goal of combatting and adapting to the effects of climate change. Our country will continue to provide a demonstration of our commitment to supporting the implementation of the Paris Agreement as we commence the updating of Belize's Nationally Determined Contributions and the development of a Low Emission Development Strategy for Belize.

Honourable Omar Figueroa
Minister of State, Ministry of Fisheries, Forestry, the Environment and Sustainable Development

CONTRIBUTORS

Coordinating Author:
Ms. Brittany Meighan, Climate Change Officer - Mitigation, National Climate Change Office

Collaborators:
Dr. Lennox Gladden, Chief Climate Change Officer
Mrs. Ide Sosa Mckoy, Project Manager of 4NC and 1BUR Project to the UNFCCC

National Circumstances Chapter
Ms. Kamil Salazar, MRV Officer
Mr. Colin Mattis, Deputy Chief Climate Change Officer

Institutional Arrangements and Domestic MRV System Chapter
Ms. Brittany Meighan, Climate Change Officer – Mitigation
Mr. Kareem Reynolds, REDD+ Technician

National Greenhouse Gas Inventory Report Chapter
Mr. Earl Green, Caribbean Community Climate Change Centre
Mr. Sergio Garcia
Mr. Evaristo Avella
Mr. James Azueta
Mr. Edgar Correa, Forest Officer
Ms. Florencia Guerra, Forest Officer

Mitigation Actions and their Effects Chapter
GAUSS International with support of the National Climate Change Office

Financial, Technical and Capacity Constraints and Needs Chapter
Mrs. Johanna Pacheco, Climate Change Officer – Adaptation
Mr. Sumeet Betancourt, REDD+ Technician

Support Group:
Ministry of Fisheries, Forestry, the Environment and Sustainable Development
Ministry of Food and Agriculture
National Climate Change Office - REDD+ Readiness Project Unit
Forest Department
Department of the Environment
Solid Waste Management Authority
Energy Unit, Ministry of Public Service, Energy and Public Utilities
Ministry of Economic Development, Petroleum, Investment, Trade and Commerce
Caribbean Agriculture Research and Development Institute

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AF	Adaptation Fund
AFOLU	Agriculture, Forestry, and Other Land Uses
AGB	Above Ground Biomass
ASR/BSI	American Sugar Refinery/Belize Sugar Industry Limited
BAHA	Belize Agriculture Health Organization
BAIMS	Belize Agriculture Management Information System
BaU	Business as Usual
BECOL	Belize Electric Co. Ltd.
BEL	Belize Electricity Ltd.
BELCOGEN	Belize Co-Generation Energy Limited
BDCA	Belize Department of Civil Aviation
BLPA	Belize Livestock Producers Association
BNCCC	Belize National Climate Change Committee
BNE	Belize Natural Energy
BOPA	Belize Organic Producers Association
BSCFA	Belize Sugar Cane Farmers Association
BUR	Biennial Update Report
BWS	Belize Water Service
BZD	Belize Dollar
CARDI	Caribbean Agricultural Research and Development Institute
CATIE	The Tropical Agricultural Research and Higher Education Centre
CC	Climate Change
CCCCC	Caribbean Community Climate Change Centre
CCD	Climate Change Department
CCMRV Hub	Caribbean Corporative Measurement Reporting and Verification Hub
CDB	Caribbean Development Bank
DFC	Development Finance Corporation
CfRN	Coalition for Rainforest Nations
CH_4	Methane (gas)
CIF	Caribbean Investment Facility
CNTMP	Comprehensive National Transportation Master Plan
COP	Conference of Parties
CO_2	Carbon Dioxide
CO_2 Eq	Carbon Dioxide Equivalent
CRIP	Climate Resilient Infrastructure Project
CRIS	Climate Resiliency Information System
CVRP	Climate Vulnerability Reduction Programme
DNE	Designated National Entity
DOE	Department of the Environment
EE	Energy Efficiency
ESD	Energy for Sustainable Development
EU	European Union
FAO	Food and Agriculture Organization
FOLU	Forestry and Other Land Uses
GCF	Green Climate Fund

GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOB	Government of Belize
GOJ	Government of Japan
GSDS	Growth and Sustainable Development Strategy
Gw	Growth Rate
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
IBRD	International Bank for Reconstruction and Development
ICAT	Initiative for Climate Action and Transparency
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IKI	International Climate Initiative
IMELS	Italian Ministry of Environment, Land and Sea
IMF	International Monetary Fund
INC	First/Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISPRA	Italian National Institute for Environmental Protection and Research
J-CCCP	Japan-Caribbean Climate Change Partnership
JICA	Japan International Agency
kW	Kilowatt
kWh	Kilowatt hour
LED	Light Emitting Diodes
LPG	Liquified Petroleum Gas
MFFESD	Ministry of Fisheries, Forestry, the Environment, and Sustainable Development
MED/MEDPITC	Ministry of Economic Development, Petroleum, Investment, Trade and Commerce
MoF	Ministry of Finance
MOU	Memorandum of Understanding
MRV	Measuring/Monitoring, Reporting, and Verification
MSW	Municipal Solid Waste
MTCA	Ministry of Tourism and Civil Aviation
MW	Megawatt
MWh	Megawatt hour
M&E	Monitoring and Evaluation
NAMA	Nationally Appropriate Mitigation Action
NC	National Communication
NCCO	National Climate Change Office
NCCPSAP	National Climate Change Policy, Strategy and Action Plan
NDC	Nationally Determined Contribution
NDCP	Nationally Determined Contribution Partnership
NFI	National Forest Inventory
NIIP	National Inventory Improvement Plan
NIR	National Inventory Report
OLADE	Latin American Energy Organization
PCS	Power Conversion System
PGIA	Phillip Goldson International Airport

PSIP	Public Sector Investment Programme
PSP	Permanent Sampling Plot
PV	Photo Votalic
QA/QC	Quality Assurance/Quality Control
RE	Renewable Energy
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SIB	Statistical Institute of Belize
SIDS	Small Island Developing State
SIRDI	Sugar Industry Research Development Institute
SLMS	Satellite and Land Monitoring System
SNC	Second National Communication
SSEL	Santander Sugars Energy Limited
SWAMA	Solid Waste Management Authority
TACCC	Transparency, Accuracy, Consistency, Comparability, Completeness
Tc/tdm	Total carbon fraction of total dry matter
TNA	Technology Needs Assessment
TNC	Third National Communication
UAE	United Arab Emirates
UB	University of Belize
UKCIP	United Kingdom Caribbean Infrastructure Partnership Fund
UNEP	United Nations Environment Programme
UNEP-DTU	United Nations Environment Programme – Denmark Technical University Partnership
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
USTDA	United States Trade and Development Agency
WB	World Bank

EXECUTIVE SUMMARY

Pursuant to Decision 2/CP.17 of the UNFCCC, Belize submits its first Biennial Update Report (1BUR) to the United Nations Framework Convention on Climate Change. This report provides an update and analysis of the national context and domestic actions and policies implemented to address this phenomenon. It provides an overview of current national circumstances, a national inventory of greenhouse gases updated for reference years 2012, 2015 and 2017, the actions developed to mitigate climate change, and the needs and support received regarding climate change for the reporting period of 2015-2018.

Belize, as a small island developing state, which is particularly vulnerable to the impacts of climate change, continues in its ambition to achieve low carbon development in accordance with the goals of the Paris Agreement and the objective of limiting the increase in global temperature to 1.5 ° C. As Belize's BUR will show, various actions in this pursuit have been done, are underway and in planning. Belize has placed notable priority in addressing the global climate concern both domestically and internationally.

ES.1 National Circumstances

Belize is the only English-speaking country in Central America, and as a feature of its geographical location and historical background, is a part of both Central America and the Caribbean. Bordered on the east by the Caribbean Sea, on the north and north-west by Mexico, and on the west and south by Guatemala, Belize lies between 15°45' and 18°30' north latitude, and 87°30' and 89°15' west longitude.

Belize is also an ethnically heterogeneous nation, with 387,879 inhabitants and a population density of about 17 persons per square kilometer (SIB, 2017). While the official language is English, dissimilar to its Central American neighbors, Spanish and Creole (Belizean Kriol) are widely spoken, followed by indigenous Maya and Garifuna languages.

The national territory consists of 95% land and the remaining 5% contributed by over 1,060 small islands and cayes. Belize is highly forested, with more than 50% of the mainland covered with forests, with the remaining consisting mainly of agriculture, arable land, and human settlements.

In the national territory, the two main ecosystems are the marine and the terrestrial ecosystems. The terrestrial ecosystem is natively comprised of broadleaf and pine forests along with several lakes and extensive river systems. Belize is also home to the largest barrier reef in the northern hemisphere and the second largest in the world and serves as an important habitat for several threatened marine species.

Belize's two main economic sectors are the agriculture and tourism sector which contribute largely to the economy. The agriculture sector is driven by sugar, citrus and bananas contributing the most in that order. The tertiary industry is made up of several services which holistically represent the tourism sector and is also a great contributor to Belize's GDP, USD $1394.86 million and GDP per capita, USD $3596.06 (SIB, 2018).

In terms of the climate system, it ranges from a subtropical climate in the northern region to a more tropical climate in southern Belize. This is characterized by annual precipitation ranging from 1500 mm (60 inches) to 3800 mm (150 inches) respectively. Precipitation follows a general seasonal pattern with two main seasons: dry and wet (rainy), with about 60% occurring during the rainy season from June to November. The average maximum temperature for the country is approximately 85°F (29.5°C), while the average minimum temperatures range in the low 70s (20°C).

Belize, marked by tropical climate and low-lying coasts, is classified as one of 44 Small Island Developing States (SIDS) who are most vulnerable to the effects of climate change. Belize, reinforced by the powerful negotiating group of the Alliance of Small Island States (AOSIS), has vied for enhanced climate action in the international community to slow and neutralize the rapidly growing greenhouse gas emissions, and rising atmospheric temperature since the industrial era.

Cognizant of the threats that climate change poses to the sustainable economic and social development and poverty reduction agenda, the Government of Belize has committed to strategically transition to low carbon development while strengthening its resilience to the effects of climate change. This national commitment led to the further unfolding of the National Climate Change Policy, Strategy and Action Plan (NCCPSAP), a National Climate Resilient Investment Plan, and the process of mainstreaming of climate change into the national Growth and Sustainable Development Strategy (GSDS) and other relevant sectoral plans. The country's NDC builds off these plans and focuses on reducing emissions from the forestry, transport, energy, and waste sectors and strengthening the resilience of coastal and marine resources, agriculture, water resources, tourism, fisheries and aquaculture, human health, infrastructure, and forestry.

ES.2 Institutional Arrangements of Climate Change Management

At present, the Belize National Climate Change Committee (BNCCC) is the leading strategic level entity for endorsement of major climate change related activities, policies, and plans, and thus has critical oversight with regard to climate change mainstreaming into the broader national development agenda. It is chaired by the Ministry of Fisheries, Forestry, the Environment, and Sustainable Development and has a wide representation of members from line ministries, private sector, civil society and academia.

The UNFCCC Focal Point heads the National Climate Change Office (NCCO), which is part of the Ministry of Fisheries, Forestry, the Environment, and Sustainable Development. The NCCO coordinates the preparation and submission of international reporting obligations under the UNFCCC and the Paris Agreement. Through the mechanism of the BNCCC, both technical and high-level support is provided to ensure the accuracy and inclusivity of national reports before approval by the Cabinet. This is supplemented by extensive stakeholder consultations, and reviews by external expertise, especially in highly technical reports such as the National Greenhouse Gas (GHG) Inventory.

The GHG inventory management process that Belize adopts is not a fixed model, but rather a model based on continuous improvement that benefits the country at large and consistently aligns with national development strategies. Significant human and financial resources have been allocated to support the development of its GHG inventory management system. In preparation for an in-situ institutional structure, with multi-ministerial participation in inventory preparation, capacity building is at the root of building strong national institutions that can adequately fulfil international reporting requirements, but more importantly be able to identify GHG emission impacts of broader domestic policy.

In the context of a domestic MRV framework, activities in this pursuit are relatively recent, however, promising efforts are being developed to ensure structured and transparent reporting for climate change, i.e. GHG Inventories, BURs, NDC implementation. The area with the most advanced MRV structure for GHG reporting is the Forestry and Other Land Use (FOLU) sector. The methodological approach instituted to estimate emissions from the FOLU sector is through the national REDD+ programme. This process has been jointly executed by the Forest Department of Belize and the National Climate Change Office's REDD+ Readiness Project Unit.

Under the National Forest Monitoring System (NFMS), activity data involving land use and land use change is collected through a fully spatially explicit method, also known as an approach 3 method. The NFMS is comprised of two parallel components, the Satellite and Land Monitoring System (SLMS) and the National Forest Inventory (NFI). The SLMS utilizes remote sensing tools and data to geospatially map land use, as well as aid forest monitoring, ensuring the availability of accurate activity data for GHG emission estimations. The second component is the National Forest Inventory (NFI). This is a permanent forest plot network and database, FORMNET-B, which was designed to study the long-term dynamics of disturbed and degraded tropical forests. The activity data collected from the SLMS and the country specific emission factors developed for the NFI ensures that the emissions estimations from the FOLU sector are as robust as possible.

Broader efforts to enhance MRV in climate change management have been integral during the elaboration of Belize's First BUR. Stakeholder engagements to evaluate sector needs and gaps in monitoring and reporting of climate related activities have been an ongoing focus in preparation of developing a framework for National MRV System for Climate Governance. Planned initiatives are underway, which aim to enhance work in institutional arrangements of a National MRV System, develop NDC tracking indicators and climate finance flows, and build GHG related capacity and regional collaborations.

Furthermore, Belize's Domestic MRV system, through its development, should enhance the quality and access to relevant climate change information and data, leading to informed assessment of climate policies and improved decision making.

ES.3 National Greenhouse Gas Inventory

The production of the Fourth National Greenhouse Gas Inventory of Emissions and Removals Report is the result of collecting activity data related to each of four sectors; namely **Energy; Industrial Processes and Product Use; Agriculture, Forestry and Other Land Use; and the Waste Sector** and covers reference years 2012, 2015, and 2017.

The following greenhouse gases were covered: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbons (HFC).

Methodology

The Tier 1 approach for calculations was used for most of the sectors including Energy, IPPU, and Waste due to the detail of the available data. The various authorities, institutions, and companies who were the sources generally do not collect or record data in detail. Tiers 1 and 2 were applied in the Agriculture sector since some level of detail was available in the data provided. Tiers 1, 2 and 3 methodologies were utilized for the Forest and Land Use sector due to country specific data that was available and developed through the ongoing REDD+ Readiness project.

Emissions for each GHG have been presented in carbon dioxide equivalents (CO_{2eq}) terms using the 100-year global warming potentials (GWPs) contained in the Second Assessment Report (SAR) for Energy, Industrial Processes and Product Use, Waste, and Agriculture, and used GWPs from the IPCC Fifth Assessment Report (AR5) for the Forestry and Other Land Uses subsector.

Emission Estimations

Through the assessment of Belize's Fourth National Greenhouse Gas Inventory, Belize continues to be a net carbon sink. Notwithstanding this, there was general increase in GHG emissions across almost all subsectors over the study period of this inventory.

The Energy Sector saw increases in emissions in three sub-sectors; transport, electricity generation, and "Other" for residential purposes. Electricity generation and transport emissions were from fossil fuel consumption. "Other" is primarily from residential fuel wood use. Even with much greater availability of butane stoves and ovens, a small increase in wood for cooking purposes was noted.

The Industrial Processes and Product Use sector displayed different behaviour between the sub-sectors. The highest emitter in this sector was refrigerant use, followed by mineral production, and very minute emissions from the other sub-sectors. Carbon dioxide emissions reflected the production level of the mineral (lime and dolomite production) over the period. Production increased between 2012 and 2015 then declined between 2015 and 2017, just the same as the market demand for the material changed. Road paving activities apparently slowed down considerably 2012 and 2015, then increased between 2015 and 2017. The least emitting subsector was food and beverage (use of wheat), with minute emissions, also attributable to data constraints.

For the Agriculture Sector, there was constant increase in GHG emissions particularly from enteric fermentation (livestock), manure management, soil management, and biomass burning. Only the subcategory of agricultural liming showed a trend decline over time. This is explained as the result of reduced application of white lime and dolomite to citrus farm soils and reduced utilization by shrimp farms. Both industries had been negatively impacted by diseases during the study period, thus requiring lower levels of application and utilization.

The Forest and Land Use Sector, and the presence of Belize's natural forests enabled a consistent trend of net carbon sequestration throughout the study period. Noteworthy are the increasing levels of emissions throughout the study period caused by natural disturbances (2 major hurricanes), and subsequent increase in emissions from forest land conversion. The major drivers of deforestation were noted to be forest conversion to grassland (pastures), followed by conversion to cropland. National forest cover continues to serve as a carbon sink, although it was noted that this function diminished somewhat over the study period.

The Waste Sector was the smallest contributor to national emissions. This sector noted improved solid waste management through the construction of managed landfill and transfer stations. This has led to a reduction in open burning of waste. Emissions from wastewater and discharge are the highest for this sector and includes industrial effluent as well. Greenhouse Gas emissions from this sector have been reduced compared to the period between 1997 and 2007.

The table below offers a summary of the total net Greenhouse Gas emissions and removals occurring within Belize as were estimated for the period 1994 to 2017.

TABLE ES 1 BELIZE'S NET GREENHOUSE GAS EMISSIONS AND REMOVALS BY SECTOR (GG CO2 EQ)

Sector	1994	1997	2000	2003	2006	2009	2012	2015	2017
Total National Emissions and Removals (*with AFOLU)*	**-6,612.97**	**-7,193.83**	**-7,718.26**	**-11,744.38**	**-11,202.62**	**-9,833.79**	**-7,179.14**	**-5,260.07**	**-5,826.79**
Total National Emissions (without FOLU removals)	**180.96**	**128.54**	**158.77**	**151.77**	**188.98**	**255.26**	**832.19**	**1,107.46**	**1,194.71**
Energy	NE	NE	NE	NE	NE	NE	538.07	781.81	786.36
Industrial Processes and Product Use	0.67	2.96	6.36	10.57	15.40	22.83	31.43	42.50	43.69
Agriculture, Forestry, and Other Land Use	-6,614.01	-7,197.20	-7,725.07	-11,755.29	-11,218.40	-9,868.83	-7,771.37	-6,104.27	-6,683.66
Waste	0.37	0.41	0.45	0.34	0.37	12.21	22.73	19.89	26.81
International Bunkers	NE	NE	NE	NE	NE	NE	40.37	40.23	71.89

Key Categories

A look at the Key Category Analyses reveals that the Agriculture, Forestry, and Other Land use sector plays a significant role in the emission and removals of Greenhouse Gases in Belize. However, this same sector was also the greatest emitter of GHGs for the same reference years. The two major contributing sub-sectors were "Forest Land converted to Cropland' and 'Forest Land converted to Grassland". Both sub-sectors showed increased emissions between 2012 and 2015, but then declined to lower levels in 2017. The "Road Transportation" sub-sector of the Energy sector remained the third most significant emitter of GHGs in the three reference years. Other sources included in the top ten producers of GHG gases were Enteric Fermentation (AFOLU), Nitrous oxide emissions from Managed Lands (AFOLU), Gaseous and Liquid Fuel consumption in the Energy sub-sector, and Refrigeration and Air-conditioning in the Industrial Processes and Product Use sector.

In general, and at the other end of the range there were a few sub-sectors from which the emissions were estimated to be negligible. These included N_2O from Open burning of Waste and Solid Waste disposal in the Waste sector. Lime production in the IPPU is dwindling in emissions. Biomass burning producing N_2O in the AFOLU sector was also estimated to be negligible. For the Energy Industries sub-sector emissions of N_20, and CH_4 from Gaseous and Liquid fuels respectively were very low.

ES.4 Mitigation Actions and their Effects

Belize, in preparation of its first BUR and fourth National Communication, conducted a comprehensive mitigation assessment. This enabled the assessment of programs and measures implemented or planned that result in the mitigation of human-induced climate change and progress in achieving the NDC. The mitigation actions implemented and planned, and the additional mitigation options identified within the assessment were in view of evaluating the mitigation progress of Belize.

The GHG emissions of Belize are dominated by the contribution of the Forestry and Other Land Use (FOLU) sector which is also a sink of GHG emissions. Removals due to the forest's growth are the main driver of the GHG emission profile of Belize in the historical period. Apart from the FOLU sector, the primary GHG emitters are the energy, agriculture, waste, and IPPU sector, in this order.

In energy industries, the very significant electricity imports (37% in 2018) limit the GHG emissions of the sector. Nevertheless, if these imports are replaced by fossil fuel generation, GHG emissions would increase significantly. The transport sub-sector represents a higher opportunity for GHG emission reductions since it is the largest GHG emitter in the energy sector.

In the agriculture sector, the primary GHG emissions sources are livestock and forest fires. The mitigation opportunities for livestock are limited, but the control of forest fires should be a priority. In the FOLU sector, the main drivers of emissions are the conversion of forest land to croplands and grasslands. Carbon dioxide removals from forest growth are substantially higher than emissions from land-use change. Reduced emission from deforestation and forest degradation is identified as a mitigation opportunity in the sector.

In the waste sector, there is room for improvement in both the solid waste and wastewater management sector. The improvement of this area will bring significant co-benefits for national health, tourism, and standards of living. In the IPPU sector, the size of the industry of the country is limited, and a significant change is not expected in this regard. Nevertheless, consumption emissions such as the emissions coming from the refrigerant and air conditioning will be rising, as Belize expects tourism to increase in the short and medium term.

Mitigation actions implemented since 2015 were assessed by sector, including details of the GHG emission impact and co-benefits of each action. The actions are presented by sector and distinguished as either Mitigation Actions with GHG Impacts or Mitigation actions with no GHG Impact. The Energy sector encompassed the largest portion of both ongoing and planned mitigation actions, followed by AFOLU and Waste. There were no ongoing or planned mitigation actions identified within the reference period of this report in the IPPU sector based on the limited effect on national emissions and economic influence.

All mitigation actions and additional options assessed were used to develop GHG emissions scenarios. Implementing the Sustainable Energy Action Plan should be a priority in the energy sector. Specifically, considering the current energy system, there is a considerable mitigation potential for new RES installed capacity. The Transportation Master Plan is the main policy instrument of Belize for developing its transport sector. Nevertheless, it provides limited information on ways to reduce the GHG emission impact of the sector. Given the GHG contribution of the sector, effort should be focused on incentivizing the use of low carbon fuels, such as LPG, and promoting public transportation. Apart from the possible implementation of energy or waste sector mitigation measures in the industry, the GHG emissions of the IPPU sector are not affected by any mitigation action implemented or planned in Belize. The National Solid Waste Management Strategy and Implementation Plan is the document that drives the country's effort for mitigation in the waste sector. The implementation of the Implementation Plan will have a significant impact in the GHG emissions of the country, so it must be prioritized. An area which has significant potential and has not been addressed is wastewater management practices. The improvement of the water discharge systems and wastewater treatment will have a significant impact on GHG emissions. The REDD+ strategy and the forestry act are the policy framework guiding the GHG emissions and removals of the AFOLU sector. The full implementation and these policies should be a priority in future mitigation efforts of Belize, given the prominence of the removals encompassed in this sector in the emission profile of the country.

ES.5 Financial, Technical and Capacity Constraints and Needs

This first Biennial Update Report showcases some of Belize's financial, technological and capacity building needs, and shows the country's need to overcome significant barriers and the need to improve and expand internal and external cooperation. This chapter covers information on finance, technology, and capacity needs and support received for the period 2015-2018 based on information available during the preparation of this report.

In 2017, a Technology Needs Assessment (TNA) was carried out to identify and prioritize technologies that can contribute to adaptation and mitigation goals that are compatible with national sustainable development goals and priorities. Between the years 2015 to 2018, important studies and assessments have been carried out that have helped to identify enabling conditions, helped to prepare national plans that integrate climate change and to project the potential impacts of climate change in Belize (TNA, Technology Action Plan, stakeholder analysis, etc.). Although these studies are not sufficient to effectively and comprehensively determine all of Belize's needs, they provide a good baseline to build upon for future assessments and development planning.

Support needed for Belize is grouped into three different categories: technical assistance, financial support and capacity building. These are expanded as to whether the needs apply to preparing and/or implementing a national plan or whether capacity building is needed for technical experts. Belize has received various support through different projects. Some of which are aimed at enhancing the resilience of several sectors to the impacts of climate change, preparing national plans, implementing adaptation and mitigation actions etc. There have also been several capacity building initiatives undertaken during the period of 2015 – 2019. These included training national experts for GHG data collection, conducting public awareness campaigns and various workshops related to the needs of the different sectors in Belize.

While funding and technical assistance is mobilized, it is often difficult to obtain all the necessary information on support received from the various state and non-state recipients. The Public Sector Investment Programme Reports is vital for the tracking of support received; however, data gaps do exist. While Belize continues to mobilize finance for the implementation of climate actions, there is a constant need for capacity building, finance and technology transfer in the country.

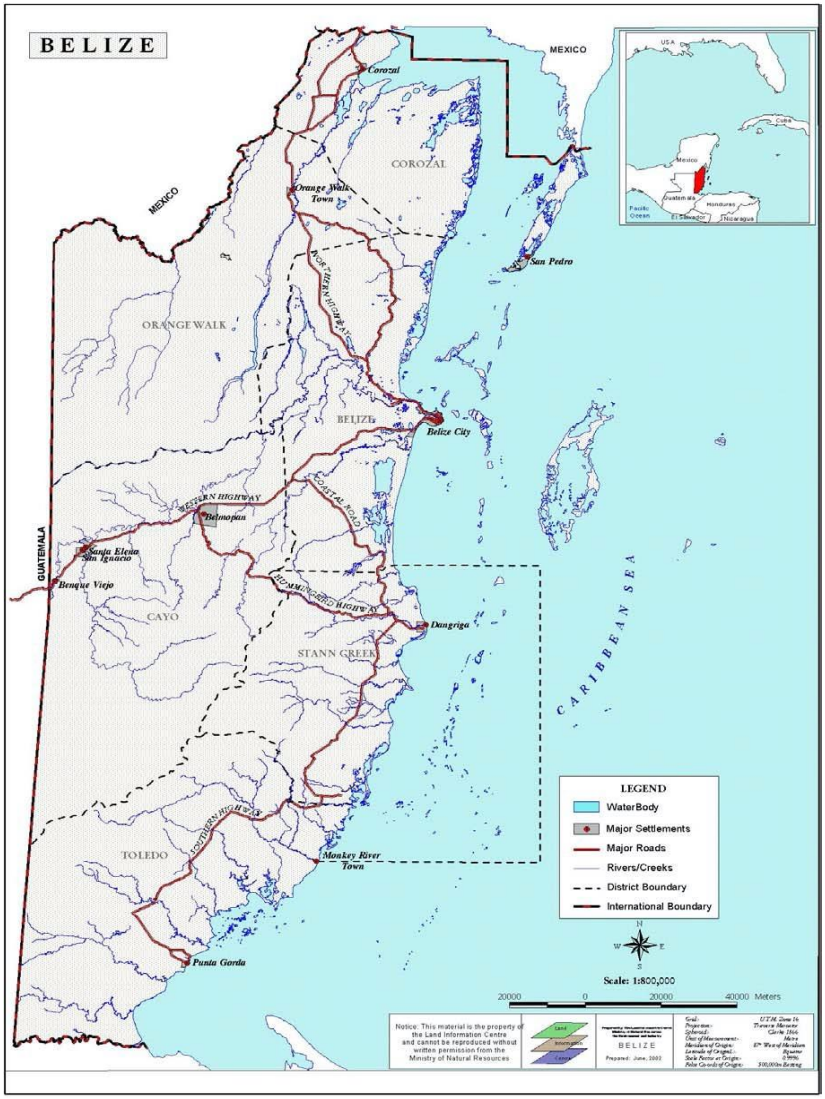
Expanding national capacity becomes increasingly important under the implementation of the Paris Agreement, whereby the focus on intensified emission reduction efforts will be needed while simultaneously increasing resilience to climate change impacts. Belize, as a Non-Annex 1 party to the UNFCCC, as well as a Small Island Developing State, is without a doubt, lacking in know-how and resources to entirely fulfil its mandate under the Paris Agreement without proactive intervention.

1 NATIONAL CIRCUMSTANCES

1.1 GEOGRAPHIC PROFILE

Belize is the only English-speaking country in Central America, and as a feature of its geographical location and historical background, is a part of both Central America and the Caribbean. Bordered on the east by the Caribbean Sea, on the north and north-west by Mexico, and on the west and south by Guatemala, Belize lies between 15°45' and 18°30' north latitude, and 87°30' and 89°15' west longitude (see Figure 1.1). The country's national territory is made up of 46,620 sq. km (18,000 sq. miles) (GOB, 2002).

FIGURE 1.1 MAP OF BELIZE



Source: Land Information Center, Ministry of Natural Resources

Of this, the land area is approximately 22,967 sq. km (8,867 sq. miles) which includes 280 km of coastal land. The mainland makes up 95% of the national territory with the remaining 5% contributed by over 1,060 small islands and cayes (National Meteorological Service, n.d.). Belize is highly forested, with more than 50% of the mainland covered with forests, and the remaining land consisting mainly of agriculture, arable land, and human settlements.

1.2 ECOLOGICAL PROFILE

There are two main ecosystems that encompass Belize's territory, the marine and the terrestrial ecosystem. The marine ecosystem consists of open ocean, coral reefs and seagrass beds, while the terrestrial ecosystem is made up of both broadleaf and pine forests along with several lakes and rivers in country.

Belize has the largest barrier reef in the northern hemisphere and the second largest in the world. The Belize Barrier Reef Reserve Systems is a UNESCO World Heritage site and is important as it provides a habitat for several threatened marine species. Belize is also known for its pre-Columbian Mayan archaeological sites, namely Xunantunich, Altun Ha, and Caracol, etc. There are also several protected areas in the country covering about 36% of Belize's land surface (Cherrington et al., 2010).

1.3 CLIMATE PROFILE

Belize's climate is made up of two seasons: wet (rainy) and dry. The rainy season runs through June to November initially starting in the southern part of the country and making its way up to the north. Northern Belize has a subtropical climate with an annual rainfall of 1500 mm (60 inches) while southward, the climate becomes increasingly tropical and annual rainfall increases to 3800 mm (150 inches) (National Meteorological Service, n.d.). About 60% of annual precipitation occurs during the wet season. The dry season is then introduced by a cool transition period that occurs from November to February. During this transition period, rainfall declines and approximately 12 cold fronts cross the country. The true dry season then begins in February and goes through to April. The average maximum temperature for the country is approximately 85°F (29.5°C) while the average minimum temperatures range in the low 70s (20°C). The diurnal temperature range is greater inland and cooler along the coast due to sea breezes. The mountainous regions of the country are also cooler as it experiences a 5°F (-15 °C) fall in temperature per 1000ft. Humidity hovers around 80% throughout the year but is lower during the dry season (National Meteorological Service, n.d.).

Apart from the weather seasons discussed above, Belize also has a hurricane season which starts on June 1st to November 31st. Being a country that is bordered on the East by the Caribbean Sea, Belize is vulnerable to tropical cyclones. Below is a table that shows the years Belize has been impacted by tropical cyclones.

TABLE 1.1 SHOWING THE YEARS (1992-2017) BELIZE HAS BEEN IMPACTED BY STORMS

Year	Storm	Nearest Distance (mi)
1992	-	-
1993	TS Gert	13
1996	TS Kyle	67
1998	H Mitch (C5)	150
2000	H Keith (C3)	35
2001	H Iris (C4)	Made landfall
	TS Chantal	70
2007	H Dean (C5)	85
2008	TS Arthur	35
2010	H Richard (C2)	Made landfall
	TS Alex	10
	TS Karl	85
	TS Matthew	90
2011	H Rina (C1)	130
	TS Harvey	Made landfall
2012	H Ernesto (C1)	85
2016	H Earl (C1)	Made landfall
2017	TS Franklin	185
	TS Nate	240

Note: H – Hurricane, TS – Tropical Storm, C – Category
Source: National Meteorological Service, 2020

1.4 POPULATION PROFILE

As of 2017, Belize had a total population of 387,879 inhabitants with a population density of about 17 persons per square kilometer. Growth rate has been approximately 2.5% in recent years and is expected to remain at that level into the near future. In 2015, majority of the population were people between the ages of 10 and 15 years. The country's fertility rate is 22.2% and mortality rate is 3.6%. Belize's average life expectancy is 70 years: 68 for males and 73 for females (Statistical Institute of Belize, n.d.).

Table 1.2 below shows how the population is distributed in Belize, with the majority residing in the rural parts of the country. Belize remains as one of few countries within the Central American and Caribbean regions to have a predominantly rural population. The two cities are Belize City, the former capital, located in east bordering the Caribbean Sea, and the now capital, Belmopan City, in the west land locked Cayo district.

TABLE 1.2 POPULATION DISTRIBUTION

Population by Area	
Urban	173, 841
Rural	214, 038
Population by District	
Corozal	47, 437
Orange Walk	50, 969
Belize	117, 196
Cayo	93, 352
Stann Creek	42, 230
Toledo	36, 695
Total population	387, 879
Population density	16.88 sq. km

Source: Statistical Institute of Belize, 2018

Belize's official language is English, while Spanish and Creole (Belizean Kriol) are widely spoken, followed by indigenous Maya and Garifuna languages. Similarly, Belize is also an ethnically heterogeneous nation, with blend of Afro-Caribbean Creole, Central American Mestizo (Spanish Latino) and indigenous ethnicities (Ketchi, Mopan and Yucatec Maya), various of oriental origin (Chinese, Japanese, Taiwanese), Caucasian, West Indians and Mennonites. As of 2017, 48.2 percent of all Belizeans identify as belonging to the Mestizo ethnic group. The second largest ethnic group is the Creole, at 25.7 percent of the population, followed by the Maya (at 10.6 percent) who along with the Garifuna (4.5 percent) form the two indigenous groups in Belize (SIB, 2017).

1.5 ECONOMIC PROFILE

Belize's GDP for the year 2017 was BZD $2,809.5 million dollars (USD $1394.86 million) and its GDP per capita at market prices was BZD $7,243.12 (USD $3596.06) (SIB, 2017). Figure 1.2 on the following page shows the country's GDP for the years 2000 to 2017 in which GDP has increased about 3.5% annually. Industries in Belize's economy can be categorized based on three (3) levels: primary, secondary and tertiary. Table 1.3 breaks down the sectors that make up each industry and their contribution to the country's GDP.

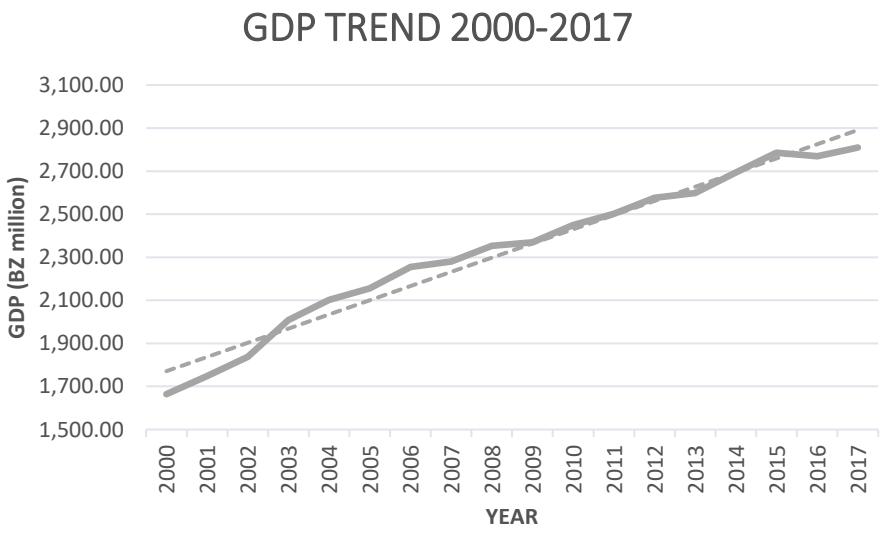
TABLE 1.3 GDP BY INDUSTRY AND CORRESPONDING SECTORS (IN BZD MILLION)

Primary Industries	Agriculture & Forestry	255.5 (10%)
	Fishing	28.6 (1%)
	Mining & Quarrying	8.7 (0%)
	Total	*292.8*
Secondary Industries	Manufacturing	160.2 (6%)
	Electricity & water supply	149.6 (6%)
	Construction	86.8 (3%)
	Total	*396.6*
Tertiary Industries	Wholesale & retail trade	576.5 (22%)
	Hotels & restaurants	108.3 (4%)
	Transport & communication	286.5 (11%)
	Financial intermediation	300.9 (12%)
	Real estate, renting & business services	177.8 (7%)
	Community, social and personal services	146.5 (6%)
	General government services	299.3 (12%)
	Total	*1895.8*

Source: Statistical Institute of Belize, 2018

Belize's two main sectors are the agriculture and tourism sectors which contribute largely to the economy with steady growth over time (Figure 1.2). The agriculture sector is driven by sugar, citrus and bananas contributing the most in that order. The tertiary industry is made up of several services which holistically represent the tourism sector and is also a great contributor to Belize's GDP.

FIGURE 1.2 GDP FOR 2000-2017



Source: Statistical Institute of Belize, 2018

1.6 ENERGY PROFILE

Energy production in Belize comes from sources such as wood (11.7%), petroleum gas (0.7%), hydro (11.4%), biomass (50.1%) and crude oil (26.1%), (Energy Report, 2017). Belize Natural Energy (BNE) is currently the only agency that produces oil within the country with an estimated 20 million barrels of recoverable oil reserves in its portfolio.

Belize has four hydropower plants that supply renewable power. Three of these energy producing plants and their installed capacities, which are on the Macal River, are: the Mollejon Hydroelectric Plant (22.5 MW), the Vaca Hydroelectric Plant (19 MW) and the Chalillo Hydro Dam (7.30 MW). The fourth energy producing plant and its installed capacity, this one being on the Columbia River, is named Hydro Maya Limited (3.00 MW) (World Small Hydropower Development Report for Belize, 2016). A visual representation of this information can be seen in Figure 1.3. Biomass is another major source of Belize's renewable energy supply. The American Sugar Refinery/Belize Sugar Industry Ltd (ASR/BSI) and Santander Sugar Energy Ltd are the two sugar mill cogeneration plants that use sugar cane bagasse for both facility level generation and national grid exports.

Notwithstanding the high renewable energy capacity, Belize also requires an external source of electricity. This energy is imported from Comisión Federal de Energía in Mexico. All these sources supply power to Belize Electricity Limited (BEL) who is charged with the responsibility of distributing power throughout the country. BEL's national electricity grid connects all major municipalities and as of 2017, just under 96% of the country has access to safe and reliable supply of electricity (BEL Annual Report, 2017). BEL receives 58% renewable energy, 37% imported energy and 5% non-renewable energy (as seen in Figure 1.4). The Net Generation by BEL for 2017 was 630,159 MWh and the mean electricity rate in that same year was BZ$0.3751/kWh which is a slight increase from 2016 of BZ$0.3642/kWh (BEL Annual Report, 2017).

Belize also imports a significant amount of its energy supply, besides electricity generation from Mexico, in the form of petroleum products such as liquefied petroleum gas (LPG), gasoline, kerosene, light fuel oils and diesel oil. The country imported BZD$35.45 million worth of Crude Materials and $215.66 million of Mineral Fuels and Lubricants in 2017. In that same year, Belize exported 11.22 million gallons of crude petroleum which was valued at BZ$22.75 million. Wood is used by local entities to produce charcoal for consumption by households and small scale commercial and industrial entities (Tillett et al., 2012). Thirty-seven percent (37%) of energy supplied in 2014 was from the above-mentioned domestic energy sources (SIB, 2017).

FIGURE 1.3 ENERGY PRODUCED FROM HYDROPOWER PLANTS

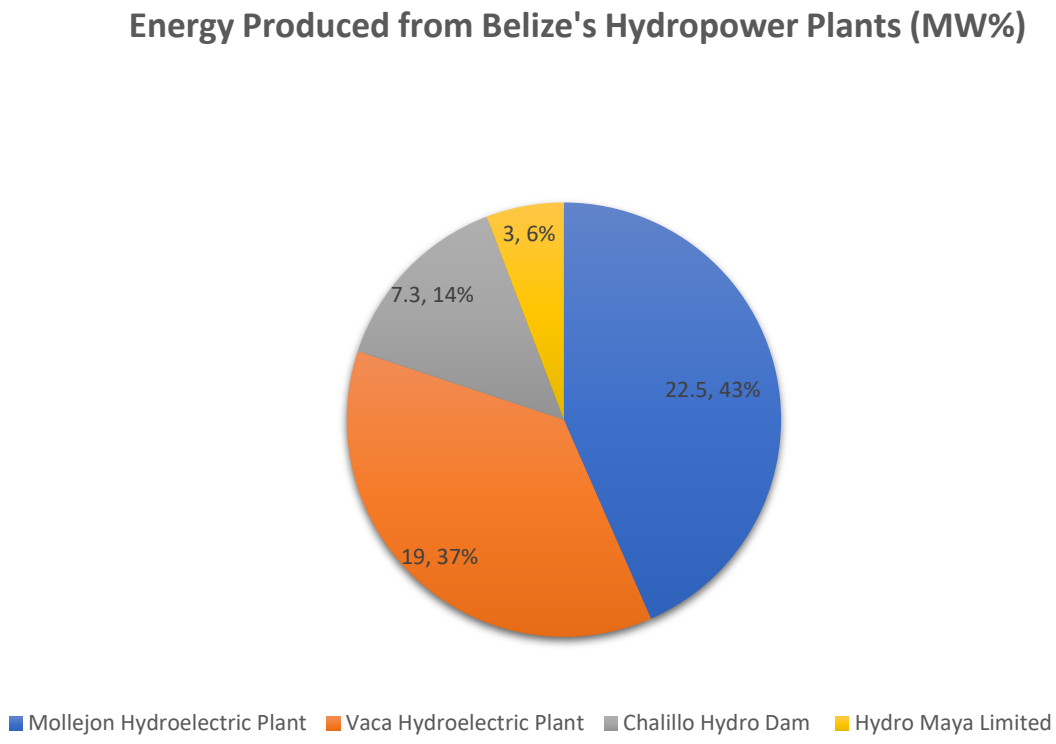
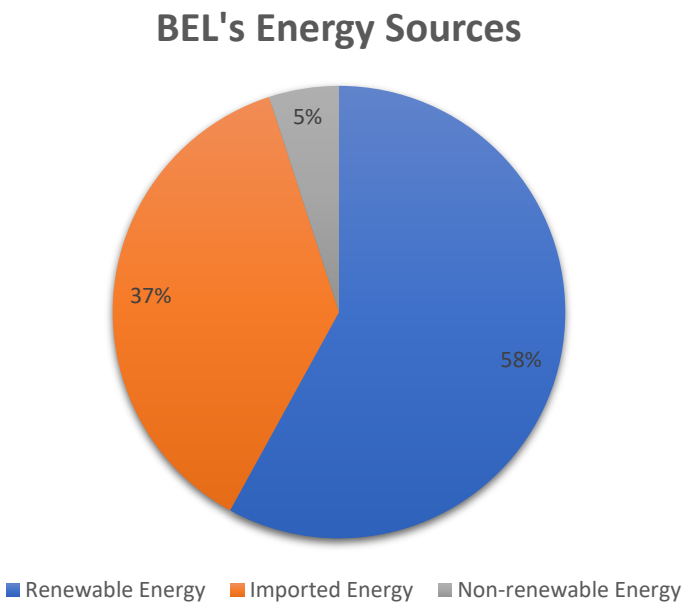


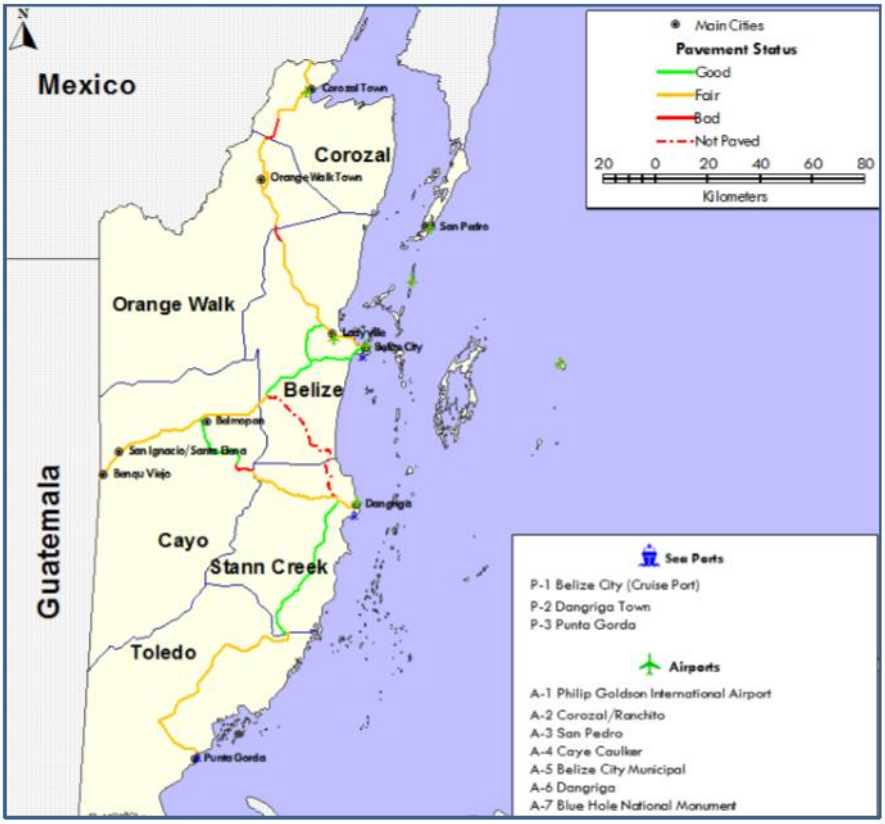
FIGURE 1.4 BEL'S ENERGY SOURCES



1.7 TRANSPORTATION

The main entities responsible for the transport sector in Belize are the Ministry of Transport, who manages and establishes policies and guidelines for road users, and the Ministry of Works who is responsible for the physical provision and maintenance of roads, highways and waterways. Belize's transport system comprises of three modes: road, sea and air. The road system is approximately 13,000 km and is separated into primary (highways) (601 km) and secondary roads (1,831 km). The remainder of the road system is made up of lower-class roads which is about 10,674 km. Figure 1.5 below provides a visual representation of Belize's transport system and the conditions of the road system (CNTMP, 2018).

FIGURE 1.5 BELIZE'S TRANSPORT SYSTEM AND ROAD CONDITIONS



Source: CNTMP, 2018

On an average day, there are approximately 107,000 passengers (almost 140 million passengers per year) in Belize. Roughly 35% of passengers travel in public transport, except for the passengers traveling for study purposes, for which the public transport share is 84% (CNTMP, 2018). For freight, the average 31,472 tons per day translates to more than 11.3 million tons per year. The average hauling per vehicle-trip is 7.5 tons for semi-trailers, 14 tons for trailers, and 16.9 tons for full-trailers (8.7 tons average for all trucks) (CNTMP, 2018).

Belize has two main commercial seaports: The Port of Belize and the Port of Big Creek. The Port of Belize, located in Belize City, is the primary cargo entry port for containers and manufactured consumer products as well as fuel import. The port is reached by an access channel 4.6 km long and 120 m wide. It has one main wharf, 67 m long and 21 m wide accommodating one-149 m vessel at a time, and one low berth, 150 m long with a depth of 2 m, that is primarily used for transporting domestic cargo by barge to and from the Cayes. The Port of Big Creek, located in the south of Belize, has been used to export bananas and other agricultural products as well as crude oil. The access channel of the port is 5 miles long, 7 m deep and 63 m wide limiting bulk carriers to a carrying capacity of 13,000 t. The port has two berths with a total length of 305 m (CNTMP, 2018).

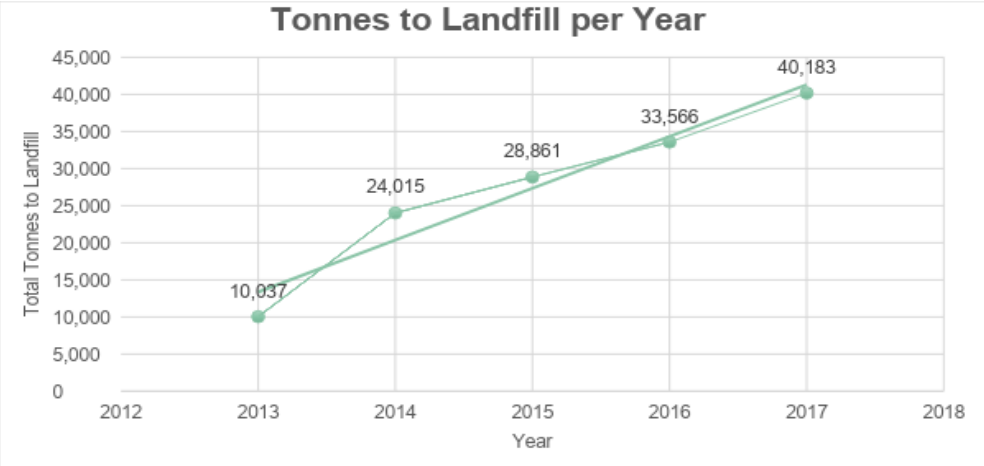
The Belize Airport Authority regulates the country's airstrips with the use of the Civil Aviation Act of 2000. Belize has one international airport, the Phillip Goldson International Airport (PGIA). Additionally, there are five aerodromes with 5 paved runways and 41 with unpaved runways. Belize also has two registered domestic air carriers: Tropic Air and Maya Island Air. Passenger traffic at PGIA increased from 143,928 to 935,603 over the period 2010-2015, the majority being international arrivals (CNTMP, 2017). According to the Belize Department of Civil Aviation (BDCA), Belize has one of the busiest air spaces in Central America.

Belize recently produced its first Comprehensive National Transportation Master Plan (CNTMP) in February of 2018 with an objective to aid in facilitating strategic sector planning and more efficient and effective transport of people and freight within the country, and between Belize and its main trading partners.

1.8 WASTE

Belize has one sanitary landfill with a total size of 350 acres, including a 50 m buffer strip at the perimeter and is the final location for disposal of waste from municipalities in the Western Corridor (Belize Solid Waste Management and Authority). Figure 1.6 shows the increase of total tonnes the landfill has received annually.

FIGURE 1.6 TONNES TO LANDFILL PER YEAR



Municipal Solid Waste (MSW), hazardous, sewerage and agro-industrial wastes are all generated in Belize. An estimate of 100,000 metric tonnes of MSW is generated annually of which approximately 70% is collected through an organized collection service. This is equivalent to around 270 kg (597 lbs)/inhabitant/year. Majority of the collected MSW (>60%) is disposed in uncontrolled dumpsites. Hazardous waste has a stricter disposal process as Belize ratified to the Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal in 1997. There is no data on sources, types, quantities and fates of hazardous waste generated in Belize, but the quantities generated is believed to be relatively small (National SWM Policy, Strategy & Plan, 2015).

Currently, only ~11% of the population has access to sewerage services, which includes both wastewater collection and treatment (National SWM Policy, Strategy & Plan, 2015). The treatment facilities in Belize City and San Pedro provide secondary level treatment, while the facility in Belmopan provides only primary treatment. Agro-industrial wastes include bagasse (waste from sugar cane processing), shrimp heads, chicken offal, pig and cattle offal, blood and bone meal, reject bananas, brewery waste, citrus pulp and peel, and beans trash. Wastes from production of lumber and other forestry products mainly consist of residues from logging and commercial sawmilling (National SWM Policy, Strategy & Plan, 2015).

1.9 AGRICULTURE

The agriculture and food sector are one of the main pillars of the Belizean economy, contributing approximately $590 million annually to economic output, representing 80% of domestic exports, and directly employs 17.9% of the Belizean population (Ministry of Agriculture, 2018). Belize's agriculture sector is categorized into three sub-sectors: (i) a traditional export sector for sugar, banana, citrus and marine products, (ii) a traditional small-scale farm sector producing for local consumption, and (iii) a large-scale commercial sector (CARDI, n.d.). Banana (17.4%), citrus (21.9%) and sugar (25.6%) are the dominating industries that contribute to Belize's economy. Products that are exported include sugar (25.6%), citrus juices (21.9%), banana (17.4%), marine products (10.4%) and animal feed (3.1%) (Ministry of Agriculture, 2018).

Agriculture in Belize is distributed throughout the country. About one fourth of farms are concentrated in the south, specifically the Toledo District. In the north, the Orange Walk district has 22% of farms followed by the Corozal district with 21% of farms. Estimates are about 24,000 ha in sugar cane, 19,000 ha in citrus, 15,000 ha in corn and 61,000 ha in pastures grazed by approximately 80,000 head of cattle (FAO, 2011). The types of production systems used in Belize range from shifting cultivation practices to fully mechanized operations; it varies dependent of what is being farmed. Shifting cultivation practices are mainly used by small famers whose products are specifically for the domestic market. The larger crop industries such as sugarcane, citrus, banana, beans and vegetables are cultivated using semi-mechanized practices. Corn and rice are grown under mechanized practices, which are predominantly farmed by large scale Mennonite farmers. Furthermore, an emerging interest in agroforestry practices, particularly in southern Belize is in motion. Cacao-based, and other rotational crop agro-forestry in the rain forests in Southern Belize is considered a viable alternative to traditional slash and burn or intensive monoculture farming. In June 2014,

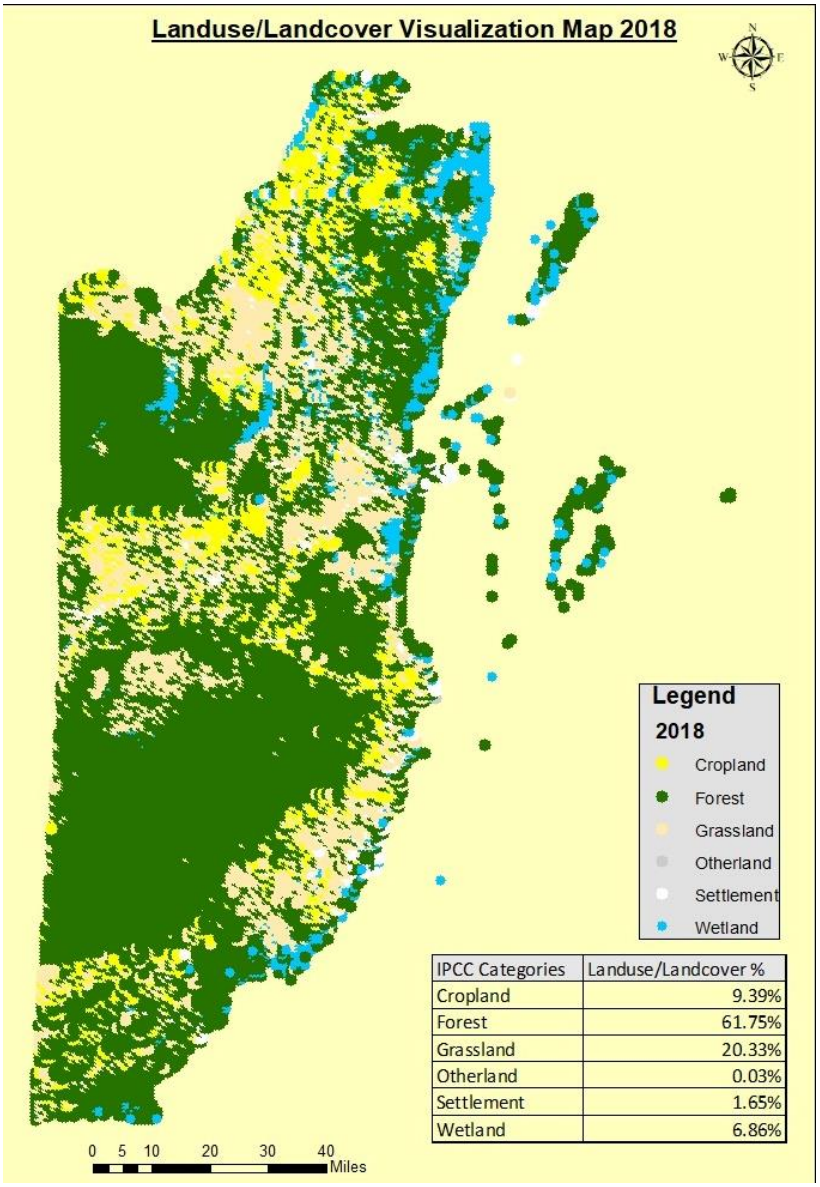
the first agroforestry concession within a protected area was granted by the Government of Belize to the Trio Farmers Cacao Growers Association. The Maya Mountain North Forest Reserve cacao agroforestry concession is Belize's first community concession allowing local residents to access a protected area and become stewards of that area and is managed by Ya'axché Conservation Trust (Beaton, 2019).

Belize has a revised National Agriculture and Food Policy (2015 - 2030) with an objective to provide an environment that is conducive to increasing production and productivity, promoting investment, and encouraging private sector involvement in agribusiness enterprises in a manner that ensures competitiveness, quality production, trade and sustainability. The National Climate Change Office, with technical assistance from the Climate Technology Centre and Network, is also in the process of developing an agroforestry policy for Belize, with CATIE as the consultant hired to carry out the technical assistance.

1.10 FOREST

Recent studies show the total forest cover to be around 61.75% with a deforestation rate of 9712 ha per annum or 5.56% forest cover loss per year as of 2018 (Forest Department, 2019). Belize is primarily dominated by broadleaf forests while also consisting of pine forests, mixed forests and mangrove forests. Figure 1.7 shows Belize's land cover along with coverage of forest types. About 40% of the national forest cover is under protected area status, and the other 60% is privately owned or situated on public lands that are not directly managed for forestry purposes. Of the publicly owned and managed forests, 65% are set aside for timber production (forest reserves), and the remaining areas are managed for non-extractive purposes (Forest Department, n.d.). Since 2005, the Forest Department has shifted from granting short term logging licenses to granting long term (20 and 40 years) licenses which are designed to practice sustainable forest management (SFM), enabling logging companies to replant timber trees and harvest logs on a rotation basis. Sustainable Forest Management also consists of certifying timber harvesting operations which can act as an incentive for logging companies to manage forests sustainably as it allows them to transfer some of the costs of sound management to the consumer. The initiative also practices community forestry which aims to get local people more involved in the management of their forests.

FIGURE 1.7 FOREST TYPE AND COVER



IPCC Categories	Landuse/Landcover %
Cropland	9.39%
Forest	61.75%
Grassland	20.33%
Otherland	0.03%
Settlement	1.65%
Wetland	6.86%

Source: Forest Department, Collect Earth LUC assessment, 2019

1.11 NATIONAL PRIORITIES RELATED TO CLIMATE CHANGE

Cognizant of the threats that Climate Change poses to the sustainable economic and social development and poverty reduction agenda, the Government of Belize has committed to strategically transition to low carbon development while strengthening its resilience to the effects of Climate Change (NDC, 2016). In April 2016, Belize ratified the Paris Agreement (Climate Action Plan) and submitted its Nationally Determined Contributions (NDCs) to implement the Paris Agreement.

This national commitment led to the further unfolding of the National Climate Change Policy, Strategy and

Action Plan (NCCPSAP), a National Climate Resilient Investment Plan, and the process of mainstreaming climate change into the national Growth and Sustainable Development Strategy (GSDS) and other relevant sectoral plans. The country's NDC builds off these plans and focuses on reducing emissions from the forestry, transport, energy, and waste sectors and strengthening the resilience of coastal and marine resources, agriculture, water resources, tourism, fisheries and aquaculture, human health, infrastructure, and forestry.

Regarding mitigation actions undertaken in the country, recent reports (TNC, 2016; NDC, 2016) highlight the importance of the National Climate Change Policy (2015), Strategy and Action Plan and Low Carbon Development Roadmap (two phases until 2020), along other key policy initiatives such as the development and implementation of an Integrated Coastal Zone Management Plan (2013), the Ministry of Energy, Science & Technology and Public Utilities (MESTPU) Strategic Plan 2012-2017, the Sustainable Energy Action Plan for Belize, the National Sustainable Tourism Master Plan of Belize (2010), Growth and Sustainable Development Strategy (GSDS) 2014 – 2017, the National Agenda for Sustainable Development (2013),and the National Climate Resilience Investment Plan (2013). Besides the information presented in the relevant chapters within the INC, SNC and TNC, Belize presented in its NDC information on voluntary activities conditional on the availability of support related to *reserves and sustainable forest management, fuel wood consumption, mangroves, transport Sector, and Belize's Sustainable Energy Strategy and Action Plan*. For these activities, the NDC describes objectives and ex-ante emission estimates.

Moving forward, Belize intends to develop an updated NDC based on enhanced innovation, ambition, and accuracy with respect to the proposed actions, costs, accounting of GHG emissions and transparency. Whilst the country has made substantial advancement in setting the foundation for climate action, there are still needs to create and strengthen technical capacities and mobilize the necessary financial resources to achieve the country's climate-related objectives.

A recent Climate Change Policy Assessment by the IMF and World Bank (IMF, 2018) estimated that one-third of budget investment goes to resilience-building projects. The report presents a rough estimate of NDC Implementation costs at 28% of FY2018–19 GDP, matching about 2.5% of GDP a year between now and 2030. This would be additional to the private sector investments needed on the mitigation interventions. This assessment underscores the importance of creating financial mechanisms to address climate risks and extreme events building on national and international capacities to mobilize required resources.

2 INSTITUTIONAL ARRANGEMENTS OF CLIMATE CHANGE MANAGEMENT

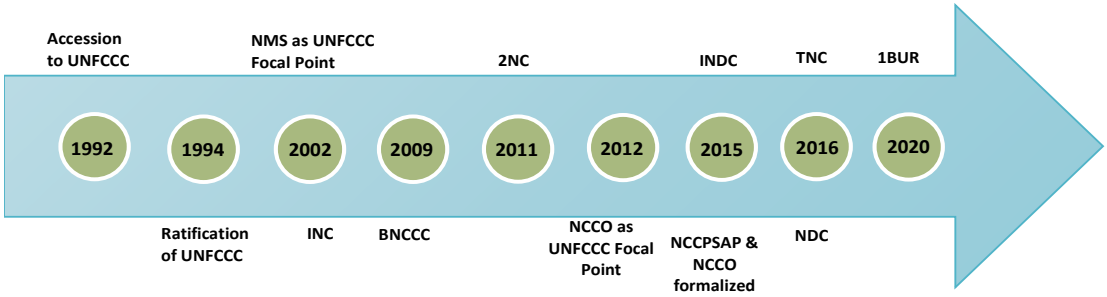
2.1 HISTORY OF CLIMATE CHANGE INSTITUTIONAL ARRANGEMENTS

Belize, in recognition of the global response to climate change, became party to the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified it in 1994. In 2003, Belize acceded to the Kyoto Protocol which came into force on the 16th February 2005. Belize continued to unite with other countries in addressing climate change as a part of the 195 countries who signed unto the Paris agreement between 2015 and 2016.

To further national efforts to mitigate climate change, the National Climate Change Policy, Strategy and Action Plan (NCCPSAP) was drafted and approved by the Cabinet in September 2015. This policy and action plan regard climate change as one of the greatest pressures to sustainable development and works towards the pursuit of further enhancing Belize's commitment to ensure the full implementation of the Convention. Following suit under the Convention, Belize also submitted its Nationally Determined Contributions (NDCs) in 2016, the compendium of the country's climate change plan under the Paris Agreement.

Prior to the establishment of a National Climate Change Office (NCCO) as the current climate change focal point, there were various institutional shifts that lead to its evolution. The National Meteorological Service under the Ministry of Natural Resources was the initial climate change focal point, under which Belize's Initial and Second National Communications were coordinated. In 2009, the Belize National Climate Change Committee was formalized, whose main objective was to provide policy guidance and facilitate the mainstreaming of climate change adaptation and mitigation. Through its establishment, a dedicated office for climate change coordination and communication was recognized, and the National Climate Change Office became a pro tem office in 2012, then formalized 3 years later with the approval of the NCCPSAP. Figure 2.1 below replicates the timeline of major climate change related activities in Belize.

FIGURE 2.1 TIMELINE OF CLIMATE CHANGE ACTIVITIES IN BELIZE

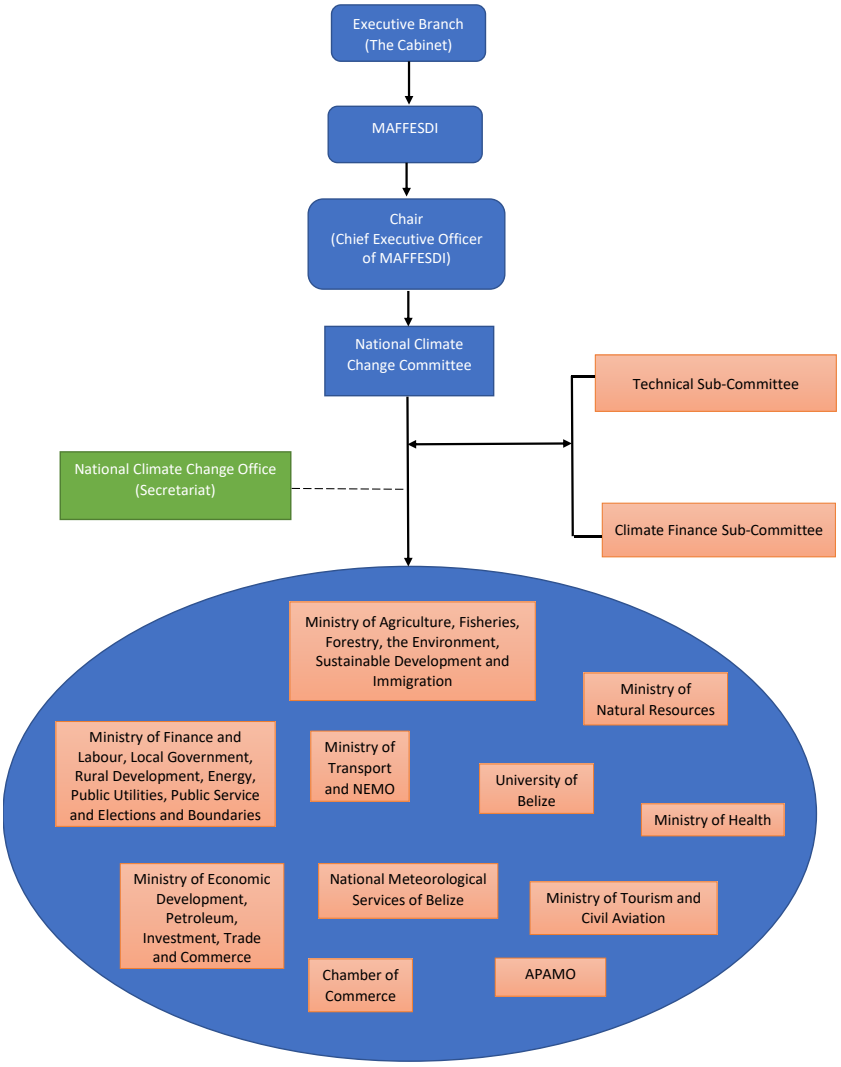


2.2 GENERAL GOVERNANCE OF CLIMATE CHANGE IN BELIZE

At present, the BNCCC is the leading strategic level entity for endorsement of major climate change related activities, policies, and plans, and thus has critical oversight with regard to climate change mainstreaming into the broader national development agenda. It is chaired by MFFESD and has a wide representation of members from related governmental bodies, private sector, civil society and academia (NCCSAP, 2015). Membership includes: CEO of *MFFESD* (climate change and environment portfolio) (Chair), Ministry of Economic Development, Petroleum, Investment, Trade and Commerce (MEDPITC) (Vice Chair); Ministry of Natural Resources; Ministry of Health; Ministry of Works; Ministry of Transport and National Emergency Management Organization; Ministry of Tourism and Civil Aviation; Ministry of Finance, Labour, Local Government, Rural Development, Energy, Public Utilities, Public Service and Elections and Boundaries; a representative of the private sector (Vice Chair); a representative from the NGO/CBO umbrella group; and a representative from the University of Belize. The NCCO under MFFESD functions as the Secretariat. The committee meets at quarterly intervals and is able to advise the Government through the Cabinet.

As an aid to the coordination, advisory, and implementation functions of the BNCCC, there are two subcommittees who provide technical guidance for final decision making. These subcommittees are the Technical Sub-Committee, which provides technical guidance on adaption and mitigation efforts, and the Climate Finance Sub-Committee, which provides oversight of the delivery of climate change financing and areas of economic expansion. The organization of the BNCCC can be seen in Figure 2.2.

FIGURE 2.2 THE CURRENT ORGANIZATIONAL STRUCTURE FOR CLIMATE CHANGE



2.3 INSTITUTIONAL ARRANGEMENTS RELEVANT TO THE PREPARATION OF NC, BUR AND NIR

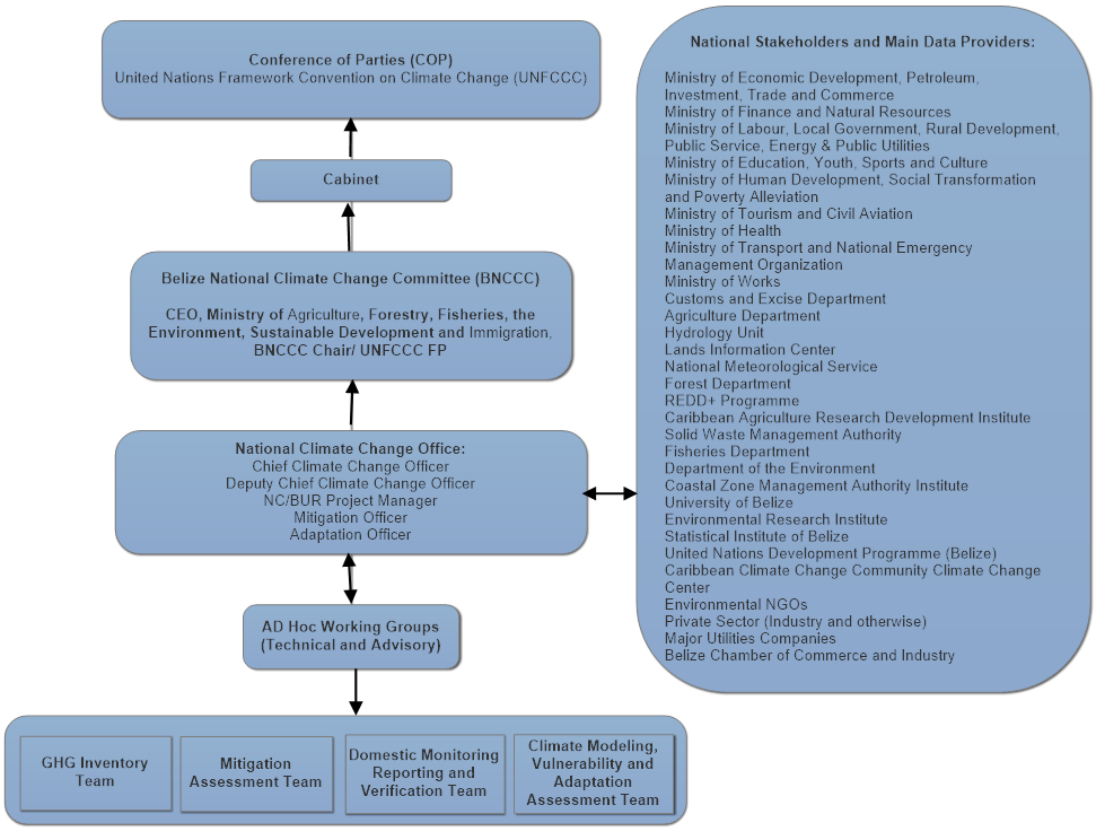
The MFFESD currently houses the UNFCCC Focal Point, whereby the NCCO takes the leading role in ensuring preparation and submission of major national reports such as NCs, BURs and NIRs for review and endorsement at the committee level before final endorsement from the Cabinet. In the case of NIRs, extensive quality control and quality assurance measures are taken before submission as an annex to NCs, and BURs. These measures involve multi-sectoral participation during data collection and emission estimation, as well as peer review by external experts in all major reporting areas (Agriculture, Forestry and other Land Uses, Industrial Processes and Product Use, Energy and Waste).

For reporting on mitigation and adaptation actions, support needed and received (financial, technology, and capacity building), climate change projects, and domestic measuring, reporting and verification (MRV)

arrangements for climate change activities in the country, stakeholder engagement is the primary means of acquiring information.

Stakeholder consultations are done on a periodic basis to engage the key national stakeholders carrying out climate-related activities and to receive updates on activity progression. Ad hoc sessions are similarly hosted amongst working teams of key stakeholders who carry out mitigation and adaptation activities. For the purpose of reporting, such activities are often completed within projects or consultancies, providing relevant updates to climate actions in forms of project reports, action plans, studies, NAMAs, critical success factor 3 of the GSDS, Public Sector Investment Programme (PSIP), etc. Figure 2.3 outlines the main arrangements for institutional coordination of climate change reporting under the main thematic areas.

FIGURE 2.3 INSTITUTIONAL ARRANGEMENTS RELEVANT FOR THE PREPARATIONS OF NATIONAL COMMUNICATIONS AND BIENNIAL UPDATE REPORTS OF BELIZE



2.4 INSTITUTIONAL ARRANGEMENTS FOR THE GHG MANAGEMENT SYSTEM

The National Climate Change Office (NCCO), is entrusted with the role of leading Belize's national and international agenda on climate change, including coordinating the National GHG Inventory, and establishing an appropriate GHG Management System that focuses on timely submission obligations in

accordance to the Paris Agreement, adherence to TACCC (Transparency, Accuracy, Completeness, Comparability, Consistency) principles, national ownership, and sustainability of its preparation.

In this context, Figure 2.4 describes in detail the processes that comprise the GHG Inventory preparation and reporting cycle. Belize's national GHG Inventory team is comprised of an Inventory Coordinator charged with the synchronization of all sector and crosscutting activities/reports, including uncertainty management, and ensures functionality of GHG Inventory Management System; Sector Leads who take the executive roles in coordinating data collection, estimating, and reporting GHG emissions and sinks for their sectors, and crosscutting roles such as the QA/QC.

Belize's inventory process intends to elucidate the roles and responsibilities of all GHG Inventory Team members and stakeholders into an understandable process flow from role establishment, to inventory preparation to publication to the wider public. A comprehensive inventory requires the identification and documentation of all relevant contributors to the National Inventory. Reviewing the status of existing methods, data sources, and emissions factors plays a vital role in emissions estimation, and ultimately report writing. These portions of the inventory process require various quality inputs such as uncertainty analysis, key category analysis and QA/QC checks to ensure that country estimations are reported according to IPCC Good Practice Guidelines and follow the TACCC Principles. At the final stages of the process, where the draft NIR is revised to produce the final NIR, publication and dissemination to policy makers as well as the wider public ensure that transparency efforts are covered, and that informed national decisions and policy mainstreaming is facilitated. The Inventory Process that Belize adopts is not a fixed model, but rather a model based on continuous improvement that benefits the country at large and consistently aligns with national development strategies.

The Institutional arrangements for inventory development will guarantee its perpetuity and integrity, promote institutionalization of the inventory process, and enable prioritization of future sector-based mitigation actions. GHG inventory reporting under the Convention has been evolutionary and takes years to develop a long-term, sustainable system. Belize has devoted significant human and financial resources to support the development of its GHG inventory system. In preparation for an in-situ institutional structure, with multi-ministerial participation in inventory preparation, various capacity building activities is needed to build familiarity and understanding of international reporting requirements of NIRs.

As this capacity is being nurtured, national experts with experience in conducting NIRs carried out inventory preparation for this reporting cycle. Keen attention and expert guidance are fostered to the next generation inventory team during the preparatory phase serving as an introduction to carrying out key components of inventory preparation. The members of the inventory preparation team for the 4th National Inventory Report, national consultants, were also encouraged to seek guidance from the incoming sector leads during data solicitation, due to their expertise in their respective sectors. The sector leads were also involved in the data validation process (QC checks), and the final technical validation (peer review) of the final report. In subsequent GHG preparation cycles, the sector leads should assume the role of core inventory preparation team, and the use of consultants should be discontinued. The key roles and responsibilities of each GHG Inventory Team member for the preparation of the 4th National Inventory Report is detailed in Table 2.1 on the following page.

FIGURE 2.4 NIR PROCESS IN BELIZE

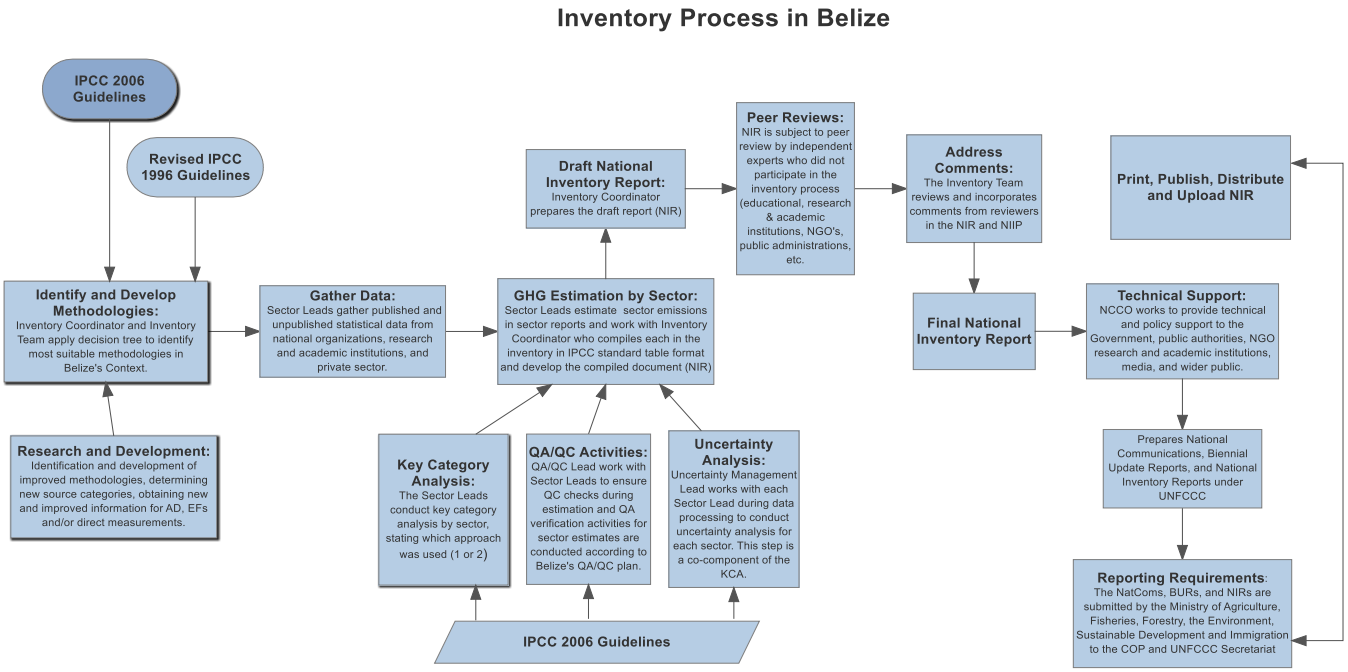


TABLE 2.1 FUNCTIONAL GHG INVENTORY ENTITIES AND THEIR ROLES/RESPONSIBILITIES

Inventory Task	Lead Institution	Specific Duties
Approval and submission of Inventory Report	Ministry of Fisheries, Forestry, Environment and Sustainable Development	Reviews and approves national inventory report Uses inventory estimates to inform policy Provides overall policy direction to the national inventory compilers
Designated National Entity (DNE)	National Climate Change Office	Overall technical oversight and coordinates timely deliverables. Develops programs and strategies which will ensure long-term improvements in the inventory system Dissemination and awareness creation on all the inventory products Serves as the UNFCCC Focal Point
National Inventory Coordinator and Inventory Compiler	National Climate Change Office (GHG Inventory Coordinator)	Acts as the inventory coordinator to oversee the entire inventory on behalf of the NCCO Plans the preparation of the inventory and provides operational, management and technical oversight.

		Reports directly to the Designated National Entity (DNE) for onward transmission to its Board and Ministry of Fisheries, Forestry, Environment and Sustainable Development Manages all MoUs, contracts, and information agreements to facilitate efficient delivery of all contracts, data, tasks and agreements. Creates schedule based on the inventory cycle timelines and all the inventory preparation steps that need to be completed prior to, and after, the due date, taking into account the time needed to complete each of those steps. In the event of an inventory undergoing review (internal or external), the compiler will interface between reviewers and inventory experts. Responsible for data and document management, which is critical to the long-term improvement of the inventory Acts as the receiver of inventory files from the working groups – all worksheets and text and would be responsible for putting the pieces together into one unified inventory document Doubles as the generalist for the inventory. This implies that, the compiler ensures that all the inventory activities which border on issues such as decisions and choices to undertake recalculation, key category analysis, completeness and reporting are consistent with IPCC GPGs both at the inventory and sector level Ensures new developments concerning the inventory are thoroughly discussed and implemented. The compiler works closely with the sector leads in order to make the sector inventory internally consistent. Maintains a duplicate version of all GHG data at the host institution
Inventory Preparation Team	Caribbean Community Climate Change Centre	Conduct comprehensive assessment of GHG data requirements Identify the sources and access them with the support of the inventory coordinator/compiler using appropriate channels and document all the data and processes involved.

		Collect, collate, process and update all GHG related data in the sector. Perform sector level QC checks on data being collected and estimations made, guided by the checklists in the QA/QC Plan. Submit all processed data and any other supplemental data to the central database. Liaise with the National Entity to undertake comprehensive review of available methodological choices and make sound methodological choices on the basis of its applicability to the estimation of GHG emissions. Estimate GHG emissions for all categories and gases under sectors using appropriate factors/ GWPs and ensure that the processes/ assumptions for the estimation, including the software used, are consistent with the IPCC guidelines and fully documented. Conduct key category analysis for the sector and uncertainty assessment in collaboration with the coordinator/generalist and the uncertainty management lead. Compile all the sector estimates in the worksheets into "detailed" and "synthesis" reports. Including clearly prioritised plans for improvements to be incorporated into the national inventory report and inventory improvement plan. Create and maintain hard and soft copies of all information, data, and estimates at the sector level and for onward transmission to the inventory documentation and archiving depository.

2.5 DOMESTIC MRV SYSTEM

In 2007, Decision 1 of the Bali Action Plan at COP 13 explains that reducing emissions with the urgency needed should be executed by having "measurable, reportable and verifiable" mitigation actions (UNFCCC, 2007). In Belize's case, MRV systems for climate change actions are germinal, however, promising efforts are being developed to ensure structured and transparent reporting.

2.5.1 FOLU Sector and REDD+ MRV Elements

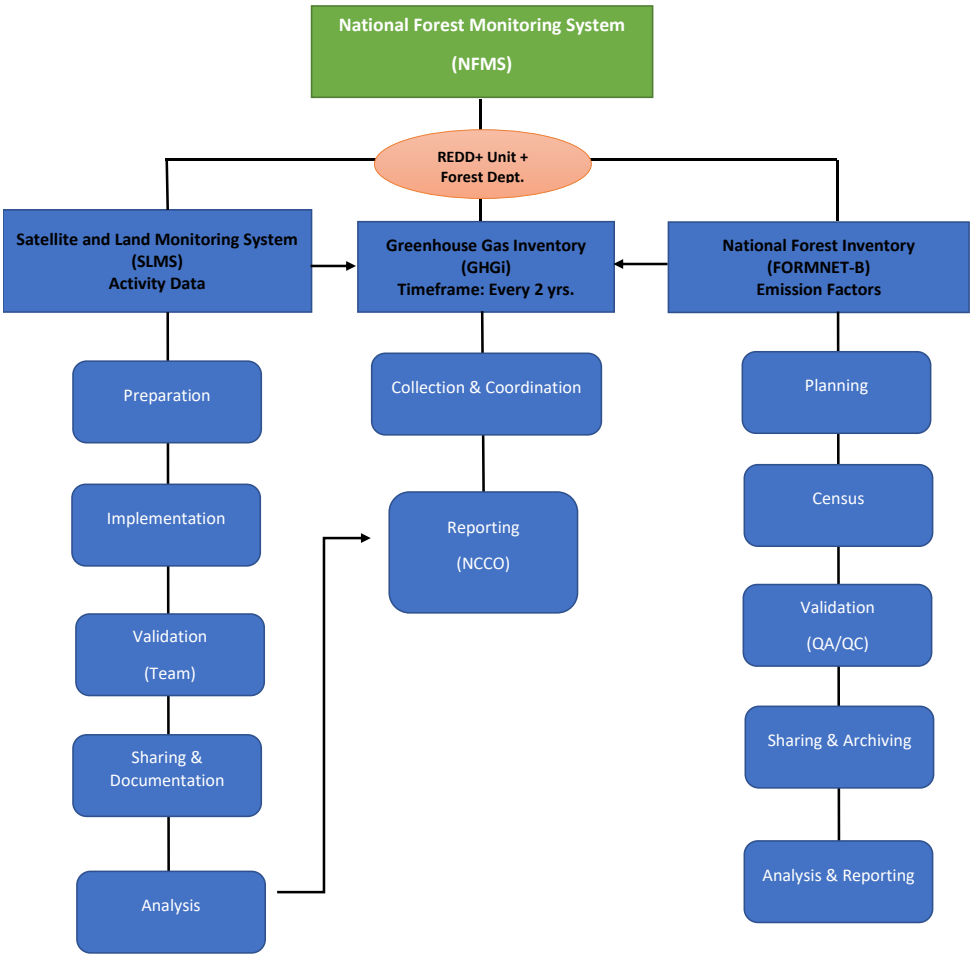
Out of all the GHG sectors, the Forestry and Other Land Use sector is the most advanced MRV structure in Belize. Under the Mitigation section of Belize's NDC, it states that the methodological approach that Belize will institute to estimate emissions from the FOLU sector is by utilizing REDD+ data and processes (NDC, 2015). To date, this process has been jointly executed by the Forest Department of Belize and the National Climate Change Office which houses the REDD+ Readiness Project Unit.

Besides preparing Belize to receive results-based payments, the REDD+ process also highlights the importance of having an established National Forest Monitoring System. Capitalizing on some of the existing processes for forest management under the Forest Department, the REDD+ process enhanced other activities that not only supplement REDD+ reporting, but forest monitoring operations, as well as GHG inventory estimations.

The first activity under the National Forest Monitoring System is the Satellite and Land Monitoring System (SLMS). This involves an approach 3 methodology, which utilizes the Open Foris Collect Earth tool which utilizes Google Earth, Google Earth Engine, Bing Maps and HereWeGo Maps for the collection of land use change activity data. This geospatial mapping process has been adopted by the Forest Department to strengthen forest monitoring efforts, as well as ensures that accurate activity data is available for emission estimations for further GHG inventories.

The second part of the NFMS is the National Forest Inventory (NFI). This is a permanent forest plot network and database, FORMNET-B, which was designed to study the long-term dynamics of disturbed and degraded tropical forests (Cho, et. al., 2013). This database is comprised of forest dynamic data collected from permanent sampling plots (PSP) in national forest types. This operation is undertaken by the Forest Department to monitor forest health, and the data collected is also used to estimate some country specific emission factors for the main forest types. The activity data collected from the SLMS and the country specific emission factors collected by the NFI ensures that the emissions estimations from the FOLU sector are as robust as possible. This process can be seen in Figure 2.5 below.

FIGURE 2.5 MRV SYSTEM FOR REDD+ NFMS



2.5.2 STEPS TAKEN TO ENHANCE DOMESTIC MRV SYSTEM

Belize's approach to develop and operationalize its domestic MRV system focuses on integration of existing national development M&E processes to both enhance and complement other existing systems and fill any gaps that may exist, rather than duplicating efforts. Efforts to enhance MRV in climate change management have been integral during the elaboration of Belize's First BUR. Stakeholder engagements to evaluate sector needs and gaps in monitoring and reporting of climate related activities have been an ongoing focus in preparation of developing a framework for National MRV System for Climate Governance. This framework has been coined as the Climate Risk Information System (CRIS) which will be managed by the NCCO. The CRIS will serve as the main measurement and monitoring tool for the NCCO and will aid stakeholders in reporting their climate data and information. The CRIS will be hosted on a web-based platform to aid in data collection, facilitate easy access of information to key stakeholders, and support analysis required for both national and international reporting. Its scope includes six main areas: climate risk, adaptation, mitigation, greenhouse gas inventory, climate finance and reporting structures and documentation. Additional to the CRIS, opportunities exist for the harmonization of other MRV and Transparency related

initiatives to support the successful rollout of a National MRV System. For the year 2020, entities such as ICAT, NDC Partnership and the CCMRV Hub have planned initiatives which aim to enhance work in institutional arrangements of a National MRV System, develop NDC tracking indicators and climate finance flows, and build GHG related capacity and regional collaborations, respectively (Table 2.2).

TABLE 2.2 MRV PROGRAMS AND INITIATIVES

Initiative	Donor	Implementing Agency	MRV Activities
FNC/BUR Project	GEF	National Climate Change Office	• Elaboration of Institutional Arrangements for NIRs, NCs and BURs • Development of GHG QA/QC Plan and NIIP (based on UNFCCC Voluntary QA Exercise) • Mitigation Assessment of key NDC Sectors and Mitigation Action plan • Development of Data Management and Archiving Procedure and System for GHG Inventory • Project Support for MRV Initiatives, i.e. ICAT, NDC Initiatives, etc.
REDD+ Readiness Project	World Bank	National Climate Change Office/ Forest Department	• REDD+ MRV Framework, National Forest Monitoring System • FOLU GHG Inventory • FREL development
NDC Partnership (Belize's NDC Implementation Plan and CAEP)	NDCP	National Climate Change Office	• Development of an NDC implementation plan • Development of a financial strategy (financing options for adaptation, mitigation and cross-cutting areas) • development of a MRV tool to track and report on the implementation and impacts of NDC mitigation and adaptation actions • Update of NDC
Technical Assistance (TA) by CTCN	CTCN	National Climate Change Office/ CATIE	• Development of an integrated and comprehensive agroforestry policy for Belize –
Capacity Development II Project	GEF	MAFFESDI	• Development of MOUs between DOE and SIB to include environmental indicators on National Statistical System (incomplete)
Climate Vulnerability Reduction Program	IDB	Ministry of Works	• Development of Climate Risk Information System (CRIS) (main platform for Climate Change MRV in Belize)
CCMRV Hub for English Speaking Caribbean Countries	IKI	National Climate Change Office/ CCMRV Hub	• IPCC 2006 Guidelines Training for National Experts • Data Management Working Crew to develop Regional GHG Management System

These initiatives can strengthen the coordination with relevant climate change stakeholders both in the private and government sectors since the access of reliable national data and information is in high demand. The development of these MRV initiatives is an opportunity to enhance national capability in MRV of climate related activities and processes and facilitate the establishment of formal reporting processes. Furthermore, Belize's Domestic MRV system, through its development, should enhance the quality and access to relevant climate change information and data, leading to informed assessment of climate policies and improved decision making.

3 NATIONAL GREENHOUSE GAS INVENTORY

3.1 INTRODUCTION

Over the last two decades, Belize has compiled national greenhouse gas inventories of emissions and removals. This 2020 submission, marks Belize's fourth National Inventory Report, and the first that utilizes the revised IPCC 2006 guidelines, and a combination of Tier 1, 2 and 3 methodologies.

These inventories have allowed for the identification of the highest emitting sectors, as well as trends in the emission of the different gases evaluated in the sectors evaluated.

A description of institutional arrangements for the planning and execution of this Greenhouse Gas Inventory was described previously in Chapter 2.2 on Institutional Arrangements for the GHG Management System.

3.2 OUTLINE OF THE NATIONAL INVENTORY REPORT

3.2.1 KEY ECONOMIC SECTORS COVERED

The national inventory report described greenhouse gas emissions and removals in the Energy; Industrial Processes and Product Use; Agriculture, Forest and Other Land Use; and Waste Sectors.

Activities contributing to GHG emissions in the Energy sector included electricity generation, transportation, Other (Residential fuel use), and International Bunkers. Belize is not a highly industrialized country, so there were few sources of emissions within the IPPU sector such as lime production, road paving, refrigerants, and alcohol and bread production. The AFOLU sector contributed to both emissions and removals of GHG through sources such as enteric fermentation, crop residue burning, tillage, rice cultivation, and changes in land use, while the maintenance and management of forests helped to remove Carbon dioxide from the atmosphere. Waste sector emissions were produced from the solid waste production and disposal sub-sector, and wastewater management.

3.2.2 GASES INCLUDED IN THE INVENTORY

Gas emissions to be estimated and reported on include Carbon dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). However, emissions of Non-methane volatile organic compounds and fluorocarbons would also be estimated and reported.

3.2.3 REPORTING YEARS

Reporting years for Belize's fourth national inventory were established as 2012, 2015, and 2017.

3.2.4 DESCRIPTION OF METHODOLOGIES AND DATA SOURCES

Following paragraph 13, annex to 17/CP.8, a brief description of procedures and arrangements undertaken to collect and archive data for the preparation of the national GHG inventories is included, as well as efforts to make this a continuous process, including information on the role of the institutions involved.

Fuel data for the Energy sector inventory was obtained from local sources including the main importer of fuel, PUMA; the Energy Unit in the Ministry of Public Service, Energy and Public Utilities; and the Farmers' Light Plant of Spanish Lookout. Other relevant data for this sector was obtained from the Department of Transport.

The Tier 1 approach for calculations was used for most of the sectors including Energy, IPPU, and Waste due to the detail of the available data. The various authorities, institutions, and companies who were the sources generally do not collect or record data in detail. Tiers 1 and 2 were applied in the Agriculture sector since some level of detail was available in the data provided.

Tiers 1, 2 and 3 were utilized for the Forest and Land Use sector due to the data that was available or developed through the ongoing REDD+ Readiness Plus project being implemented with the support of the Forest Carbon Partnership Facility "FCPF", and the Coalition for Rainforest Nations. The information on Activity Data used was obtained from land use and land-use change assessments, which were conducted on the basis of a sampling approach (IPCC approach 3) using Collect Earth, in which the land-use condition was determined for each year of the time series 2000 - 2017. The information on Emission Factors was obtained from country specific research, scientific literature, and default values of the 2006 IPCC Guidelines and 2013 IPCC Wetlands supplement. For the estimation of GHG emissions and removals the 2006 IPCC Guidelines were applied, following the Gain-Loss method and implementing a country-specific excel calculation tool. The information on wood removals was derived from the Collect Earth assessment. Disturbances were also identified including Hurricanes, Fires, Logging, Grazing, Shifting Cultivation, Infrastructure, Pests and Other Human Impact.

Belize's National GHG Inventory includes a distinction between managed and unmanaged lands, following the 2006 IPCC guidelines and the managed lands proxy (MLP). Therefore, the GHGI excludes the effect of recurrent hurricanes and pests, which have historically dominated emissions and removals in the country. Unmanaged Land is Forest land with no evidence of human activity. Managed Lands cover the entire territory in Belize that does not fall under the definition of Unmanaged Lands. Following IPCC's best practice, the area of unmanaged lands is monitored by Belize. Emissions and removals are estimated for both types of land, as this is important information for the Government of Belize. The current GHG

Inventory includes only emissions and removals in Managed Lands. Unmanaged lands converted to managed lands will be tracked in the future and those emissions and removals will be considered.

3.2.5 GLOBAL WARMING POTENTIALS (GWP) APPLIED

The greenhouse gas emissions are usually reported as units of Carbon dioxide equivalents (CO_2e). This value is obtained by multiplying the amount of the gases by their Global Warming Potentials (GWPs). The Global Warming Potentials used for these inventory calculations were those based on the 100-year time horizon and are presented below. GWPs from the IPCC Second Assessment Report (SAR) were used for Energy, IPPU, Waste, and Agriculture sectors, and GWPs from the IPCC Fifth Assessment Report (AR5) were used for the FOLU sector.

TABLE 3.1: GLOBAL WARMING POTENTIALS

Gas	GWP (SAR)	GWP (AR5)
CO_2	1	1
CH_4	21	28
N_2O	310	265

3.3 KEY CATEGORY ANALYSIS

Key Source Category analyses enable inventory planners to identify the sector activities requiring additional attention to address gaps in data, or to improve the data where that data was determined to be unreliable or inaccurate. It is also a useful tool to understand the national emission profiles, and key priority areas.

These analyses also enable decision makers at national level to determine where investments can be made to mitigate the GHG emissions through the development and implementation of mitigation actions. At the same time, a series of such analyses can demonstrate whether or what effect the remedial action is having on the particular activity. The following analyses were generated for Belize's fourth national greenhouse inventory of emissions and removals.

Using Approach 1 Level Assessment, the following tables display the Key Category Analyses for the three reference years. The top four sources of GHG emissions and removals are the same and fall into the same order for the three reference years. According to the analyses, the key categories account for 95% of cumulative net emissions and removals for 2012, 2015, and 2017 were:

+ *REMOVALS FROM FORESTLAND (CO_2)*

- *LAND CONVERTED TO CROPLAND (CO_2)*

- *LAND CONVERTED TO GRASSLAND (CO_2)*

- *ROAD TRANSPORTATION (CO_2)*

Of the emitting activities, the highest would be (1) *CO_2 from land converted to cropland*, followed by (2) *CO_2 from land converted to grassland*, (3) *CH_4 emissions from Enteric Fermentation (Livestock)*, (4) *N_2O emissions from Direct Emissions from Managed Soils,* and (5) *CO_2 from Gaseous Fuels consumed for* electricity in the most recent reference year, 2017. Details of analyses for each reference year can be seen in the following table.

TABLE 3.2: KEY CATEGORY ANALYSIS – 2012

IPCC Category code	IPCC Category	Gas	2012 Ex,t (Gg CO_2 Eq)	|Ex,t| (Gg CO_2 Eq)	Contribution	Cumulative Total
3.B.1.a and 3. B.1.b	Forest land Remaining Forest land and Land Converted to Forest land	CO_2	-13250.304	13250.304	0.671	0.671244
3.B.2.b and 3. B.2.a	Land Converted to Cropland and Cropland Remaining Cropland	CO_2	3651.007	3651.007	0.185	0.856200
3.B.3.b	Land Converted to Grassland	CO_2	1797.166	1797.166	0.091	0.947242
1.A.3.b	Road Transportation	CO_2	480.183	480.183	0.024	0.971568

TABLE 3.3: KEY CATEGORY ANALYSIS – 2015

IPCC Category code	IPCC Category	Gas	2015 Ex,t (Gg CO_2 Eq)	|Ex,t| (Gg CO_2 Eq)	Contribution	Cumulative Total
3.B.1.a and 3.B.1.b	Forest land Remaining Forest land and Land Converted to Forest land	CO_2	-12289.9200	12289.9200	0.6315	0.6315
3.B.2.b and 3.B.2.a	Land Converted to Cropland and Cropland Remaining Cropland	CO_2	4391.9980	4391.9980	0.2257	0.8572
3.B.3.b	Land Converted to Grassland	CO_2	1593.8530	1593.8530	0.0819	0.9391
1.A.3.b	Road Transportation	CO_2	663.5535	663.5535	0.0341	0.9732

TABLE 3.4: KEY CATEGORY ANALYSIS – 2017

IPCC Category code	IPCC Category	Gas	2017 Ex,t (Gg CO_2 Eq)	|Ex,t| (Gg CO_2 Eq)	Contribution	Cumulative Total
3.B.1.a and 3.B.1.b	Forest land Remaining Forest land and Land Converted to Forest land	CO_2	-12289.9200	12289.9200	0.6315	0.6315
3.B.2.b and 3.B.2.a	Land Converted to Cropland and Cropland Remaining Cropland	CO_2	4391.9980	4391.9980	0.2257	0.8572
3.B.3.b	Land Converted to Grassland	CO_2	1593.8530	1593.8530	0.0819	0.9391
1.A.3.b	Road Transportation	CO_2	663.5535	663.5535	0.0341	0.9732

3.4 ENERGY

3.4.1 BACKGROUND

Belize has made considerable advances in the usage of alternative energy sources such as biomass and hydro power, but petroleum-based fuels are still the main sources of energy as is described in this report through the analysis of fuel importation and usage. The generation of electricity saw slight increases in the usage of petroleum fuels combined with the continual use of hydro power, biomass and the importation of electricity from neighbouring Mexico. As the economy continues to grow, the transport sector increased the use of petroleum fuels such as gasoline (premium, regular, and aviation), diesel and kerosene. The local aviation transport sector, once considered insignificant in relation to greenhouse gas emissions reporting, has started to show an increase in petroleum fuel usage. This can be tied to the usage of fuel by the domestic airlines, but this is supplemented by the increased number of international airlines landing in Belize. The fuel usage by international airlines is described under international bunkers. Lastly, fugitive emissions from natural gas flaring from Belize's small oil and gas industry were not estimated due to data limitations.

3.4.2 RESULTS OF GHG EMISSIONS AND REMOVALS

Table 3.5 presents some details of the emissions generated through activities within the Energy sector. Biomass continued to be a major contributor in the mix for energy generation in Belize. It is noted that biomass for residential consumption is also increasing as a source of CO_2 emissions, indicating that the use of wood for residential energy (cooking) is increasing. Continually increasing cost of kerosene and propane/butane is probably influencing the increased use of firewood for cooking.

It was observed that consumption of Petroleum fuels increased within the Transport sub-sector although the values for land and marine showed slight decreases in 2017 (Table 3.5). It further shows that CO_2 emissions by residential use of biomass continue to increase.

TABLE 3.5: SUMMARY OF ENERGY SECTOR GHG EMISSIONS BY GAS AND SUB-SECTORS, 2012, 2015, 2017 (GG CO_2 EQ)

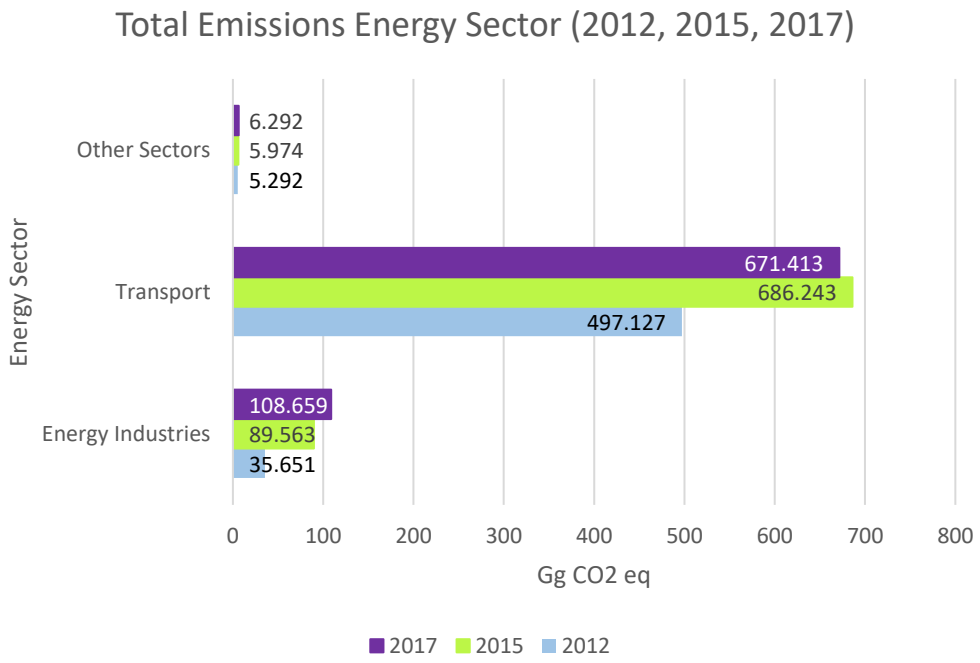
Sub-Sector		2012			2015			2017		
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Total		951.70 Gg CO_2 eq			1275.82 Gg CO_2 eq			1441.07 Gg CO_2 eq		
Energy Industries										
Electricity	Liquid	14.274	0.012	0.036	25.259	0.022	0.064	31.053	0.026	0.078
	Gas	13.582	0.005	0.008	54.930	0.021	0.030	66.945	0.025	0.037
	Biomass	413.630[1]	2.606	5.129	494.040[1]	3.113	6.126	561.25[1]	3.536	6.960
Transport										
Domestic Aviation	Liquid	9.293	0.001	0.082	11.898	0.002	0.105	12.776	0.002	0.112
International Aviation[2]	Liquid	40.009	0.0003	0.001	39.869	0.0003	0.0001	71.248	0.001	0.0001
Land/Marine Transport	Liquid	480.183	0.480	7.087	663.554	0.678	10.007	648.192	0.655	9.675

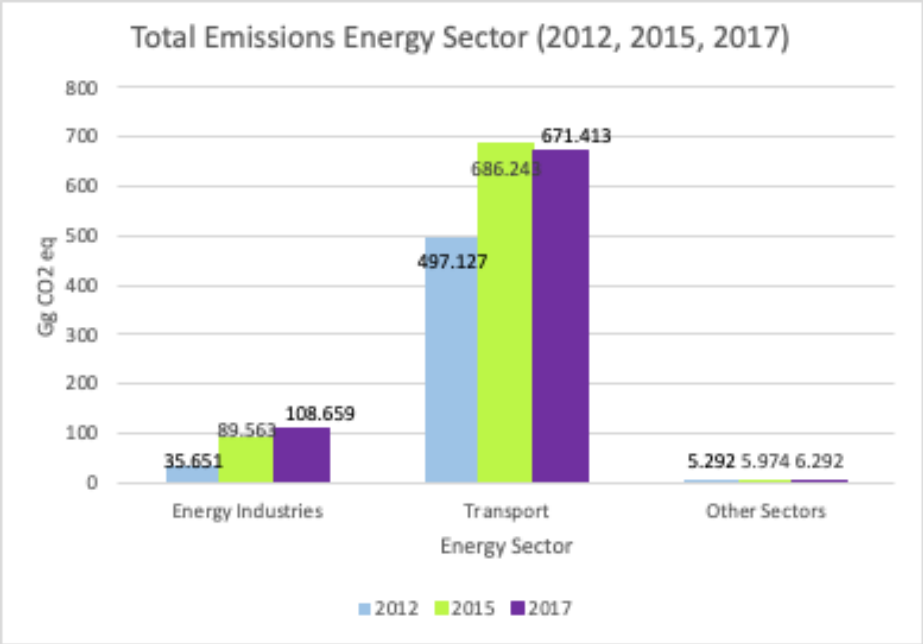
Others										
Residential[3]	Biomass	78.610[1]	4.422	0.870	88.730[1]	4.992	0.982	93.451[1]	5.257	1.035

[1] *CO_2 emissions from biomass not included in national total*
[2] *International Aviation is a memo item, not included in national total*
[3] *Residential Biomass Use reflected as estimate of usage by population growth as a result of data limitations*

Examination of Figure 3.1 demonstrates that the Transport sub-sector was the most significant source of GHG emissions during this study period. Throughout the study period, emissions from the Transport and Energy generation sub-sector have taken a steady increase, highlighting the increasing energy demand, as well as increased vehicle use. The emissions due to biomass use for "Other", residential cook stoves, is significantly less than other energy uses, and indicates a steady trend throughout the study period.

FIGURE 3.1: TOTAL EMISSIONS FOR ALL ENERGY SUB-SECTORS (GG CO_2 EQ)





3.4.3 ANALYSIS OF RESULTS

Petroleum fuels import increased since 2012. The electricity generation sub-sector saw a slight increase in the use of petroleum fuels. The usage of renewable resources along with the importation of electricity from Mexico mitigated greater greenhouse gases emissions for electricity generation. The largest increase of petroleum fuel usage for the same study period was in the transport sub-sector which increased the greenhouse gases emissions between 2012 and 2015. The increase in petroleum fuel usage was for land, maritime and air transportation. However, there was a decrease in petroleum products usage and emissions for the transport sub-sector in 2017. The fuel usage for national aviation has now become significant compared to the last national report which categorized it as insignificant. There was a large increase in aviation fuel which was used by international flights arriving in Belize. The greenhouse emissions for international aviation were reported under the caption of international bunkers and not accounted in national total.

Biomass usage for industrial and domestic energy production continued to increase as an alternate to petroleum products. Biomass is primarily used in the generation of energy by utilizing sugarcane bagasse from the sugar industry. There was an increase for the past two years especially with the addition of Santander Sugar Energy Ltd. producing electricity for the national grid. The increase of biomass use also increased the greenhouse gases emissions. However, the sugarcane plants that are used as biomass capture nearly the equivalent amount of CO_2 through photosynthesis which contributes to removal of CO_2 generated from the combustion of this biomass. For his reason, CO_2 emissions from biomass combustion are not included in national total, however non-CO_2 emissions are.

3.5 INDUSTRIAL PROCESSES AND PRODUCT USE

3.5.1 SECTOR BACKGROUND

Industrialization in Belize is advancing at a slow pace being somewhat limited by energy and labour costs. Activities which release greenhouse gas emissions within the Industrial Processes and other Product Use Sectors occur within a narrow range. There are very few of the sub-sectors displaying any reasonable level of activity to be estimated, these being lime production and road paving with asphalt in the Mineral Products sub-sector; and the production of beer, wine, and spirits, production of meat, fish, poultry, production of bread, and production of animal feed in the Food and Drink production sub-sector.

Activities within this sector resulting in GHG emissions include industrial processes such as fermentation, limekiln and dolomite operations and road paving with asphalt. The fermentation processes, commonly used in the production of bread and alcoholic beverage; and road paving, produce Non-Methane Volatile Organic Compounds (NMVOC). Limekilns produce quantities of CO_2 as the rocks are burned and converted to calcium oxide. Liming applications, for citrus and sugarcane, using crushed calcite or dolomitic limestone do not produce measurable emissions when applied by spreading. Emissions in the industrial process and product use sectors remained negligible throughout the period under review despite the increases in sugar production.

Also accounted for in the IPPU sector are GHG emissions used in products such as refrigerators, foams and aerosols. The estimation of GHG emissions from non-energy sources is often difficult because they are widespread and diverse. The difficulties in the allocation of GHG emissions between fuel combustion and industrial processes arise when by-product fuels or waste gases are transferred from the manufacturing site and combusted elsewhere in different activities.

3.5.2 RESULTS OF GHG EMISSIONS AND REMOVALS

The Fourth National Greenhouse Gas Inventory shows that emissions from the industrial sector continue to be released from the same sources as those for the previous inventories. Indications are that industrial activities continue to increase slowly as Belize's economic development progresses.

Table 3.6 summarizes the emissions from the activity areas for the reference years under study. The results obtained for the study period indicated that overall emissions from the IPPU sector have shown slow increase between 2012 and 2015 and remained relatively consistent between 2015 and 2017.

The current inventory results show that only two areas are significant sources of GHGs in the IPPU sector in Belize. These are product uses as substitutes for ozone depleting substances, and mineral production. Mineral production includes lime production and use of asphalt for paving. Emissions from food and drink processing include the production of liquor, bread, processed meats, sugar and animal feeds. Based on the available data, the software revealed negligible levels of emissions. Similar results of negligible emissions (in some cases displaying as "zero" through software calculation) were obtained from the estimations of emissions from bread production.

TABLE 3.6: SUMMARY OF GHG EMISSIONS FROM INDUSTRIAL PROCESSES & PRODUCT USE SECTORS –2012, 2015, 2017 (GG CO_2EQ)

CATEGORY	Subcategory	GHG Produced	2012 (Gg)	2015 (Gg)	2017 (Gg)
Mineral Industry	Lime and dolomite production	CO_2	1.525	1.649	0.488
Non-energy Products from Fuel	Road paving with asphalt	CO_2	3.75E-12	9.29E-08	9.16E-08
Product Uses as Substitutes for Ozone Depleting Substances	Refrigerant Use CH2FCF3 (Mobile and Stationary)	HFC (CO_2eq)	29.904	40.855	43.199
Others – Food and beverages	Use of wheat	CO_2	0	1.12E-06	6.52E-07
TOTAL		**All gases (Gg CO_2eq)**	**31.43**	**42.50**	**43.69**

The main gas released from this sector in any appreciable quantity was carbon dioxide; with the results of the calculations showing a net decrease in CO_2 emissions by the end of the study period. Total Emissions of the gas (carbon dioxide) increased slightly between 2012 and 2015, and then declined between 2015 and 2017.

Emissions from the road paving sub-category increased between 2012 and 2015 but decreased between 2015 and 2017. This trend suggests that road paving activities increased considerably between 2012 and 2015, but marginally declined between 2015 and 2017. Emissions from refrigerants also showed an increase between 2012 and 2015. CO_2 emissions from lime and dolomite production increased slightly between 2012 and 2015, then declined between 2015 and 2017. The latter decline in the emissions is likely due to the decreased consumption/production of the lime brought by lower demand in the shrimp and citrus industries. The shrimp industry in Belize, like a number of other nations, has recently been negatively impacted by diseases resulting in closure of some of the ponds. The citrus industry has been affected by the disease citrus greening, resulting in rehabilitation of some of the orchards, as a result requiring lower applications of lime.

3.5.3 Analysis of Results

The inventory estimates the primary emissions from the sector is HFCs followed by CO_2, mostly from refrigerant use in stationary and mobile sources, and lime production which involves the heating of limestone rocks in kilns over a three-day period. GHG emissions were also derived from food and beverage production, and road paving with asphalt.

The inventory also shows that the source of emissions from the IPPU sector remain the same as in earlier inventories. Increasing refrigerant use caused emissions to increase by 30% between 2012 to 2017. This can be attributed to the increase in the number of vehicles present in the country, as well as buildings being equipped with air conditioning units.

There was a net decrease in CO_2 emissions by the end of the study period. Total emissions of the CO_2 gas increased slightly between 2012 and 2015, and then declined between 2015 and 2017. This is mainly attributed to emissions from lime production, reflecting the decreased consumption/production of the lime brought by lower demand in the shrimp and citrus industries.

Lastly, CO_2 emissions from road paving sub-sector increased between 2012 and 2015, but decreased between 2015 and 2017, suggesting that road paving activities increased considerably between 2012 and 2015, but declined between 2015 and 2017.

3.6 AGRICULTURE, FORESTRY, AND OTHER LAND USES

3.6.1 Sector Background

3.6.1.1 AGRICULTURE BACKGROUND

Agriculture remains one of the main pillars of the Belizean economy. The vast majority of the rural population and the livelihood of the rural communities are also dependent on the environment through farming and forestry activities[1]. A census of farms in Belize in 2003 indicated that 24% of farms have less

[1] Barnett et. al, 2010

than 5 acres, 33% between 5 and 20 acres, and 74% of farms in the country is below 50 acres[2]. Toledo District has one fourth of all farms in Belize and the highest level of concentration of small farms (77% below 20 acres). Orange Walk is next with 22% of farms and Corozal with 21%. The farming population of approximately 11,000 farmers operates on about 5% of the agricultural land area. Small farmers account for more than 75% of the farming population. A large percentage of these small farms produce primary export crops such as sugar, bananas, and citrus, while others concentrate on domestic food crops, viz., rice, corn, beans, root crops and vegetables.

Agriculture in Belize is characterized by three main sub-sectors: a) a fairly well-organized traditional export sector for sugar, banana, citrus, and marine products, b) a more traditional, small-scale farm sector, producing food mainly for local consumption, and c) a large-scale commercial sector.

Liming is a practice conducted in the citrus and banana industries to reduce the acidity of the soils in southern Belize. Currently liming is done using either limestone or dolomite. Additionally, dolomite is also used in aquaculture applications.

Rice management. Rice production is grown under three systems in Belize, namely: Milpa or upland rice, mechanized and irrigated. Mechanized rice production uses farming equipment but is rain-fed instead of being irrigated mechanically. In flood irrigation between 15-30 cm of water is applied to the field and only one crop harvested per annum.

Livestock and manure management. The animal waste management system most common in Belize is the open range and paddock systems where the nitrogen from animal waste is considered as fertilizer. Most of the livestock herds are reared on natural range except for dairy cattle, some feedlots and poultry.

Some dairy farmers and beef feedlot farmers would apply manure directly to the fields. In poultry, manure management is based on the use of litter which is left in ambient temperature and used after a couple of months. This is also used as soil amendment in the rural areas such as Springfield and Barton Creek where the Mennonite farmers produce vegetables. However, the poultry manure cannot be applied immediately to plants due to its high Nitrogen content that “burns” the plant. Poultry manure needs to be aged or composted before use.

Field burning is a practice that is normally used in the traditional Milpa system and in other production systems. However, in the mechanized systems of production the crop residue is normally incorporated and is especially done in crops such as the legumes to add nitrogen to the soil, especially where they are in rotation with grain cereals

3.6.1.2 FORESTRY AND OTHER LAND USE BACKGROUND

Belize is endowed with vast and unique tropical forests that are also habitat to unique biodiversity of global significance[3]. Most of the country and the entire coastal area consist of low-lying plains. Belize is known for

[2] MAF Farm Registry

[3] https://www.thegef.org/sites/default/files/project_documents/9-19-11%2520Belize%2520PIF_0.pdf

its abundant natural resources and vast array of ecotypes especially with respect to water and biodiversity. Belize hosts more than 150 species of mammals, 540 species of birds, 151 species of amphibians and reptiles, nearly 600 species of freshwater and marine fish, and 3,408 species of vascular plants[4]. In fact, Belize has the highest forest cover in both Central America and the Caribbean, including the largest intact blocks of forests in Central America, namely the Selva Maya and the Maya Mountain Massif [5].

Forest conservation has, historically, been a major priority for Belize. This is evidenced by the country's extensive protected areas system[6]. The Protected Areas of Belize have evolved over the last few decades from being considered primarily as a resource bank, typically for forestry, to become a complex network of large and small "enclaves" having a diversity of purposes and under a variety of management regimes, some more effective than others, reflecting changing conservation attitudes, as has the scope and direction of the various agencies responsible for their administration[7].

The country has 44% (1.22 million hectares) of its land and sea resources protected under a variety of management structures: 769,093 ha of terrestrial reserves, 159,030 ha of marine reserves, and a further 128,535 ha protected through 'officially recognized' private conservation initiatives[8]. Belize has 102 protected areas (PAs) representing 22.6% of its national territory (land and marine). These include 19 Forest Reserves, 17 National Parks, 3 Nature Reserves, 7 Wildlife sanctuaries, 5 Natural Monuments, 9 Archeological Reserves, 8 Private Reserves, 8 Marines Reserves, 13 Spawning Sites, 6 Public Reserves, and 7 Bird sanctuaries. The terrestrial PAs cover 34.9% of the total land surface, while the marine reserves cover 10.6% of the country's marine area[9].

These forests also provide sustenance for a majority of the population. Unfortunately, the forests have been under increasing pressures from land conversion and degradation activities[10]. Belize's biodiversity is exposed to various direct anthropogenic and natural threats both within and outside of the Protected Areas (PAs). Over the last five decades the forest cover in Belize had steadily decreased due in general, to the expansion of unsustainable economic activities, such as large-scale and slash and burn agriculture, aquaculture, illegal logging, unsustainable logging, encroachment, forest/bush fires and other uncontrolled conversion of forest to intense anthropogenic land uses and extensive damages from climate related hurricanes and storms. These include unregulated development of urban and coastal areas and the rising pollution from cruise ship tourism leading to the degradation of mangroves and coral reefs and deforestation and unsustainable extraction of non-timber forest products in hotspot areas [11,12,13].

[4] https://www.thegef.org/sites/default/files/project_documents/PIMS%25204907_GEF5%2520BD%2520EA%2520Belize_20-Jun-2012_0.pdf
[5] FCPF R-PP Belize https://www.forestcarbonpartnership.org/redd-countries-1
[6] FCPF R-PP Belize https://www.forestcarbonpartnership.org/redd-countries-1
[7] https://www.thegef.org/sites/default/files/project_documents/PIMS%25204907_GEF5%2520BD%2520EA%2520Belize_20-Jun-2012_0.pdf
[8] https://www.thegef.org/sites/default/files/project_documents/PIMS%25204907_GEF5%2520BD%2520EA%2520Belize_20-Jun-2012_0.pdf
[9] https://www.thegef.org/sites/default/files/project_documents/9-19-11%2520Belize%2520PIF_0.pdf
[10] FCPF R-PP Belize https://www.forestcarbonpartnership.org/redd-countries-1
[11] https://www.thegef.org/sites/default/files/project_documents/PIMS%25204907_GEF5%2520BD%2520EA%2520Belize_20-Jun-2012_0.pdf
[12] https://www.thegef.org/sites/default/files/project_documents/9-19-11%2520Belize%2520PIF_0.pdf
[13] Drivers Deforestation report 5

In 2010, hurricane damage led to extensive forest areas being destroyed leaving much debris that accumulated and dried up to form fuel. Consequently, during the 2011 dry season, Belize experienced some of the most extensive forest fires all over the country. The large fire in the Broadleaf forest was in Central Belize, with was mostly in the Belize and Cayo District, some south of Orange Walk District. These fires and other forest degradation are leading to loss of biodiversity and emissions of GHGs into the atmosphere and contributing to further climate change.

3.6.2 RESULTS

3.6.2.1 AGRICULTURE RESULTS AND ANALYSIS

Table 3.7 below presents in detail the emissions generated through activities within the agriculture sector for the entire time series, as sufficient data was available for this sub-sector. Biomass continued to be a major contributor in the mix for energy generation in Belize. For the 3 reference years, main emitters from this sector include CH_4 from enteric fermentation, direct N_2O emissions from managed soils, and CH_4 from manure management.

TABLE 3.7: AGRICULTURE EMISSIONS AND REMOVALS FROM SECTOR SOURCES (GG CO_2 EQ)

Source Category Code	Source Category	1994	1997	2000	2003	2006	2009	2012	2015	2017
		Gg CO_2 eq								
Total Emissions Agriculture		**131.88**	**78.05**	**107.74**	**125.32**	**145.27**	**184.50**	**207.04**	**232.07**	**293.40**
3.A	Livestock	74.51	50.33	71.26	75.33	98.39	121.63	131.65	138.85	177.27
3.A.1	Enteric Fermentation	68.64	47.89	66.44	72.36	94.63	117.30	122.23	128.43	162.64
3.A.2	Manure Management	5.87	2.45	4.82	2.97	3.76	4.32	9.42	10.42	14.63
3.C	Aggregate sources and non-CO2 emissions sources on land (Agriculture)	57.37	27.72	36.48	49.99	46.87	62.87	75.39	93.22	116.13
3.C.1	Biomass burning (Agriculture)	NE	NE	1.21	1.21	NE	4.67	7.74	12.79	15.75
3.C.2	Liming	2.54	3.67	4.39	5.31	4.89	4.27	0.94	1.01	0.30
3.C.3	Urea application	9.37	2.33	1.26	15.18	2.10	4.30	4.47	12.92	12.33
3.C.4	Direct N2O emissions from managed soils	40.67	19.06	22.94	22.61	34.69	41.83	51.33	54.42	70.43
3.C.5	Indirect N2O emissions from managed soils	3.88	0.34	4.42	0.61	1.31	1.40	7.01	7.90	11.78
3.C.6	Indirect N2O Emissions from Manure Management	3.88	0.34	4.42	0.61	1.31	1.40	7.01	7.90	11.78
3.C.7	Rice cultivations	0.90	2.33	2.26	5.07	3.89	6.40	3.90	4.18	5.54

NOTES:

3.A.2: –THIS VALUE IS THE TOTAL EMISSIONS FOR CH4 AND N20, BUT THE ESTIMATE IS NEGLIGIBLE.

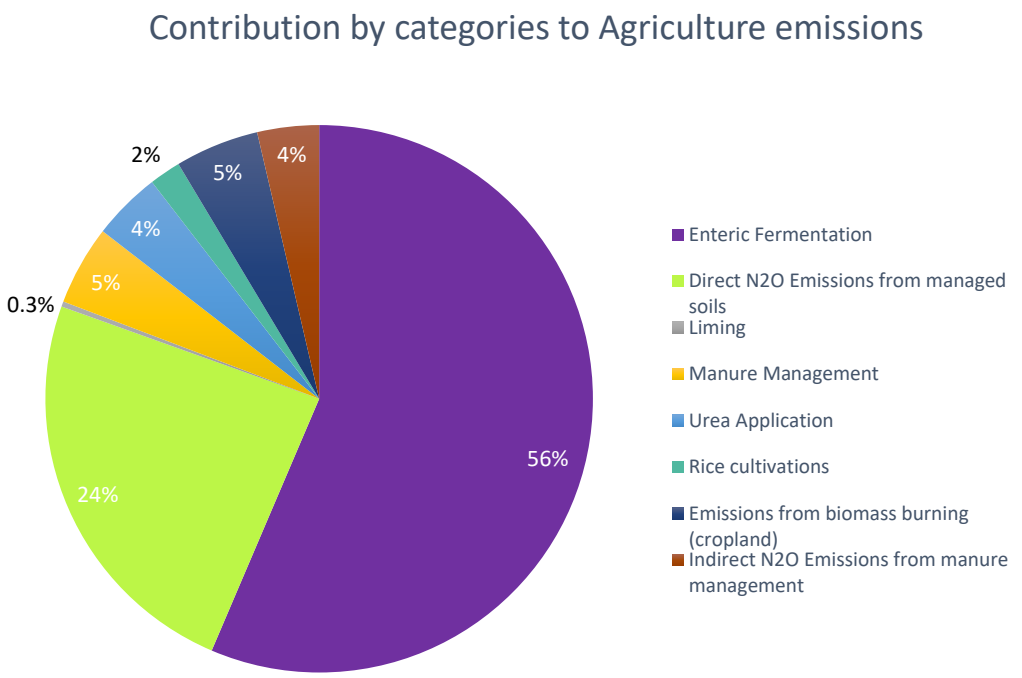
3.C.1: - BIOMASS BURNING IN AGRICULTURAL LAND REPRESENTS ONLY SECONDARY BURNING OF SUGARCANE FIELDS

3.C.7: - RICE WAS SEPARATED AS THE AGGREGATE FOR LAND USE WAS SPLIT BETWEEN AGRICULTURE AND FOLU.

Furthermore, Figure 3.2 below illustrates the main categories from which these emissions are coming from. Enteric fermentation accounts for 56% of the emissions from agriculture on an annual average over the study period, 2012-2017. N_2O emissions from soil management accounts for 24%, followed by biomass

burning and manure management at approximately 5% respectively. Rice cultivation accounts for 2% of emissions in the sector.

FIGURE 3.2: MAJOR CONTRIBUTORS TO EMISSIONS IN THE AGRICULTURE SECTOR



The results of the estimations of the GHG emissions in Table 3.7 from the AFOLU sector suggest that the emissions from the agriculture sector vary depending on the annual crop and livestock production. Methane emissions from livestock demonstrated a trend of constant increase over the study period. On the other hand, emissions from rice production remained almost constant over the same period. This is probably related to the level of production maintained by the Mennonite farmers who are the major commercial producers. They produce in order to satisfy the national local demand as there is no export of this commodity. Rice consumption has not increased rapidly and might even be affected by clandestine imports. Observations also suggest that the trends in local production also respond to the global markets for these commodities in any given year.

Agriculture residue burning is linked to the volume of sugarcane harvested and milled. The lower level of emissions estimated for 2012 could therefore reflect similarly lower volume of sugar cane processed by the factory in that year. Otherwise the GHG emissions from this source appear to remain almost constant.

3.6.2.2 FORESTRY AND OTHER LAND USES RESULTS AND ANALYSIS

Highly accurate activity data for Forestry and Other Land Use sector was derived from the Collect Earth image visualization tool to obtain spatially explicit annual data of land use and land use change for time series of 2000-2017. For this inventory, emissions and removals are shown for the reference years and the recalculated years (1994-2017), and year by year data on FOLU emissions and removals can be seen in Figure 3.4.

The Forest and Other Land Use sub-sector as shown in Table 3.8 shows a generalized increase in land based emissions (subcategory 3B, Land) from 1994 to 1997. However, for the time 2000 onward the generalized trend is one of fluctuating decreases and increases which can be attributed to natural disturbances, and in some instances attributed to the change in land-use.

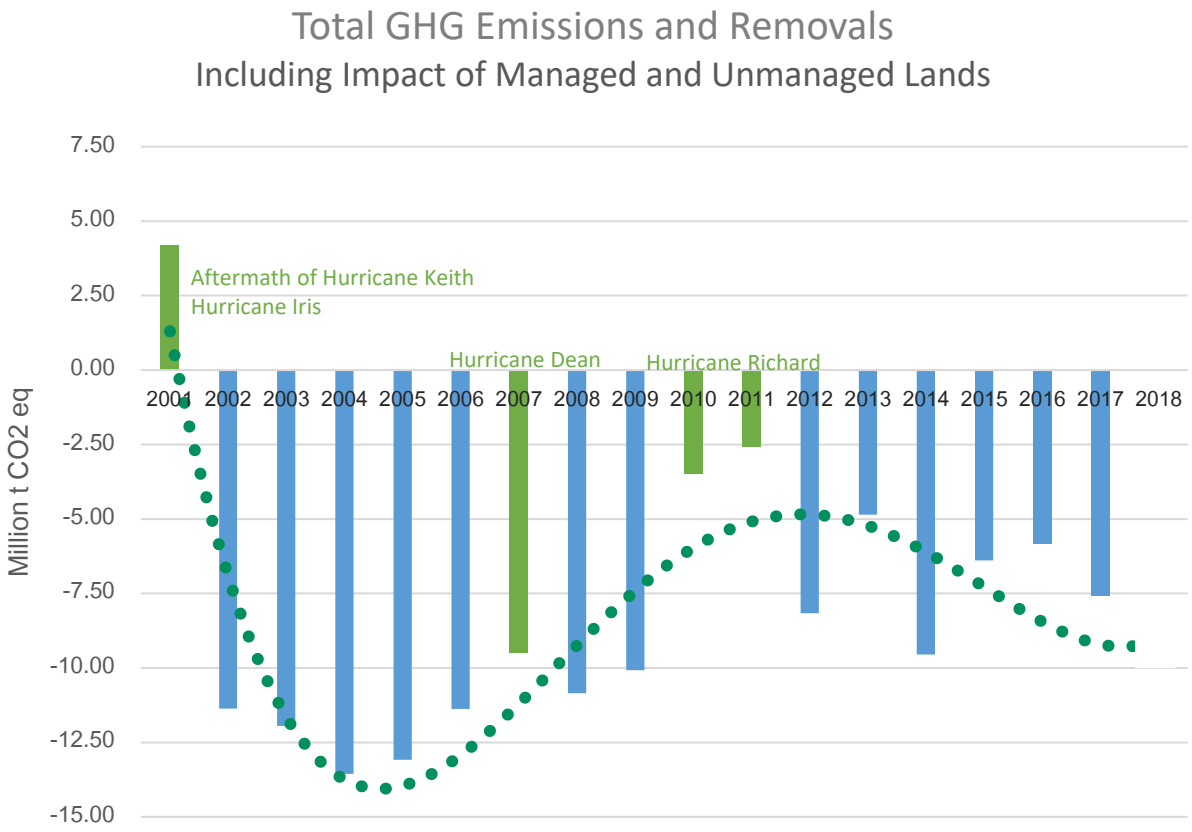
TABLE 3.8: SUMMARY OF EMISSIONS AND REMOVALS FROM AFOLU SECTOR 1994 – 2017 (T CO_{2EQ})

IPCC Source Category		Gases	1994	1997	2000	2003	2006	2009	2012	2015	2017
3	**Agriculture, Forestry, and Other Land Use**		**-6,614,016**	**-7,197,206**	**-7,725,051**	**-11,755,290**	**-11,218,400**	**-9,868,805**	**-7,771,371**	**-6,104,957**	**-6,683,156**
3.A	Livestock	CH_4 & N_2O	74,511	50,332	72,361	75,329	98,392	121,627	131,649	138,853	177,268
3.A.1	Enteric Fermentation	CH_4	68,641	47,886	66,439	72,359	94,630	117,303	122,228	128,428	162,642
3.A.2	Manure Management	CH_4 & N_2O	5,871	2,446	5,922	2,970	3,761	4,325	9,421	10,424	14,626
3.B	Land (remaining and conversions to)	CO_2	**-6,777,535**	**-7,307,694**	**-7,837,854**	**-11,885,207**	**-11,391,358**	**-10,089,052**	**-8,011,329**	**-6,344,682**	**-6,986,500**
3.B.1	Forest Land	CO_2	*	*	-6,679,819	-14,575,305	-14,249,679	-14,040,096	-13,250,304	-12,289,920	-10,935,231
3.B.2	Cropland	CO_2	*	*	-85,934	1,549,973	1,770,295	2,411,436	3,651,007	4,391,998	2,717,100
3.B.3	Grassland	CO_2	*	*	-1,074,237	1,137,989	1,310,018	1,583,780	1,797,166	1,593,853	1,239,398
3.B.4	Wetlands	CO_2	*	*	0	0	-198,339	0	-198,339	0	0
3.B.5	Settlements	CO_2	*	*	2,136	2,136	-23,653	-44,173	-10,859	-40,612	-7,768
3.B.6	Other Land	CO_2	*	*	0	0	0	0	0	0	0
3.C	Aggregate Sources and Non-CO2 Emissions Sources on Land	CO_2, CH_4 & N_2O	**105,406**	**74,835**	**79,622**	**65,532**	**74,807**	**92,423**	**106,666**	**124,394**	**160,576**
3.C.1	Emissions from Biomass Burning (Land F, G)	CH_4 & N_2O in CO_2 eq	48,034	48,034	43,142	15,541	27,934	29,555	31,280	31,175	44,446
3.C.1	Emissions from Biomass Burning (Agriculture)	CH_4 & N_2O in CO_2 eq	57,372	26,801	1,210	1,210	NE	4,669	7,736	12,792	15,753
3.C.2	Liming	CO_2	IE	IE	4,390	5,310	4,890	4,270	940	1,010	300
3.C.3	Urea Application	CO_2	IE	IE	1,264	15,176	2,098	4,296	4,470	12,918	12,329
3.C.4	Direct N2O Emissions from Managed Soils	N_2O	IE	IE	22,937	22,612	34,687	41,831	51,328	54,421	70,430
3.C.5	Indirect N2O Emissions from Managed Soils	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.C.6	Indirect N2O Emissions from Manure Management	N_2O	IE	IE	NE	NE	NE	NE	NE	NE	NE
3.C.7	Rice Cultivations	CH_4	IE	IE	4,419	611	1,307	1,397	7,014	7,902	11,777
3.C.8	Other		NE	NE	2,260	5,073	3,892	6,405	3,898	4,177	5,541
3.D	Other		**-16,398**	**-14,678**	**-39,181**	**-10,944**	**-241**	**6,197**	**1,643**	**-23,522**	**-34,500**
3.D.1	Harvested Wood Products	CO_2	-16,398	-14,678	-39,181	-10,944	-241	6,197	1,643	-23,522	-34,500

Land Use Change in Forests

In reviewing the overall impact of forests and land use change on total emissions and removals, Figure 3.3 shows the cyclical behaviour of increasing and decreasing absorption of CO_2. This is largely due to recurring hurricanes that impact national forests, with the most impactful hurricane events highlighted in the graph. Usually in the year of a large-scale hurricane, emissions increase, followed by a period of recovery (increased removals).

FIGURE 3.3: TOTAL EMISSIONS AND REMOVALS IN BELIZE (INCLUDING MANAGED AND UNMANAGED LANDS (MILLION T CO_2EQ)

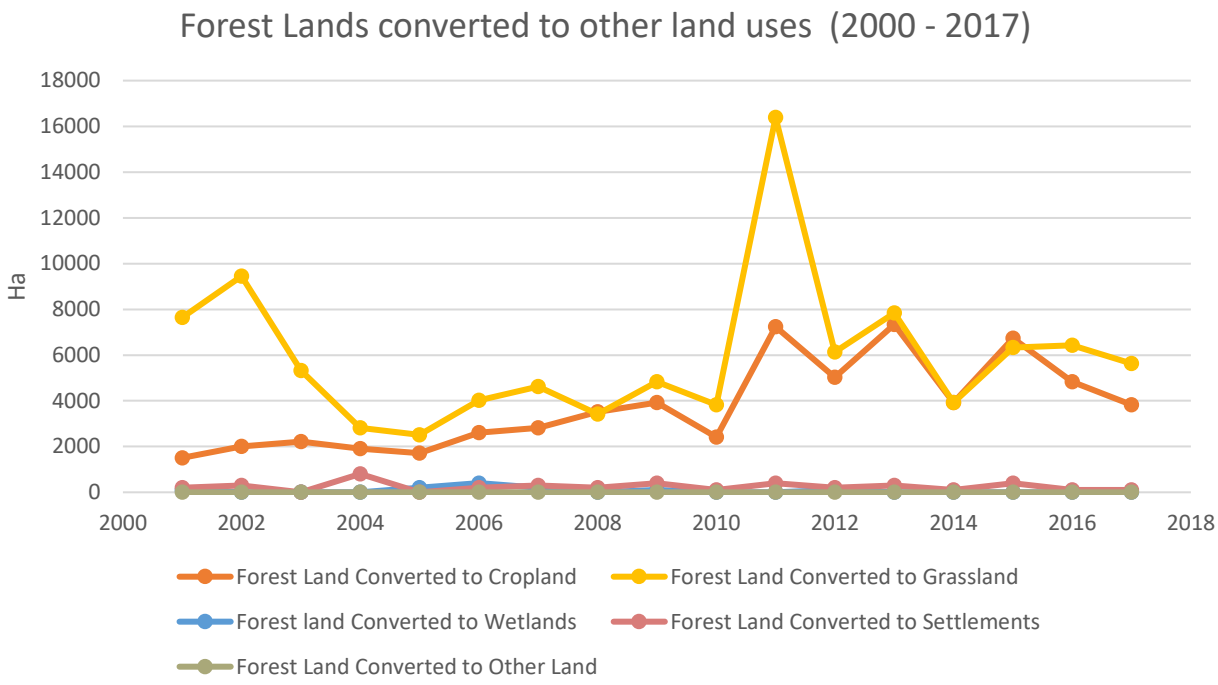


Land use change conversions are visually represented in Figure 3.4; it can be seen that Cropland (food crops) and Grassland (livestock pastures) were the major drivers of Forest conversion, with Grassland being the most significant contributor on average for the three reference years. While the forest conversions might have been initiated by natural phenomenon (hurricane events), the continuing changes were mainly caused as farmers and landowners took advantage of the loss of forest cover to convert the land to other uses, such as farms, pastures, or otherwise.

There was a major spike in emissions in 2011 when an estimated area of 16,386 ha of forest were converted to Grassland. This was due to Hurricane Richard, which hit the country in 2010 and damaged large areas of forests. Large open patches of almost severely destroyed forests were converted to grasslands because of this incident. It is also noted that in the years 2001, 2002, and 2003, there were major conversions of Forest

lands to Grasslands. This particular period of conversion was due to thousands of hectares of forested lands in the Mountain Pine Ridge and Coastal Plains area being affected by the southern pine bark beetle pest infestation that impacted the country between 1999 and 2001.

FIGURE 3.4: FOREST LANDS CONVERTED TO OTHER LAND USES (2000 – 2017)

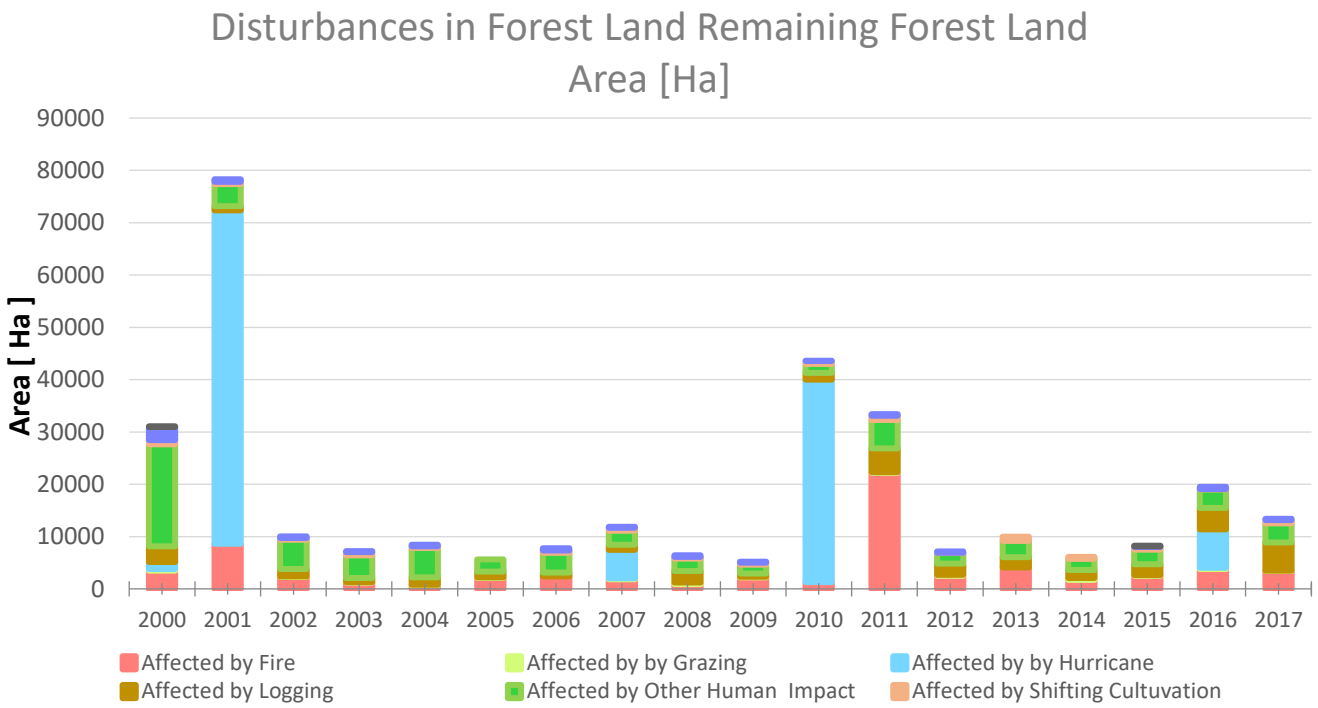


The more recent forest conversion to cropland after 2010 is believed to be because of Hurricane Richard. Some of the forested areas that were affected by the hurricane were turned into agricultural lands in the mid-western part of the country. This activity seemed to have caused a continuing trend of the conversion of forest lands for crops during the years that followed. Examination of the data for forest conversions for the reference years of 2012, 2015 and 2017, revealed that both Cropland and Grassland were major drivers for forest conversions.

Forest Disturbances

As for the disturbances occurring in national forests that were not converted to other land uses, it can be noted in Figure 3.5, that hurricanes have impacted forests sink capabilities, and commonly lead to other disturbance types such as fire, logging activities, conversion to pasture, and cultivation. For the years 2001 and 2010, there were significant disturbances noted in areas that did not have a land conversion but still were affected by Hurricane Iris (2001) and Hurricane Richard (2010) showing once more the significance of the occurrence of hurricanes over the years.

FIGURE 3.5: DISTURBANCES IN FOREST LAND REMAINING FOREST LAND



Belize like most countries in the Latin American region shows that one of the major sources of greenhouse gas emissions is deforestation. Increases in land degradation and increased utilization of land with less productive potential coupled with the present rate of population increase all contribute to greater forest conversion.

3.7 WASTE

3.7.1 SECTOR BACKGROUND

The Solid Waste Management Authority (SWAMA) and its Board is charged with the responsibility to handle all matters pertaining to and conducive to the management of solid waste in Belize. Existing service areas are primarily areas being served by the municipalities (Town and City Councils). The Western Corridor is served by waste disposal services including waste management at the National Sanitary Landfill that presently serves Belize City and the communities along the George Price Highway Corridor. This landfill receives daily garbage waste from transfer stations in San Ignacio, San Pedro, Caye Caulker, Burrell Boom and Belize City.

Solid Waste: The SWAMA has commissioned several investigations and reports in relation to solid waste management. One such investigation was a waste characterization study of the major population centers

of the Western Corridor that was carried out in 2011. The study estimated the waste production rate and waste characterization of several municipalities including San Ignacio/Santa Elena, Belize City, San Pedro and Caye Caulker. This study determined that the rate of solid waste coming from the domestic sector was estimated at 1.07 kg or 2.36 pounds per capita per day (Hydroplan for Solid Waste Management Authority, May 2011). This same study also determined that residential waste amounts to 63.8% of all municipal waste produced in the corridor, while waste from the business/commercial sector accounts for 31.8% and the industrial sector produces 4.5% of waste.

Liquid waste includes domestic and industrial wastewater, although data about both is limited in availability. Domestic wastewater data was obtained from Belize Water Services Limited (BWSL) generated through official surveys of the population served by septic tank systems, latrines, and open disposal, was entered using the Tier 2 approach

Industrial Solid Waste. Both the citrus and the shrimp industry utilize some level of anaerobic treatment in ponds, and therefore, the volume of this effluent was categorized as managed anaerobic, and the volume of the bagasse from the sugar cane as uncategorized waste.

Biological Treatment of Solid Waste. Citrus peels and other solid waste from this industry are mostly re-used after treatment for organic fertilizer. The remaining waste is composted (and accounted for in "Biological treatment of solid waste". Due to processing for fertilizer, volumes are now low. Shrimp farming also produces some waste in the form of shrimp heads with effluent that are treated by burying and is also accounted for in "Biological treatment of solid waste". However, due to the decline of the shrimp industry as a result of challenges such as virus infestations over the past years, the waste from the sector is minimal.

Table 3.9 below shows the total emissions of all gases emitted (Gg CO_2 eq) from the Waste sector for the current inventory for the three reference years. The combined solid waste and wastewater sectors results in a total of 16.243 Gg CO_2 eq of methane in 2012, decreasing to 12.889 Gg CO_2eq in 2015 and rising to 16.895 Gg CO_2 eq in 2017. Carbon dioxide, attributable to open burning of waste, was estimated at 0.054 Gg CO_2 eq in 2012, increasing to 0.057 Gg CO_2eq in 2015 and 0.072 Gg CO_2 eq in 2017. Nitrous oxide showed a pattern similar to methane by decreasing from 8.78 Gg in 2012 to 7.54 in 2015 and increasing to 9.72 in 2017, as the majority of these N_2O emissions are attributed to wastewater (and a small fraction to open burning). The combined total emissions of these gases from the Waste sector are 22.73 Gg in 2012, decreasing to 19.89 in 2015 and increasing again to 26.81 Gg in 2017.

TABLE 3.9: TOTAL GREENHOUSE GAS EMISSIONS FROM THE WASTE SECTOR (GG CO_2 EQ)

Sector	Gas	2012	2015	2017
4 - Waste	*Gg CO_2 eq*	*Gg CO_2 eq*	*Gg CO_2 eq*	*Gg CO_2 eq*
Total	All gases	22.729	19.8648	26.81298
4.A - Solid Waste Disposal	CH_4	0.023	0.023	0.054
4.B - Biological Treatment of Solid Waste	CH_4	0	0	2.86755
	N_2O	0	0	2.53983
4.C - Incineration and Open Burning of Waste	CO_2	0.054	0.0568	0.0716
	CH_4	0.122	0.128	0.128
	N_2O	0.035	0.036	0.036
4.D - Wastewater Treatment and Discharge	CH_4	16.22	12.839	13.974
	N_2O	6.275	6.782	7.142

3.7.1.1 ANALYSIS OF RESULTS

The Waste sector inventory has been facilitated by the recent solid waste studies, including waste characterization and waste composition studies commissioned by the Solid Waste Management Authority. These studies have led to availability of improved quality of data.

The results indicate that there is a significant improvement in solid waste data management that is useful for inventory exercises. Additional studies are required if waste generation data are to be applied by region (western corridor, northern and southern corridors), or for each town and city.

There is an overall trend of increasing methane emissions from solid waste disposal that arose from increasing population. The improved treatment of waste has not totally cancelled the methane emissions as the population increases. However, there is a notable decrease in GHG emissions as a result of decreased open burning, particularly in municipalities that are serviced by transfer stations and sanitary landfills.

Emissions from wastewater discharge represent the majority emissions in the waste sector (16.22, 12.84 and 13.97 Gg CO_2 eq for 2012, 2015 and 2017, respectively). For industrial liquid waste sub-sector, there is no formal registration or estimation of liquid waste generated within the industrial sector (including both large industries like banana, and smaller ones like shrimp). Some data is available from the citrus and sugar industries. This source of data is important because it is noted that the waste-water sector is increasingly becoming of greater significance in greenhouse gas emissions. Even with the limited data available about this source of greenhouse gas emissions, the total emissions from the waste sector increased significantly with the input of the wastewater sector data over the study period.

3.8 RECALCULATIONS

Recalculations were done for past inventories, where possible, beginning with that of 1994 reported in the Initial National Communication that Belize submitted. The software used to estimate Greenhouse Gas emissions has been changed since the first national inventory. The 1996 IPCC tool was used in Belize for the first through to the third national inventory of greenhouse gases emissions and removals. However, all previous inventory results were recalculated using the 2006 software. During this period from 1994 to 2017, some of the source categories have been redefined by the IPCC, but some new or corrected or more accurate data have been obtained for a few sub-categories. In a few instances, additional sources of emissions are now accounted for when there was no data previously available.

In the Energy sector, recalculation of previous inventory reference years proved to be difficult because the data available was recorded in a manner unsuitable for disaggregated analysis using the IPCC 2006 software. For example, it was not possible to segregate the fuel consumption between road and maritime transport because the fuel data obtained from the source was not recorded with that level of detail. Similarly, the Waste sector recalculation was not possible because different methods of determining waste generation rates were used by different studies, rendering older data incompatible. The overview of total emissions and removals of all sectors can be seen in Table 3.10 below.

TABLE 3.10: BELIZE'S RECALCULATED NET GREENHOUSE GAS EMISSIONS AND REMOVALS, 1994-2017 (GG CO_2 EQ)

Sectors /sub-sectors	1994	1997	2000	2003	2006	2009	2012	2015	2017
Total National Emissions and Removals (with FOLU)	**-6,612.97**	**-7,193.83**	**-7,718.26**	**-11,744.38**	**-11,202.62**	**-9,833.79**	**-7,179.14**	**-5,260.07**	**-5,826.79**
Total National Emissions (without FOLU removals)	**180.96**	**128.54**	**158.77**	**151.77**	**188.98**	**255.26**	**832.19**	**1,107.46**	**1,194.71**
1 - Energy	NE	NE	NE	NE	NE	NE	**538.0705586**	**781.8082484**	**786.364153**
1.A - Fuel Combustion Activities	NE	NE	NE	NE	NE	NE	538.071	781.808	786.364
2 - Industrial Processes and Product Use	**0.669**	**2.960**	**6.363**	**10.572**	**15.399**	**22.825**	**31.429**	**42.504**	**43.688**
2.A - Mineral Industry	NE	NE	NE	NE	NE	NE	1.525	1.649	0.488
2.D - Non-Energy Products from Fuels and Solvent Use	NE	NE	NE	NE	NE	NE	0	9.29E-08	9.16E-08
2.F - Product Uses as Subsitutes for Ozone Depleting Substances	0.669	2.960	6.363	10.572	15.399	22.825	29.90	40.86	43.20
2.H - Other	NE	NE	NE	NE	NE	NE	3.747E-12	1.116E-06	6.525E-07
3 - Agriculture, Forestry, and Other Land Use	**-6,614.01**	**-7,197.20**	**-7,725.07**	**-11,755.29**	**-11,218.40**	**-9,868.83**	**-7,771.37**	**-6,104.27**	**-6,683.66**
3.A - Livestock	74.51	50.33	72.36	75.33	98.392	121.63	131.65	138.85	177.27
3.B - Land	-6,777.53	-7,307.69	-7,837.85	-11,885.21	-11,391.360	-10,089.05	-8,011.33	-6,344.00	-6,987.00
3.C - Aggregate Sources and non-CO2 emissions sources on land - *FOLU*	48.034	48.034	43.123	15.541	27.934	29.556	31.280	31.175	44.446
3.C - Aggregate Sources and non-CO2 emissions sources on land - *Agriculture*	57.372	26.801	36.478	49.992	46.879	62.844	75.387	93.224	116.129
3.D - Other	-16.398	-14.678	-39.181	-10.944	-0.241	6.197	1.643	-23.522	-34.500
4 - Waste	**0.372**	**0.412**	**0.450**	**0.338**	**0.374**	**12.211**	**22.729**	**19.892**	**26.813**
4.A - Solid Waste Disposal	0	0.007	0.011	0.014	0.016	0.019	0.023	0.049	0.054
4.B - Biological Treatment of Solid Waste	NO	NO	NO	NO	NO	5.407	0	0	5.407
4.C - Incineration and Open Burning of Waste	0.372	0.405	0.439	0.325	0.357	0.190	0.211	0.222	0.236
4.D - Wastewater Treatment and Discharge	NE	NE	NE	NE	NE	6.594	22.495	19.622	21.116
International Bunkers	NE	NE	NE	NE	NE	NE	**40.369**	**39.800**	**71.240**
1.A.3.a.i - International Aviation	NE	NE	NE	NE	NE	NE	40.369	39.8	71.24

3.9 SUMMARY OF NATIONAL GHG PROFILE

The net GHG emissions and removals for the recalculated period, estimated with and without the FOLU removals, are presented graphically in Figure 3.6 and Figure 3.7 below.

In 1994 when Belize prepared and submitted its initial national greenhouse gas inventory to the UNFCCC the estimated population stood at 201,677 persons, with a growth rate of 2.03 % per annum, and population density of 8.78 persons per square kilometre. These parameters had changed to 332,960 people in 2012 with a growth rate of 2.32 % and population density of 16.66 persons/km^2; then to a population estimate of 375,769 in 2017. That year the growth rate was determined to be 2.00 % with a population density of 16.31 persons/km^2. During this period, Belize experienced some economic growth, which was largely driven by agriculture and tourism. It is possible that these areas of economic development have influenced the trend displayed in the country's greenhouse gas emissions. The two sectors contributing significantly to the GHG emissions continue to be AFOLU and Energy.

With Belize being a largely service oriented country with an expanding tourism industry, Belize is able to offer residents and visitors terrestrial and marine experiences. This has probably helped to stimulate growth in the transport sector in the expansion in the public and private sector vehicle fleet, the local maritime ferries, and the local aviation fleet. This has resulted in continuing increases in emissions from the Transport sub-sector even while the emissions from energy generation are not increasing as rapidly even with an increased energy demand by the growing population. The mitigation effect in the Energy sector is produced by the increasing utilization of renewable energy sources in the energy generation mix.

Within the AFOLU sector, land conversion from forested land to other uses (croplands and grasslands) displayed the greatest influence on sector emissions; this is most likely due to the continued expansion in agriculture, in the most recent cases to grassland (pastures) and cropland at the cost of the natural forests. It is noted that not all of this change is man-caused, since natural phenomena like hurricanes and insect infestation have been the precursor of the change and forest disturbance. Hurricane impact across the mid-western section of the country and the pine bark beetle infestation have left their mark on the broadleaf and pine forests, respectively.

FIGURE 3.6: TREND OF BELIZE'S NET EMISSIONS AND REMOVALS INCLUDING FORESTRY AND OTHER LAND USES (GG C02 EQ)

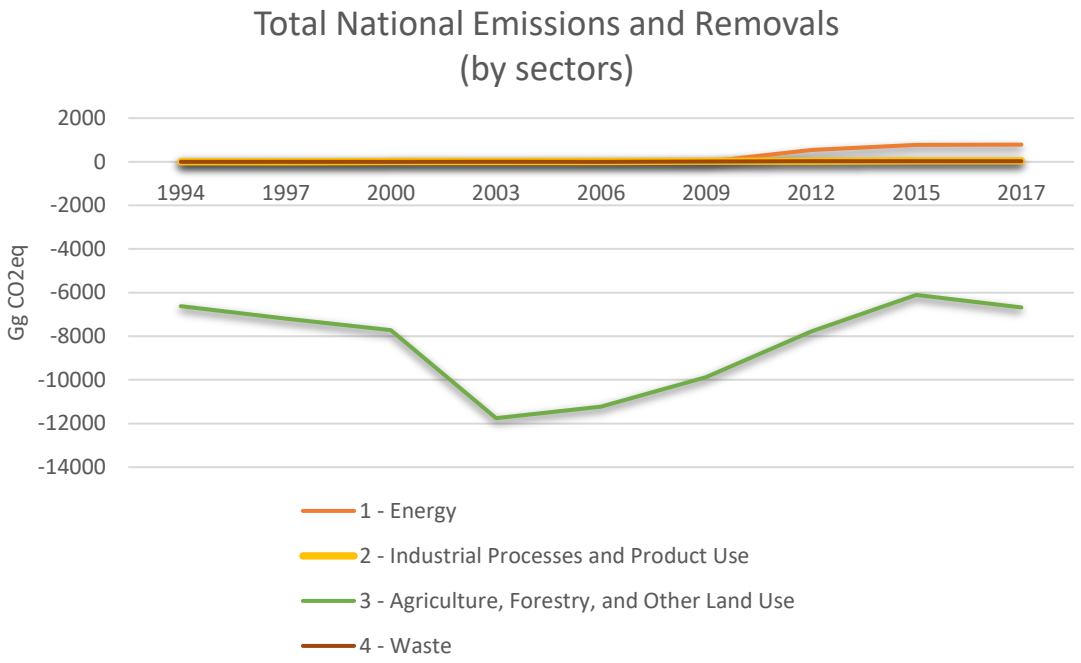
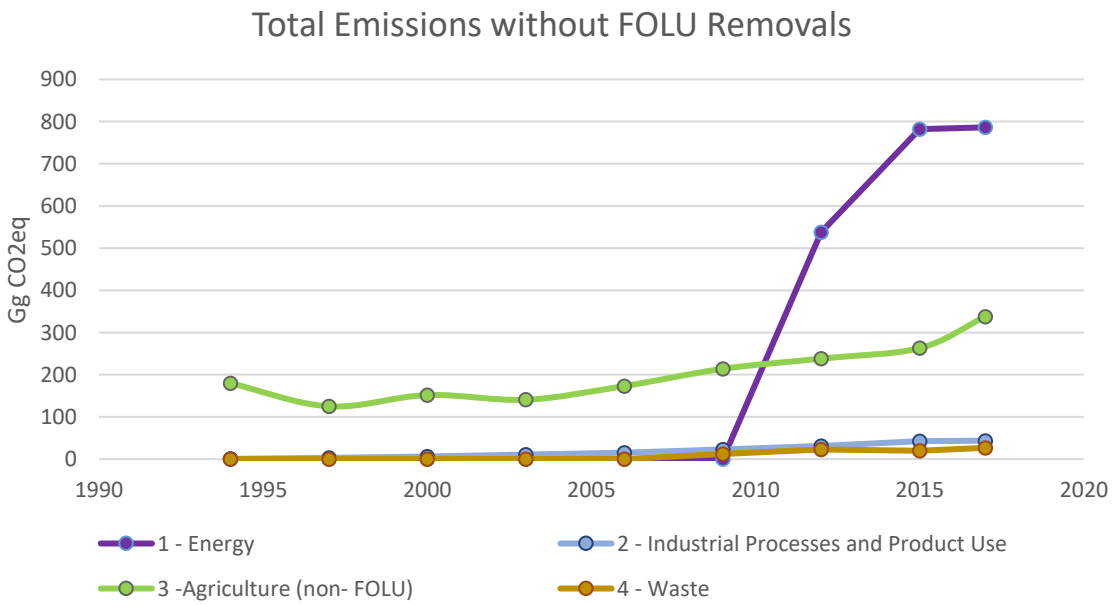


FIGURE 3.7: TREND OF BELIZE'S NET EMISSIONS AND REMOVALS EXCLUDING FORESTRY AND OTHER LAND USES (GG C02 EQ)



The observed increases in the emission trends in the Energy sector corresponded to some increases in the imports of petroleum fuels since 2012. This was because of increases in the consumption of petroleum fuels for electricity generation, and in the transport sub-sector. Local aviation has also expanded, as has the vehicular and sea-going fleets. Both public transportation and numbers of privately-owned vehicles continue to increase. Charter boats and commuter ferries are also on the increase as the tourism industry grows. Biomass usage for industrial and domestic energy production continued to increase as an alternate to petroleum products, thus somewhat tempering the impact of emissions from this sector. Biomass is primarily used in the generation of energy for the sugar industry, and additional conversions are sold to the national grid. There was an increase in the use of this fuel late in the study period due to another company, Santander Sugar Energy Ltd., coming on stream and producing electricity for the national grid. The increase of biomass also increased the greenhouse gases emissions from this source, but this is largely recycled by the additional biomass being cultivated. Solar powered energy is increasing for domestic application, but also for applications like street lighting, and public service buildings. Noteworthy in the transport sub-sector, is the unavailability of disaggregated fuel type data preceding 2010. National data collection mandate was formalized in 2012 under the Energy Unit.

The Industrial sector continues to display slow growth. The trends in GHG emissions displayed by the IPPU sector were the result of increased refrigerants use with the large number of new buildings constructed, along with the noticeable growth in the number of air-conditioning service facilities for vehicles. The tourism industry probably contributed to the use of refrigerants in both accommodations and transportation. Further, there was a general decrease in production and application of lime in the agriculture sectors, and slow growth in the production of beer, spirits, and bread. Beer, spirits, and bread are primarily for local consumption, so are probably apace with population growth. During the study period, there were a few road-improvement projects underway in the municipalities, but these were mostly completed by building reinforced concrete roads. The cement was imported, so no discernible levels of GHG emissions could be attributed to this particular activity. However, there was some highway rehabilitation using asphalt. Road paving activities using asphalt appeared to fluctuate somewhat with levels of emissions in 2017 being lower than in 2015. The construction industry was busy across the study period with the building of private homes, expansion of resorts on the cayes, some public building construction like schools and office buildings, etc. Many of these were being equipped with air-conditioning.

The most noticeable trend in the Agriculture, Forest, and Other Land Use sector is continuing increases by all the gases in all the sub-sectors. While the national forests continued to remove CO_2 allowing Belize to be a net sink of overall emissions, this function is diminishing as the process of deforestation and forest conversion continued. It is also noted that the current inventory revealed that the greatest causes of GHG emissions in this sector were due to land conversions to grasslands and croplands. Enteric fermentation emissions from the agriculture sub-sector increased as the livestock populations increased, although some of the emissions in this sector were from land preparation for crop cultivation.

The emissions within the Waste Sector show some small changes over the study period, this being due to the fact that some data for wastewater disposal and treatment was accessed and introduced to the

estimates. This sector also displayed some fluctuations in emissions across the study period with some decline in 2015 but increasing again in 2017. The level of GHG emissions was almost flat across the three reference years, this most likely due to the construction of the managed landfill at mile 23 on the George Price Highway. The improved management of solid waste resulting from the construction and use of the managed landfill and the waste transfer station infrastructure, reinforced by law enforcement has resulted in great reduction in open burning of solid wastes. Greenhouse Gas emissions from this sector has been reduced compared to the period between 1997 and 2007 even with the inclusion of wastewater emissions. Future inventories of this sector may demonstrate that the Methane emissions from wastewater treatment have more impact on national emissions as the data collection improves.

3.10 UNCERTAINTY ASSESSMENT

Uncertainties were introduced to the calculations from the activity data and through the emissions factors. Uncertainty trend assessments were conducted for the reference years 2015 and 2017 using the capabilities of the IPCC inventory tool. Uncertainty was measured and the sector with the largest contribution to inventory and trend uncertainty was within fuel combustion activities in the Energy sector.

Uncertainty measurements were assessed for the periods between 2012 and the other reference years 2015 and 2017, as emissions for all sectors and gases were done for these years, being a more representative comparison than an earlier base year with fewer analyzed sectors and gases.

For reference year 2015, the uncertainty in the total inventory was 17.19%, and trend uncertainty was 15.66%. For year 2017, total inventory uncertainty was 26.87% and trend uncertainty was 6.72%.

4 MITIGATIONS ACTIONS AND THEIR EFFECTS

Mitigation actions are defined as human interventions that reduce sources or enhance the sinks of GHGs. Within the scope of this chapter, the activities or interventions that avoid the increase of GHG emissions or avoid the reduction of sinks are also considered as mitigation actions. These key actions are those implemented or planned mainly by government and some through private sector.

Belize, in preparation of its first BUR and fourth National Communication, conducted a comprehensive mitigation assessment. This enabled the assessment of programs and measures implemented or planned that result in the mitigation of human-induced climate change and progress in achieving the NDC. Year 2015 was established as the reference year for the mitigation assessment, as it is the reference year of the NDC and within the scope of the BUR reference years (Mitigation Assessment, 2019).

This chapter covers the mitigation potential of Belize, the mitigation actions (implemented and planned) and their impacts by sector, and some mitigation options. The mitigation actions implemented, mitigation actions planned, and the additional mitigation options identified within the assessment were in view of evaluating the mitigation progress of Belize and identifying the additional effort needed to achieve national mitigation objectives, such as the Nationally Determined Contributions (NDC).

4.1 MITIGATION POTENTIAL OF BELIZE

Mitigation potential is the amount of mitigation, i.e., the amount of reduction of GHG emissions, that could be realized over time. When performed at a national level, the assessment of the mitigation potential addresses the identification of areas which have more potential to reduce GHG emissions given the current circumstances, and the areas or activity sectors which have more potential to reduce GHG emissions considering alternative future scenarios of economic development.

The following areas have been assessed for evaluating the mitigation potential of Belize:

1. Current GHG emissions profile, as available in the latest national GHG emission inventory
2. Alternative future scenarios of economic development. Specifically, different scenarios of population and GDP growth have been considered.

Current GHG emissions profile

The GHG emissions of Belize are dominated by the contribution of Forestry and Other Land Use (FOLU). This sector is a sink of GHG emissions due to the removals from the forest's growth that occurred in the country. Removals due to the forest's growth are, indeed, the main driver of the GHG emission profile of Belize in the historical period. Apart from the FOLU sector, the primary GHG emitters are the energy, agriculture, IPPU and waste in this order.

Maintaining the key contribution of the FOLU sector, as well as addressing the mitigation opportunities in the emitter sectors are essential for the future mitigation of Belize.

Table 4.1 below shows the historical GHG emissions used in this GHG assessment, which has been estimated based on the *National Greenhouse Gas Inventory* (*Chapter 3*). Estimations were based on national emissions estimates prior to the submission of the current National Inventory Report, and vary sparingly, however maintaining the current emission profile.

TABLE 4.1 GHG EMISSIONS IN THE HISTORICAL PERIOD (GG CO_2-EQ)

Inventory sector	2012	2015	2017
Energy	546.89	794.58	802.46
IPPU	17.72	44.63	54.16
Agriculture	303.35	292.32	399.37
FOLU	-8,232.46	-5,898.41	-6,714.37
Waste	126.58	133.43	139.08
Total without FOLU	994.54	1,264.96	1,395.07
Total With FOLU	-7,237.96	-4,633.44	-5,319.33

To obtain this data, several adjustments have been made from the GHG national inventory in order to use this information for the development of GHG emission scenarios and the estimation of impact of mitigation actions. The most relevant changes are seen in Box 1.

BOX 1 ADJUSTMENTS MADE TO GHG INVENTORY TO DEVELOP GHG EMISSION SCENARIOS

Energy sector:

- Using the most disaggregated activity data provided by the inventory to estimate the GHG emissions using default 2006 IPCC Emission factors
- Splitting the transport aggregated fuel consumption by fuel
- Estimating the GHG emissions from the consumption of charcoal.

IPPU sector:

- Using the AD provided to estimate the GHG emissions using default 2006 IPCC emission factors for lime production and lubricants consumption.
- Estimating the GHG emissions of refrigerant and air conditioning using an IPCC methodology and the data on refrigerant blends provided by the inventory.

Waste sector:

- This sector has been calculated entirely using tier 1 2006 IPCC methodologies using some data (waste generation rates, waste composition, etc.) from the national GHG emissions inventory.

Agriculture, Forestry and Other Land Use (AFOLU):

- The estimate of GHG emissions from forest fires has been moved from FOLU to Agriculture (biomass burning).
- The emissions due to hazards, i.e. hurricane effects on forests, are subtracted from the estimation as non-anthropogenic emission.

To gain a better understanding of the mitigation possibilities, all GHG sectors were assessed and detailed by category level in the mitigation assessment aligned with the current GHG Inventory.

In energy industries, the very significant electricity imports (37% in 2018) limit the GHG emissions of the sector. If these imports are replaced by fossil fuel generation, GHG emissions would increase significantly.

The transport sector represents a higher opportunity for GHG emission reductions since it is the largest GHG emitter in the energy sector.

In the agriculture sector, the primary GHG emissions sources are livestock and forest fires. The mitigation opportunities for livestock are limited, but the control of forest fires should be a priority.

In the FOLU sector, the main drivers of emissions are the conversion of forest land to croplands and grasslands. Carbon dioxide removals from forest growth are substantially higher than emissions from land-use change. Reduced emission from deforestation and forest degradation are identified as mitigation opportunities in the sector.

In the waste sector, there is room for improvement in both the solid waste and wastewater management sub sectors. The improvement of these areas will bring significant co-benefits for national health, tourism, and standards of living.

In the IPPU sector, the size of the industry of the country is limited, and a significant change is not expected in this regard. Nevertheless, consumption emissions such as the emissions coming from the refrigerant and air conditioning will be rising, as Belize expects tourism to increase in the short and medium term.

4.2 MITIGATION ACTIONS AND THEIR IMPACTS

Mitigation actions implemented since 2015 were assessed by sector, including details of the GHG emission impact and co-benefits of each action. The actions are presented by sector and distinguished as follows:

i. Mitigation Actions with GHG Impacts
ii. Mitigation actions with no GHG Impact

The segregation of these actions was done to facilitate the understanding of actions considered in the GHG Mitigation Assessment which are those with quantifiable GHG reduction impacts, and those whereby impacts could not be quantified. The Energy sector encompassed the largest portion of both ongoing and planned mitigation actions, followed by AFOLU and Waste. There were no ongoing or planned mitigation actions identified within the reference period of this report in the IPPU sector based on the limited effect on national emissions and economic influence.

TABLE 4.2 ENERGY SECTOR MITIGATION ACTIONS WITH GHG IMPACTS

Mitigation Action	Don	Specific Objectives	Coverage							Emissions Reduction Potential	Co-Benefits
			Scope	Implementing Entity	Support Entity	Support Type	Gas	Funding Provided	Status		
1. emPOWER Rural Electrification Project - Caribbean Renewable Energy Fund	November 2018 - February 2020	Provide renewable energy solutions to assist Belize in achieving universal energy access.	Community Level (3)	Energy Unit, Ministry of Labour, Local Government, Rural Development, Public Service, Energy & Public Utilities	United Arab Emirates (UAE)	Financial	CO_2	2.3M USD	Ongoing	319 tCO2 eq/year	Access to clean energy to the population of rural villages that currently do not have access to the national grid. Improvement in community livelihood, economic development, increased employment and quality of jobs.
Description	The emPower Rural Electrification Project plans to install 400kW of solar PV and battery storage in rural villages that currently do not have access to the national grid. These villages are Medina Bank, Golden State, and Indian Creek. This project is in alignment with Belize's Sustainable Energy Action Plan (SEAP), which sets a goal of universal access to energy services by 2030.										
Assumptions	The estimated grid emission factor is 0.218 tCO2/MWh, calculated by splitting the GHG emissions of electricity production (GHG inventory category 1A1) for year 2017 by the MWh produced (data obtained from BEL). The estimation of impact of this policy is made by applying the grid emission factor to the 400kW installed. The value of capacity factor is obtained by multiplying daily isolation hours by 365 days.										
2. ESD-Caraibes (Energy for Sustainable Development in Caribbean Buildings)	April 2014 - Present	Promotion of sustainable energy use in buildings through interventions that constitute energy efficiency applications and renewable energy technologies within the project territories	Project Pilot Territories	Caribbean Community Climate Change Centre (5Cs)	United Nations Environment Programme (UNEP)	Financial	CO_2	988,000 USD	Ongoing	11.79 Gg CO2 Eq by 2033	The reduction of electricity consumption will reduce the need to consume fossil fuels for producing electricity, reducing the GHG emissions, and improving the air quality of the country.

Description	The ESD Project activities, a mix of policy proposals and pilot demonstrations, is intended to reduce electricity use by 20 per cent from the business as usual (BAU) scenario. Its strategic priority the reduction of greenhouse gas emissions and the promotion of energy efficient technologies and practices in appliances and buildings (households, businesses, and Government). Check http://energyunit.gov.vc/energyunit/index.php/projects1/esd-caraibes and ESD_Caraibes.JPG for more information										
Assumptions	The production of electricity is reduced by 20% and the emissions of category 1A1 Energy industries are reduced accordingly. We assume the 20% reduction is obtained by 2033, and it is obtained progressively by using a linear extrapolation from year 2014.										
3. PALCEE Project: Latin America and the Caribbean Energy Efficiency Programme	July 2017 - August 2018	Promotion of energy conservation measures in southern Belize through a bulb exchange program.	Sub-National	Energy Unit, Ministry of Labour, Local Government, Rural Development, **Public Service, Energy & Public Utilities**	Latin American Energy Organization (OLADE)	Capacity /Financial	CO_2	188,000 USD	Completed	28 tCO2 eq/year	LEDs produce a better-quality light, and the useful life of the tube is significantly higher than bulbs. Communities will save money and will have access to a better, more durable light.
Description	Capacity Building in energy audits was given for officers of the public service and agents promoting energy efficiency throughout Belize. The second phase of this program involved the implementation of these recommended energy conservation measures, and the final phase of the program focused on awareness creation of energy efficiency in lighting. This was done via a bulb exchange program to replace inefficient bulbs and tubes with LEDs in low income households. The bulb and tube exchange program involved trading in incandescent bulbs and compact fluorescent lamp for the more energy efficient light emitting diodes (LEDS). A total of 1,448 LED bulbs and 100 LED tubes were distributed to recipients in Dangriga, Sarawee and Hope Creek. The remaining 300 bulbs were distributed to other residents across the country.										
Assumptions	The estimation of the impact of this policy is made by estimating the impact of the reference technology and applying default assumption from the GAMCO model to obtain the annual emission reduction. The estimated grid emission factor is 0.218 tCO2/MWh, calculated splitting the GHG emissions of electricity production (GHG inventory category 1A1) for year 2017 by the MWh produced (data obtained from BEL). There is no difference between the scenarios, as the evolution of GDP and/or population does not affect this mitigation action.										

4. La Gracia Smart Solar Off-Grid Project	March 2016 - May 2017	Expanded Access of sustainable electricity to rural community, La Gracia, consistent with the Sustainable Energy Action Plan to extend electricity access to villages that remain un-electrified.	Community Level	Energy Unit, Ministry of Labour, Local Government, Rural Development, Public Service, Energy & Public Utilities	Government of Switzerland (90%); Government of Belize and the British High Commission (10%)	Financial	CO_2	400,000 USD	Completed	19 tCO2 eq/year	This mitigation action will enable access to clean energy to the population of rural villages that currently do not have access to the national grid. The population of these areas will see their livelihood improved, and the prospects for the economic development of the area, including higher and better-quality employment, improve.
Description	The La Gracia solar PV system pilot project was the first renewable energy smart off grid system in Belize. A total of 45 buildings including homes, churches, and shops were connected to a 24kW system PV system. The participants were educated on the operation of the system in respect to charging the card, discharging the card on the meter, and verifying their account on the meter. The pilot system is currently serving the community's electricity needs.										
Assumptions	The estimated grid emission factor is 0.218 tCO2/MWh, calculated splitting the GHG emissions of electricity production (GHG inventory category 1A1) for year 2017 by the MWh produced (data obtained from BEL). The estimation of impact of this policy is made by applying the grid emission factor to the 24kW installed. The value of capacity factor is obtained by multiplying daily isolation hours by 365 days. There is no difference between the scenarios, as the evolution of GDP and/or population does not affect this mitigation action.										
5. Solar Water Heating NAMA (status: queued)	Aug-17	Implementation of solar heating technology for industrial, commercial and residential sectors, to reduce GHGs from traditional energy sources	Project Scope	National Climate Change Office	Latin American Energy Organization (OLADE)	Financial /Capacity	CO_2	N/A	Queued	7.98 Gg CO2 eq by 2033	The co-benefits identified for this mitigation action are the increasing access to affordable clean energy and a positive impact in local employment for the installation and maintenance of solar collectors and storage tanks.

Description	Solar Water Heating NAMA Concept aims to implement the solar heating technology for industrial, commercial and residential sectors, to reduce the emission of greenhouse gases from the use of fossil fuels for water heating through the installation and use of solar collectors and storage tanks.										
Assumptions	The estimation of impact of this mitigation action was developed in the NAMA concept. This action has not been implemented and its implementation is not foreseen.										
6. Street Light LED's Conversion Project	Nov-18	Reduce energy consumption by converting public streetlights to LEDs	Sub-National	Caribbean Community Climate Change Centre (5Cs) and the Sustainable Development Unit, MAFFESDI	Government of Italy through the Italian Ministry of Environment, Land and Sea (IMELS).	Financial /Capacity	CO_2	Approx. 3,200,000 USD	Ongoing	184 Gg CO2 eq/ year	LEDs produce a better-quality light, and the useful life of the tube is significantly higher than bulbs. Communities will save money and will have access to a better, more durable light in the streets.
Description	Through the project titled "Reducing the Carbon Footprint of San Ignacio Town and five surrounding villages in the Cayo District", its aim is to replace street lighting with LED fixtures to quantify the benefits to be derived: financial, and the reduction of Greenhouse Gas (GHG) emissions. The project aims to replace 1,000 low- efficiency street lighting fixtures with 1,000 LED fixtures.										
Assumptions	It is expected that the replacements will result in: • A significant reduction in energy consumption per lamp from 150 W to 60 W, thus realizing a 60% reduction in energy use. • A reduction of 184 metric tons of CO2 per year. • An annual savings of some US$40,000 that can benefit the communities.										
7. Energy efficiency in the public sector	2020	Stemming from the Sustainable energy action plan, section 2.1. details the decentralization of Government	National	Energy Unit, Ministry of Labour, Local Government, Rural Development, Public Service, Energy & Public Utilities	N/A	Policy	N/A	N/A	Planned	205.18 tCO2 eq/year	The reduction of electricity consumption will reduce the need to consume fossil fuels for producing electricity, reducing the GHG emissions, and improving the air quality of the country.

		Payment for Electricity.									
Description	Making ministries pay for electricity out of budgets allocated to them by the Ministry of Finance will give them an incentive to be more energy efficient. At present, the bills for all of the ministries' electricity consumption are sent to the Ministry of Finance, which pays them directly without considering any breakdown between ministries. This gives the individual ministries little incentive to be more efficient.										
Assumptions	This mitigation action is complementary to mitigation action 2 ESD Caraibes in which 20% of electricity consumption is reduced in households, business, and government. The sustainable energy action plan estimates that the "standard energy efficiency measures across the government's building stock could save approximately US$4 million per year on average the cost of the improvement in energy efficiency in US$ 4 million per year average". Despite no information on the energy savings obtained is available, the estimation of this mitigation action is based on this cost. We also assume that the implementation starts in 2020.										
8. Expand Access to Electricity Using RE	2020	This action stems from the Sustainable Energy Action Plan on the section "Expand Access to electricity using RE".	National	Energy Unit, Ministry of Labour, Local Government, Rural Development, Publ ic Service, Energy & Public Utilities	N/A	Policy	N/A	N/A	Planned	15.98 Gg CO2 eq by 2033	This mitigation action will enable access to clean energy to the population of rural villages that currently do not have access to the national grid. The population of these areas will see their livelihood improved, and the prospects for the economic development of the area, including higher and better-quality employment, improve.
Description	Government wants to extend electricity access to villages that remain un-electrified. In many cases, RE can be a cheaper alternative to grid extension or diesel generation.										
Assumptions	Belize's current electricity system is well-managed and reaches 92% of the country's population. The assumption is that the remaining 8% of population gain access to electricity through renewable systems. The national electricity demand will increase by an analogous percentage and the fuel consumption of fuel for electricity generation will increase accordingly.										
9. European Union 11th EDF National Indicative Programme	2014-2020	Provide energy service for Rural communities, increase energy efficiency in	Community Scope	Energy Unit, Ministry of Labour, Local Government, Rural Development, Publ ic Service, Energy & Public Utilities	European Union	Financial /Capacit y	N/A	15,525,00 0 USD	Planned	*See Mitigation action 8*	*See Mitigation action 8*

		the country and support renewable energy uptake.									
Description	This mitigation action (planned) comes from the European Union 11th EDF National Indicative Programme and is consistent with the Sustainable Energy Action Plan for Belize to expand electricity access to villages that remain electrified as well as promotion of large -scale renewable energy. This project aims to further the rural electrification project, support energy efficiency in the country and conduct feasibility studies for different renewable energy systems.										
Assumptions	Same assumptions as mitigation action 8 "Expand access to Electricity using RE".										
10. Caye Caulker Interconnection Project	September 2018-June 2020	Interconnection of island power distribution to the mainland to remove island reliance on power by diesel generation.	Sub-National	Belize Electricity Limited	Caribbean Development Bank (CDB)	Financial /Technical	CO_2	7,500,00 USD	Planned	0.2391 Gg CO2 eq by 2033	Linking Caye Caulker to the national grid will have benefits regarding the security of supply. The supply of electricity will be ensured, and the prices will be reduced, resulting from the interconnection. In turn, this will impact the employment and GDP growth of the country.
Description	Caye Caulker is a high priority load centre as it is not currently connected to the main grid, its load demand is increasing significantly, and the island is powered by diesel generation. The initial assessment of the routes for interconnecting the distribution network on Caye Caulker with the Belize mainland transmission has been completed. BEL appointed Mott MacDonald (MM) to undertake the feasibility study to determine the technical, economic, social, and environmental feasibility of supplying electricity from the main grid. This assessment was completed September 2018. BEL has applied for financing from the Caribbean Development Bank (CDB) to fund the project. The timeline for the procurement of goods, works and consultancy services for the interconnection of Caye Caulker with San Pedro Ambergris Caye is expected for the period March 2019 to June 2020.										
Assumptions	The electricity consumption rate per capita in Caye Caulker is assumed equal to the national total electricity consumption rate. The total MWh consumed in Caye Caulker is calculated with this rate, and the impact of the mitigation actions is estimated as the difference between meeting this demand only with diesel or with the average fuel consumption of the grid (i.e. the grid emission factor). The difference between both estimates is the impact in GHG emissions reduction of the mitigation action. This mitigation action is assumed to have had an impact since 2018.										
11. Build an Efficient and Enabling Utility	2014-2020	This action stems from the Sustainable Energy Action Plan to "build an efficient and enabling utility". It covers an	National	Belize Electricity Limited	N/A	Policy	CO_2	N/A	Planned	8.37 Gg CO2 eq by 2033	The co-benefits of this action will be the reduction of energy consumption and the corresponding reduction in GHG and air pollutant emissions.

		amendment of tariff structure by electricity utility provider to incentivize energy efficiency.									
Description	BEL is a relatively efficient utility company compared to its peers. According to the sustainable energy action plan, BEL has started helping its customers be more energy efficient. Building on these strengths, the right rules and incentives need to be in place. This tariff restructure will maximize BEL's efficiency on the supply side and incentivize BEL to make its customers more efficient.										
Assumptions	Estimate the reduction in consumption over time due to increases in the price of electricity. This assumes that BEL raise their prices to the average of LAC (25 USD cents per Kwh). Electricity consumption and prices data were obtained from the BEL. The median estimates for electricity price elasticity vary depending on the time and sector. The studies available show that the price elasticity for electricity is rigid in the short term, but it increases over time. The price elasticities selected for the study are -0.28 in the short run and – 0.81 in the long run. This assumes a linear increase of the elasticity starting at -0.28.										
12. Arundo Donax-Renewable Bio-Mass Fuel for Belize: Feasibility Study and Funding Proposal Preparation	2018-2019	This mitigation action comes from an Energy Project using Arundo Donax to replace fossil energy in the generation of electrical energy. It is consistent with the Sustainable Energy Action Plan for Belize to prepare resource studies for biomass to further develop Belize's biomass.	Project Scope	Caribbean Community Climate Change Centre (5Cs)	GCF	Financial /Technical	N/A	739,700 USD (GCF-694,000 USD, 5C's-45,700 USD)	Planned	N/E	

Description	The Arundo Donax Project was initiated to supplement bagasse for energy production to ensure a continuous supply of electricity to BEL annually. The ADP is identified as a suitable fuel crop that can contribute to energy cogeneration throughout the year and assist with the reduction of fossil fuel importation. The Project will be rolled out over four years involving a Compatibility Testing Phase of the technical feasibility of Arundo Donax being burnt in the BELCOGEN boilers, a Field Research Phase of various agronomic parameters, and a Commercial Production Phase.	
Assumptions	This mitigation action increases GHG emissions, as its objective is to reduce importation of electricity and exchange it by national generation. The emission reduction potential has not been estimated, because it is a feasibility study. It must be noted that biomass consumption for electricity generation also produces GHG emissions, so this action could increase GHG emissions.	

TABLE 4.3 ENERGY SECTOR MITIGATION ACTIONS WITH NO GHG IMPACTS

Mitigation Action	Duration	Specific Objectives	Coverage							Emissions Reduction Potential
			Scope	Implementing Entity	Support Entity	Support Type	Gas	Funding Provided	Status	
13. Belize Sustainable Energy Action Plan	2015	Provides the framework of actions and tasks to overcome the barriers to sustainable energy.	National	Energy Unit, Ministry of Labour, Local Government, Rural Development, Public Service, Energy & Public Utilities	Inter-American Development Bank	Financial	N/A	N/A	Completed	N/E
Description	This Sustainable Energy Action Plan is a tool to achieve Belize's renewable energy (RE) and energy efficiency (EE) potential while meeting Government's economic, social, and environmental goals. This Action Plan provides the framework of actions and tasks to overcome the barriers to sustainable energy. The Action Plan is structured around six actions that work together to unlock Belize's EE and RE potential.									
14. Cleaner and More Efficient Fuels and Vehicles in Belize - Global Fuel Economy Study	November 2016 – February 2018	Establishment of a baseline for the fuel economy of light duty vehicles that were imported into Belize during 2013 to 2016.	National	Energy Unit, Ministry of Labour, Local Government, Rural Development, **Public Service, Energy & Public Utilities**	United Nations Environment Programme (UNEP)	Financial	N/A	N/A	Completed	N/E
Description	The study facilitated policy discussions by providing a scientifically-sound assessment of the fuel economy of light duty vehicles that entered Belize's vehicle fleet. A deep knowledge of the starting point will allow legislators to choose the right combination of technology and political instruments necessary to achieve national objectives (Energy and Transportation) in the field of emissions (climate change mitigation), energy security and efficiency.									

15. BEL-USTDA Solar & Wind Feasibility Project	2016-2019	A feasibility study for the development of utility-scale wind and solar power in Belize. The study is for Belize Electricity Limited which seeks to enhance energy security by reducing dependence on imported electricity and displacing fossil-fuel-fired power generation.	Project Scope	Belize Electricity Limited	United States Trade and Development Agency ("USTDA")	Financial/Technical	N/A	N/A	Completed	N/E
Description	BEL signed a Grant Agreement, effective September 30, 2016 with the United States Trade and Development Agency ("USTDA") for the purpose of identifying potential sites for wind and solar energy development that could accommodate onshore and offshore wind energy projects of 15 MW (and above) and onshore solar energy projects of 5 MW (and above). BEL retained the services of DNV KEMA Renewables, Inc. ("DNV GL") to execute the project. BEL-USTDA has completed six (6) of a fourteen (14) task plan thus far, including the installation of three (3) 60 meter meteorological towers for wind measurement at North San Pedro, Maskall village and Long Caye island, in addition to one SRA solar measurement station at the Philip Goldson Int'l Airport for data collection in the technical analysis									
16. Santander Sugars Energy (SSEL) Limited	Dec-16	Introduction of an additional renewable energy source through biomass cogeneration in the Sugar Industry.	Plant Scope	Santander Sugars Energy Limited (SSEL)	N/A	Technical	N/A	N/A	Completed	N/E
Description	SSEL, a subsidiary of The Santander Sugar Group, signed a Power Purchase Agreement with Belize Electricity Limited to provide clean energy to the electrical grid of Belize. SSEL utilizes bagasse, the by-product of sugar cane, as a renewable power generation source. The energy produced by bagasse at The Santander Sugar Mill is used as a primary fuel source to supply energy to the local consumer electricity grid.									

17. Transport NAMA	2017-2019	The report covers the collection and collation of validated data sets for the identified vehicle categories used for public transportation.	National	National Climate Change Office	Japan-Caribbean Climate Change Partnership (J-CCCP)	Financial/Capacity	2,549,357 BZD	N/A	Completed	N/E
Description	Belize is one of eight countries that received support from the J-CCCP in advancing the process of low-emission risk-resilient development by improving energy security and integrating medium to long-term planning for adaptation to climate change. One of these activities is the preparation of a National Appropriate Mitigation Action (NAMA) in the transport sector of Belize. The NAMA covers the entire country, both urban and rural areas as well as all transport modes (land, domestic air and domestic sea). The components currently included in the NAMA focus on public transportation.									
18. MOU signed to promote tourism sector uptake of renewable energy & energy efficient technologies in Belize	June 30, 2018	The uptake of Renewable Energy and Energy Efficient (RE/EE) technology in the tourism sector.	National	Ministry of Tourism and Civil Aviation (MTCA)	Development Finance Corporation	Financial	N/A	N/A	Completed	N/E
Description	The Government of Belize has identified RE/EE as a priority area for reducing Belize's energy intensity levels. This is consistent with the Belize's Strategic Development Goals, the National Sustainable Tourism Master Plan (NSTMP) 2012-2030, and the National Tourism Policy 2017-2027. Equally, under its Responsible Tourism Implementation Plan 2018-2022, the MTCA is working towards the uptake of RE/EE technology in the tourism sector. Under the MOU, the MTCA and the Development Finance Corporation (DFC) will Promote a National Campaign for Renewable Energy in the Tourism Sector with the MTCA actively promoting DFC's RE/EE lending product within their planning, product development, promotional programs and events.									

TABLE 4.4 AFOLU SECTOR MITIGATION ACTIONS WITH GHG IMPACTS

Mitigation Action	Duration	Specific Objectives	Coverage							Emissions Reduction Potential	Co-Benefits
			Scope	Implementing Entity	Support Entity	Support Type	Gas	Funding Provided	Status		
1. Socialization and Implementation of Mangrove Act (no trimming)	2018	Reduce losses of mangrove due to housing developments, and in protected areas is an issue in Belize. The Forests (Protection of Mangroves) Regulation was developed and came into force 23rd June 2018 to address this challenge.	National	Forest Department	N/A	Policy	CO2	N/A	Ongoing	22.1 Gg CO2 eq by 2033	Maintaining mangrove ecosystems enable the protection for low-lying coastal areas against impacts of storms and soil erosion as well as provide rich habitat for nursery species.
Description	Besides a list of priority areas in the country, the Mangrove regulations set out stipulations required to alter or trim mangroves. These regulations considered, among others, potential adverse environmental impacts; carbon storage and sequestration potential of the mangroves. The Regulations also put measures in place for offsetting through restoration or planting new mangrove communities in adjacent degraded areas or other areas. Furthermore, no permit will be issued for alteration or selection trimming of mangroves within existing national parks, nature reserves, wildlife sanctuaries, natural monuments or other protected areas as defined or described in the National Protected Areas System Act.										
Assumptions	At the time of estimation, GHG Inventory estimated the conversion to Settlements land from Mangroves Forest Land in 603,18 hectares from 2001 to 2018 (33,51 ha(s)/year). In the same period, the disturbance area in mangroves is estimated at 5,59 ha(s)/year. Following this estimation, it is assumed that an average of 39,1 ha is deforested annually. Parameters and emission factor used are provided in the GHG emissions Inventory. The estimated above ground biomass (AGB) is 81 t.d.m, the ratio between below and above ground biomass (R) is estimated as 0,49; the carbon content in the biomass (tc/tdm) is equal to 0,45 and the growth rate for mangroves (Gw) is 9,90 tdm/ha/year. The Likely scenario assumes that deforestation and disturbance in mangroves will be avoided in a 100%. The carbon captures in the avoided deforestation areas are included in the emission reduction estimation.										
2. REDD+ strategy and the Forest bill act	2017-2020	Reduce carbon dioxide emissions and increase carbon sequestration from Belize's forest, strengthening legal instruments for improved forest management.	National	National Climate Change Office, REDD+ Unit	World Bank	Financial/ Technical/Capacity	CO2	4,080,000 USD	Ongoing	2055.7 t CO_2eq between 2020 and 2033	The effective rollout of REDD+ and enhanced forest management (Forest Bill) include alleviating poverty, enhancing biodiversity, improving
Description	The NDC proposes that "all forest outside reserves are to be put under management plans to secure their sustainable use and protection." This target means the halt of deforestation and forest degradation in Belize is 100%, but the timeframe is not specified.										

Assumptions	At the time of estimation, GHG Inventory estimated average emissions from forest land converted to non-forest land (deforestation) reach to 2,660 Gg CO2eq per year. Deforested area is distributed by final land use and forest strata affected. For each forest stratum, a specific value for biomass content and average growth rate is used. A reference scenario has been estimated assuming that the deforestation rate will be maintained as reported in GHG Inventory. Likely scenario assumes that deforestation will be halt in a 100% linearly from 2020 to 2033. The non-deforested areas removed carbon during this period.										forest governance and protecting other environmental services.
3. Mangroves restoration	2018-2030	Protect and restore mangrove forests through enforcement of the Forest Regulations (2018).	National	Forest Department	N/A	Policy	CO2	N/A	Ongoing	66.1 Gg CO2-eq per year between 2020 and 2033	Maintaining mangrove ecosystems enable the protection for low-lying coastal areas against impacts of storms and soil erosion as well as provide rich habitat for nursery species.
Description	Belize's NDC includes an activity to protect and restore mangrove forests. On June 18, 2018, the Forest (Protection of Mangroves) Regulations 2018, established the regulations to protect the mangroves. However, actions to promote restoration of mangroves is not explicitly incorporated in the Regulations. The restoration 4000 hectares of mangroves is considered possible by involved stakeholders, which would still offset the losses since 1980 in the long run but allows avoiding the vicinity of settlements.										
Assumptions	The estimated carbon removal by mangroves based on the GHG emissions Inventory is 9.9 t.d.m/ha/year. A reference scenario has been estimated to estimate the impact of the measure, assuming that the mitigation action is not implemented. A Likely scenario has been also estimated assuming that the 100% of the 4.000 hectares planned has been restored in a lineal progression between 2020 and 2030. The reference scenario is estimated as the average removals in mangroves during the period 2001-2018, excluding the emission due to natural hazards like hurricanes.										

TABLE 4.5 AFOLU SECTOR MITIGATION ACTIONS WITH NO GHG IMPACTS

Mitigation Action	Duration	Specific Objectives	Coverage							Emission Reduction
			Scope	Implementing Entity	Support Entity	Support Type	Gas	Funding Provided	Status	
4. Belize Agriculture Information Management System (BAIMS)	2018-2019	The Belize Agriculture Management Information System (BAIMS) is a web-based application that serves as a central repository for all agriculture data. IT was populated from the Agriculture Census 2018. This information is critical for evidence based decision making by the Ministry.	National	Department of Agriculture	IADB	Finance/ Policy	N/A	420,000 USD	Completed	N/E
Description	The BAIMS evolved from an in-depth Country Assessment on Agriculture Statistics, and a Strategic Plan for Agriculture and Rural Statistics (SPARS) following the standards set by the Food and Agriculture Organization (FAO). It is a web-based application that serves as a central repository for all agriculture data. Data are used by farmers and policy makers to analyze agriculture data for proper timely decision making on the agriculture sector's contribution to the socio-economic development including GDP, national accounts and employment. Although this activity does not have intrinsic mitigation impacts, its development contributes to the MRV of key GHG emitting agricultural practices.									
5. Resilient Rural Belize (Be-Resilient)	2019-2024	Strengthen smallholder participation through the development of climate resilient value chains and climate resilient rural infrastructure and assets for main agricultural products	Sub-national	Ministry of Economic Development (MEDPITC), Ministry of Finance	GCF via International Fund for Agricultural Development (IFAD)	Finance/Capacity/Technical	N/A	2,000,000 USD (3.2 M GoB, 8 M GCF, 8 M IFAD. Producer Organizations - 1.6 M))	Ongoing	N/E
Description	The programme aims to increase the economic, social, and environmental resilience of smallholder farmers, thus creating the conditions for farmers to have a sustainable market access for their produce. In the context of smallholder farmers in Belize, improved resilience is defined as the capacity to minimise the impacts of climatic and economic shocks, enabling farmers to better confront periodic variations and strengthening their capacity to cope and recover in times of extreme stress. Although this is mainly a adaptation and vulnerability focused, mitigation co-benefits are presented through enabling sustainable production process using less resources.									

TABLE 4.6 WASTE SECTOR MITIGATION ACTIONS WITH GHG IMPACTS

Mitigation Action	Duration	Specific Objectives	Coverage							Emissions Reduction Potential	Co-Benefits
			Scope	Implementing Entity	Support Entity	Support Type	Gas	Funding Provided	Status		
1. Improved Waste Management system via Solid Waste Management Project II	2016-2019	This mitigation action comes from the National Solid Waste Management Strategy and Implementation Plan as well as the Solid Waste Management Project II and Solid Waste Master plan for touristic areas.	National	Solid Waste Management and Authority	IADB	Financial/Policy	CO2	10,200,000 USD	Ongoing	34.78 Gg CO2 eq by 2033	The improvement of the waste management practices in the country will significantly increase the overall health conditions of the country, avoiding the spread of diseases, preventing water and soil contamination.
Description	This action aims to improve waste management system based on the following targets of the National Solid Waste Management Strategy and Implementation Plan: waste generation at a maximum of 360 kg/capita/annum, 100% of collected MSW requiring final disposal is deposited in sanitary landfills; 100% of household and commercial premises receive regular collection service.										
Assumptions	The waste generation rate is already below 360 kg/capita/annum, so it has no impact. All wastes going to landfill are managed semi-aerobically Open burning of wastes is reduced to 0, and percentage of wastes going to landfill is 100%										

4.3 MITIGATION OPTIONS

Apart from the mitigation actions which have been implemented or are planned to be implemented in the near future, substantive work has been carried out in the identification and assessment of additional mitigation options in the country. All mitigation actions and additional options assessed were used to develop GHG emissions scenarios. These options build on the previous work carried out, particularly in the Technology needs Assessment (TNA_{14}) carried out in the year 2017.

Energy

The implementation of the Sustainable Energy Action Plan should be a priority in the energy sector. Specifically, considering the current energy system, there is a considerable mitigation potential for new RES installed capacity. It is noted that Belize imports 37% of electricity. If new fossil fuels electricity capacity is installed to meet this demand, the GHG emissions will grow analogously. Thus, addressing the installation of new RES for replacing imports with national capacity should be prioritized among the actions in the energy sector.

The technological alternatives for this new generation capacity have been identified in the technology needs assessment of 2017, as follows:

- Solar PV Off-Grid: The Solar PV Off-Grid system was identified as a technology that can be utilized in homes and small businesses to produce reliable and cost-effective power. The TNA seeks to install a DC system that will power a few lights, small radio and a fan.

- Gasification: Gasification represents an efficient process to produce electricity using small modular gasifiers. This TNA intervention aims to install two gasification units at agro-processing facilities where there is an adequate biomass waste stream. Facilities that produce coconut water and oil are of interest.

- Solar PV On-Grid: In 2010, a Solar PV On-Grid system was installed at the University of Belize (UB) as a pilot project by Japan International Cooperation Agency (JICA). This project seeks to mitigate greenhouse gas emissions and produce clean energy using solar PV. The project will also provide useful information on the feasibility of uploading and selling electricity to BEL. In 2020, the Solar PV system will be handed over to UB to maintain, operate and sell energy.

- Micro Hydropower Run-of-the-River Facility for Douglas D' Silva Forest Station: The Mountain Pine Ridge Micro-Hydroelectric project included in the Mountain Pine Ridge Forest Station Master Plan seeks to transform the Douglas D' Silva Forest Station to an Eco-tourism, Research and Education Centre using a micro-hydro run-of-the-river system. This technology will replace a diesel generator currently being used with a more reliable source of affordable electricity to transform the station. This technology will also improve the supply and quantity of the electricity service. The Mountain

[14] The aim of the TNA was to assist developing country parties to the UNFCCC determine their technology priorities, for mitigation of greenhouse gas emissions and adaptation to climate change.

Pine Ridge Micro-Hydroelectric project will generate electric power of 110/220 V using the waters of the Rio On river. The system will have an installed capacity of 75-100kW.

- Waste to energy – biomass potential: Belize Sugar Industries harnesses sugar cane by-products for heat and power generation. Both American Sugar Refineries/Belize Sugar Industry Ltd. (ASR/BSI) and Santander Sugar currently hold power purchase agreements. The potential expansion in the use of biomass for electricity generation include sugar cane, rice husk, and biogas. Assessment of the rice-husk energy potential shows that it fluctuates between 1.35 to 2.65 MW for 2017 and 1.75 to 4.94 MW for 2030. According to the CPP, the Caribbean Community Climate Change Centre quantified Belize's "waste to energy" potential by harnessing the organic waste from municipal solid waste (MSW), banana plantations, shrimp farms, and animal manure. The study identified relevant sites in Belize with biogas potential. The results show that the electricity generating potential of biogas in Belize is approximately 3.46 MW.

- Improvement in energy efficiency: A measure has been already identified for improving the energy efficiency in households using more efficient cookstoves. The achievement of a reduction of 66% of wood consumption in the residential sector (as specified in the NDC) would have a significant impact in terms of GHG emissions.

The following Table 4.7 shows the mitigation potential of these options as well as the potential impact of additional GHG emissions if the electricity imports are substituted by fossil fuels.

TABLE 4.7 MITIGATION OPTIONS IN THE ENERGY SECTOR

Year	New RES capacity (Gg CO_2-eq)	Impact of imports (Gg CO_2-eq)*	Improved cookstoves (Gg CO_2-eq)	Energy efficiency commercial and residential (Gg CO_2-eq)	Energy efficiency Industry (Gg CO_2-eq)
2020	14.27	281.61	1.18	19.89	0.51
2030	157.01	393.41	12.99	27.78	0.71
2033	199.83	434.92	16.53	30.71	0.79

Note- The impact of imports is not a mitigation option, but the amount of GHG emissions that will be added (not reduced) in case the imports of electricity are replaced by fossil fuel generation.

Assumptions made for estimating the potential impact of these options are in Box 2.

BOX 2 ASSUMPTIONS FOR ESTIMATING ENERGY SECTOR MITIGATION OPTIONS

- The **17% of electricity produced** with fossil fuels is *replaced by Renewable energy sources by 2033.*
- A **66% reduction by 2033** in the consumption of fuel and associated emissions *from the use of wood in the residential sector*.
- **The impact of energy efficiency standards and labels** for appliances in commercial and domestic sectors, *is assumed as a 16% of reduction of electricity consumption*. Assumption extracted from: https://pdfs.semanticscholar.org/9734/0a359a213eb4986dabcc8bb1c1e302ffdf8a.pdf
- The **impact of energy efficiency standards and labels** for appliances in the Industrial sector *is assumed as a 10% reduction in fuel consumption* (extracted from GAMCO and industry chapter in IPCC AR4)

Transport

The Transportation Master Plan is the main policy instrument of Belize for developing its transport sector. Nevertheless, it provides limited information on ways to reduce the GHG emission impact of the sector.

Given the GHG contribution of the sector, efforts should be focused on incentivising the use of low carbon fuels, such as LPG, and promoting public transportation.

Within the TNA of 2017, the following alternatives for reducing GHG emissions in the transport sector were identified.

- Levying duties on imported vehicles based on carbon emissions: This technology intervention seeks to transform the way duties are charged on motor vehicles imported into Belize so that more fuel-efficient motor vehicles are imported. A Vehicle Emission Duty would be formulated that would change duties on imported vehicles based on the amount of CO_2 emitted per unit distance travelled (gCO_2/mile).

- Retrofitting vehicles with LPG fuel systems: This technology intervention seeks to retrofit existing petrol (gasoline) powered vehicles with liquefied petroleum gas (LPG) equipment. The aim of this exercise is to both improve fuel efficiency and reduce GHG emissions. While there are no statistics on the number of vehicles that are already connected to LPG, a proposed initiative to convert 15-25% of existing vehicles to LPG would create jobs to install and maintain the system.

- Improved Public Transport system using more fuel-efficient buses: This technology intervention is recommended to begin as a pilot project. The pilot would purchase and apply desired buses for the Belize City and Benque Viejo del Carmen route. The renewal of the fleet and the optimization of the transport routes will have an impact on GHG emission reductions. In the long term the improvement in the transportation system will indirectly impact road transportation emissions, as the preferences of the population will change towards public transportation.

The following Table 4.8 shows an approximation to the impact of these options:

TABLE 4.8 MITIGATION OPTIONS IN THE TRANSPORT SECTOR

Year	Retrofitting vehicles with LPG (Gg CO_2-eq)	Improved public transport system (Gg CO_2-eq)
2020	18.01	6.64
2030	198.10	73.07
2033	252.13	93.00

The assumptions made for estimating the potential impact of these options are seen in Box 3.

BOX 3 ASSUMPTIONS FOR ESTIMATING TRANSPORT SECTOR MITIGATION OPTIONS

- Improved public transportation: **93 Gg CO2-eq per year by 2033** (assumption extracted from 2017 TNA).
- The average g/km **emission factor is reduced from 333 g CO2-eq/km to 180 g CO2-eq/km**, the average from the study *Cleaner and more efficient fuels and vehicles in Belize*. https://www.globalfueleconomy.org/media/597572/establishment-baseline-fe-belize.pdf This would be translated in a reduction by 50% of the current emissions of the road transport sector. The approximate impact of the option is 50% of the BaU emissions of category 1A3b Road transport, to be achieved in 2050.

IPPU

Apart from the possible implementation of energy or waste sector mitigation measures in the industry, the GHG emissions of the IPPU sector are not affected by any mitigation action implemented or planned in Belize.

Nevertheless, given the rising importance of HFCs in the GHG emission profile in the country, and the potential preponderance of the touristic sector within the country GDP, measures to incentivise the use of low carbon HFC´s or partial prohibitions/measures to disincentivise their consumption will have a significant impact.

The following Table 4.9 shows an approximation to the impact of this option:

TABLE 4.9 MITIGATION IMPACTS OF HFCS

Year	Impact (Gg CO_2-eq)
2020	5.83
2030	64.10
2033	81.58

The estimate assumes that HFC 134a is totally replaced by low carbon HFC alternatives by 2033.

Waste

The National Solid Waste Management Strategy and Implementation Plan is the document that drives the country's effort for mitigation in the waste sector. The implementation of the Implementation Plan will have a significant impact in the GHG emissions of the country, so it must be prioritized.

Besides, if waste to energy practices take place in the future (see mitigation options in the energy sector), it will also have an impact on the waste sector emissions, as the amount of waste processed in landfills will be reduced. This impact, however, is not foreseen to be very big.

An area which has significant potential and has not been addressed is wastewater management practices. The improvement of the water discharge systems and wastewater treatment will have a significant impact on GHG emissions.

The following Table 4.10 shows an approximation to the impact of these options:

TABLE 4.10 MITIGATION OPTIONS IN THE WASTE SECTOR

Year	Impact (Gg CO_2-eq)
2020	3.82
2030	42.02
2033	53.48

Agriculture, Forestry and Other Land use (AFOLU)

The REDD+ strategy and the Forestry Act are the policy frameworks guiding the GHG emissions and removals of the AFOLU sector. The full implementation and these policies should be a priority in future mitigation efforts of Belize, given the prominence of the removals encompassed in this sector in the emission profile of the country.

In addition, the following mitigation options are identified as possibilities for further reducing the GHG emissions of the AFOLU sector:

For agriculture:

- Change feeding practices and quality of livestock using the proper ratio of nutrients and feeding practices and using a mixture of different feeds from several sources. This mitigation option would affect the emissions related to enteric fermentation. Changing the ratio of nutrients and feeding practices for livestock will affect the digestibility, identified by 2006 IPCC Guidelines as one of the key issues determining CH_4 emissions in the sector. Furthermore, improvement in feeding practices could affect the digestibility by a rate of 20%. Therefore, the approximate impact in GHG emission reductions would be about 20% of total emissions of category 3A livestock.

- Improve manure management through capture, storage, treatment and utilization of animal manures in an environmentally sustainable manner. Despite manure management representing just 10% of the livestock

emissions in the GHG Inventory since 2009 to 2017, the emissions are increasing 32% annually. The estimation of improvements in manure management cannot be estimated without further information about the new management practices and the amount of manure affected.

For Forestry and Other land use:

- Improve prevention and control of forest fires. Average emissions due to forest fires are estimated at 119.59 Gg $CO_{2\text{-eq}}$ year. The prevention of forest fires due to implementation of good practices for agroforestry waste management, preventive forestry actions, i.e. firewall, forest planning and/or awareness campaigns, could reduce the occurrence of forest fires, as well as improve the monitoring, control and fire combat systems. The improvement of forest practices should reduce the GHG emissions of the agriculture sector.

- Maintain and restore healthy forest ecosystems via sustainable forest management. Under this mitigation option, the managed forest would reduce emissions by avoiding bad practices in forest management and increase removals by improving the forest conditions and, as a result, increase the growth rate.

- Rehabilitation of degraded areas and Increase afforestation and reforestation through creation of specific programs. This mitigation option would increase the forest area and improve the forest conditions and, as a result, increase the growth rate. This action would increase the removals in forest.

The following Table 4.11 shows the mitigation potential of the estimated mitigation options for the AFOLU Sector.

TABLE 4.11 MITIGATION OPTIONS IN THE AFOLU SECTOR

Year	Enteric fermentation (Gg CO_2-eq)	Forest fires (Gg CO_2-eq)*
2020	36.84	119.59
2030	47.64	119.59
2033	52.81	119.59

The estimate of this mitigation option is based on a 20% GHG emission reduction in the BaU emissions of category 3A Livestock.

The potential GHG emission reduction of forest fires are assumed equal to the GHG emissions estimated in the BaU for this emission source using an average of the years 2001- 2018.

5 FINANCE, TECHNOLOGY & CAPACITY BUILDING NEEDS & SUPPORT RECEIVED

Belize continues to mobilize resources from various regional and international sources to meet the cost of the economy in battling the effects of climate change, as well as efforts to reduce national emissions. These resources include financial aid, technical assistance, and technology transfer. This chapter covers information on finance, technology, and capacity needs and support received for the period 2015-2018 based on information available during the preparation of this report.

Although a climate change lens/perspective is being incorporated into the plans and actions of many sectors, much is left for improvement in Belize and the country cannot address climate change on its own. The constraints and gaps that exist at the financial, technical and technological level require internal and external support to address needs and issues that arise. Belize's Technology Needs Assessment (2017) highlights several barriers that exist for the implementation of mitigation and adaptation actions and how some of these barriers can be addressed. While it is recognized that support is received from bilateral and multilateral cooperation, it can sometimes be difficult to establish international cooperation due to the country's limited capacity. Much more support is required for the country to be able to meet UNFCCC requirements.

This first Biennial Update Report showcases some of Belize's financial, technological and capacity building needs, and shows the country's need to overcome significant barriers and the need to improve and expand internal and external cooperation. It shows the need for knowledge exchange, tools and technical expertise to increase the effectiveness and sustainability of climate change actions proposed in several sectoral plans and strategies. It also highlights support that has been received by the country and areas where gaps and constraints exist.

5.1 SUPPORT NEEDED

In 2017, a Technology Needs Assessment was carried out to identify and prioritize technologies and tools that can contribute to adaptation and mitigation goals that are compatible with national sustainable development goals and priorities. This has been critical to quantify support in terms of actions and finance in key sectors. Nevertheless, a comprehensive and integrated needs assessment with respect to finance, technical assistance, capacity building and technology has not been done and documented in any single report or data source. The absence of a comprehensive Needs Assessment adds to the difficulty in precisely determining the support needed by the country.

Between the years 2015 to 2018 important studies and assessments have been carried out that have helped to identify enabling conditions, helped to prepare national plans that integrate climate change and to project the potential impacts of climate change in Belize (TNA, TAP, stakeholder analysis, etc). Few sector specific analyses have also been done to assess the gaps and constraints in terms of finance, technical

capacity and technology (first, second, third national communications, TNA – Barrier Analysis and Enabling Framework). Although these studies are not sufficient to determine effectively and comprehensively all of Belize's needs, they are a good baseline to build upon for future BURs and assessments.

Table 5.1 below demonstrates some of the support needed in Belize, in terms of constraints and gaps and the related financial, technical and capacity building needs. The full extent of financial support needed is not provided, however, it will be improved upon and provided as much as possible in the next BUR.

TABLE 5.1 SUPPORT NEEDS

Need identified	Support needed	Specific type of support requested [technology transfer, capacity building, financial support]	When and for how long is support needed?	Finance Required	
				National budget available in USD	Financial support needed in USD
Design an awareness and implementation plan for off-grid solar PV technology to electricity homes in rural communities	*Technical assistance for preparation of a plan*	*Technical assistance*	*2020 - 2021*		*80,0000*
Design an awareness and implementation plan for distributed and centralized on-grid solar PV systems	*Technical assistance for the preparation of a plan*	*Technical assistance*	*2020 - 2021*		*120,000*
Funding for implementation of Solar Water Heating NAMA	*Financial support to implement actions in SWH NAMA for commercial, industrial and residential sectors*	*Financial support*	*2020 - 2021*		*5,882,440*
Limited knowledge of gasification systems and proper operation	*Capacity building for technicians for proper set up, operation and maintenance of gasification systems*	*Capacity building*	*2020 - 2021*		
Limited knowledge and services offered for solar PV systems	*Capacity building for installation, use and maintenance (services offered) of solar PV systems (on-grid and off-grid)*	*Capacity building & Financial support*	*2020 - 2021*		*69,000*
Develop plan for funding options and incentives for farmers to import, purchase, and operate improved PCS technology with cooling systems using RE	*Technical assistance to develop a plan*	*Technical assistance*	*2020 - 2022*		
Funding to strengthen a grain seed production system for four farmers'	*Procure finance and technical assistance to strengthen climate*	*Financial support & technical assistance*	*2020 – 2022*		*22,000*

groups and the MoA Seed Production Unit through a CBA, project concept, policy formation and incentives for farmers	*resilient, certified grain seed production and make marketable*				
Funding for installation of small-scale solar PV off-grid systems in three villages in the Toledo District pilot project	*Financial support for purchasing equipment and installation of 75 small-scale, off-grid, 100W solar PV systems for homes in rural Toledo*	*Financial support*	*2020 - 2021*		*80,300*
Funding to install biomass gasification system at two agro-processing facilities where there is suitable biomass waste stream	*Financial support for purchasing equipment and installation of two gasification systems*	*Financial support & Technology transfer*	*2020 - 2021*	*Cost dependent on feedstock and gasifier model chosen*	*Support needed dependent on feedstock and gasifier model chosen*
Train technicians/locals to install, maintain and monitor micro-hydro power plants	*Capacity building for technical experts and interested locals by developing training program for micro-hydro power plant installation, maintenance and monitoring*	*Capacity building*	*2020 - 2021*		*30,000*
Limited national technical expertise in NAMA & NAP preparation and implementation	*Capacity building for government technical experts to prepare and implement NAMAs and NAPs*	*Capacity building*	*2020 - 2021*		
Limited knowledge about production of climate resilient grain seeds	*Finance for the development and execution of a training programme for seed producers*	*Financial support & capacity building*	*2020 - 2021*		*47,000*
Establish seven improved drip irrigation/ fertigation systems with rainwater catchments for 5 farming cooperatives and the MoA field training stations in Belmopan, Belize	*Financial support to establish seven systems for improve drip irrigation/ fertigation with rainwater harvesting*	*Financial support*	*2020 - 2021*		
Develop and execute training programme for farmers on improved drip irrigation/ fertigation systems and rainwater harvesting	*Financial support and capacity development by training individual farmers and farming cooperatives and for training of trainers*	*Financial support & capacity building*	*2020 - 2021*	*12,000*	*30,000*

Limited knowledge of improved PCSs and limited services offered for locally manufactured PCSs	*Financial support and capacity building for training on erection and operation of improved PCS and training to certify local technicians*	*Capacity building & financial support*	*2020 - 2021*		
Upgrade of UB's plant micro-propagation laboratories and nurseries to produce certified potato seed tubers	*Financial support to upgrade laboratory facility, including nurseries, at UB*	*Financial support*	*2020 - 2021*		*40,000*
No protocol exists for production of certified Irish potato seed tubers through micro propagation	*Funding for contracting of a bio-technology expert to develop Irish potato micropropagation protocol and best practices*	*Financial support*	*2020 - 2021*		*25,000*
Training programme developed by bio-technology expert and training carried out for laboratory technicians and nursery field technicians	*Funding for bio-technology expert and training to be carried out*	*Financial support & capacity building*	*Ongoing*		*35,000*
Potato seed tubers imported for planting each year due to lack of local variety for planting	*Secure funding for production of climate resilient Irish potato seed tubers through micropropagation at laboratory and nurseries*	*Financial support*	*2021*		
Refurbishment of 8 protective covered structures' cooling systems using renewable energy	*Financial support for purchasing equipment and installation of cooling systems for 8 PCSs that are in disrepair using renewable energy for cooling*	*Financial support*	2021	*8,000*	*40,000*
Funding for the development, testing and production of climate resilient, certified grain seeds (heat & drought resistant open-pollinated corn & beans) by four farmers' cooperatives and the MoA Seed Production Unit	*Financial support to establish a certified grain seed production system*	*Financial support & technology transfer*	*2022*		

5.2 SUPPORT RECEIVED

While Belize's GHG emissions remain very small, its commitments to international treaties as well as opportunities and benefits that arise from mitigation and adaptation activities continue to prompt the nation to include climate change in development plans. While funding and technical assistance is mobilized, it is often difficult to obtain all the necessary information on support received from the various state and non-state recipients. The Public Sector Investment Programme reports is vital for the tracking of support received; however, data gaps do exist.

As a signatory to the UNFCCC, Belize has done what it is capable of to respond to the adverse effects of climate change, however, as a small island developing state, its capacity is very limited. While Belize continues to mobilize finance for the implementation of climate actions, there is a constant need for capacity building, finance, and technology transfer in the country.

The following Table 5.2 introduces the support received within the period of 2015 - 2018 that have been integral in the implementation of Belize's climate change agenda.

TABLE 5.2 FINANCIAL SUPPORT RECEIVED 2015-2018

Project Name	Domestic currency	USD equivalent *	Status (Committed/ Disbursed)	Support Entity	Financial instrument	Support Area (Mitigation Adaptation Cross-cutting)	Sector	Implementing Entity	Year
Climate Resilient Infrastructure Project (CRIP)	60,000,000	30,303,030	Disbursed - $ 6,330,584.72	IBRD		Adaptation	Transport	Social Investment Fund (SIF)	2014 (active in 2015)
Description	To enhance the resilience of road infrastructure against flood risk and impacts of climate change; and to improve the Borrower's capacity to respond promptly and effectively in an eligible crisis or emergency.								
Water Utility Climate Risk and Vulnerability Assessment	336,000	169,696	Disbursed	CDB, GOB, BWS	CDB-Grant 268,000 GOB/BWS-Contribution 68,000	Adaptation	Water	Belize Water Service (BWS)	2015
Description	Consultancy services for the development of a Climate Risk and Vulnerability Assessment (CRVA) for 3 BWSL systems and formulation of an accompanying adaptation plan of action; and capacity enhancement of the BWSL in conducting CRVAs								
Agro-ecological Farming of fruits and vegetables within the Selva Maya region (Cayo District)	99,440	50,222	Disbursed	GIZ, GOB	GIZ -Grant 35,353 GOB-Contribution 8,808 Beneficiaries-Contribution 6,060	Crosscutting	AFOLU	Ministry of Natural Resources (MNRA)	2015
Description	To promote sustainable production of fruits and vegetables through the use of agro-ecological practices that will reduce the harmful effects of synthetic fertilizers and pesticides while protecting the natural forest in communities within the Selva Maya region.								

Formulation of National Agriculture and Food Policy	71,840	36,282	Disbursed	FAO	FAO – Grant 36,282	Crosscutting	AFOLU	Ministry of Natural Resources (MNRA)	2015
Description	To prepare a final draft National Agriculture and Food Policy for Belize that provides a framework for the sustainable development of the sector and increased socio-economic benefits to Belize.								
Belize Marine Conservation and Climate Adaptation Project	13,955,000	7,047,979	Disbursed - 6,000,000	Adaptation Fund, GOB	Adaptation Fund - Grant 5,585,858 GOB-Contribution 1,462,121	Adaptation	Coastal zone	MAFFESDI/PACT	2015
Description	Implement priority ecosystem-based marine conservation and climate adaptation measures to strengthen the climate resilience of the Belize Barrier Reef System. Expanding Selected MPAs to achieve about 20% of area under protection and creating replenishment zones. Improve management effectiveness by strengthening the legal framework for the MPA network. Increase protection of mangroves, seagrass and tidal marsh areas.								
Japan Caribbean Climate Change Partnership (JCCCP)	2,549,357	1,287,554	Disbursed	GOJ/UNDP	GOJ/UNDP-Grant 1,287,554	Crosscutting	Agriculture, Water Resources	UNDP	2015
Description	Activities in Belize include supporting the development of Belize's National Climate Change Communications Strategy, National Adaption Plan (NAP) and Nationally Appropriate Mitigation Actions (NAMA); and implementing a sustainable agriculture and water resources management pilot project to advance inclusive low-emission, climate-resilient development in Belize.								
REDD+ Readiness Preparation Proposal (RPP)	10,316,000	5,210,101	Disbursed	WB GOB GIZ/KBA	WB-Grant 3,838,383 GOB-Contribution 571,717 GIZ/KBA-Grant 800,000	Mitigation	Forestry	MAFFESDI	2015
Description	Reduction of deforestation and forest degradation. Develop a National Forest Reference Emission Level and/or a Forest Reference Level; Design systems for National Forest Monitoring Information on Safeguards								

Belize Education Sector Reform Programme II	70,000,000	35,000,000	Disbursed	CDB	Loan	Adaptation	Education	Ministry of Education and Youth Services	2015
Description	The use of simple reinforced concrete construction will contribute to resilience to natural hazards. On the coast, on the islands and in areas with high risk of flooding, structures will be elevated to high water protection from flooding, tsunamis and storm surges, with the concrete roofs serving as potential refuges.								
Northern Highway Upgrading - Airport Junction to Haulover Bridge (5th Road - PSW Goldson Hwy Upgrading - Project)	59,438,000	29,719,000	Disbursed	CDB	Loan	Adaptation	Transport/Road Infrastructure	Ministry of Works	2015
Description	Climate adaptation features of the works include higher capacity drainage; river training; and improved bridge freeboard to protect the infrastructure from scour, higher intensity flood events, and sea level rise.								
George Price Highway Rehabilitation	60,112,000	28,528,000	Disbursed	IDB	IDB Loan 28, 528,000 GOB Contribution 1,528,000	Adaptation	Transport/Road Infrastructure	Ministry of Works and Transport	2015
Description	To improve the road connectivity by rehabilitating road infrastructure to national standards, decreasing travel time and costs, reducing road fatalities and injuries, and ensuring road accessibility by improving the CC resilience of the corridor. Planning for projected CC impacts and disaster risk planning for impacts associated with current climate variability and the consequences of future CC								
Energy Resilience for Climate Adaptation Project	23,950,000	12,095,959	Disbursed	GEF/WB	GEF/WB-Grant (16,000,000) BEL-Contribution (6,750,000) GOB-Contribution (1,200,000)	Adaptation	Energy	Belize Electricity Ltd	2016
Description	To enhance resilience of the energy system to adverse weather and climate change impacts through long-term planning and capacity-building for adaptation and implementation of demonstration measures targeting the electricity transmission and distribution networks.								

Solid Waste Management project II	20,000,000	10,000,000	Disbursed	IDB	IDB – Loan 10,000,000	Mitigation	Waste	BSWAMA	2016
Description	Investment in 5 new transfer stations and expansion of existing sanitary landfill								
Improving Disaster and Climate Resilience in Sustainable Tourism	1,400,000	707,070	Disbursed	IADB	IADB-Grant 707,070	Adaptation	Tourism	IADB	2016
Description	Mainstreaming disaster and climate resilience in tourism destination planning in Belize, emphasizing ecosystem-based adaptation and risk reduction. The specific objective is to increase the availability of destination-specific risk information, addressing existing and future vulnerabilities, in order to improve risk awareness and knowledge, inform local level tourism plans and the design and feasibility of physical investments.								
Flood Mitigation Infrastructure Program for Belize City	21,500,000	10,750,000	Disbursed	IADB	Loan	Adaptation	Transport	Ministry of Works	2016
Description	Protection of the Belize City's drainage and urban road networks aiming at reducing Belize City's vulnerability to flooding events. Implementation 2011 – 2016.								
Project Preparation Studies for the Rehabilitation of the Caracol Road	1,500,000	750,000	Disbursed	Kuwait Fund for Arab Economic Development	Grant	Mitigation	Transport	Ministry of Works and Transport	2016
Description	An action plan to identify mitigation measures required to control and prevent negative impacts, particularly the degradation or significant conversion of the forest.								
Sustainable Tourism Program II	32,000,000	16,000,000	Disbursed	IADB, GOB	IADB-Loan 15,000,000 GOB-Contribution 500,000	Crosscutting	Tourism	Ministry of Tourism and Civil Aviation	2016
Description	Project aims to increase tourism employment, income and revenues through increased overnight tourism expenditures in the selected destinations while improving sector governance, promoting environmental sustainability and creating enabling conditions for private sector investment in overnight tourism.								

Implementation of the Emerging and Sustainable Cities Initiative (ESCI) in Belize City	2,200,000	1,100,000	Disbursed	IADB	Grant	Mitigation	Infrastructure, Social Welfare	UNDP	2016
Description	Diagnosis and preparation of an action plan to address critical environmental, urban and fiscal/governance challenges; pre-investment studies for prioritised interventions; and a system to monitor the results and impact of the plan.								
San Ignacio/ Santa Elena Bypass Project	58,355,000	29,472,222	Disbursed	CDB, GOB	CDB - Loan 24,968,686 GOB-Contribution 4,503,535	Adaptation	Transport/ Road Infrastructure	Ministry of Works (MOW)	2017
Description	Construction of a bypass road and new all-weather bridge across the Macal River to increase the efficiency of road transportation in and through San Ignacio and Santa Elena. The project also includes activities to determine the extent of vehicle overloading and the accompanying economic and financial impacts.								
Improving Livestock Sector Productivity and Climate Resilience in Belize	1,751,400	884,545	Disbursed	IADB, BLPA, LICU, CATIE	IADB-Grant 556,060 BLPA/LICU/CATIE-Contribution 328,484	Crosscutting	AFOLU	Belize Livestock Producers Association (BLPA)	2017
Description	To improve the productivity of the livestock sector in Belize through the promotion of pasture intensification and address the low capacity for adaptation to climate change of especially small and medium-sized producers.								
Technology Needs Assessment for Climate Change Mitigation and Adaptation	330,000	166,666	Disbursed	UNEP/DTU, GOB	UNEP/DTU Partnership–Grant 121,212 GOB-Contribution 45,454	Crosscutting	Multisectoral	MAFFESD	2017
Description	To implement priority ecosystem-based marine conservation and climate adaptation measures to strengthen the climate resilience of the Belize Barrier Reef System								
Fourth National Communication and First Biennial Update Report to the UNFCC	3,810,000	1,905,000	Disbursed	GEF, UNDP, GOB	GEF-Grant 1,704,000	Crosscutting	Multisectoral	NCCO, MAFFESDI	2017

					UNDP-Grant 40,000 GOB-Contribution 161,000				
Description	The Project will seek to assist the country of Belize in meeting reporting requirements under Article 12 of the UNFCCC								
Social Investment Fund III Project	20,000,000	10,000,000	Disbursed	CDB, EIB, GOB	CDB-Loan EIB CALC-Loan GOB-Contribution	Adaptation	Infrastructure, Social Welfare	SIF	2017
Description	Provide increased gender-equitable and inclusive access to climate-resilient infrastructure and quality basic social-services for poor and vulnerable communities. The Project comprises small-scale infrastructure works and capacity building for stakeholders								
Paving/Upgrading of the Manatee Road (Coastal Highway Upgrading)	3,000,000	1,150,000 pounds	Disbursed	United Kingdom Caribbean Infrastructure Partnership Fund (UKCIF) through the CDB	UKCIF grant	Adaptation	Transport	Ministry of Works	2017
Description	Update feasibility study and prepare preliminary and detailed designs to upgrade the Coastal Highway incorporating CC considerations; identify CC vulnerabilities, assessment of hydrological and hydraulic conditions, Climate Vulnerability Assessment: identifying and evaluating potential effects of CC on the road and the surrounding watersheds and identifying resilience measures to address the identified vulnerabilities								
PROADAPT2 - Proadapt Belize - Increasing Climate Change Resilience and Related Business Opportunities	406,000	203,000	Disbursed	IDB	IDB – Technical Cooperation 203,000	Adaptation	Commercial	Belize Chamber of Commerce and Industry (BCCI)	2017
Description	PROADAPT was created to pilot and support the development of new and innovative methodologies, tools and business models to help micro, small and medium enterprises (MSMEs) in Latin America and the Caribbean increase their climate resilience and take advantage of related businesses.								

Climate Vulnerability Reduction Program (CVRP)	20,000,000	10,000,000	Disbursed	IDB	IDB-Loan 10,000,000	Adaptation	Disaster Risk Management / Infrastructure / Climate Change Management	Ministry of Works	2017
Description	Preparation of implementation and monitoring tools and technical studies in the following areas: climate change risk in the tourism sector, disaster risk management governance, climate change adaptation, and framework for a National Climate Risk Information System.								
EcoMicro - BCUL Green Finance for MSMEs in the Agricultural and Fisheries Sectors	1,200,000	600,000	Disbursed	IDB	IDB-Technical Cooperation – 600,000	Adaptation	Agriculture & Fisheries	Belize Credit Union League Limited	2018
Description	It focuses on providing financing for adaptation technologies and methods to increase the climate resilience of micro, small and medium-sized enterprises in the agricultural and fisheries sectors.								
George Price Highway Rehabilitation Project	68,576,766	34,288,383	Disbursed	IADB, EU CIF, GOB	IADB-Loan 27,272,727 EUCIF-Grant 5,472,222 GOB-Contribution 1,543,434	Adaptation	Transport	Ministry of Works (MOW)	2018
Description	Rehabilitation of the George Price Highway road infrastructure between miles 47.90 in Belmopan and 67.30 in Santa Elena to national standards								
Total (2015-2018)		**USD $277,774,709**							

5.3 CAPACITY BUILDING RECEIVED

Expanding national capacity becomes increasingly important under the implementation of the Paris Agreement, whereby the focus on intensified emission reduction efforts will be needed while simultaneously increasing resilience to climate change impacts. In the face of this global challenge, however, countries are at different stages of development, with different levels of capabilities in both implementing adaptation and mitigation actions, as well as resources to shift into climate action realization. Belize, as Non-Annex 1 party to the convention, as well as a Small Island Developing State, is without a doubt, lacking in know-how and resources to entirely fulfil its mandate under the Paris Agreement without proactive intervention. This was further supported through the climate change stakeholder analysis done in 2018.

This Table 5.3 outlines capacity building initiatives that were untaken during the reference period of 2015-2018, many of which have been capacity gained through the elaboration of Belize's First BUR.

TABLE 5.3 CAPACITY BUILDING RECEIVED 2015-2018

Capacity Building Activity	Period	Source of support
Education and human resource development: capacity-building interventions for government institutions and NGOs in planning and monitoring	2015	Basic Needs Trust Fund VIII
Build capacity for BWS to conduct CRVA of their remaining systems. Prepare and conduct workshops for BWS's key personnel and relevant staff of government ministries.	2015	Water Utility Climate Risk and Vulnerability Assessment Project
Public awareness campaign aimed at educating residents on the importance of avoiding littering and the disposition of solid waste in drains and canals; Development of the DOE's capacity to supervise and ensure the Program's compliance with environmental regulations, training in program supervision and monitoring in Belize, support with a technical environment specialist; Conduct a natural disaster risk assessment study of Belize City	2016	Flood Mitigation Infrastructure Program for Belize City
Coastal Zone, Sea Level Rise and Related Processes workshop: Capacity Building for national technical experts for integrating coastal zone, sea level rise and other related processes into climate actions, development plans and strategies by using analytical and modelling methods to gather data for informed assessments. The workshop focused on sea level variation and coastal dynamics and ecosystems, how to measure variations and analytical and modelling methods that	2018	Fourth National Communication/First Biennial Update Report Project (GEF)

can be used to collect data on such variations and processes. Participants learned how to assess variations found and how sea level rise can influence coastal ecosystems and its components, such as water quality, wetlands, coral reefs, etc.		
Training in the use of Collect Earth Software, Saiku data analysis tool, and GHG Inventory Tool for AFOLU Sector	2018	REDD+ Readiness Preparation Project CfRN FAO
Training national experts in IPCC 2006 GLs	2018 - 2019	CCMRV Hub for English Speaking Caribbean Countries and GHG Management Institute
Engagement with Data Management Working Crew to develop Regional GHG Management System	2018 - 2019	CCMRV Hub for English Speaking Caribbean Countries and GHG Management Institute
Vulnerability and Capacity Assessment Workshop: Training of 20 technical personnel from the public and private sector on how to conduct vulnerability assessments and increase adaptive capacity knowing what vulnerabilities exist. Attendees were also taught how to use vulnerability assessments in their decision making. Four technical officers from key sectors, namely, coastal zone, fisheries, water and climate change, were then further trained in Cuba.	2018 - 2019	Fourth National Communication/First Biennial Update Report Project (GEF)

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