First Biennial Update Report (BUR1) of The Commonwealth of The Bahamas to the United Nations Framework Convention on Climate Change (UNFCCC)

December 2022

The Commonwealth of The Bahamas'

First Biennial Update Report (BUR1)

in fulfilment of its commitment under the

United Nations Framework Convention on Climate Change (UNFCCC)

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Ministry of Environment and Natural Resources
Ground Floor, Charlotte House
Shirley and Charlotte Street
Nassau,
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Contact Details: +1242-322-4546 / inquiries@depp.gov.bs

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    b. United Nations Environment Programme — Implementing Entity
    c. The Bahamas National Climate Change Committee (NCCC)

The climate crisis is an enormous threat to The Bahamas and other vulnerable Small Island Developing States (SIDS). If global emissions are not slowed, our country and many other nations will look different from the country we love today. Rising seas levels will cause our islands and other SIDS to disappear, drought will impact our food security, and warmer waters are likely to bring more catastrophic storms like Hurricane Dorian.

The Bahamas contributes less than 0.01% of global greenhouse gas (GHG) emissions, and despite this minimal contribution, our country has prioritized providing the domestic and international community with the required reports highlighted in the Paris Agreement, that adhere to TACCC principles, in an effort to demonstrate leadership and commitment to action to combat this global issue.

The realities of war, economic headwinds, the hangover from the pandemic, and competition among world powers, cannot be used as justification not to confront the imminent danger of the climate crisis.

At COP27, The Bahamas called on other nations to get real about tackling the climate crisis. We are not sitting still. The Bahamas has committed to the implementation of 41 mitigation actions in this BUR, to achieve an economy-wide reduction of GHG emissions of 30% when compared to Business as Usual (BAU) by 2030. This is mirrored in our recently submitted NDC. These actions will improve the lives and livelihoods of Bahamians. And we will continue our drive for innovation and ingenuity.

Our needs are clear. Review this BUR. And whoever you are, wherever you are, bring your climate solutions to The Bahamas. Help us convert our front-line vulnerabilities into cutting-edge solutions for all!

Hon. Philip Edward Davis, K.C., M.P,
Prime Minister and Minister of Finance
Commonwealth of The Bahamas

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Acronyms/Abbreviations

5Cs	Caribbean Community Climate Change Centre
AD	Activity Data
AFLOU	Agriculture, Forestry and Other Land Use
AR5	IPCC Fifth Assessment Report
BAHFSA	Bahamas Agricultural Health and Food Safety Authority
BAMSI	Bahamas Agriculture & Marine Science Institute
BAU	Business as Usual
BBSQ	Bahamas Bureau of Standards and Quality
BCCEC	Bahamas Chamber of Commerce & Employers Confederation
BDB	Bahamas Development Bank
BEST	Bahamas Environment Science and Technology Commission
BDM	Bahamas Department of Meteorology
BHTA	Bahamas Hotel and Tourism Association
BIS	Bahamas Information Services
BMA	Bahamas Maritime Authority
BNSI	Bahamas National Statistical Institute (formerly the Department of Statistics)
BNT	Bahamas National Trust
BPL	Bahamas Power and Light Company Limited
BPAF	Bahamas Protected Area Fund
BREEF	Bahamas Reef Environment Educational Foundation
BSD	Bahamian Dollar
BTR	Biennial Transparency Report
BTVI	Bahamas Technical and Vocational Institute
BUR1	First Biennial Update Report
C2EAU	Climate Change and Environmental Advisory Unit
CAAB	Civil Aviation Authority Bahamas
CARICOM	Caribbean Community
CBB	Central Bank of The Bahamas

CCARR	Climate Change Adaptation and Resilience Research Centre (University of The Bahamas)
CCCCCC	Caribbean Community Climate Change Centre
CCREEE	Caribbean Community for Renewable Energy and Energy Efficiency
CDB	Caribbean Development Bank
CFL	Compact Fluorescent Light
COP	Conference of the Parties
COVID-19	Coronavirus disease of 2019
CRF	Common Reporting Format
CTF	Common Tabular Format
DEHS	Department of Environmental Health Services
DEPP	Department of Environmental Planning & Protection (formerly the BEST Commission)
DFID	United Kingdom's Department for International Development
DMR	Department of Marine Resources
DOA	Department of Agriculture
DRA	Disaster Reconstruction Authority
ECLAC	Economic Commission for Latin America and the Caribbean
EB	Energy Balance
EE	Energy Efficiency
EF	Emission Factor
ESCO	Energy Service Company
EST	Environmentally Sound Technologies
EIB	European Investment Bank
EU	European Union
EV	Electric Vehicle
FAO	Food and Agriculture Organization of the United Nations
FNC	First National Communication
FOCOL	Freeport Oil Company/Sun Oil Limited
GBPA	Grand Bahama Port Authority
GBPC	Grand Bahama Power Company

GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOB	Government of The Bahamas
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Inventory
GHGMI	Greenhouse Gas Management Institute
GIZ	German Development Agency
GWP	Global Warming Potential
ICA	International Consultation and Analysis
IDB	Inter-American Development Bank
IE	Included Elsewhere
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IICA	Inter-American Institute for Cooperation on Agriculture
INDC	Intended Nationally Determined Contribution
IPCC	Inter-governmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IUCN	International Union for Conservation of Nature (IUCN)
JICA	Japanese International Cooperation Agency
KCA	Key Category Analysis
KfW	German Development Bank
LAC	Latin America and Caribbean
LEAP	Low Emissions Analysis Platform
LED	Light-emitting diode
LPG	Liquefied petroleum gas
LULUCF	Land Use Land Use Change and Forestry
MEAs	Multilateral Environmental Agreements
MOEH	Ministry of Environment & Housing
MOHW	Ministry of Health and Wellness
MOT	Ministry of Tourism

MOWU	Ministry of Works and Utilities
MPG	Modalities, Procedures and Guidelines
MRV	Measurement, Reporting and Verification
MRV Hub	Caribbean Cooperative MRV Hub
MSW	Municipal Solid Waste
NA	Not Applicable
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCV	Net Calorific Value
NCCC	National Climate Change Committee
NDC	Nationally Determined Contributions
NDP	National Development Plan
NE	Not Estimate
NEA	National Executing Agency
NEMA	National Emergency Management Agency
NGO	Non-Governmental Organization
NHI	National Health Insurance
NHSSP	National Health System Strategic Plan
NO	Not Occurring
NOAA	National Oceanic Atmospheric Administration
NPAC	National Project Advisory Committee
NPEP	New Providence Ecology Park
NPC	National Project Coordinator
OAS	Organization of American States
OLADE	Latin American Energy Organisation
OPM	Office of the Prime Minister
OTEC	Ocean Thermal Energy Conversion
PAHO	Pan American Health Organization
PEO	Public Education & Outreach
PM	Project Manager
PMU	Project Management Unit

PV	Photovoltaic
QA	Quality Assurance
QC	Quality Control
RE	Renewable Energy
REDD-plus	Reducing Emissions from Deforestation and Forest Degradation plus enhancing forest carbon stocks
RER	Renewable Energy Rider
RET	Renewable Energy Technologies
RSO	Research and Systematic Observation
SDG	Sustainable Development Goal
SEV	SEV Consulting Group
SGP	Small Grants Programme
SIDS	Small Island Developing States
SLOSH	Sea, lake and overland surges from hurricanes
SLR	Sea Level Rise
SNC	Second National Communication
SSP	Shared Socioeconomic Pathways
TEG	Technical Expert Group
TNA	Technology Needs Assessment
TNC	Third National Communication
TOR	Terms of Reference
UB	University of The Bahamas
UCL	University College London
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
URCA	Utilities Regulation and Competition Authority

USAID	United States Agency for International Development
USD	United States Dollar
V&A	Vulnerability and Adaptation
WB	World Bank
WHO	World Health Organization
WMO	World Meteorological Organization
WSC	Water & Sewerage Corporation

Units and Chemical Elements

Units

g	Gram
Gg	Gigagram
ha	Hectare
kg	Kilogram
km	Kilometre
km^2	Square Kilometre
kW	Kilowatt
kWh	Kilowatt-hour
m^2	Square metre
MW	Megawatt
MWh	Megawatt-hour
t	Tonne
TJ	Terajoule
W	Watt

Chemicals/Chemical Related Terms

BOD	Biological Oxygen Demand
CH_4	Methane
CO_2	Carbon dioxide
CO_2–eq	Carbon dioxide equivalent
EF	Emission Factor
HFCs	Hydrofluorocarbons
MCF	Methane correction factor
N_2O	Nitrous oxide
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride

Executive Summary

a) National Circumstances

According to the Intergovernmental Panel on Climate Change (IPCC), global climate change impacts are evident, particularly for Small Island Developing States (SIDS) like The Bahamas, which was ranked third on the Climate Risk Index. Further, the Global Circulation Model (GCM) provides grime projected outlined of The Bahamas' vulnerability to temperature rise, changing precipitation patterns, and increased intensity of tropical storms the country may face throughout its archipelago. To address these concerns, The Bahamas has taken strong national and diplomatic approaches.

Located on the Western North Atlantic, The Bahamas' lowline coastal biogenic limestones rockland and oolitic sand landmass lies less than 1.5 meters above sea level on the Great and Small Bahama Banks. The subtropical summer months usually reach 90 degrees Fahrenheit, and the winter months typically reach 75 degrees Fahrenheit. The Bahamas' dry and wet seasons are distinct, with the seasonal effect of tropical cyclones having a pronounced effect on annual rainfalls across The Bahamas. Consequently, projections show a decline in rainfall in the Southeast Bahamas in contrast to the North and North Central Bahamas. The decreased rainfall, the sole natural means of recharging the aquifers, may affect the country's hydrogeology systems. The Bahamas will face several challenges with respect to its water security due to climate change impact.

The population of The Bahamas was estimated to be approximately 295,000 in 2000, compared comparison to the 2025 projection of 408,930, which is progressing at an annual rate of 0.92%. Most of the infrastructure and settlements of the islands are located along or near the coast, where they are particularly vulnerable to flooding and sea level rise that will have socioeconomic implications for residents and sectors, particularly the tourism sector.

The tourism sector is the primary driver of the Bahamian economy, accounts for approximately 50% of the GDP. Prior to Hurricane Dorian's landfall in 2019, more than

7.2 million visitors visited The Bahamas. Subsequently, due to the devastating impact of Hurricane Dorian on the islands of Grand Bahama and Abaco, along with the global onset of COVID-19, The Bahamas experienced a significant decline of 75% in 2020 in stopover visitors.

The energy sector of The Bahamas is heavily dependent on fossil fuels. The dependency on imported oil, almost 100%, has made energy production in The Bahamas vulnerable to global oil price fluctuations. The electricity and transport sectors are the country's primary users of fossil fuels. To address these concerns, the Government of The Bahamas has established and implemented The Bahamas National Energy Policy 2013 – 2033, which aims to achieve a diversified efficient energy sector, affordable energy supplies, and long-term energy security. In addition, The Bahamas' Government established the Ragged Island Microgrid and the Solar Car Park and is embarking on further efforts to expand renewable energy generation and electric vehicle utilization across the archipelago.

Water resources within The Bahamas vary between islands, and the supply-demand balance is highly dependent on population density. Having the highest population density, the island of New Providence has far less aquifer capacity and faces challenges with water quality and water resources. The water sector is identified as a national priority for climate change adaptation in the first and updated Nationally Determined Contribution (NDC).

Agriculture and fisheries are vital to The Bahamas Family Islands' socioeconomic security. The Agricultural sector land use is classified as arable land, permanent corps, permanent pasture, forestry, and others. Approximately 90% of the available agricultural land is owned by the government and leased to farmers. Major crops for export are grapefruit, limes, avocados, papaya, okras, and pineapples. Moreover, the fisheries sector contributes approximately US$80 million in foreign currency annually in export earnings. It provides full-time employment to 9,300 commercial fishers and thousands more jobs in recreational fisheries, vessel maintenance, fish processing, retail, and trade.

The Bahamas' financial sector accounts for about 15% of the GDP that consists of commercial banks, savings banks, trust companies, offshore banks, insurance companies, a development bank, a publicly controlled pension fund, a housing corporation, a public savings bank, private pension funds, cooperative societies and credit unions, including international business companies (IBC), mutual funds, and insurances services.

Generating more than 264,000 tons of municipal solid waste annually, the management of solid waste disposal varies throughout The Bahamas archipelago. Most Family Islands' solid waste disposal processes are underdeveloped compared to New Providence's solid waste and landfill management system carried out by the New Providence Ecology Park (NPEP). Notwithstanding, in 2011, The Bahamas established its first biodiesel production facility, Bahamas Waste Limited. The facility has the capacity to convert up to one million gallons of waste cooking oil into biodiesel. Currently, the facility is using a 50:50 blend of biodiesel to petroleum diesel in four vehicles in hopes of running its entire fleet on 100% biodiesel as production increases.

The Public Hospitals Authority oversees the quality of the three public hospitals in The Bahama. In contrast, the National Health Insurance (NHI) offers Bahamian residents access to primary health care, free at the point of service. Making a conscious effort to improve its healthcare system, the Government invested around 8% of its GDP into health care in 2018. In addition to improving the health care system and addressing climate change impact, the Government executed the "Developing a Climate Resilient Health System in The Bahamas" and the "EU/CARIFORUM Climate Change and Health Project".

Over the last decade, The Bahamas have experienced a significant impact in the form of frequent natural disasters. For example, in 2015, The Bahamas experienced Hurricane Joaquin, followed by Hurricane Matthew in 2016; the preceding year, the country experienced Hurricane Maria and Irma. In 2019, Hurricane Dorian (a Category 5 Hurricane) caused significant loss of life, evacuation of affected islands, climate migration, and damage to infrastructure and the economy, estimated to have caused over US$ 3 billion in loss and damages. The Internal Displacement Monitoring Centre (2020) estimated that 9,840 people were displaced due to Hurricane Dorian. Most persons displaced were from the islands of Abaco and Grand Bahama.

Initial discussions about institutional arrangements were held during a stakeholder workshop for the Project Identification Plan phase for the development of The Bahamas' First Biennial Update Report (BUR1). Through the development of the BUR1, these discussions have been further refined.

The BUR1 development was led by the Department of Environmental Planning and Protection (DEPP) and the National Climate Change Committee (NCCC). The Project Manager is a staff member of The Climate Change & Environmental Advisory Unit (CCEAU), a technical advisory arm of the Office of the Prime Minister (OPM). Consultants were engaged to complete the various chapters of the BUR1. And all chapter drafts were reviewed by the project team members and the NCCC. The NCCC members have also supported the process by providing information and data from their respective organizations and ensuring the chapters accurately reflect circumstances in The Bahamas and future plans for addressing climate change.

The following technical group was established to address future National Communications (NC) and other reports to the UNFCCC: Greenhouse Gas Inventory, Vulnerability & Adaptation Assessment, Mitigation Analysis, Environmentally Sound Technologies, Research & Systematic Observations, Education-Training & Public Awareness, Information & Networking Capacity-building.

b) Domestic measurement, reporting and verification (MRV) Summary

This chapter highlights how work during The Bahamas' Third National Communications/First Biennial Update Report (TNC/BUR1) cycle, as well as previous and on-going climate projects, that the Government of The Bahamas has positioned itself on a path towards establishing a comprehensive and all-encompassing MRV system through its National Climate Change Committee (NCCC) and intensive capacity building of local experts to meet the demands of the newer reporting requirements.

Through implementation and continued prioritization for future reporting cycles, the country has envisaged that this system will measure, report, and verify the following activities and actions in adherence with the Transparency, Accuracy, Completeness, Comparability, and Consistency (TACCC) principles:

- Activities that cause climate change (Greenhouse Gas Inventory (GHGI));
- Actions taken that prevent climate change (mitigation actions and Nationally Determined Contributions (NDC) implementation progress);
- Climate change impacts and adaptation;
- Actions taken to adapt to climate change (adaptation actions and NDC implementation progress); and
- Financial and other support needed and received for undertaking actions above.

Like many SIDS, The Bahamas faces challenges due to limited human, technical and institutional capacity within the country and has normally engaged regional and international consultants to conduct the relevant planning and preparation activities to meet its reporting obligations, with previous reports conducted using a decentralized, project-based MRV system.

Cognizant of the obstacles faced in previous reporting cycles and an understanding of the necessary improvements to previous institutional arrangements, The Bahamas decided to use the opportunity of the NC3 and BUR1 reporting cycle to move from a decentralized project-based system to a centralised project-based system. Several initiatives were conducted over the course of the reporting cycle to enhance the technical and institutional capacity of the local team, in addition to an MRV system status assessment.

Completed in 2022, the MRV system status described within this assessment report underscores the key premise of implementing it in the first place - that expectations based on existing decisions under the Paris Agreement will lead to increased levels of scrutiny on adherence to the TACCC principles of countries' reporting and MRV system institutional arrangements. The assessment provided an understanding of the current MRV system barriers and established a starting point for future improvement areas to be made (as outlined in Table 15 in Chapter 2).

The Bahamas MRV assessment also informed an initial "roadmap" of prioritised set of recommendations. The roadmap builds out a step-by-step process that, if implemented, will move The Bahamas towards a centralised project-based system, and then to an eventual centralised on-going system. The roadmap sets out prioritized activities across the following MRV system component areas:

- Legal framework(s)
- Institutional formal and informal procedural agreements or arrangements
- Data sources and data collection procedures
- Documentation of resource (financial and human resource) allocation
- Country-specific planning or preparation documents
- Quality assurance and quality control procedures
- Type and number of reporting documents
- Methodologies applied for estimation
- Information management and archiving procedures
- Stakeholder engagement

Furthermore, domestically, it is expected that this future MRV system will allow for the Government of The Bahamas to:

- Demonstrate transparency, accountability, and trust to the taxpayers of The Bahamas
- Determine the impacts and costs of climate change actions
- Determine the investments needed to achieve The Bahamas' adaptation and mitigation priorities
- Track progress of climate policies to improve implementation and ensure climate priorities and outcomes are achieved

In regard to support and climate finance MRV, the country has developed a climate finance MRV methodology and tool for tracking climate support needed and received. The feasibility study conducted to develop this tool provided data for reporting support needed and received. The climate finance MRV tool has yet to be integrated with other finance systems in the Ministry of Finance (but should be prioritized).

This tool would allow for The Government of The Bahamas to:

- Have a clear overview of NDC related financial flows, sources, and purposes
- Indicate the recipients of financial support and identify gaps in sectoral and geographical support
- Demonstrate accountability, transparency, and trust in future United Nations Framework Convention on Climate Change's (UNFCCC) negotiations and to the taxpayers of The Bahamas.
- Through the outputs of the project, the Bahamas intends to determine the following to prioritise its implementation next steps:
- The costs to implement the adaptation and mitigation actions that are outlined in the NDC, using results from a cost analysis
- The investments and finance needed to achieve The Bahamas' adaptation and mitigation priorities as outlined in the NDC

c) National Greenhouse Gas (GHG) Inventories Summary

i) GHG inventory scope and approach

This chapter presents The Bahamas's national GHG inventory for the years 2001-2018, prepared in line with the IPCC 2006 Guidelines for national GHG inventories. The inventory scope covers the geographical borders of The Bahamas. Gases covered are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While it is assumed that emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are at least likely to occur, the necessary data to perform estimates for these gases were not available. The Bahamas intends to move towards covering these gases in future GHG inventory submissions.

The Global Warming Potential (GWP) values from the IPCC's 5th Assessment report[1] were used (see Table 1).

Table 1: Global warming potentials used

Gas	GWP
CO_2	1
CH_4 (biogenic origin)	28
CH_4 (fossil origin)	30
N_2O	265

ii) GHG inventory preparation

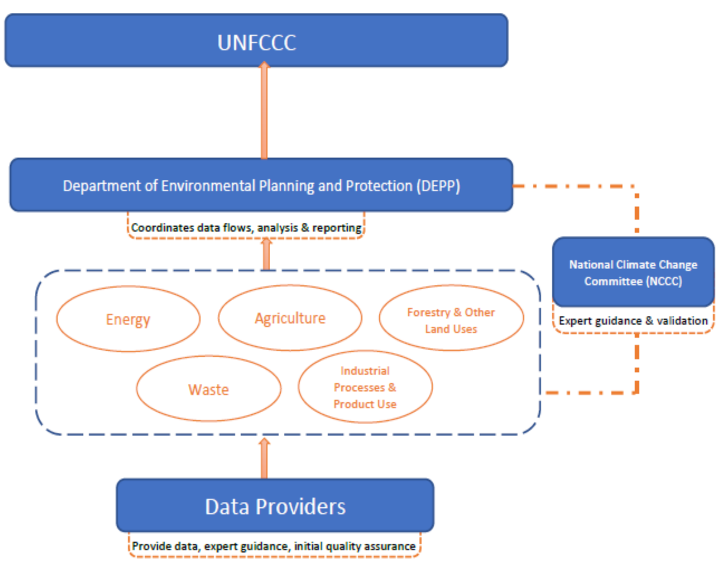
At present, The Bahamas National Climate Change Committee (NCCC) provides strategic level guidance on climate change related activities, policies, and plans, including the preparation of National Communications (NC), Biennial Update Reports (BUR),

[1] See Table 8.A.1, WG III, Chapter 8. Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

National Greenhouse Gas Inventory Reports (NIR), among others. The NCCC is chaired and led by the Department of Environmental Planning and Protection (DEPP) (formerly BEST Commission) and consists of representatives from the government, private sector, non-governmental agencies and academic institutions.

The DEPP, apart from its role as the chair of the NCCC, is also the UNFCCC and Global Environmental Facility (GEF) operational focal point, and coordinates the preparation and presentation of all reporting requirements to the UNFCCC. The technical aspects of the preparation of this NIR were led by regional consultants in a collaborative fashion with national experts with an aim to build national capacity. This included both GHG inventory data collection, estimation, compilation, and quality control and assurance throughout the inventory compilation period. The institutions and roles of these actors involved are described in “Annex II - Institutions and Roles of those involved in the Preparation of The Bahamas’ NIR”. An illustration of these roles is shown below in Figure 1.

Figure 1: Institutional arrangements for the national GHG inventory preparation



iii) Quality assurance and quality control

The following quality control steps were undertaken initially by the inventory compiler, and secondarily internally reviewed by the Caribbean Cooperative MRV Hub GHG accounting experts not involved in the preparation of the NIR as a quality control check for each sector inventory. These quality control steps include:

- Check that assumptions and criteria for the selection of activity data and emission factors are documented.
- Check for transcription errors in data input and reference.
- Check for correct calculation of emissions and removals that utilize appropriate equations and steps based on the methods used.
- Check that parameters and emission and removal units are correctly recorded and that appropriate conversion factors are used.
- Check that estimates are complete, that all categories and all years from the base year (2001) to the current inventory year (2018).

In terms of quality assurance, national sector experts were involved in data collection and understanding sector specific assumptions for methods. Other line Ministry representatives and experts from non-governmental organizations and academia reviewed emissions estimates and methodological assumptions. Additional quality assurance reviews were performed by regional GHG Inventory experts who were not involved in the compilation of the NIR.

The documentation and archiving of emissions estimates, worksheets, activity data, expert judgement, and assumptions was completed by the inventory compilers, and shared with DEPP through a Dropbox folder, organized and used throughout all stages of the GHG inventory cycle. This was done to ensure transparency, national ownership of data and reports, and promote continuity of inventory preparation for subsequent cycles.

The final stage of the inventory preparation cycle included identification and documentation of further improvements. The identified improvements (cross-cutting as well as sectoral) relate to both the emissions inventory data and also the institutional arrangements and are detailed in Annex II. These will be taken into account as the Government of The Bahamas continues to develop its national inventory team and climate measurement, reporting, and verification (MRV) system.

iv) Key Categories

A key category assessment was carried out for The Bahamas' GHG inventory estimates for the time series 2001-2018.[2] Both the level and trend assessments under approach 1 according to Volume 1, Chapter 4 of the IPCC 2006 Guidelines were conducted.

Table 2 below presents the 13 key categories identified and indicates whether they have been identified by the level assessment (L) and/or the trend assessment (T).

The majority of key categories identified, were identified under both level and trend assessment. They include stationary as well as mobile fuel combustion activities in the energy sector, land-based categories in the AFOLU sector (all for CO_2) as well as solid waste disposal (for CH_4).

Table 2: Key categories identified

IPCC Category Code	IPCC Category Name	Gas	Key category related to Level (L) and/or Trend (T)
1.a.1.a.i	Electricity Generation	CO_2	L, T
1.A.2.m	Non-specified Industry	CO_2	L, T
1.A.3.b.i	Cars	CO_2	L, T
1.A.3.b.ii	Light-duty trucks	CO_2	L
1.A.3.b.iii	Heavy-duty trucks and buses	CO_2	L, T
1.A.4.a	Commercial/Institutional	CO_2	L, T

[2] The previous National GHG Inventory of The Bahamas was published as part of The Bahamas' Second National Communication in 2014. This GHG inventory did not include a key category assessment, it is therefore not possible to assess how key categories have changed over time.

3.B.1.a	Forest land Remaining Forest Land	CO_2	L, T
3.B.1.b	Land Converted to Forest Land	CO_2	L, T
3.B.2.b	Land Converted to Cropland	CO_2	L, T
3.B.3.b	Land Converted to Grassland	CO_2	L, T
3.B.4.b	Land Converted to Wetlands	CO_2	L, T
3.B.5.b	Land Converted to Settlements	CO_2	L, T
4.A	Solid Waste Disposal	CH_4	L

v) Source and sink category emission estimates and trends

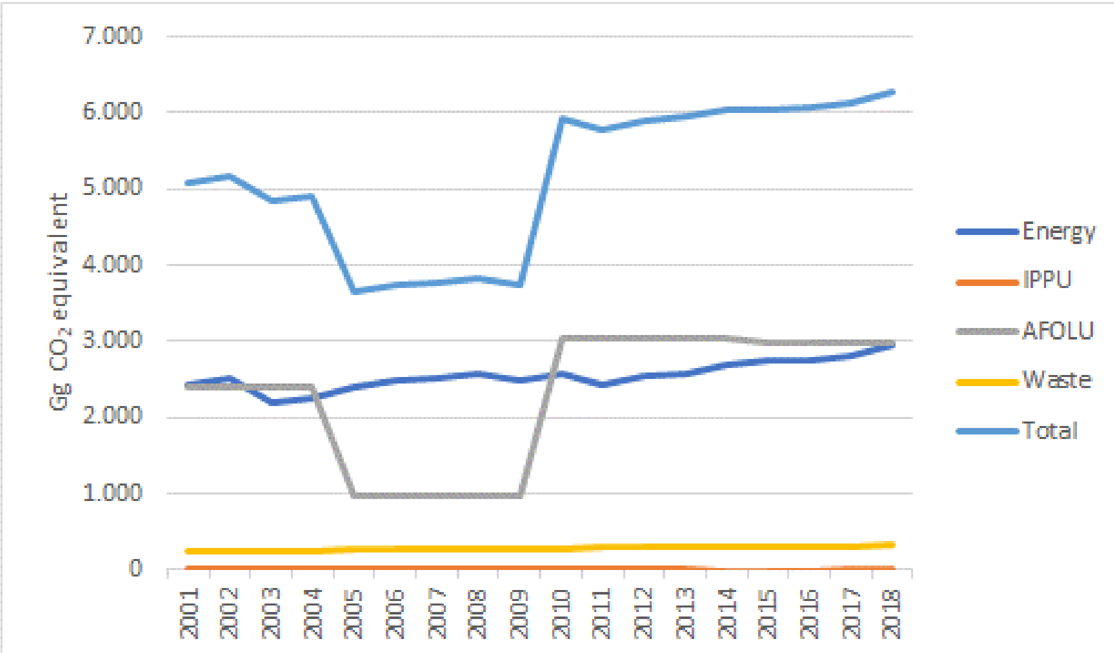
V.I Overview

Total GHG emissions in The Bahamas rose from 5,074.09 Gg CO_2-eq in 2001 to 6,264.39 Gg CO_2-eq in 2018, which equals an increase by 23.5 cent.[3] During the same time period GHG emissions from the waste sector rose by 30.6 per cent, from the AFOLU sector (including both emissions and removals) by 25.1 per cent, and from the energy sector by 21.1 per cent. IPPU sector emissions, to the extent estimated in this GHG inventory publication which covered only lubricant use[4], fell by 71.1 per cent. Total GHG emissions by sector are presented in Figure 2 (below). GHG estimates for 2001-2018 are presented in Table 2 (above). Developments of and drivers for sectoral and category-level trends are presented in the forthcoming sectoral chapters (3.7 - 3.10)

[3] The previous GHG inventory of the BAHAMAs published as part of The Bahamas Second National Communication in 2014 presented GHG emissions for the year 2000, amounting to 702.82 Gg CO_2-eq. when considering the gases CO_2, CH_4 and N_2O. These had been estimated using the IPCC Revised 1996 Guidelines for national GHG inventories and the GWPs from the IPCC's 2nd Assessment Report.

[4] Due to lack of data, GHG emissions from the use of HFCs and PFCs and of other potentially relevant sources could not be estimated. More information is provided in section 2 of this report.

Figure 2: Total GHG emissions by sector 2001-2018



The AFOLU and energy sectors dominate total national GHG emissions in The Bahamas, contributing 47.8 per cent and 47.1 per cent, respectively, to total emissions in 2018. The waste sector contributes 5.1 per cent and the IPPU sector was less than 0.1 per cent during the same year (see Figure 3 below).

Total CO_2 emissions amounted to 5909.18 Gg in 2018, representing 94.3 per cent of total GHG emissions. CH_4 amounted to 11.68 Gg in 2018, representing 5.2 per cent of the total and N2O to 0.12 Gg in 2018, representing 0.5 per cent of the total (see Figure 4 below).

Likely drivers to The Bahamas' GHG inventory emissions are the population and economic development. The increase in tourism has likely lead to an increase in demand on fuel and transportation, thus affecting energy sector emissions. GDP has increased by 56 per cent since 2001, the population by 27 per cent (see Figure 5 below).

Figure 3: Percent contribution of IPCC sectors to total GHG emissions in 2018

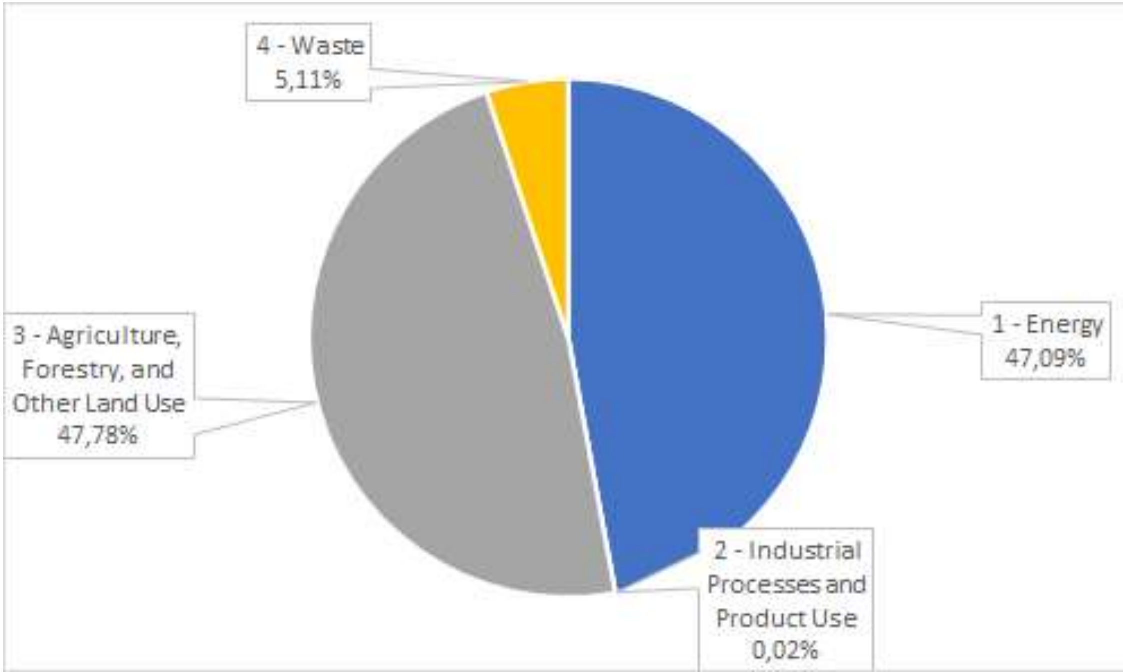


Figure 4: Contribution of gases to total GHG emissions in 2018

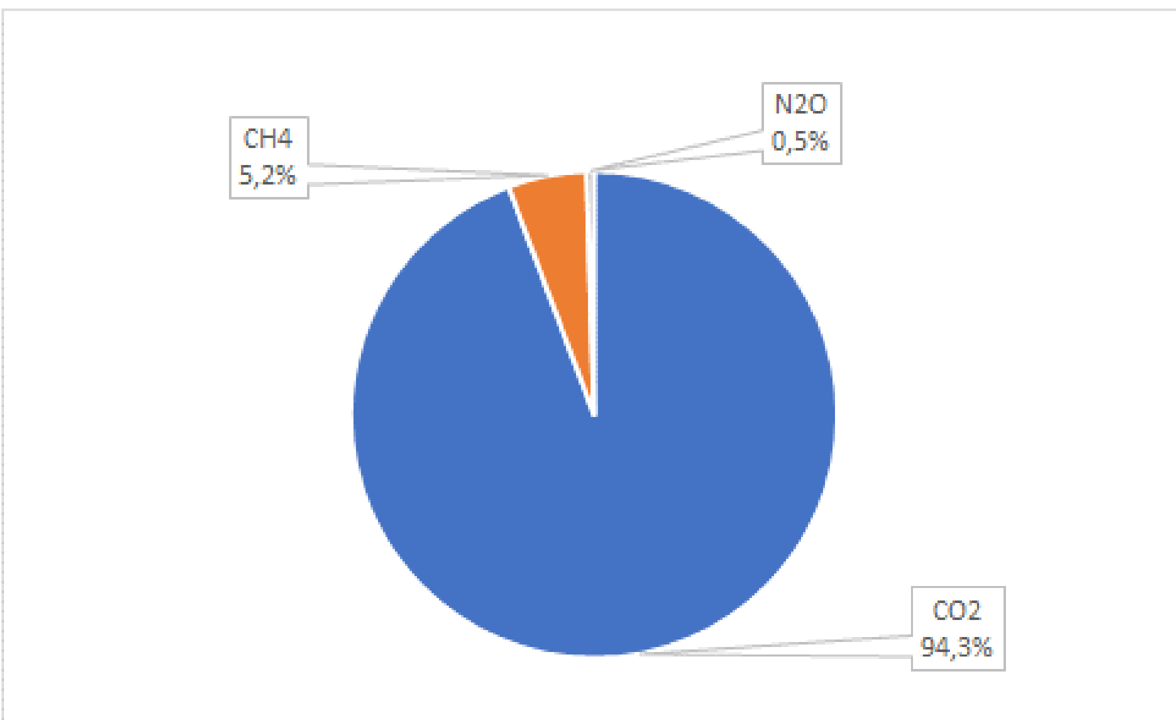
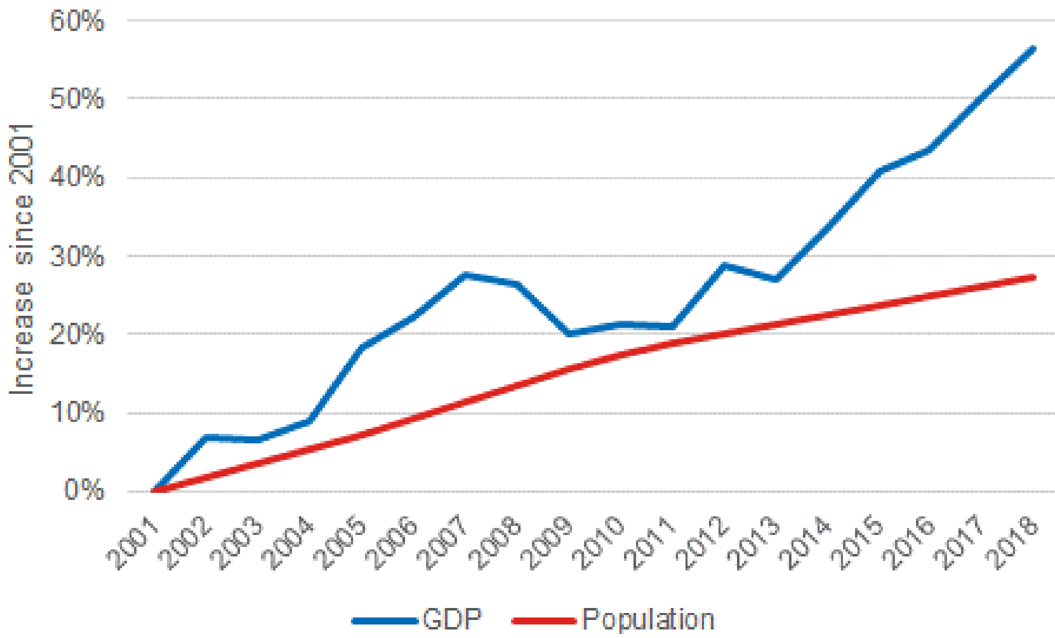


Figure 5: Increase in GDP and population in the Bahamas between 2001-2018



The GHG emissions per capita in The Bahamas was 16.24 tCO_2eq in 2018, which represents a decrease of 3.2 per cent compared to 2001.

V.II Energy sector

An overview of GHG emissions in the Energy sector by category and by gas is presented below. Total GHG emissions in the energy sector amounted to 2435.21 Gg CO_2-eq in 2001 and 2949.58 Gg CO_2-eq in 2018, see Figure 6. This represents an increase by 21.1 per cent. In the same time frame, GDP has increased by over 60 per cent and population by nearly 30 per cent.

Main power and heat generation is the largest GHG emission source in the energy sector with 48.5 per cent of total emissions, followed by transport with 24.7 per cent. Manufacture and construction contributes 11.9 per cent and Other 15.0 per cent. The contribution of Fugitive Emissions category is minute with 0.0006 per cent (Figure 7).

Figure 6: GHG emissions in the energy sector 2001-2018, by categories

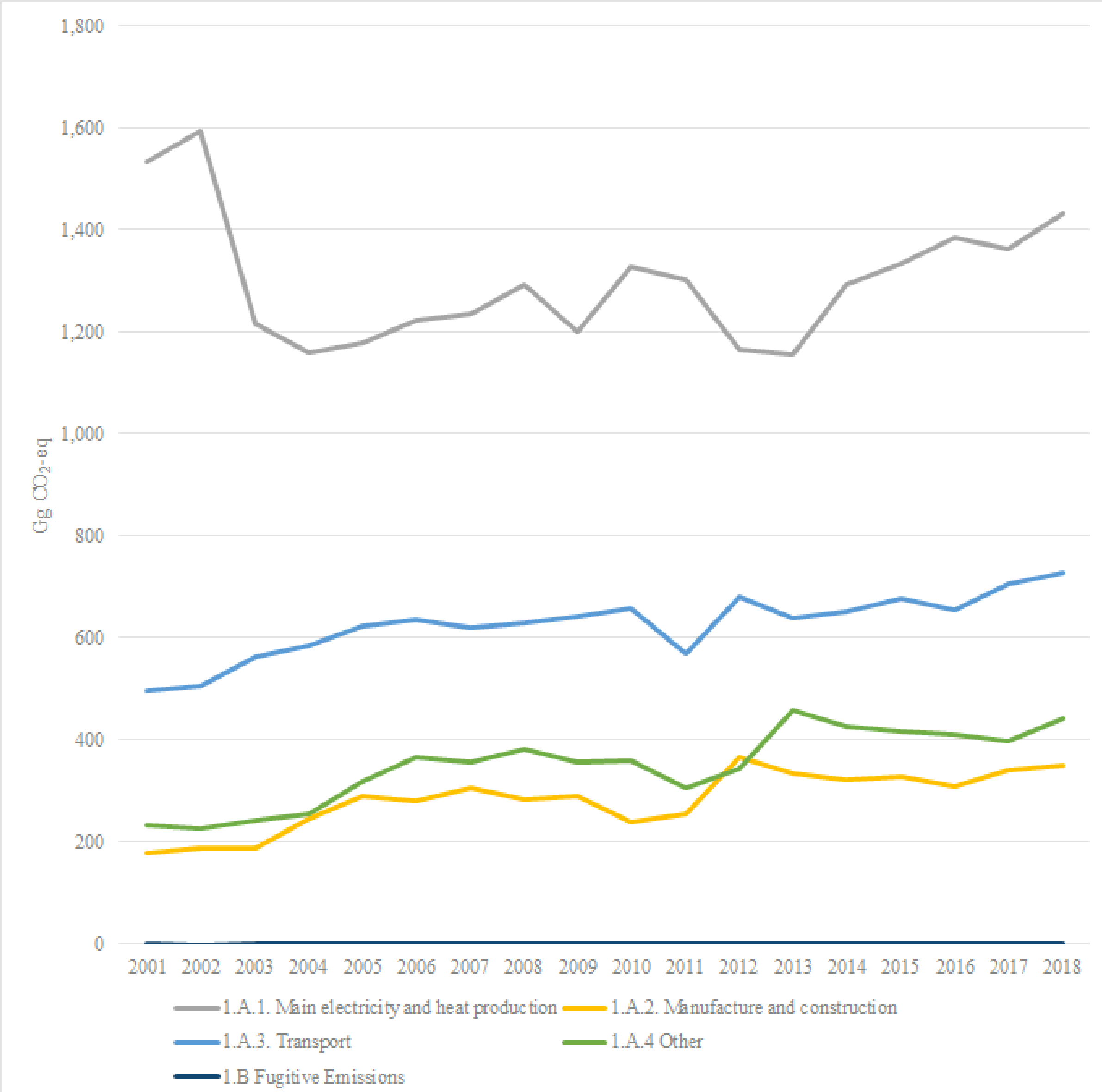
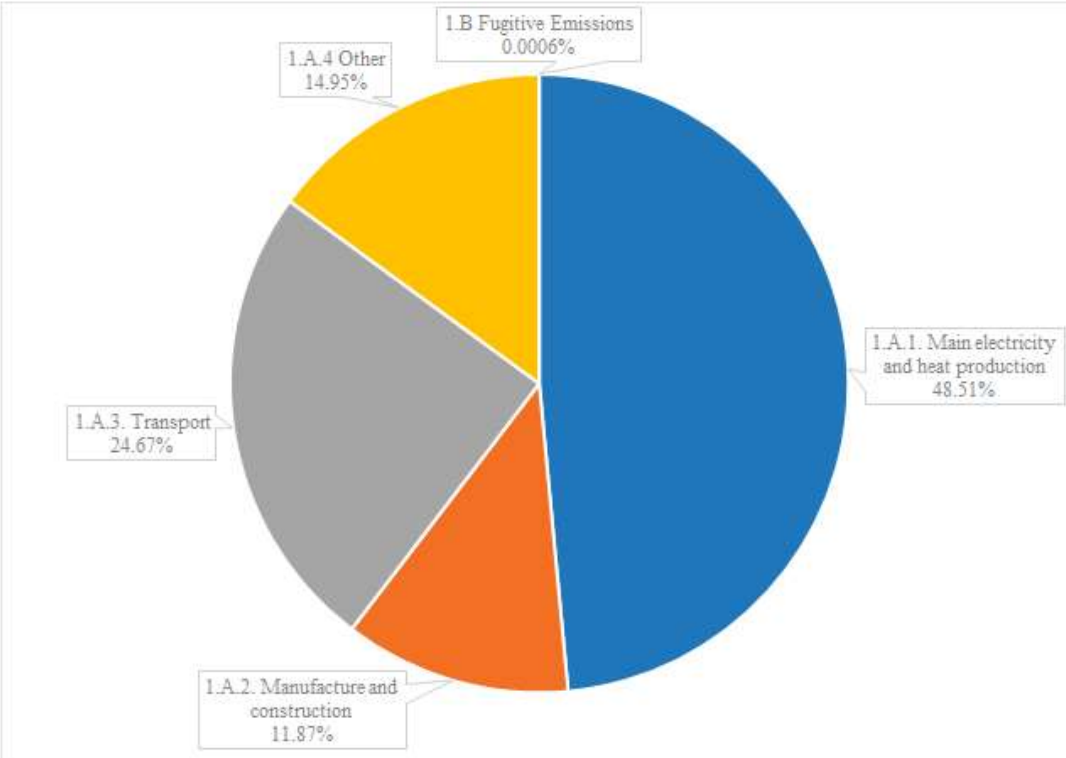
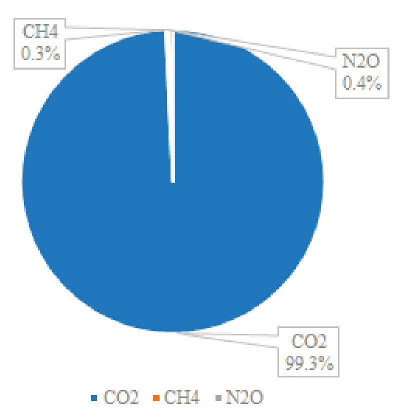


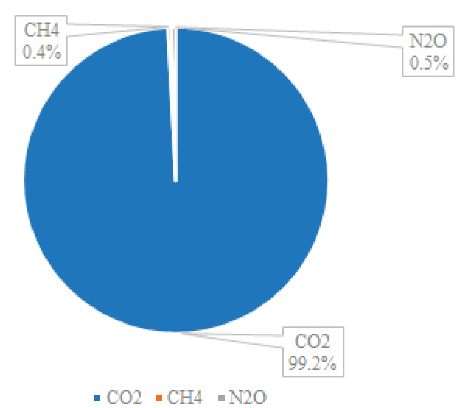
Figure 7: Contribution of categories to total GHG emissions in the energy sector in 2018



Shares of the gases in total emissions have remained similar over time, around 99 per cent for CO_2 and below 1 per cent for CH_4 as well as for N_2O. Figure 8 shows the contribution of the three gases to total GHG emissions in the energy sector in 2001 as well as in 2018.

Figure 8: Contribution of gases to total GHG emissions in the energy sector in 2001 and 2018





GHG emissions for the subcategories 1.A.1 Main Electricity and Heat Production, 1.A.2 Manufacture and Construction, 1.A.3 Transport and 1.A.4 Other sector all show an increasing trend since 2011. Before, they had shown an overall slightly downward trend. For the energy sector as a whole, GHG emissions have increased by 21.1 per cent between 2001 and 2018. This includes a reduction of 6.6 per cent from Main Electricity and Heat Production, and an increase by 97.7 per cent in Manufacture and Industries, 90.8 per cent in Other and 47.2 per cent in Transport. The increase in population as well as in GDP and related to that, tourism activity, can be deemed to have played a key role in the generally upwards moving trend since 2011. Technological change, e.g. the replacement of equipment for power generation, might potentially have played a role in reducing fuel consumption in earlier years of the time series. Data indicates that generation efficiency has considerably increased from 2003 onwards compared to 2001 and 2002. Furthermore, GDP has remained nearly stable between 2002-2004. A general decrease in fuel consumption in the sectors Transport and Other can be seen between 2009-2010. This might be related to the global financial crisis 2008-2010.

V.III Industrial Processes and Product Use

The industrial processes and product use sector covers a wide range of sources of GHG emissions. These include process (i.e., non-energy related) emissions from industrial production as well as emissions related to the use of certain products. GDP in The Bahamas focuses on the financial sector as well as on tourism, with only very limited industrial production taking place.

Data collection and consultation with experts indicates that no relevant industrial production, e.g., of cement clinker, glass, ceramics or steel takes place in The Bahamas at present.

A number of product use categories clearly occur or are likely to occur, while no data is available. These are presented in
Table 3.

Table 3: Categories of the IPPU sector not estimated due to lack of data

Gas and IPCC category	IPCC category code	Likelihood of occurrence
CO_2 emissions from the use of paraffin waxes and solvent use	2.D.2, 2.D3	Likely
HFC emissions from the operation and discharge of refrigeration and air conditioning equipment	2.F.1	Emissions do occur
HFC emissions from the use of building foams, aerosols and solvents	2.F.2, 2.F.3, 2.F.4	Likely
SF_6 emissions from the operation of electrical equipment	2.G.1	Likely
N_2O emissions from the use of N_2O in hospitals	2.G.3	Likely

Due to the lack of data, GHG emissions from these categories could not be estimated. Particularly the HFC emissions from the operation and discharge of refrigeration and air conditioning equipment are likely to make a relevant contribution to The Bahamas total GHG emissions. The collection of relevant data for the compilation of the next GHG inventory should thus be considered a priority. Annex III presents suggestions on how to retrieve relevant data in the course of future GHG inventory compilations.

Emissions of product use which occur and for which data was available, relates to the use of lubricants. This source only leads to emissions of CO_2. These fell from 3.75 Gg CO_2-eq in 2001 to 1.08 Gg CO_2-eq in 2018. This means that emissions have decreased by over 70% over the time series, with a dip of over 50% happening between 2010 and 2011. Reasons for this development are presently unknown and should be researched as part of future GHG inventory compilations. A potential explanation could be structural changes after the economic crisis 2008-2010.

V.IV Agriculture, Forestry and Other Land Use

Agriculture

The agriculture sector covers a wide range of sources of GHG emissions including from livestock, crop production, fertilizer use, and soil management. The agriculture sector in The Bahamas represents about 2.3% of the national GDP. These practices include small-scale farming of food crops, limited livestock production throughout the islands and more significantly, poultry egg and broiler production, and soil enrichment from fertilizers. The addition of lime to agricultural soils was not estimated, as all national soils are considered calcareous[5].Biomass burning was also not estimated, as post-crop burning is not considered a common practice.

Total GHG emissions in the agriculture sector amounted to 16.08 Gg CO_2-eq in 2001 and 14.23 Gg CO_2-eq in 2018, see Figure 9 (below). This represents a decrease by 11.54% per cent.

Per cent contributions of individual gases in total emissions have remained similar over time, with N_2O accounting for 88.3 per cent in 2001 and 83.6 per cent in 2018, less than 1% CO_2 in both 2001 and 2018, and 11.3 per cent and 15.6 per cent for CH_4. Total direct N_2O emissions on managed soils, particularly from fertilizer was the highest contributor to sector emissions (56.1 per cent). This is attributable to the importation of nitrogen-based fertilizers during the time series. This is followed by indirect N_2O emissions to managed soils from leaching and atmospheric volatilization from fertilizers and managed animal waste, accounting for (18.per cent). Emissions from livestock enteric fermentation (11.9 per cent) and manure management (10.2 per cent) followed. Indirect N_2O emissions from manure management and urea application jointly represented about 3 per cent of sector emissions (see Figure 10).

[5] All Bahamian protosols are alkaline, usually in the range 7.5 t0 8.5, with its red soils being less so, or neutral depending on the amount of limestone they include, *Soil and Land Resources of The Bahamas, N. Sealey*

Figure 9: GHG emissions in the agriculture-sector 2001-2018, by categories

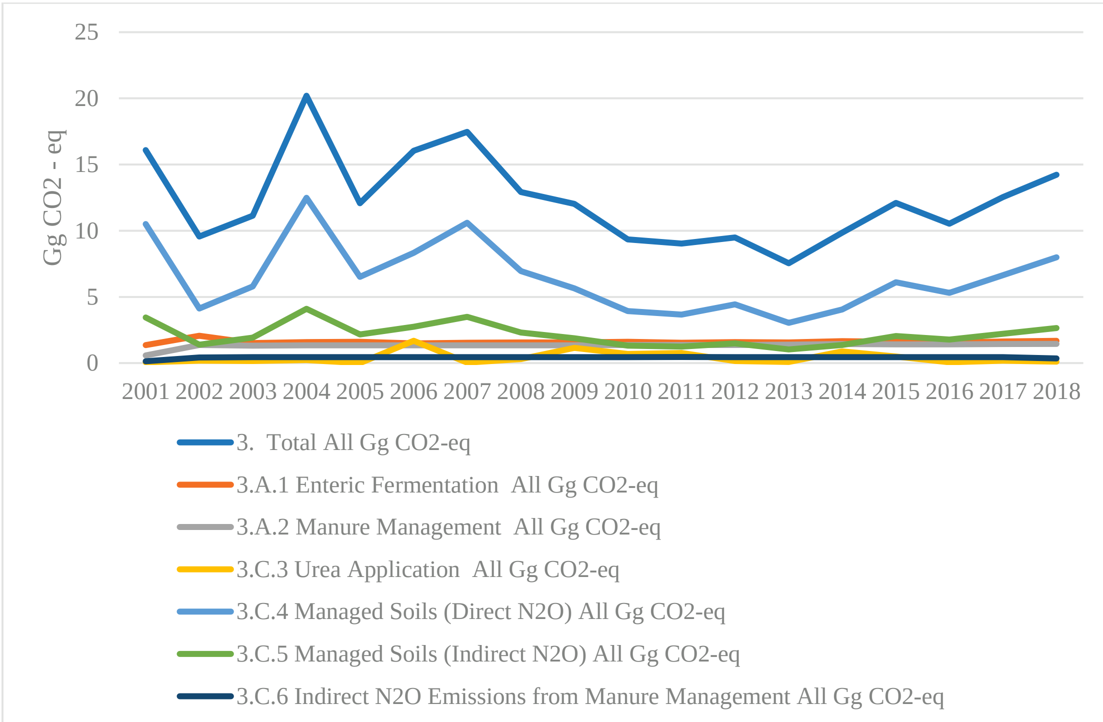
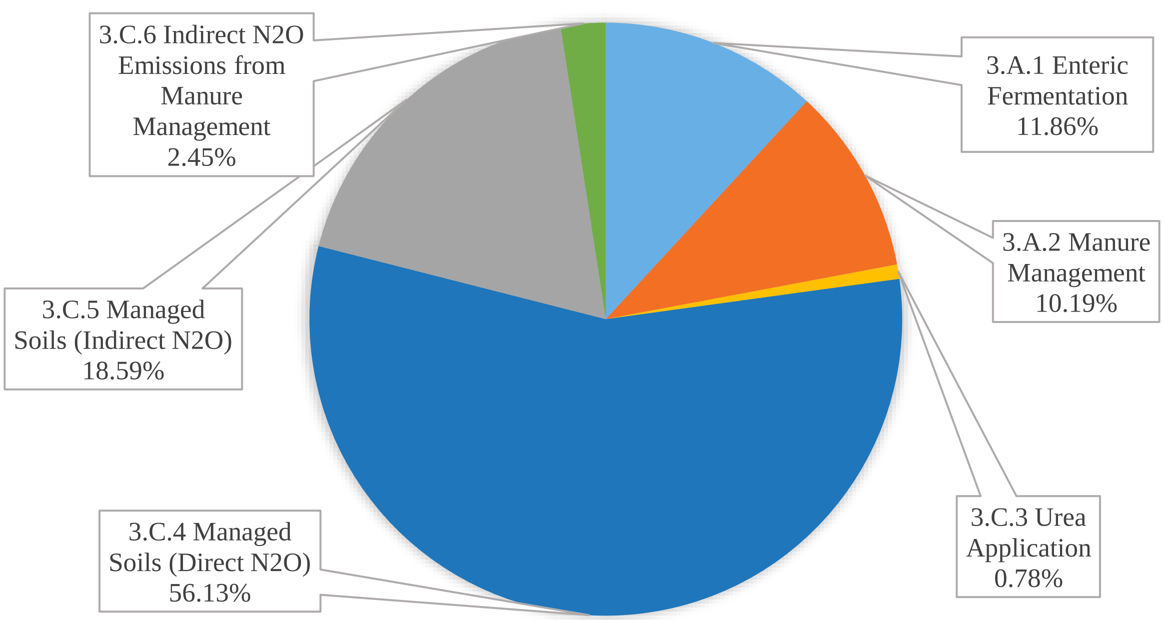


Figure 10: Per cent contribution of agriculture categories to total agriculture sector GHG emissions in 2018



Forestry and Other Land Uses

GHG emissions in the Forestry and Other Land Use (FOLU) sector typically come from a number of sources related to CO_2 emissions and removals from carbon stock changes in above and below-ground biomass pools of forest land. This includes forest land converted to other land uses such as cropland, grasslands, wetlands, and settlements. CH_4 and N_2O, and additional CO_2 emissions arise from fires and drainage of organic soils, however, these emissions were not estimated due to unavailability of data on forest fires and non-occurring drainage of organic soils.

Total GHG emissions in the FOLU sector were dominated by the land converted to grassland category in 2018, with conversion from forest land to grassland (shrublands and grasslands) representing 75 percent of emissions (as opposed to net-emissions) in this sector. All emissions and removals estimated within this sector relate to CO_2.

Across the time series, the trends that influenced annual emissions were those categories that contain the greatest amount of carbon stock (i.e. Forest land, Grassland, and conversion to either). Lowest emissions were noted within the time period of 2005-2009 (955.66 Gg CO_2 eq yearly emissions) attributed to land conversion to forest land (more removals). This effect was noted after the passing of two hurricanes, Hurricane Frances and Hurricane Jeanne, occurring two weeks apart in October of 2004. Both hurricanes severely impacted the north-western Bahamas, including Abaco, Andros, Berry, Bimini, Eleuthera, Exuma, Grand Bahama, and New Providence islands which are mainly forested islands. The pine forests of Grand Bahama were especially impacted with regeneration not comparable to its previous state. The effects of secondary foliage regrowth (and subsequently greater removals) enhanced sinks and reduced emissions in the 2005-2010. This regrowth is discernible by satellite imagery and can be viewed for the year 2010 on Grand Bahama and Abaco Islands.

In the subsequent years, from 2010 to 2014, a 30 per cent increase in emissions occurred

Figure 11: FOLU Sector Emissions by Category

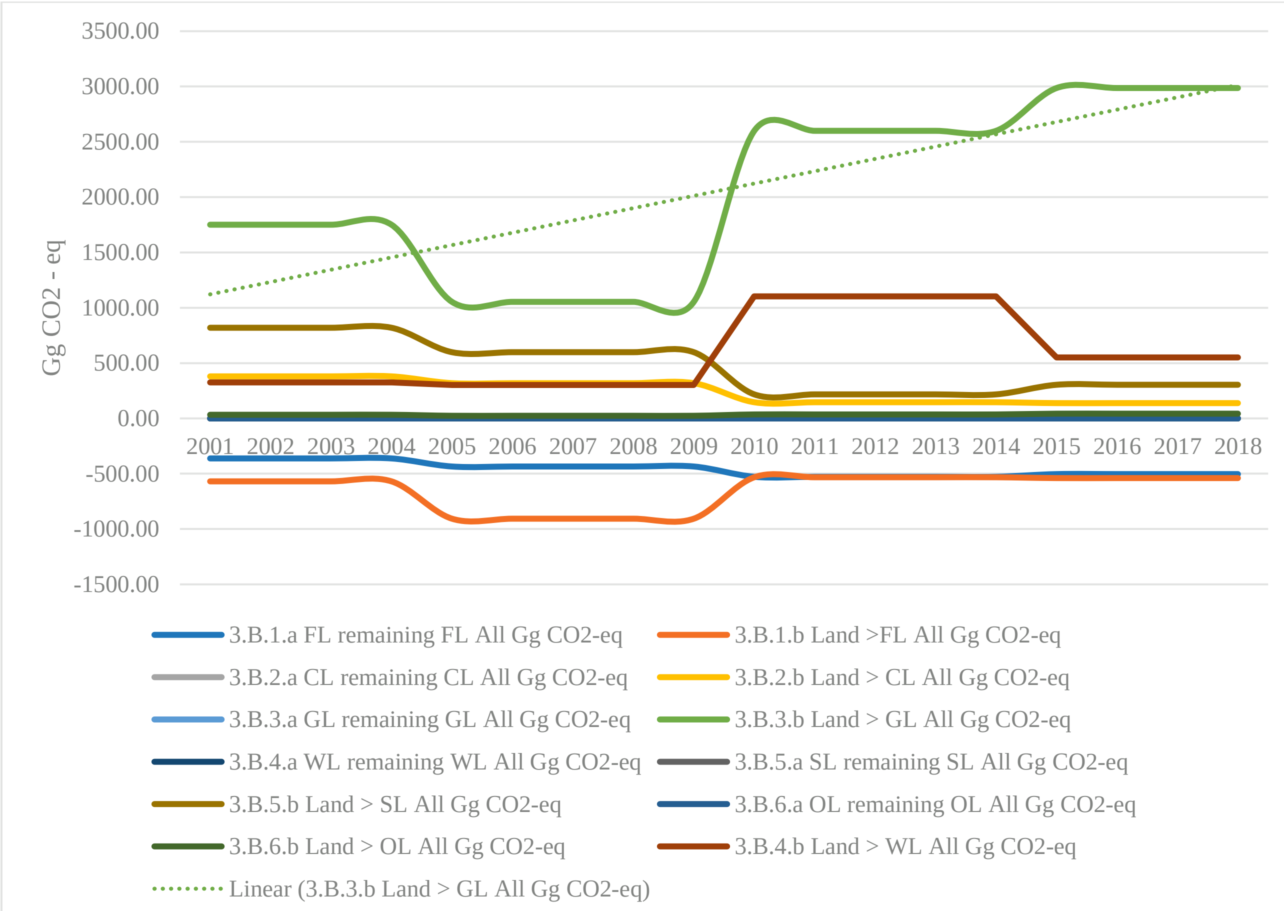
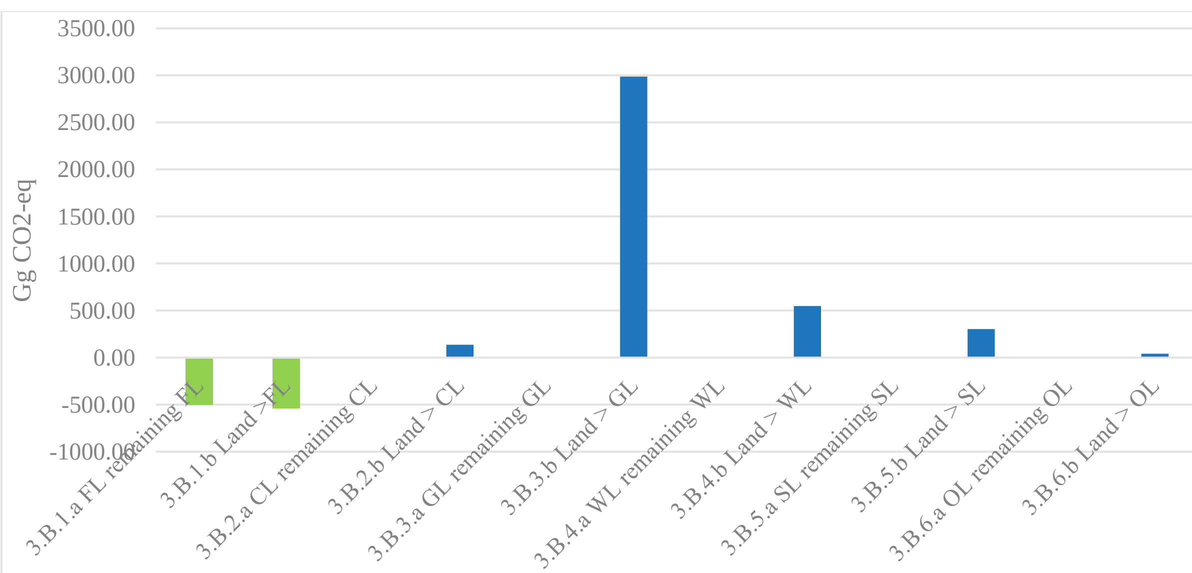


Figure 12: Contribution of categories to total FOLU GHG emissions in 2018



due to conversion from forestland to grassland and secondarily from a large conversion of forest land to wetlands (reduction in carbon stocks). Furthermore, in more recent natural disasters, Hurricane Dorian in 2019 has demonstrated partial to severe destruction to mangroves, coral reefs, and forests of Abaco and Grand Bahama, particularly the eastern sides of Grand Bahama, however the overall emissions from land use change between 2010 and 2020 were relatively constant.

V.V Waste

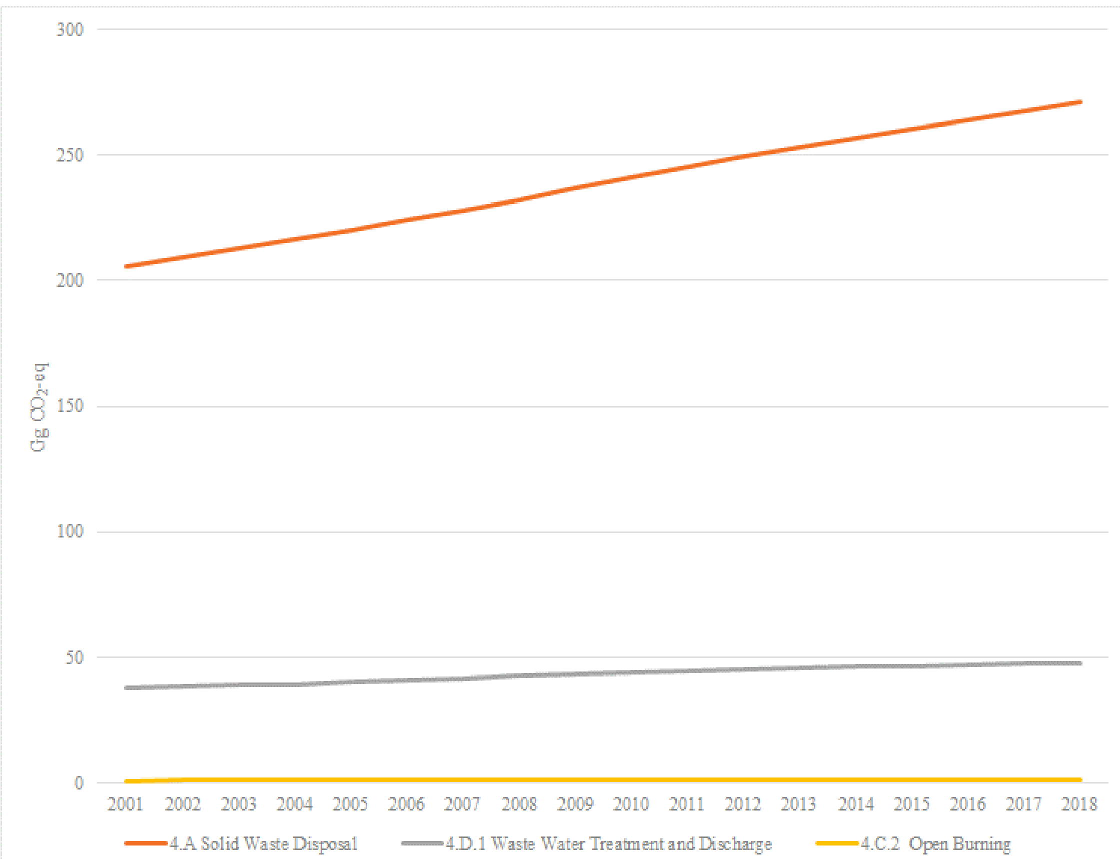
GHG emissions in the waste sector typically come from a number of sources related to the treatment of solid waste as well as the management of wastewater. With regards to solid waste, solid waste disposal (i.e., landfilling of solid waste) and, to a small extent, open burning of waste, take place in The Bahamas. One landfill is currently being converted to a managed form, while the remaining landfills are unmanaged. Biological treatment of solid waste does not take place. Large scale waste incineration does not take place in The Bahamas according to available information and expert judgement. The incineration of hazardous waste at smaller facilities, e.g. in hospitals, might take place according to expert judgement. Information on amounts of hazardous waste and treatment approaches could not be obtained, this is clearly an area for improvement.
On this basis, GHG emission estimates for the gases CO_2, CH_4, N_2O were compiled for the waste sector categories presented in Table 4 below.

Table 4: IPCC 2006 GL categories for which Waste GHG emissions were estimated

IPCC Category	Category Name
4.A	Solid Waste Disposal
4.C.2	Open burning of waste
4.D.1	Domestic Wastewater Treatment and Discharge

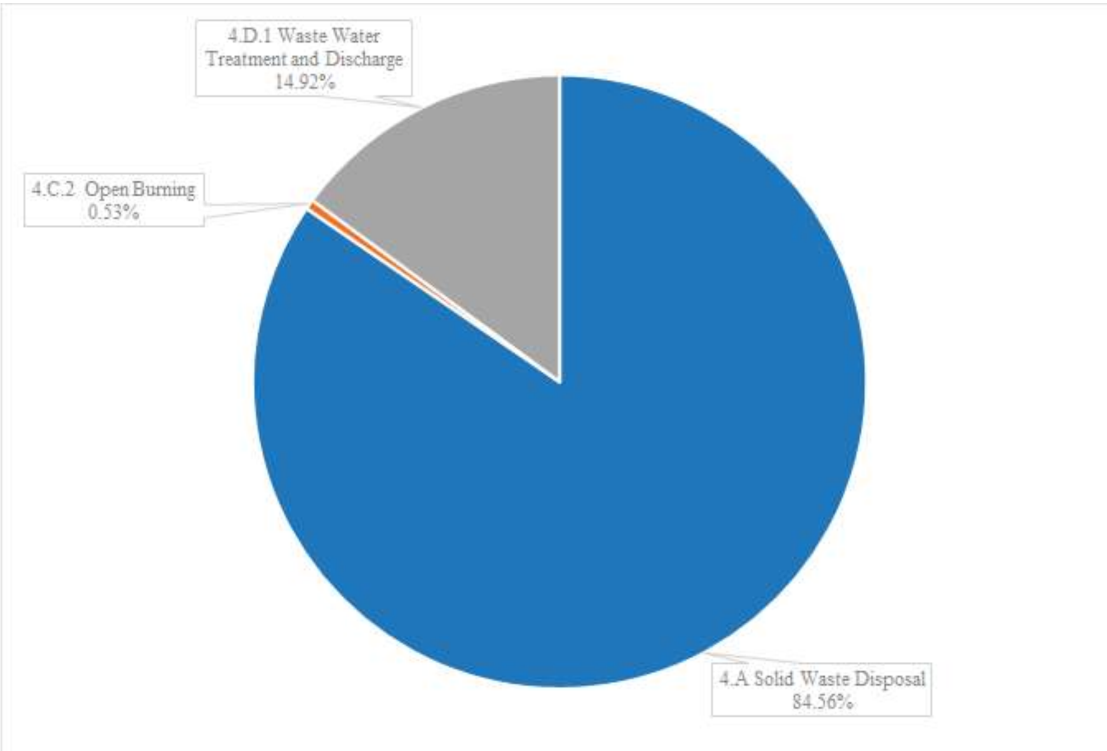
Total GHG emissions in the waste sector amounted to 245.20 Gg CO_2-eq in 2001 and 320.31 Gg CO_2-eq in 2018, see Figure 13. This represents an increase by 30.6 per cent. It is important to note that the calculation has heavily relied on IPCC default values and assumptions (e.g., waste generation rate, waste composition), so that the current estimations mainly reflect The Bahamas' population increase over the time series. Information indicating technological change and change in treatment approaches (e.g., moving from shallow to deep landfills over time) was not available. Generally, the increase in GDP and also tourism activity are likely to influence GHG emission developments in the waste sector, but are currently not reflected in the calculation. Annex II suggests improvements which would allow considering these drivers in the future.

Figure 13: Total GHG emissions in the waste sector 2001-2018, by categories



Total GHG emissions in the waste sector are dominated by the category solid waste disposal contributing 84.6 per cent in 2018. Wastewater treatment and discharge contribute 14.9 per cent and 0.5 per cent, see Figure 14. Between 2001 and 2018, the three subcategories show similar growth rates. GHG emissions from solid waste disposal grew by 31.6 per cent, from wastewater treatment and discharge by 27.4 cent and from open burning by 25.4 per cent.

Figure 14: Contribution of categories to total GHG emissions in 2018 in the waste sector



Planned improvements

During the compilation of The Bahamas' national GHG inventory, future improvement potential was identified and documented. The full list of improvements are presented in Annex III. The improvement options presented in the Annex differ in both their urgency and timeframes for which they could be implemented in. This chapter presents the improvements deemed most relevant, as they pertain to the set-up of a sustainable national GHG inventory system, the existing key categories, and the categories for which no or only limited activity data were available.

Table 5: Most relevant areas for improvement

Area	Most relevant areas for improvement
Cross-cutting	• Set up appropriate institutional, procedural, legal arrangements, and documentation for recurring preparation of the national GHG inventory • Appoint a national GHG inventory compilation team • Fully establish and implement QA/QC procedures for the national GHG inventory
Energy	• Ensure data on fuel imports compiled by the Central Bank of the Bahamas are complete and accurate • Obtain disaggregated data of fuel imports (potentially with the help of fuel distributors) by relevant subcategories, e.g. manufacture and industries (1.A.2), commercial/institutional (1.A.4.a), and residential (1.A.4.b). • Develop a national energy balance in the longer term • Collect power generation and fuel consumption from local power producers (Bahamas Power and Light, Company Ltd. Grand Bahama Power Company) • Develop country-specific emission factors • Better understand which relevant manufacture and production activities take place and collect activity data • Obtain complete activity data on vehicle population across the entire time series
IPPU	• Collect HFC and PFC import data (as substance and in products) • Assess which IPPU categories occur (e.g. electrical equipment, category 2.G.1)
AFOLU	• Develop country-specific emission factors for categories 3.B.1.a-b, 3.B.2.b, 3.b.3.b, 3.B.4.b and 3.b.5.b

	• Establish and validate (i.e. ground-truth) a sample of permanent plots of each land use type (at minimum the main IPCC classes, especially pine and mangrove for forest land which are prominent in the Bahamas) to improve land classification maps and remote sensing model • Determine the occurrence of harvested wood products, biomass burning and mineral soils in the country • Determine the end use of fertilizers and other agricultural additives reported in the annually produced Customs Imports report with Agriculture experts • Conduct a survey of livestock in country, including livestock manure management practices on an annual basis, and align with National Agricultural Census cycle
Waste	• Collect information on the depth of landfills (one-time survey) • Assess solid waste generation and composition • Collect data from national food and beverage manufacturing companies on industrial wastewater flows

d) Mitigation actions and their effects, including associated methodologies and assumptions (BUR)

The purpose of this chapter is to discuss existing and proposed mitigation actions for five IPCC sectors (Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land Use Change and Forestry, and Waste) in The Bahamas. Based on the latest inventory estimates, the majority of GHG emissions are contributed by two sectors; the Land Use, Land Use Change and Forestry and Energy sectors, which each account for over 45 % of the total emissions.

To address The Bahamas' GHG emissions, mitigation actions presented in this chapter were prepared based on desk reviews and consultations with key stakeholders in both the private and public sector. Many mitigation actions discussed in this chapter result in direct emissions reductions. Other actions, known as enabling measures, create opportunities for direct emissions reductions. These measures are policies or incentives whose implementation will indirectly lead to emission reductions.

In addition to GHG emissions reduction, the mitigation actions have many sustainable development benefits associated with the seventeen sustainable development goals (SDGs).

This chapter outlines a total of 35 mitigation actions and 6 enabling measures, with several being enhanced from the Second National Communication (SNC) or are newly proposed actions.

The actions are heavily focused on the energy sector, with over eighty per cent (80%) of the actions focussed on the subsectors of Energy Demand, Electricity Generation and Transport.

Examples of country-wide mitigation actions include increasing the use of solar water heaters by 40%, increasing sales of electric vehicles by 35%, lighting retrofits for all government occupied buildings in The Bahamas, and the phasing out of hydrofluorocarbons. While, examples of island specific mitigation actions include implementing sustainable agroforestry practices in Acklins, Andros, Crooked Island, Grand Bahama Plana and Samana Cays or the installation of a 3-megawatt solar farm in Grand Bahama.

Examples of enabling measures include upgrading incentives for renewable energy systems, implementing standards for vehicle fuel efficiency and the implementation of charging stations for electric vehicles. All of proposals in this chapter, whether a mitigation action or an enabling measure, are intended to achieve the goals of the Paris Agreement, to limit global temperature rise to 1.5℃, and enable The Bahamas to meet its 2030 NDC Targets.

This chapter provides two scenarios for mitigation actions and enabling measures. They are the mitigation and ambitious mitigation scenarios. Compared to a business as usual (BAU) scenario for 2030, the mitigation scenario reduces emissions by 16% and the ambitious mitigation scenario by 33%. Compared to the BAU for 2050, the mitigation and ambitious mitigation scenario reduce emissions by 18% and 63% respectively.

Where possible, this chapter models mitigation actions and estimates emission reductions in gigagrams of carbon dioxide equivalent. The total estimated reductions from modeled mitigation actions is approximately 4,170 Gg CO_2-eq

As a non-Annex 1 Party, The Bahamas was eligible to participate in the Clean Development Mechanism (CDM) under the Kyoto Protocol. There are currently no projects registered with the CDM or other international markets. Under Article 6, The Bahamas is interested in pursuing suitable, beneficial projects, in the International Markets and is also exploring opportunities in the Voluntary Carbon Market space.

e) Constraints, gaps and related financial, technical and capacity needs, including information on support received for preparation and submission on BUR

This chapter outlines constraints and gaps that has hindered complete and accurate UNFCCC reporting for The Bahamas. In preparation of this BUR, The Government of The Bahamas has focused on a review of the following:

- Constraints and gaps in GHG inventory, mitigation, adaptation, and climate finance reporting
- Prioritised needs and improvements to facilitate improved reporting for future cycles in adherence with the TACCC principles

The Bahamas, like most SIDS and other developing countries, faces challenges due to limited human, technical and institutional capacity while attempting to meet its reporting requirements to the UNFCCC and to implement planned and ongoing climate action activities. The Bahamas has shown its commitment to improvements, as outlined in the previous 4 chapters and in noting its challenges, will require both internal and external support to close these gaps.

Regarding GHG inventory, lack of adequate data, limited coordination for the GHG inventory cycle, capacity constrains in applying GHG inventory methodologies, limited understanding of all GHG emitting activities in country, and a lack of archiving previous reporting cycles were constraints and gaps observed in this reporting cycle.

Regarding Mitigation, lack of adequate data, willingness to supply data, intra-ministerial coordination and communication, high capital costs, and technology suitability/availability, and data transparency issues were constraints and gaps observed in this reporting cycle.

Regarding Adaptation, stakeholders with technical capacity constraints, intra/inter-organization coordination and communication, lack of adequate data, key equipment and regulatory frameworks, in addition to high capital costs were constraints and gaps observed in this reporting cycle.

While regarding MRV Assessment, intra-organizational coordination and communication, need for greater public awareness, limited staff and funding, stakeholder hesitation, and difficulty in collecting data were constraints and gaps observed in this reporting cycle.

Prioritized needs to address the above related constraints and gaps include, setting up appropriate intuitional, procedural, legal arrangements and documentation for the recurring preparation of reports for the UNFCCC, appointing a national GHG inventory compilation team, fully establishing and implementing the QA/QC procedures for the national GHG inventory (particular from the QA exercise conducted by the UNFCCC in January 2022), fully establishing data collection and archiving procedures for climate data, improving training and capacity, continuation of modelling done in country (i.e. LEAP), and ensuring all relevant agencies and industries are involved in continuous and open communication to enhance data collection/exchange and improve the timely production of climate reports.

The country has made good progress from its last reporting cycle to the UNFCCC, as outlined in Table 143 of Chapter 5 and identifying Environmentally Sound Technologies (ESTs) for the country to implement via a Technology Needs Assessment (TNA) project, to be concluded in the 2023. The TNA project has prioritized the following sectors: Waste, Forestry, Meteorology and Education.

While The Bahamas has not been able to conduct an assessment and quantification of supported needed during this reporting cycle, given the special circumstance of The Bahamas as a small island developing state across all areas of climate MRV in The Bahamas, technology transfer, capacity-building, and financial - support is needed as soon as possible.

Regarding support received, as highlighted in the climate finance section of the domestic MRV chapter (Chapter 2), The Bahamas through the GCF Readiness and Preparatory Support Programme, engaged in a project to develop a national database system for the

MRV of financial investments with specific emphasis on identified actions in The Bahamas' NDC.

After extensive analysis of readily available documentation and a data collection mission in-country (inclusive of stakeholder interviews), The Bahamas was able to provide an initial mapping of climate finance recipients, mobilising entities and support received values (USD) for the time period 2010-2020. It should be noted that due to data gaps from stakeholders, as well as the need to improve on the outputs of the project, will be improved upon in future reporting cycles.

A summary of The Bahamas climate finance inflows for the period 2010-2020 can be described as follows:

a) Overall climate finance inflows amount to approximately $155M USD
b) When the above figure is disaggregated into Mitigation focused activities, this amounts to over $140M USD, while Adaptation focused activities were funded approximately $15M USD.

This shows a clear imbalance in Adaptation vs Mitigation funding that has been called for by SIDS like The Bahamas, where the former is vital to improving the country's resilience to climate change.

Taking into account finance flows disaggregated by mobilizing entity during the 2010-2020 time series:

a) The Ministry of Environment has mobilized the largest amount of funds – as an in-country/national entity (approx. $56.5M USD). This is not surprising given that the Ministry contains the Department for which Multilateral Environmental Agreements are executed (the DEPP).
b) The largest out of country entity, mobilizing funds for The Bahamas is the UN Environment Programme (UNEP), with approximately $89.2M USD.

Regarding preparation of the BUR, The Bahamas received multilateral financial support from the GEF in 2019 in the amount of 852,0000 (USD) to develop its first BUR (in addition to its Third National Communication). The funding was administered through the Global Environment Facility (GEF) with UNEP having the responsibility as the implementing agency, and the DEPP serving on behalf of the Government of The Bahamas, as the executing agency. The funding was used to contract members of the PMU, consultants and auditors to ensure the production of a high-quality document and proper fiscal management of donor funds.

Chapter 1 – National Circumstances

Introduction

The Commonwealth of The Bahamas is recognized as one of the most vulnerable countries in the world to climate change. The country was ranked third of most affected countries in 2019 with a Climate Risk Index of 6.5 and losses per unit GDP of 31.59% (Eckstein et al, 2021).

The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) provides evidence that the global climate is changing (Nurse et al 2014), and that Small Island Developing States (SIDS), like The Bahamas, are on the frontline of these changes; the economic cost of adapting to the impacts of climate change is high. Global Circulation Model (GCM) projections from a 15-model ensemble indicate that The Bahamas may experience the following impacts:

- *“Temperature rise*: The Bahamas may experience warming of mean annual temperature of between 0.8°C to 1.9°C by the 2050s and 1.0°C to 3.2°C by the 2080s, relative to the 1970-1999 mean. The ranges reflect minimum and maximum projections under three emissions scenarios (A2, high emissions; A1B, medium high emissions; and B1, low emissions) from the Special Report on Emissions Scenarios (SRES). The rate of warming is expected to be pronounced year-round, but particularly significant in the summer months (June-August).

- *Changing precipitation patterns*: GCM projections of future precipitation for The Bahamas span both overall increases and decreases, but tend towards decreases in most models. Projected change in mean annual precipitation range from -20 mm per month to 15 mm per month across the SRES A2, A1B and B1 emissions scenarios. The more recent Representative Concentration Pathways (RCPs) scenarios were used in the IPCC’s Working Group I AR5 report, which project that warm/wet season (summer) precipitation will likely decrease in the Caribbean region over the coming century (Nurse et al, 2014). This is consistent with other recent assessments that predict declining annual average precipitation across the Caribbean, with the most pronounced drying during the wet season from May to October. In addition to the overall drying trends, recent models also predict that The Bahamas and other Caribbean countries will have to grapple with increasingly intense precipitation events (Taylor et al, 2018).

- *Increasing intensity of tropical storms*: Climate modelling of projected changes in tropical storms is associated with high uncertainty; however, both the IPCC AR4 and AR5 reports conclude that projections suggest little change in tropical storm frequency, but a likely increase in intensity of tropical storms making landfall in the Caribbean. Some recent models suggest that over the coming decades, rainfall associated with tropical cyclones could increase by 20-30% (near centre of the storm) and 10% at radii of 200km or greater, and that maximum winds speeds could increase by 2-11% (Taylor et al., 2018)".

1.1 Geography

The geography of The Bahamas contributes to its vulnerability. Geographic characteristics of the country include low relief with generally flat terrain and elevations of less than 32 feet (10 metres). 80% of the land lies less than 1.5 metres above sea level and as such, is vulnerable to floods cause by sea level rise and storm surges due to hurricanes (World Bank Group, 2021). A higher coast ridge occurs on most islands, usually located on the exposed side. Islands of the southeast and central Bahamas are generally of higher elevation than islands in the northern Bahamas. The highest elevation in the country is Mount Alvernia on Cat Island which is approximately 211 feet (64 metres).

1.2 Geology

The Bahamas archipelago is situated in the western North Atlantic and is comprised of extensive carbonate islands and shallow banks. There are 29 large islands, over 600 small cays, and more than 2,000 rocks, all low-lying. The surface deposits of archipelago are of Late Quaternary limestones from a glacioeustatic sea-level highstand position; a depositional record of platform flooding and carbonate sediment production. Simply put, alternating glacial expansions and retreats created vast changes in sea levels across geologic time, allowing for the formation of the islands. The islands are tectonically stable, consisting of carbonate sediments with interspersed paleosols (Mylroie, 2016).

With geologic origins that are biogenic and completely carbonate, The Bahamas differs from other islands in the region. The islands rest on shallow water banks which are primarily composed of calcium carbonate sediments. These limestone sediments were created from rapidly growing marine life which extracted calcium carbonate from seawater creating voluminous depositions of sand and mud. The Bahamas consists of eight carbonate banks with the north and central islands resting on two of these banks. New Providence, centrally located, is part of the largest formation – the Great Bahama Bank. The banks are separated by a series of deep-water channels upon which the islands occur unevenly usually on the margins of the larger and in the center of the shallower banks.

Oolitic sands have also contributed to the geologic development of the islands, specifically during the last ice age when sea levels were significantly lower. It was during that time period that oolitic sand dunes hardened and when sea levels rose, the rock ridges formed by these dunes became islands along the edges of the shallow banks.

Another source of islands in the archipelago are limestone rocklands, which were formed from the seabed when sea levels were at their highest. As sea level declined, the exposed seabed underwent erosion and weathering. The resulting formation was rocklands. Rocklands make up the broader islands in the archipelago (such as Andros and Grand Bahama) and oolitic sand dunes are represented in thin long islands (for example, Long Island and Cat Island).

Soil composition in the archipelago consists of organic and inorganic materials and the young age of the soil is reflective of the geologically young age of the limestone. Soils layers are typically thin and usually arranged in one or two layers above bedrock. Three soil types are recognized throughout the islands: organic, red clay, and sedimentary soils. New Providence is primarily made up of organic soils, which is the most common soil type in the archipelago (Currie, 2019).

The dry nature of the soils in The Bahamas means that they are particularly vulnerable to temperature increases and decreasing rainfall.

1.2.1. Hydrogeology

In The Bahamas, the physical geology, hydrogeology, water resources, and coastal zone are diametrically linked, as there are no true rivers in The Bahamas. The sole natural means of recharge for the underlying 'freshwater resources' is via rainfall.

The groundwater resources of The Bahamas are comprised of the fresh, brackish, saline and hyper-saline waters found in the subsurface and in the lakes and ponds that intercept the land surface. There is a direct connection between the landform and the marine and coastal environment, which are separated by a typical mangrove vegetation buffer on the protected coastal flats.

The freshwater resources occur as three-dimensional lens-shaped bodies, which overlie brackish and saline water. All freshwater in The Bahamas is as a result of rainwater that penetrates the ground surface.

Generally, there is no place on the islands that groundwater cannot be met in holes that penetrate 10 ft (3 m) below sea level. Water is typically encountered in the range 0 to 3 ft (0 to 0.9 m) above sea level. Tidal action induces an up and down movement to the entire groundwater table ranging from negligible amounts to about 3 ft (0.9 m). The effect of tides usually decreases inland, but may be substantial if an established cavern or other large opening directly connects an inland area to the sea. In many places inland, rise and fall of the water table is less than 1 ft (0.3 m).

The typical normal water table elevations are estimated at 3 to 5 ft (0.9 to 1.5 m) below ground level. Seasonal high-water table elevations can range from 1 to 3 ft (0.3 to 0.9 m) below ground level. During certain storm periods, the water table elevation can be above ground for a period (“perennial wetland areas”), but dissipates following the storm period. The main freshwater aquifer in The Bahamas occurs in the ‘Pleistocene Age’ formations named the Lucayan Limestone, from approximately 3 to 130 ft (1 to 40 m) below ground level (BGL). Younger Holocene deposits can contain freshwater, but freshwater is not present in older deposits beyond 150 ft (45 m) BGL (Cant & Weech, 1986).

Groundwater saturates the rock and all its pores, fissures and interconnected cavities. The size, shape and orientation of the island, the subsurface geology and the amount of rainfall control the shape size and thickness of the freshwater bodies. In excess of 90% of the freshwater lenses are within five feet of the surface.

Due to climate change, The Bahamas will face several challenges with respect to its water security. These include (MOEH & CDB, 2017):

- *Declining freshwater availability:* With declining average precipitation in the wet (summer) season, increasing temperatures throughout the year (thus increasing evaporation and evapotranspiration) and a potentially longer and drier dry (winter) season, the frequency of droughts is expected to increase and the availability of freshwater is likely to decline. These challenges will be particularly pronounced for the southernmost islands, which already have more limited freshwater supplies due to the tendency for precipitation to decline from north to south in the archipelago. At the same time, the prospects for expanding water supply through seawater reverse osmosis (SWRO) is somewhat constrained. SWRO provides more than 50% of The Bahamas potable water supply, but comes from groundwater sources due to limitations set on marine environment abstractions. Although SWRO will continue to form an important part of the country’s system and efforts to safeguard water security, these regulations limit the extent to which the country can depend on SWRO – a reality that reinforces the need to pursue other solutions in parallel.

- *Increasing contamination of freshwater:* Compounding the challenge of declining freshwater availability is the fact that climate change will increase contamination of freshwater in The Bahamas. Increasingly intense precipitation events and tropical storms, coupled with sea level rise, are expected to increase the frequency and intensity of floods in The Bahamas. This is expected to increase turbidity and the rate at which pollutants contaminate the islands' groundwater lenses which (due to their shallow nature) are highly vulnerable to anthropogenic pollution. Further exacerbating this dynamic is the fact that increasingly intense extreme weather events may damage wastewater treatment and collection systems, flood septic tanks and thereby also increase the risk of contaminated groundwater. Previous flooding in The Bahamas resulted in contamination of the soil and groundwater with seawater, sewage, petroleum and agricultural pesticides – occurrences that could become more pronounced as climate change progresses. Furthermore, The Bahamas is already grappling with sea level rise that is causing saline intrusion of aquifers. These challenges could become increasingly difficult to manage as sea levels continue to rise over the coming decades.

- *Negative impacts on critical water infrastructure:* More intense hurricanes and other extreme weather, as well as heavier precipitation events, are expected to inflict significant damage on water storage, treatment and distribution infrastructure in The Bahamas. This may disrupt efforts to reliably distribute water to end-users throughout the country. This may also increase leakage rates precisely as the country is grappling with declining freshwater availability. The Government is currently working to reduce non-revenue water (NRW) rates in recognition of the fact that this constitutes an effective way to address looming water supply shortages.

Table 6 details freshwater availability per island in The Bahamas.

Table 6: Freshwater resources in The Bahamas

Island	Size (Acres)	Freshwater Lens (Acres)	LensArea/Size	Max. Daily Abstraction (MIG)	Water Available (IG/D) Person 1990 Census	Total Population 1990 Census
Abaco	415,360	116,280	0.28	79.10	7.906	10,003
Acklins	96,000	15,783	0.16	4.36	10,765	405
Andros	1,472,000	338,585	0.23	209.92	25,672	8,177
Bimini	7,040	395	0.06	0.17	104	1,639
Cat Island	96,000	14,774	0.15	6.80	4,005	1,698
Crooked Is.	58,900	5,923	0.10	1.74	4,223	412
Eleuthera	128,000	16,599	0.13	8.13	768	10,584
Exumas	71,680	6,586	0.09	2.90	816	3,556
Grand Bahama	339,200	147,884	0.44	93.17	2,278	40,898
Gt, Inagua	383,360	3,571	0.01	0.86	873	985
Long Island	147,200	9,301	0.06	2.88	977	2,949
Mayaguana	70,400		0.03	0.65	2,083	312
New Providence	51,200	2,340	0.34	9.63	60	172,196
TOTAL	**3,336,340**	**695,524**	**0.208**	**420.31**	**60,530**	**253,814**

Source: Water & Sewerage Corporation, 2007

1.3 Climate

The climate of The Bahamas is tropical marine, wet and dry with winter incursions of modified polar air from the North American continent (Bahamas Department of Meteorology, 2021).

The Bahamas Department of Meteorology (2021) characterizes the trade wind flow as “the single most important climatic agent affecting The Bahamas”. The trade wind is generated by the quasi-permanent Bermuda Azores anticyclone, which is a large area of high atmospheric pressure, covering part of the subtropical north Atlantic Ocean. The trade winds blow at an average speed of 8 knots, mainly from the east and southeast during the months of May to September and mainly from northeast and east during the remaining months. The trade winds are “relatively dry and yield fair-weather cumulus clouds with long period of bright sunshine, broken from time to time by weather systems” (Bahamas Department of Meteorology, 2021).

Summer conditions

“During the summer months, temperatures reach 32 degrees Celsius (90 degrees Fahrenheit) by day and afternoon showers or thunderstorms occur for up to an hour; [the latter] may be widespread and more prolonged when developing weather systems are affecting the islands. These systems include migratory areas of persistent rain, tropical waves and tropical cyclones. These latter may be tropical storms with winds up to 63 knots (73 miles per hour), or hurricanes with stronger winds.” (Bahamas Department of Meteorology, 2021).

Winter conditions

“From about late October through April into early May, the trade winds flow from the east and northeast is interrupted by cold fronts which move south and southeast over North America into The Bahamas, followed by cold polar air and strong northwesterly breezes. In winter months, periods of a day or two of north and northeast winds of about 25 knots may occur. Winds gradually slacken as they shift through northeast, and return to east, their normal direction, over a varying period of up to four days.

Temperatures fall soon after frontal passage, sometimes going as low as the upper forties Fahrenheit, but gradually warm up as the wind returns to its normal easterly direction. These cold fronts from the leading edge of bursts of polar air from the continent and are the main winter feature. This cold air is modified as it traverses the warm Gulf Stream and ambient Bahamian waters, which save The Bahamas from the full frigid blast of the North America winter.

Although cold fronts can yield much rain, they pass through these islands once every five days and therefore the rainfall in winter is scant; the dry season is from November to April. January the driest month for New Providence has an average of 1.86 inches (47.24mm) of rain.” (Bahamas Department of Meteorology, 2021).

1.3.1. Weather conditions

Temperature

"In centrally situated New Providence, winter temperatures seldom fall much below 60°F and usually reach about 75°F in the afternoon (the lowest recorded temperature was 41.4°F on 20 January 1981). In summer, temperatures usually fall to 78°F or less at night, and seldom rise above 90°F during the day. Winter temperatures are lower in more northerly islands than in New Providence, and about five degrees higher than in the south. In summer, temperatures tend to be similar all over The Bahamas. Winds are predominantly easterly throughout the year, but there has been a tendency to become northeasterly from October to April and southeasterly from May to September" (Bahamas Department of Meteorology, 2021).

The CMIP5 models included in the IPCC's Fifth Assessment Report (AR5) projected the mean annual temperature to increase by 0.8 - 2.3°C by the 2060's and 1.2 - 2.5°C by the 2090's (Nurse et al, 2014). Projected rate of warming is most rapid in the summer from June-August and September - November. Substantial increases in the frequency of 'hot' days and nights and decreases in the frequency of cold days and nights are projected to occur, with the most rapid changes occurring in the June - August period.

Rainfall

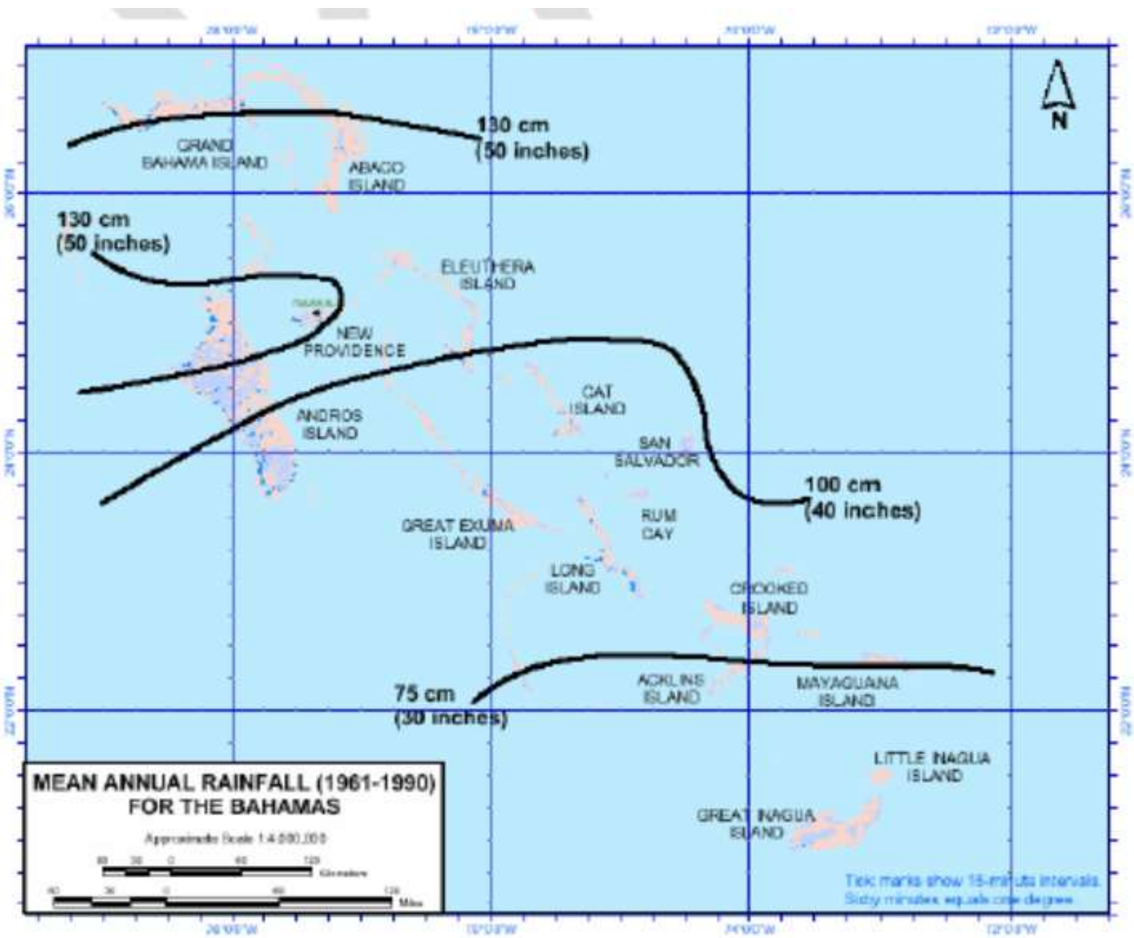
Rainfall is unevenly distributed across The Bahamas.

Figure 15 shows the distribution of rainfall for The Bahamas.

The north and north central Bahamas receive annually some 50 to 60 inches (1270 to 1524 millimeters) of rainfall annually, while in the southeast Bahamas, the rainfall decreases to some 36 inches (914 millimeters) annually. Moving across the archipelago, the average annual rainfall varies from about 60 inches (15.24mm) per year at Abaco in the northwest to less than half this amount at Inagua in the southeast.

There is a distinct dry season (November to April) and a pronounced wet season (May to October). The seasonal effects of tropical cyclones have a pronounced effect on annual rainfalls across The Bahamas. Additionally, winter storms flowing off the North American continent also impact rainfall during the normally dry period. However, this effect rarely extends into the central and southern Bahamas.

Figure 15: Mean annual rainfall for The Bahamas



Rainfall projections indicate decreases in rainfall for The Bahamas, mainly due to decreases in rainfall during the March-May and June-August periods. The decreases in the months from March to August however are partly offset by overall increases in rainfall in the September-November period.

The risk of drought increases along a southeastern gradient since the more southern islands already experience only half of the rainfall that falls in the more northern islands.

Additionally, since the weather of The Bahamas is influenced by ENSO events, the likelihood of drought is increased if El Nino episodes become more frequent and/or intense.

1.3.2. Hurricanes and other extreme events

Natural hazards to the country are tropical storms (including hurricanes), lightning, tornado and droughts. These are the extreme events that would cause major losses in the future in The Bahamas. There are other natural phenomena that have lower probability of affecting the country, such as floods and storm surge, but these can also result in significant local damage.

The Bahamas has a history of suffering major impacts from destructive storms and hurricanes. From 1871 to 2000, 186 hurricanes and 86 tropical storms passed within 160 km of The Bahamas (BEST Commission, 2014).

Hurricanes Maria and Irma in 2017 and Dorian in 2019 (a Category 5 Hurricane) have caused significant loss of life, evacuation of affected islands and damage to infrastructure and the economy in billions of dollars. Hurricane Dorian alone is estimated to have caused over US$ 3 billion in damages. These hurricanes happened shortly after Hurricanes Joaquin (2015) and Matthew (2016) which also inflicted significant damage on The Bahamas. Hurricanes have had dramatic negative impacts on economic development across The Bahamas (as outlined in Table 7)

During Hurricane Dorian, the wind speeds were up to 220 mph with gusts of 310 mph, Dorian decimated the islands of Abaco and Grand Bahama. In January 2020, the Government of The Bahamas reported the official deaths from Dorian as 71 persons and 282 persons missing. According to the official Census 2010, the islands of Abaco and Grand Bahama are home to approximately 17,000 and 51,000 residents respectively.

According to Shelter Cluster Bahamas, it is estimated that 9,000 homes were affected. Damage to the housing sector is estimated at US$1.48 billion, 88.9% of which took place in Abaco. The Ministry of Housing and Environment issued a Prohibition to Build Order for the Mudd, Pigeon Pea, Sand Bank and Farm Road shanty towns located on the island of Abaco, where a large number of vulnerable, irregular migrants used to live.

Table 7: Hurricanes impacting The Bahamas 2015 – 2019

Name of Hurricane	Active dates	Category	Estimates of loss and damage (US$)
Joaquin	28 Sep – 15 Oct 2015	4	120+ Million
Matthew	28 Sep – 10 Oct 2016	4	600 Million
Irma	30 Aug – 13 Sep 2017	5	135 Million
Dorian	24 Aug – 8 Sep 2019	5	3.4 Billion

Sources: NOAA, 2021; Bahamas Department of Meteorology, 2016; IADB, 2019; MOEH, 2018

1.3.3. Sea level rise

Sea level rise (SLR) and other oceanic climate change will result in salinization, flooding, and erosion. SLR will also affect human and ecological systems, including health, heritage, freshwater, biodiversity, agriculture, fisheries and other services. Increased heat in the upper layer of the ocean is also driving more intensive storms and greater rates of inundation, which, together with SLR, are already driving significant impacts to sensitive coastal and low-lying areas.

By the end of the 21st century, it is very likely that sea level will rise in more than about 95% of the ocean area and about 70% of the coastlines worldwide are projected to experience a sea level change within ±20% of the global mean (IPCC Global Warming of 1.5 °C Report, 2018).

1.4 Governance in The Bahamas

A sovereign nation since 1973, The Bahamas has a democratic, Parliamentary system of governance. The Head of State (King of England) is represented by the Governor-

General and the Government comprises the Executive Branch with the Prime Minister, the Attorney-General and at least seven other members. The other Cabinet Ministers and Ministers of State are responsible for running their Government ministries.

1.4.1. National government

Parliament constitutes the Legislative Branch and is a two-chamber system based on the Westminster model, with a House of Assembly and a Senate. There are currently 39 seats in the House of Assembly and 16 members of the Senate.

The Judiciary comprises the Court of Appeal and the Supreme Court. They function as independent institutions under the Constitution and are not Government departments.

1.4.2. Local government

Each island, with the exception of New Providence, is divided into Local Government districts under the Local Government Act 1996. There are 32 Local Government districts. Local elections are held every three years.

Local Government districts do not have revenue-raising powers; they receive transfers from Central Government. Their responsibilities include supply of potable water by standpipes, upkeep of public schools and other public buildings as well as general health and sanitation.

1.5 Population

The most recent published population census was in 2010. Approximately 30 of the over 700 islands are inhabited. The population of The Bahamas was estimated to be approximately 295,000 in 2000, growing at a rate of just over 1%. By 2010, The Department of Statistics recorded that the population growth increased to approximately 351,471 persons in The Bahamas. The key demographic indicators for 2020 and 2025 are outlined in Table 8 (Bahamas Census, 2010).

Table 8: Key Demographic indicators for The Bahamas 2020 and 2025

Demographic Indicator	2020 Projection	2025 Projection
Total population	389,410	408,930
Average annual growth rate	1.02	0.92
Number of births	6,040	6,260
Number of deaths	2,470	2,800
Natural increase	3,570	3,460
Total immigrants	400	300

Most of the population lives in urban areas, with two-thirds living on New Providence Island where the capital city of Nassau is located.

1.5.1. Living conditions

According the 2013 Bahamas Household Expenditure Survey, 58.5% of the dwellings in The Bahamas are separate, detached houses (houses that did not share walls, roofs, or floors with other houses). The second most significant type of dwelling is single, attached houses (24.8%), while apartments or flats account for 15.1% of total dwelling units. In New Providence, there is a higher proportion of separate, detached houses (27.3%) and of apartments or flats (16.5%), while in Grand Bahama and Family Islands is significantly higher the proportion of separate, detached houses (66.8% and 70.2%, respectively).
There seems to be a positive relation among the percentage of households living in separate detached houses and the level of per capita consumption of the quintile: the proportion of households living in separate detached houses tends to increase when consumption level grows.

The average number of rooms of a Bahamian dwelling is 4.2, with 2.6 bedrooms. Dwellings in Grand Bahama have, on average, more rooms (4.5), while the opposite is true for dwellings in Family Islands (3.9). The numbers of rooms in the dwelling increases as the level of per capita consumption expenditure of the household increases. Over fifty-night percent (59.2%) of the households in The Bahamas have access to public water piped into the dwellings, and 33.1% have a private source of water piped into the dwelling.

At the regional level there are some differences: in Grand Bahama the percentage of households with public water piped into the dwellings is 94%, but in New Providence and Family Islands this percentage decreases to 52% and 59%, respectively.

Regarding the access to lighting, the information presented shows that electricity is the main lighting source (98%). The rate of coverage is almost the same as the national level in New Providence and Grand Bahama, but in the Family Islands, the rate of coverage is lower (96%). Electricity is the main source of lighting for households across all consumption quintiles. However, a significant proportion (almost 8%) of households in the poorest quintiles tends to use kerosene, oil or gas lamp as source of lighting.

At the national level, 74% of the households have toilets attached to a cesspit or septic tank and for 14% of the households the toilet is linked to public sewer. Only 0.6% of households report having no toilet.

The three most important expenditure items for total population, in terms of its budget share, are the following:

- housing, water, electricity, gas and other fuels (46.7%);
- transportation (13.8%); and
- food and non-alcoholic beverages (11.9%).

For the poorest 10% of the population, the budget share of food and non-alcoholic beverages climbs to 24.7%, while the budget share of transportation decreases to 7.4%. The overall poverty rate in The Bahamas is 12.5 %. New Providence and Grand Bahama present similar or lower poverty rates (respectively 12.4% and 9.4%) whereas Family Islands have a higher rate (17.2%). Hence, poverty rates are higher in rural communities. However, the majority of the poor (71.5%) are located in New Providence (Bahamas Household Expenditure Survey, 2013).

1.5.2. Migration trends due to hurricanes and other extreme events

All the major hurricanes in the past 7 years have resulted in displacement of people. As of January 2020, the International Organization for Migration (IOM) estimated that 2,000 internally displaced people were still residing in collective centres, rental apartments and with host families in New Providence following Hurricane Dorian.

The Internal Displacement Monitoring Centre (2020) estimated that 9,840 people were displaced due to Hurricane Dorian. The majority of persons displaced were from the islands of Abaco and Grand Bahama, which were hardest hit by the storm. Most of them were evacuated to New Providence, while approximately 500 went to Eleuthera; some migrated to the United States and Canada with the help of extended family members. According to the Miami-based Consul General of The Bahamas, an estimated 650 people now reside in Florida.

Two months following Dorian, 3,142 displaced people returned to Abaco. The majority were men who returned to their home communities where they lived in tents and began clean-up and reconstruction efforts (IDMC, 2020).

1.6 Economy

The economy of The Bahamas is primarily dependent on tourism and financial services. Tourism accounts for approximately 50% of GDP; financial services account for about 15% of GDP (Government of The Bahamas, n.d.). Manufacturing and agriculture contribute approximately 7% of GDP. Public debt increased in 2017 largely due to hurricane reconstruction and relief financing.

Due its heavy reliance on tourism, the country is vulnerable to changes in the global economy. The 2017 assessment by the Central Bank of The Bahamas showed very mild growth of the economy. The country’s GDP was US$12.16 billion in 2017 with tourism accounting for more than 50%, financial services about 20% and the balance spread among retail and wholesale trade, fishing, light manufacturing and agriculture. The Bahamian tourism infrastructure supports approximately 1.5 million stopover visitors and 3.5 million cruise visitors annually. Just under 50% of the labour force is directly employed in tourism. When one adds persons indirectly employed, this increases to 70%.

Most of the infrastructure and settlements of the islands are located along or near to the coast where they are particularly vulnerable to flooding and sea level rise which will have serious economic and social implications for residents and for sectors of the economy, particularly the tourism sector.

Table 9 provides information on GDP per capita since 2000 along with unemployment rates. Table 10 provides nominal GDP by island with percentage change from 2015 – 2019. Of the 2019 GDP of $13,578 billion in nominal (current) dollars, New Providence represented $10.114 billion (74%), Grand Bahama $1.876 billion (14%) and other Family Islands grouping, the remaining $1.588 billion (12%). The high percentage for New Providence was primarily due to high levels of construction and tourism activity as well as gains in economic activity, stemming from the relocation of persons from hurricane-affected islands to the capital. Grand Bahama's overall increase in 2019 was supported by increases in contribution from construction, accommodation, and food services sectors.

Table 9: The Bahamas unemployment rate and GDP per capita

Year	**Unemployment rate**	**% change**	**GDP per capita, current prices**	**% change**
2000	7	-10.21%	25823.64	4.79%
2001	6.9	-1.43%	26682.62	3.33%
2002	9.102	31.91%	27436.9	2.83%
2003	10.835	19.04%	27206.74	-0.84%

2004	10.202	-5.84%	27802.01	2.19%
2005	10.17	-0.31%	29249.63	5.21%
2006	7.628	-25%	30518.48	4.34%
2007	7.853	2.95%	31412.35	2.93%
2008	8.703	10.82%	30914.64	-1.58%
2009	14.246	63.69%	29510.23	-4.54%
2010	15.082	5.87%	29978.72	1.59%
2011	15.889	5.35%	30452.46	1.58%
2012	14.367	-9.58%	31641.21	3.9%
2013	15.782	9.85%	31710.07	0.22%
2014	14.636	-7.26%	31905.94	0.62%
2015	13.379	-8.59%	32224.26	1.0%
2016	12.15	-9.19%	31672.41	-1.71%
2017	10.1	-16.87%	32376.79	2.22%
2018	9.2	-8.91%	33494.19	3.45%
2019	9.046	-1.67%	34421.23	2.77%

Source: International Monetary Fund, 2019

Table 10: Nominal GDP by Island 2015 – 2019 (in B$ Million)

ISLANDS/YEARS	2015	2016	2017	2018	2019
New Providence	8,258	8,524	8,950	9,513	10,114
NP % change		3.2%	5.0%	6.3%	6.3%
% of Total GDP	71%	71%	72%	73%	74%
Grand Bahama	1,980	2,025	2,008	1,833	1,876
GB % change		2.3%	-0.8%	-8.7%	2.3%
% of Total GDP	17%	17%	16%	14%	14%
Family Islands	1,473	1,380	1,533	1,676	1,588
FI % change		-6.3%	11.1%	9.3%	-5.2%
% of Total GDP	13%	12%	12%	13%	12%
All Bahamas	11,711	11,929	12,491	13,022	13,579
All Bah % change		1.9%	4.7%	4.3%	4.3%

Source: Bahamas Department of Statistics, 2019

1.6.1. Energy

The electricity and transport sectors are the main users of fossil fuels in the country. The two major utility companies in the country, Bahamas Power and Light Company Limited (BPL) and Grand Bahama Power Company respectively generate 438 MW and 98.5 MW of power (Bahamas National Energy Policy, 2013).

The high dependency on imported oil, almost 100%, has made energy production in The Bahamas vulnerable to global oil price fluctuations, making budgeting and reinvestment into equipment difficult for state-owned electricity company, Bahamas Power and Light Company Limited (Holdom, 2019), as well as other energy providers. This has resulted in significant debt to BPL and the reliance on price increases to maintain its service.

For renewable energies to supply more than 20% of The Bahamas' power needs, different islands must be interconnected to enable electricity to flow between them. This was the recommendation from the National Energy Policy Committee's second report presented to the Government in April 2011 that also urged the Government to focus on deploying water heaters, bio-energy and nearshore wind power as renewable energies in the short-term.

The Bahamas National Energy Policy 2013 – 2033 was designed to ensure that by 2033 The Bahamas has "a modern, diversified and efficient energy sector, providing Bahamians with affordable energy supplies and long-term energy security towards enhancing international competitiveness and sustainable prosperity".

In an effort to achieve the targets set by the Policy, the Government has developed and implemented a number of projects including:

- **Ragged Island Microgrid** – A hybrid solar-battery microgrid coupled with an existing diesel plant is being developed on Ragged Island for power generation. Previous power generation was approximately 100% diesel. Once completed, the capacity of the microgrid will be 402 kW.

- **Solar car park** – A 925 kW-solar array has been installed at the Thomas A. Robinson Sports Centre car park. The installation is estimated to displace 310,000 litres of diesel and offset 856 tonnes of carbon dioxide annually. The system has been designed to withstand extreme weather conditions with winds of up to 160 mph. The power generated at the facility feeds into the national grid and also provides power to charging stations for electric cars free of charge to the public (The Tribune, 2019).

Other mitigation measures are further outlined in the Chapter 4 of this BUR1.

1.6.2. Transport

The Bahamas has 13 international airports and numerous smaller Government-owned and private airports with regularly scheduled flights across the island chain and to various parts of the world. 23 seaports span the archipelago, facilitating regular shipping connections to Europe and the Americas. The ports in Nassau and Freeport are major international transshipment centres, servicing both tourism and commerce.

Electric vehicles (EVs) sales have continued to increase annually in The Bahamas. From 2019 to 2020, there was a 133% increase in sales and sales for 2021 are on track to be higher (Tribune, 2021). Tax incentives for purchasing electric vehicles include lower import duty of 10% (for EVs under $70,000) and 25% (for EVs over $70,000) compared to vehicles powered by fossil fuels. Government agencies, including BPL, have also begun transition to include electric vehicles as a part of their vehicle fleet.

1.6.3. Water

In general, water resources vary between islands and the supply-demand balance is highly dependent on population density. New Providence, which is the main population centre, has far less water available in freshwater lenses than is needed, and therefore relies heavily on reverse osmosis plants. Although there is not yet a net shortage of water on many islands, the population centres on each island have a major deficiency.

The Water and Sewerage Corporation (WSC) is the country's main water supplier; the Corporation is owned by the Government and falls under the portfolio of the Ministry of

Works and Utilities. The Water and Sewerage Corporation Act of 1976 established WSC and defines the responsibilities of the Corporation. WSC has a Water Resource Management Unit (WMRU) to manage water resources and water quality.

The water sector is identified as a national priority for climate change adaptation in the first Nationally Determined Contribution (NDC) for The Bahamas, and previously in the National Climate Change Adaptation Policy.

Agricultural practises have negatively impacted the water quality of The Bahamas. Studies on water quality have found traces of pesticides within the available freshwater. Floods are a particular problem in agricultural landscapes due to the erosion of the topsoil and the flushing of pesticides, fertilisers, animal waste and sewage into water sources. There is also increasing evidence of contaminants such as hormones, endocrine disruptors and drugs in the water supply. To safeguard water security in a changing climate, it is essential that The Bahamas minimize the extent to which climate change exacerbates these trends and risks.

Internally, WSC is making strides to assess, retrofit and fortify existing infrastructure to become more climate-resilient as well as implementing climate resilience for new construction. A project funded by the Caribbean Development Bank and the Bahamas Government is focused on increasing climate resilience for water infrastructure on five Family Islands.

1.6.4. Tourism

Tourism sector is the major driver of the Bahamian economy. In 2019, there were more than 7.2 Million visitors to The Bahamas even with destinations in Abaco and Grand Bahama being severely impacted by Hurricane Dorian. A significant decline in visitor numbers is expected for 2020 and 2021 due to COVID-19. Initial estimates indicate that stopover visitors for the country for 2020 was 452,640 versus over 1.8 Million in 2019, representing a decrease of 75% (Ministry of Tourism, 2021).

Accommodation is the most vital component of the tourism product and the tourist destination. There are approximately 65 hotels in Nassau, with 8,688 rooms. In The Bahamas there are 270 hotels with 14,797 rooms (Ministry of Tourism, 2021). Other components of the sector include food and beverage, recreation, transportation, attractions and conferences.

A 2011 ECLAC report on the economic impact of climate change on the Bahamian tourism sector noted the following:

The Bahamas is at great risk and vulnerability given its geographical features as a low-lying, sea encircled country. If projected sea level rise is reached by 2050, between 10-12% of territory will be lost, especially in coastal zones where the main tourism assets are located…The second and no less important threat is tropical cyclones, which may be associated with raising sea level. Estimations posited the amount of losses in excess of 2,400 million US$ for the four decades under examination…In the same period, total estimated impacts of progressive climate change are between 17 and 19 billions of B$ with estimated discount rates applied.

1.6.5. Agriculture – crops and livestock

Different types of land use in The Bahamas include (2016 estimates):

- Agricultural land – 1.4% which includes:
    - Arable land – 0.8%
    - Permanent crops – 0.4%
    - Permanent pasture – 0.2%
- Forest – 51.4%
- Other – 47.2%

Land classified as other includes developed areas, roads, other transportation features, barren land and waste land.

Approximately 90% of the available agricultural land is owned by the government and leased to farmers. Of the 95,000 ha of arable land in the country, only 7,650 ha is under cultivation, with two very distinct systems of agricultural production: mechanized methods in the northern islands that receive more rainfall and have large underground freshwater reserves; and shifting cultivation in the central and southern islands that are characterized by subsistence farming. More than 5,000 acres of agricultural land in The Bahamas are used for citrus production. Major crops for export are grapefruit, limes, avocados, papaya, okras and pineapples. The soils in the country are generally poor in terms of nutrient availability and water holding capacity, so farmers rely on heavy inputs of chemical fertilizer.

A 2014 IICA-IFAD report on climate-smart agricultural production in The Bahamas noted the following concerns about the impacts of climate change which were raised by smallholder rural producers and other stakeholders in the agricultural sectors:

- Crop loss and infrastructure damage (e.g. access roads washed out) due to hurricanes;
- Variability of access to freshwater due to unpredictable rainfall. There seems to be variation from drought to flood in any given year. This also impacts recharge of groundwater lenses which some farmers use for irrigation;
- Lack of information available to them about climate change and its potential impacts on their farms. Farmers want there to be more training opportunities and more communication from the Ministry of Agriculture, Marine Resources and Local Government and the Department of Agriculture; and
- Insurance for farmers so that they can receive at least 15% of the value of their farms in the event of a hurricane or storm surge. After Hurricane Sandy, farmers in Cat Island were given $75 - $100 by the Ministry as damage assistance.

Some of the recommendations for the same report to facilitate climate-smart agriculture in the country include:

- Replacement of traditional slash-and-burn systems with agroforestry systems, greenhouse production and/or hydroponics. These methods are already being used by some farmers.
- Increase soil carbon stocks through restoration of degraded lands and conservation agriculture.

- Using drought-resistant and salt-tolerant varieties of crop species.
- Identification of lands that are best suited for agriculture over the long-term, considering sea level rise and SLOSH (sea, lake and overland surges from hurricanes) modeling, and designation of these areas as agricultural lands.
- Development of policies to build economic resilience at the farm level (e.g. provision of insurance, securing land tenure).
- Training for farmers in sustainable soil and water management practices. This could involve local preparation of bio-fertilizers and bio-pesticides to reduce dependency on expensive, imported fertilizers and to replace hazardous agro-chemicals being used in local agriculture (Sanchez Hermosillo, 2011). Inter-cropping or alley cropping were also recommended; inter-cropping was observed on small farms in Cat Island.

1.6.6. Fisheries

The fisheries sector plays an important role in the Bahamian economy in terms of foreign currency earnings, food supply and employment. The commercial fisheries sector supplies 31 kg/capita/year of fish and fishery products to the population, generates some US$80 million annually in export earnings and provides full-time employment to 9,300 commercial fishers and thousands of jobs more in recreational fisheries, vessel maintenance, fish processing, retail and trade. The fishing fleet is characterized as small-scale and counts approximately 4,000 fishing vessels ranging in length from 3 meters to 30 meters, but generally less than 7 meter in length.

The total commercial fisheries production in 2015 was estimated at nearly 12,000 tonnes. The total production has fluctuated in recent years. Fluctuations are largely caused by the variations in landings of spiny lobster, which were nearly 10,000 tonnes in 2010 and 2012 and around 6,500 tonnes in 2015 (FAO, 2021).

Spiny lobster stocks in The Bahamas are being fully exploited, while conch, snappers and groupers are, like in the rest of the Caribbean, under heavy fishing pressure and some stocks are probably overexploited. The major threats to the marine fisheries resources are coastal zone development, boat and diver damage to the reef, over-harvesting of commercial species and disturbance to sensitive sites.

The recreational and sport fisheries subsector of the fisheries sector is also very important to the country contributes an estimated US$500+ million annually to the national economy through related expenditures by tourists and provides employment for some 18,000 Bahamians. The recreational and sport fisheries target game fish, such as marlins and sailfishes, as well as bone fish.

1.6.7. Industry

Industry includes activities such as light manufacturing and resource mining, particularly for aragonite. There has been recent consideration by the Government of oil exploration. Oil refining is presently occurring on Grand Bahama. Grand Bahama is the most industrialized of the Bahamian islands with an industrial sector which includes a container port, shipyard, oil refining, storage and transshipment, cement manufacturing, and pharmaceutical manufacturing.

1.6.8. Construction

The entire Bahamas due to its size and topography is vulnerable to the impacts of climate change. Increased development along coastlines tends to increase coastal erosion and therefore vulnerability of populations. Yet coastal development is one of the primary income generators of the country, and therefore this dichotomy has engendered conflicting approaches to management of coastal resources. Most of the critical infrastructure in the country (e.g. ports, roads, power stations) is found in vulnerable coastal areas.

1.6.9. Finance

The sector consists of commercial banks, savings banks, trust companies, offshore banks, insurance companies, a development bank, a publicly controlled pension fund, a housing corporation, a public savings bank, private pension funds, cooperative societies and credit unions. Capital and money market activities received a significant boost in

2000, with the introduction of The Bahamas International Securities Exchange (BISX), which operates alongside the informal over-the-counter exchange of public sector bonds and bills, which is administered through the Central Bank.

The array of financial services in The Bahamas also includes international business companies (IBC), mutual funds, and insurances services. The IBC is a flexible form of corporate vehicle governed by the International Business Companies Act, 2000. IBCs can only be incorporated by a bank or trust company - which is regulated by the Central Bank - or a person licensed under the Financial and Corporate Services Providers Act, 2000. Mutual funds operating in The Bahamas take the form of either managed investment companies with shares, or trusts with units representing ownership.

A significant number of insurance companies are also registered to operate in or from within The Bahamas. While many of these insurance companies service the domestic risk needs of The Bahamas, a number were also established to insure risks situated elsewhere in the world.

1.6.10. Waste management

Bahamians and visitors together generate more than 264,000 tons of municipal solid waste annually (World Bank, 2016) with New Providence contributing about 77% (GIS, 2016) and Grand Bahamas 17% of this total, leaving only about 6% or 15,800 tons annually generated on the Family Islands.

The typical mode of solid waste disposal on the Family Islands is to dump at formal sites near main settlements, burn and sporadically push aside the burned material to make room for more refuse. Almost all sites are unregulated, have debris spread over wide areas and are contaminating water supply areas. Indiscriminate dumping along roadsides is common on all islands, including New Providence. Some islands do have sanitary landfills that are maintained and some resorts operate a system of daily waste management geared toward maintaining compost bins, segregating, preparing and transporting bottles and cans for shipment to recycling facilities overseas.

New Providence Ecology Park (NPEP) is a private entity that has been engaged by the Government to manage the landfill on New Providence. NPEP has undertaken several activities to improve waste management at the landfill including:

- Consolidating and capping over 80 acres of waste;
- Implementing rigorous solid waste handling practices; and
- Commencing recycling and recovery activities for construction demolition debris and vegetative waste.

Future plans include landfill gas collection and recycling infrastructure as well as a public green space on reclaimed landfill property.

The Bahamas first large-scale biodiesel production facility was opened in February 2011 by Bahamas Waste Limited. It will allow for up to one million gallons of waste cooking oil collected from restaurants in Nassau, such as McDonald's, Burger King, KFC and Wendy's, as well as cruise ships to be processed and converted into biodiesel each year. Currently, four Bahamas Waste trucks are using a 50:50 blend of biodiesel to petroleum diesel. The company hopes to eventually run its entire fleet of 50 vehicles off of 100% biodiesel as production increases.

1.6.11. Health

The Bahamian government is making a conscious effort to improve its health care system, investing around 8% of its GDP into health care in 2018, and building new hospitals and facilities. Public health services are delivered through a network of 57 community clinics and 54 satellite clinics in New Providence and the Family Islands (PAHO, 2021). For those living on smaller islands without medical facilities, travel by boat or plane is required. The Public Hospitals Authority in the Bahamas oversees the quality of the three public hospitals in The Bahamas. These three hospitals are the Princess Margaret Hospital, the Sandilands Rehabilitation Centre, both on New Providence, and the Rand Memorial Hospital on Grand Bahama. There are also two main private hospitals in The Bahamas, both on New Providence - Doctors Hospital and Lyford Cay Medical Facility.

The National Health Insurance (NHI) programme was launched in 2016 and offers Bahamian residents access to primary health care, which is free at the point of service. While the government is initially paying for the care offered, this is expected to change in the future with NHI members and their employers being required to pay up to 1.5% of their income towards the programme.

Despite initiatives like NHI, many Bahamians still struggle to access the health care they need. The majority of Bahamians do not have health insurance and are unable to afford the high costs of secondary (specialists such as cardiologists) and tertiary medical care (such as surgeries).

There are a number of projects underway to mainstream climate change into the health sector. These include:

- **Developing a climate resilient health system in The Bahamas** – Through funding from the Green Climate Fund, the project will result in the development of climate change-specific chapters as a part of The Bahamas National Health System Strategic Plan (NHSSP). These chapters will address resource mobilization, SMART health facilities and policies, and health workforce to address climate change and health mainstreaming. The project will also enhance national public health surveillance systems of hospitals and primary care clinics and strengthen communication across agencies to respond to climate change impacts.
- **EU/CARIFORUM climate change and health project** – The objective of this project is to improve the capacity of Caribbean countries (including The Bahamas) to reduce the negative impacts of climate change on health. Benefits of the project to The Bahamas will include development of a health adaptation plan to advance national climate change and health prioritization and financing; strengthening of water, sanitation and food safety systems to be more resilient to climate change; and a national climate informed disease surveillance and modelling system.

1.6.12. Education

Education is available to all segments of the Bahamian population and is compulsory to children aged 5 to 16. There are 170 public schools in the country; total enrollment for K-12 is more than 50,000.

The Bahamian education system is structured in a 6-3-3 format. The first cycle is primary education, which lasts for six years and is designed to cater to students aged five to eleven. Secondary education is divided into two equal parts of three years' duration; junior high is designed to accommodate students from age 11 to 14 while it is expected that students aged 14 to 17 attend senior high. Although not yet mandatory, education at the preschool and post-secondary levels is rapidly expanding (MOEST, 2020). Climate change is incorporated into the national curriculum beginning in primary school at fourth grade level.

An example of climate change activities at school was a climate change workshop held at Columbus Primary School for fourth and fifth grade students; the students learned about global warming, climate change, and its impact on the environment. The workshop was a collaborative effort between the Science Specialist at the Sadie Curtis and Columbus Primary Schools and Innovative Science, a private sector organization that provides interactive science experiments for primary school children.

The Bahamas has further strengthened its commitment to climate education, with the appointment of an Action for Climate Empowerment (ACE) Focal Point in the Ministry of Education.

Tertiary education is provided at the University of The Bahamas (UB), which offers both associate's and bachelor's degrees in the arts and sciences. The Climate Change Adaptation and Resilience Research Centre (CCARRC) is a part of UB. Established in 2019, the Centre serves as a resource for SIDS and coastal communities throughout the world to effectively address the human dimensions of climate change. The Centre focuses on the impacts of climate change on societies in at-risk regions and how members of these communities can best prepare for and respond to the many risks posed by climate change.

There are also a number of privately-run institutions that also offer associate degrees and are affiliated with tertiary educational institutions in the United States. Technical and vocational training is available at the Bahamas Technical and Vocational Institute (BTVI) (PAHO, 2021).

Considerable efforts have been made within the past ten years to incorporate technology in the both public and private schools in The Bahamas. To date, Almost 5 million dollars was spent in the last 2 years to install computer labs, and E-literacy capabilities in every junior and senior high school in The Bahamas.

The Ministry of Education has implemented training programmes for teachers to ensure that they are able to teach technology to students and improve achievement levels using this vital teaching tool.

The Ministry of Education also works with non-Governmental agencies on climate change education including:

Bahamas Reef Environment Educational Foundation (BREEF) – BREEF provides teacher training programmes every summer. It also produces teacher resource materials including a guide for educators on consumers, corals and climate change.

1.6.13. Social Services

The Department of Social Services provides food, financial services, counselling, advocacy, education, health and wellness, shelter and housing, and protection services. There are 13 divisions within the Department including a Disaster Management Unit.
The Disaster Management Unit (DMU) is primarily responsible for hurricane shelter management. The Unit is also tasked with assisting in national disaster preparedness and mitigation efforts relative to all natural and man-made events and disasters

throughout The Bahamas. DMU works in partnership with the National Emergency Management Agency (NEMA) and in compliance with the National Disaster Plan.

Benefits offered by the Department of Social Services following Hurricane Dorian included food assistance, home repair, assistance to purchase beds and appliances (up to $2,000), rent assistance for displaced hurricane victims (up to $700 per month), and burial assistance for persons who died during the hurricane (up to $5,000) (Freeport News, 2020).

1.7 National Priorities

National priorities specifically related to climate change are included in the 2001 First National Communication, 2014 Second National Communication, 2004 National Policy for Adaptation to Climate Change and the 2015 Intended Nationally Determined Contributions (INDC), and 2022 Updated Nationally Determined Contributions (NDC)

Other national policies and plans that identify priorities with respect to climate change include:

- 1968 Coastal Protection Act
- 1997 Conservation and Protection of the Physical Landscape of The Bahamas Act and Regulations
- 1999 National Biodiversity Strategy and Action Plan
- 2003 The Bahamas Building Code – 3rd edition – Ministry of Works and Utilities
- 2004 National Wetlands Policy
- 2004 The Environmental Health Services Act
- 2005 National Environmental Management and Action Plan
- 2006 The Planning and Subdivision Act
- 2009 The Utilities Regulation and Competition Authority (URCA) Act
- 2010 Disaster Preparedness and Response Act
- 2013 The Bahamas National Energy Policy 2013 -2033
- 2013 The Montreal Protocol (Controlled Substances) Act (Cap. 216A) and Customs Management (Amendment) Act of 2013

- 2013 National Invasive Species Strategy
- 2014 Forestry Act (Amended 2014) and Forestry Regulations
- 2015 National Maritime Policy
- 2015 SIDS DOCK
- 2015 Electricity Act (Renewable Energy) (Amended)
- 2015 Water and Sewerage Corporation Act (Amended)
- 2017 National Tourism Development Strategy 2017-2022
- 2019 Environmental Planning and Protection Act
- 2019 Environmental Protection (Control of Plastic Pollution) Act, 2019
- 2020 Bahamas Power and Light (BPL) requirements for grid interconnection of small-scale renewable energy generation systems
- 2021 National Biodiversity Strategy and Action Plan
- 2021 Civil Aviation Authority Bahamas (CAAB) Environmental Regulation
- 2022 Climate Change and Carbon Market Initiatives Act Bill
- 2022 Carbon Credit Trading Act Bill
- 2022 Grand Bahama Power Company (GBPC) rules and regulations for Renewable Generation Systems (RGS)
- 2022 Disaster Risk Management Act

A National Development Plan (NDP) was drafted in 2017, but has not been approved by Cabinet to be considered an official national document. The drafting of plan involved consultations across the country. Goals in the draft plan relevant to climate change include development of modern infrastructure in the country built to withstand the effects of climate change and rising sea levels and positioning The Bahamas as a leader in researching and implementing climate change adaptation and mitigation measures and as an incubator of green technologies.

The SDG informed policy recommendations report by the National SDGs Technical Committee and SDG Unit of the Office of the Prime Minister made the following climate change recommendations (OPM, 2020):

- Ensuring that support is not given to industries or practices that are not climate resilient including stockpiling oil, encouraging oil drilling or development that increases vulnerability to the impacts of climate change;
- Strengthen national social protection systems and the coherence of disaster management and climate change adaptation policies;
- Build national climate change expertise through capacity development to prepare and respond to all climate risks;
- Increase the number of communities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, and resilience to disasters; and
- Promote mechanisms for raising capacity for effective climate change-related planning and management, focusing on women, youth and local and marginalized communities.

Moreover, in January 2022, the Climate Change & Environmental Advisory Unit (CCEAU) was established, as the technical advisory arm of the Office of the Prime Minister (The Bahamas) to provide support on matters of the blue and green economy, renewable energy, reduction in the use of fossil fuels, carbon credits, large scale climate change mitigation and adaptation projects, climate risk insurance and the other progressive climate policy agenda items.

1.8 The Environment

The environment of The Bahamas is characterised by coastal and marine habitats and ecosystems that are areas with high productivity, biological diversity and natural beauty (Newbold, 2016). These attributes have been the foundation of the country's tourism-based economy for decades and provide opportunities for sustainable livelihoods, including ecotourism and sustainable harvesting. Sustainable forestry is an area that the Government is exploring through the GEF Pine Islands project. Sustainable fisheries is being promoted through the Marine Stewardship Council certification program for spiny lobster in The Bahamas.

Exploring opportunities for economic growth linked to sustainability and the environment are vital for The Bahamas. The country must find ways to adapt to the shocks of increasingly frequent hurricanes associated with climate change. If immediate and significant mitigation action is not taken globally, even diversifying its economy to these sectors may not make The Bahamas sufficiently resilient to the severe impacts of climate change.

1.8.1. Land use, land use changes and forestry

The thin, dry, calcareous soils of The Bahamas are generally low in fertility and soon become exhausted when used for farming. Historically, subsistence farming was a common activity. The slash and burn farming method would see large plots cleared and the foliage burnt so that the ashes would quickly return a small amount of nutrients to the soil. The land would typically become exhausted after a few seasons of farming and when yield dropped significantly, a new area was cleared. Due to the rapid spread of this type of agriculture, most islands now have very little old growth or pristine forests.

Large scale agricultural operations including cotton, citrus, pineapple, sisal, tomatoes and watermelon have seen limited or short-lived success in the thin Bahamian soil.

The tourism industry has boomed in recent decades and luxury resorts are being built throughout The Bahamas. Coastlines of New Providence, in particular, have been extensively cleared for hotels, luxury housing complexes and private homes. The interior of the island is also subject to unprecedented urban sprawl. Large tracts of land are being cleared for housing and business developments as well as road construction. Other islands in the archipelago have also been affected by rapid urbanization and development.

The lumber industry in the 20th century devastated the pine forests of The Bahamas. A sawmill operated in Abaco until 1943, and then Grand Bahama until 1970, leaving the pine forests virtually denuded. Similar operations in New Providence and Andros were much smaller though they amounted to similar effects on the environment. Abaco currently has the largest area of pine forest habitat in The Bahamas, but very few of the original trees remain standing there. After its eclipse, the logging industry left numerous logging and access roads throughout the aforementioned islands, which are now used by hunters in those islands and, to a limited extent, bird watchers and persons participating in ecotourism.

The Abaco species of the Bahama Parrot is currently known to be the only Amazon parrot to nest in ground cavities. It has been suggested that this may be in response to the removal of the vast majority of trees large enough to hold nesting cavities as is normal for the parrots in Inagua. Stahala (2004) and Gnam (1990 & 1991) discuss the ecology and conservation of the ground nesting Bahama parrot. The pine forests are recognized as an important and exploitable resource. The restoration of the forests is important to the viability of future sustainable use activities as well as to the many under-storey broadleaf plants, orchids, bromeliads, ferns and vines. Crabs in the forests of Andros are an intimate part of that island's heritage and culture.

1.8.2. Marine and coastal habitats

Marine and coastal habitats of The Bahamas include coral reefs, seagrass beds, mangroves, sandy beaches, and rocky shorelines. The health of these habitats are important to ensuring resilience of the islands of The Bahamas. With unplanned and unregulated development, these are often some of the most impacted habitats, particularly for tourism-based development.

The Bahamas Coral Reef Report Card, Volume 2011 – 2013 classifies Bahamian reefs as impaired overall (Dahlgren et al, 2016). Other key findings of the report include (Dahlgren et al, 2016):

1) Lower live coral cover on Bahamian reefs than on other Caribbean reefs;
2) Low coral recruitment (though similar to the rest of the Caribbean);
3) Reef structure, parrotfish populations were scored as fair in most areas surveyed; and

4) Large groupers were fairly common on Bahamian reefs but practically absent from the rest of the Caribbean. Grouper populations were healthiest in the Exuma Cays. It is important to note that the Exuma Cays Land and Sea Park is a marine protected area in the Exuma chain.

Key threats to coral reefs include climate change. Climate-related changes in habitat include coral bleaching as a result of increasing sea surface temperatures, rising sea levels, and coastal erosion. Impacts on the marine environment specifically, will be felt across ecosystems like coral reefs, and mangroves due to changes in sea level. With changes to these ecosystems, we may also see changes in populations of marine and terrestrial organisms that are dependent on these ecosystems for the various ecosystem services they provide (NBSAP, 2021).

1.8.3. Biodiversity

The distinct environment of The Bahamas gives rise to numerous irreplaceable habitats and species, including vast expanses of Caribbean pine forest, tidal flats with thriving bonefish populations, extensive barrier reefs, the highest concentration of blue holes in the Western Hemisphere, and critical fish nursery habitat believed to contribute significantly to fisheries stocks throughout the Caribbean region. The insularity and extensive carbonate shelf with productive coral reefs and other habitats, plus a large area of coastal wetlands, especially mangrove forests, contribute to the abundance and diversity of fish. Rare, critically endangered, and endemic species can also be found in The Bahamas including the Bahama parrot, several species of Rock iguana, Kirtland's warbler, West Indian flamingo, Hutia, Smalltooth sawfish, Queen conch, and Loggerhead, Hawksbill, and Green turtles.

Important, and easily-recognized, Bahamian ecosystems include — but are not limited to — the following:

- Pine woodland (forest) – northern islands
- Coppice – central and southern islands

- Wetlands – may be allocated amongst five categories: mangrove swamps and marshes, beach vegetation, swashes, pine forests/barrens, broad-leaf coppice. Mangroves are dominated by one or more species of mangrove (*Avicennia, Laguncularia* and *Rhizophora,)*.
- Seagrass beds – dominated by turtle grass (*Thalassia testudinum*)
- Coral Reefs – of great significance in terms of Bahamian biodiversity
- Other shallow water marine habitats – rock and unvegetated sediments
- Caves, sinkholes and blue holes

In partnership with BirdLife International, the Bahamas National Trust (BNT) is in the process of developing a climate change adaptation strategy for the national parks and Key Biodiversity Areas (KBAs) on the islands of Grand Bahama, Abaco, New Providence, Andros, Eleuthera, Exuma, San Salvador and Inagua.

1.9 Institutional arrangement for preparation of NCs and BURs

The UNFCCC has prepared a toolkit to provide recommendations to non-Annex I Parties on establishing and maintaining institutional arrangement for preparing national communications (NCs) and biennial update reports (BURs). These recommendations include the following (UNFCCC, 2013):

- A single body be designated to be responsible for the overall coordination and management of the process and preparation of NCs and BURs.
- Due to volume and diversity of information required to prepare these reports, providers of key information should be identified and their roles and responsibilities within the process clearly defined.
- It is strongly recommended that the process, roles and responsibilities, including procedures for the flow of information, be formalized through an MOU or other formal agreement between the coordinating body and key stakeholders.

The initial discussion of institutional arrangements was held during stakeholder workshop for the Project Identification Plan phase of this project. Through the development of the BUR, these discussions have been further refined.

1.9.1. Current institutional arrangements

The Bahamas has never submitted a Biennial Update Report. However, past reports to the UNFCCC including its FNC and SNC were prepared through a collaborative effort of the National Climate Change Committee (NCCC) under the Bahamas Environment, Science and Technology (BEST) Commission (now the Department of Environmental Protection and Planning, DEPP). Experts from various Government and non-Governmental organizations were members of the Committee and responsible for either drafting sections of each Communication or reviewing sections. Some sections were developed by consultants, such as greenhouse gas inventory and vulnerability and adaptation assessments. A project manager was tasked with ensuring all the information provided by both Committee members and consultants was compiled into the final reports.

Figure 16: Institutional framework for 2001 First National Communication (FNC)

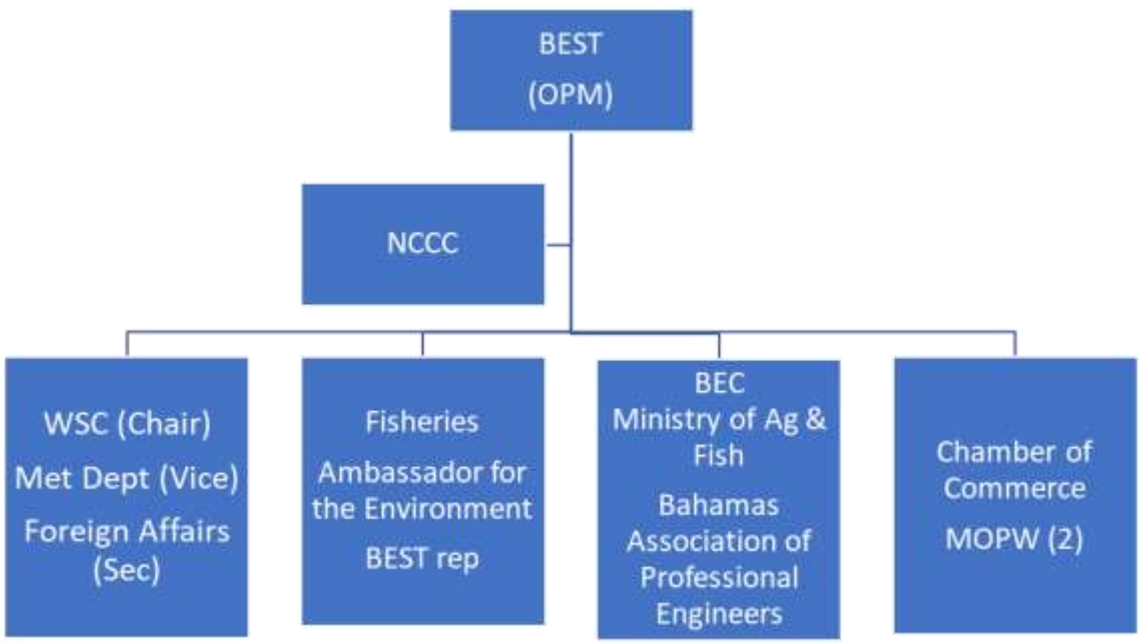
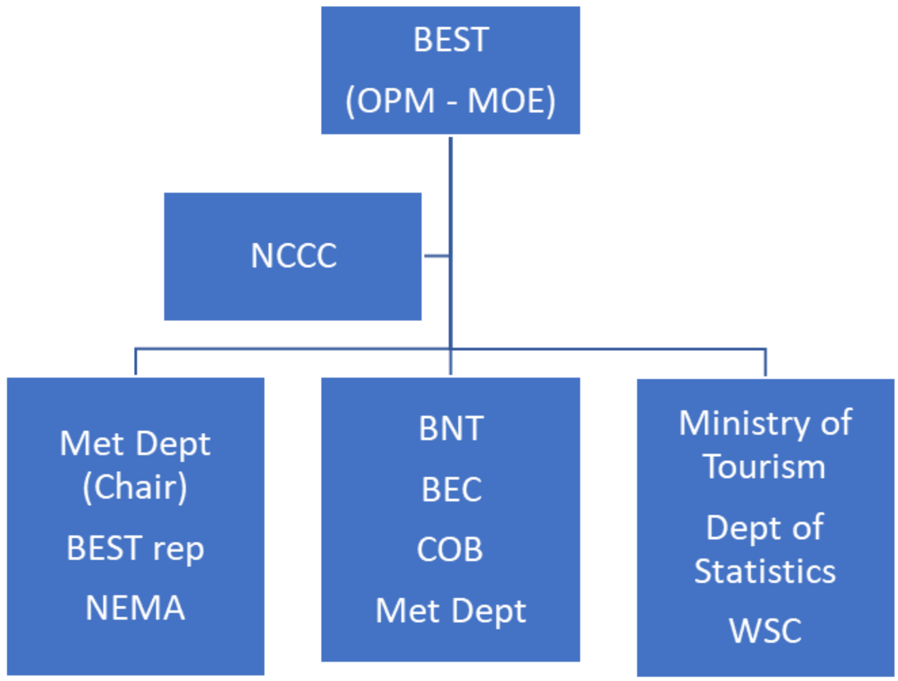


Figure 17: Institutional framework for the 2014 Second National Communication (SNC)



The TNC and BUR1 process is currently being led by DEPP and the NCCC. Again, consultants have been engaged to complete the various chapters of both documents. The project manager is a staff member of The Climate Change & Environmental Advisory Unit (CCEAU), a technical advisory arm of the Office of the Prime Minister (OPM), and all chapter drafts are reviewed by the project team members and the NCCC. NCCC members have also supported the process through provision of information and data from their respective organizations as well as ensuring the chapters accurately reflect circumstances in The Bahamas and future plans for addressing climate change.

The following agencies are currently represented on the NCCC:

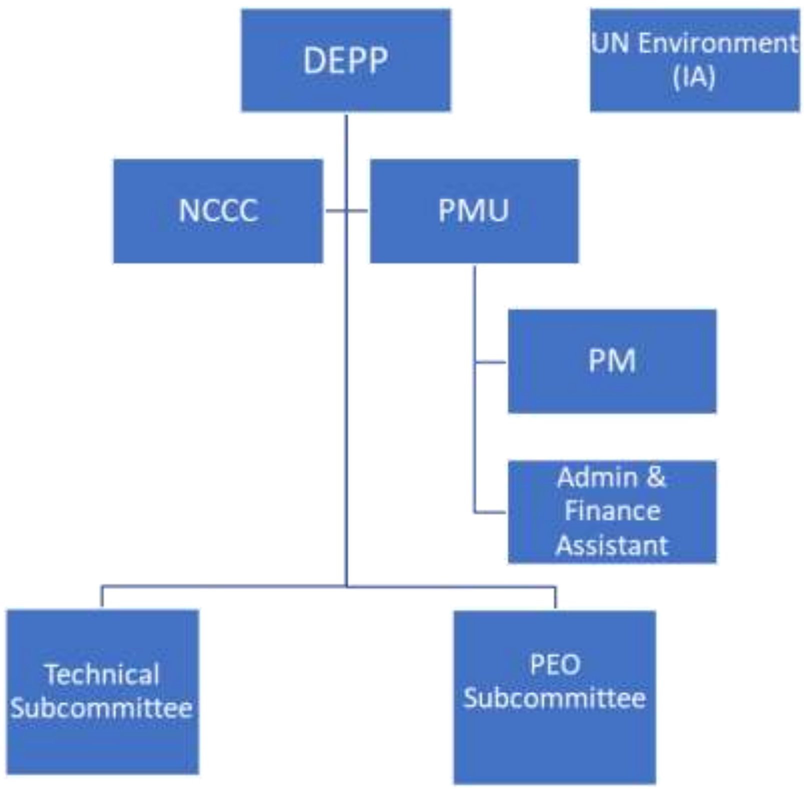
1. DEPP – Department of Environmental Protection and Planning
2. BDM – Bahamas Department of Meteorology
3. DMR – Department of Marine Resources
4. DMU - Disaster Management Unit (Department of Social Services)
5. DOA – Department of Agriculture
6. Department of Gender & Family Affairs

7. Department of Statistics (Bahamas National Statistical Institute)
8. Forestry Unit
9. MOHW – Ministry of Health and Wellness
10. MOWI – Ministry of Public Works
11. MOT – Ministry of Tourism
12. Ministry of Transport & Local Government
13. NEMA – National Emergency Management Agency
14. OPM – Office of the Prime Minister of The Bahamas
15. Port Department
16. UB – University of The Bahamas
17. BAHFSA - Bahamas Agricultural Health and Food Safety Authority
18. BMA – Bahamas Maritime Authority
19. BPL – Bahamas Power & Light Company Limited
20. WSC – Water & Sewerage Corporation
21. BNT – Bahamas National Trust
22. BPAF – Bahamas Protected Area Fund
23. BREEF – Bahamas Reef Environment Educational Foundation
24. TNC – The Nature Conservancy
25. BCCEC – Bahamas Chamber of Commerce & Employers’ Confederation

1.9.2. New institutional arrangements

It is recommended that the institutional arrangement outlined in Figure 18 be established for the TNC-BUR1 process and be utilized moving forward to facilitate the preparation of NCs and BURs

Figure 18: Recommended institutional arrangement for NC-BUR preparation



As the UNFCCC Focal Point, DEPP will serve as the Coordinating Body for the NC-BUR process. Its responsibilities will include:

1. Identify all institutions and teams that will be involved in the preparation of the NC and BUR, including establishing any formal working arrangements.
2. Ensure that the Project Management Unit (PMU) is adequately staffed throughout the NC and BUR preparation process.
3. Allocate responsibilities for all components of the NC and BUR ensuring that there is a clear lead for each section, and establish a formal approval process.

4. Develop and maintain an archiving system to ensure institutional memory.
5. Keep stakeholders informed of any emerging issues related to climate change and the UNFCCC.

Specific responsibilities of the PMU will include:

1. Plan and conduct all coordination and consultation activities with stakeholders.
2. Develop and monitor a timeframe and schedule for the preparation of the NC and BUR, including specific milestones and dates for deliverables.
3. Keep stakeholders informed of progress and any emerging issues related to NC and BUR.
4. Develop and oversee the implementation of a quality assurance strategy for the reports.
5. Manager the overall budget for the preparation of reports.
6. Document systematically all the assumptions, data and methods used to prepare the reports.
7. Integrate and compile all sections of the NC and BUR into a cohesive document.
8. Conduct an evaluation exercise to identify key lessons learned and areas for improvement.

For any GEF-funded projects, DEPP will liaise with UN Environment as the Implementing Agency (IA).

A Project Management Unit (PMU) will be created within DEPP, consisting of a project manager and assistant for administrative and finance issues related to NC-BUR preparation. The NCCC will continue to fulfil its role with respect to the UNFCCC. Over time, the capacity of the Committee will be built to develop all chapters within the reports without the need for external consultants.

The NCCC will create two subcommittees:

- **Technical Subcommittee** – This Subcommittee will provide technical expertise for the five Technical Expert Group (TEG) areas – GHG Inventory, V&A Assessment, Mitigation Analysis, Environmentally Sound Technologies (EST) and

Research & Systematic Observations (RSO). Recommended agencies to be represented include: Bahamas National Statistical Institute (formerly known as the Department of Statistics), BDM, DMR, DOA, MOWU (MOPW), Road Traffic Department, BPL and WSC.

- **Public Education & Outreach (PEO) Subcommittee** – This Subcommittee will be responsible for the sixth TEG area. Recommended agencies to be represented include Bahamas Information Services (BIS), Department of Gender & Family Affairs, Ministry of Education, UB, BREEF, BCCEC and Bahamas Press Club.

Table 11: Recommended duties for Technical Expert Groups (TEG)

	TEG	**Recommended Duties**
Technical Subcommittee (TEGs 1 through 5)	Greenhouse Gas Inventory	1. Advise on selection and application of appropriate inventory methodologies. 2. Assist in data quality assistance and key source analysis. 3. Recommend the ways of improvement of the national emission actors. 4. Contribute substantially to development of the *National Inventory Report* and identify the follow-up activities. 5. Assist the PMU in arrangement of the national review and training workshops on improving quality of the national GHG inventory. 6. Make suggestions on technical capacity building and participate in the subregional, regional and

		international training on GHG inventory.
	Vulnerability & Adaptation Assessment	1. Advise on selection of appropriate methodologies to assess vulnerability and adaptation. 2. Oversee the development of climatic scenarios and selection of relevant methodologies. 3. Supervise/conduct an assessment of vulnerability and climate change impact. 4. Contribute substantially to development of the National Strategy on Adaptation to Climate Change and identify the follow-up activities. 5. Help the PMU to organize the national review and training workshops on vulnerability and adaptation measures. 6. Make suggestions on capacity building and participate in the subregional, regional and international trainings on integrated assessment modeling.
	Mitigation Analysis	1. Assist the PMU in search and choice of appropriate training courses on applying macro-economic models. 2. Advise on selection of macro-economic models for evaluating mitigation options and measures for GHG emission reduction.

		3. Overview and select measures to mitigate climate change and identify the follow-up activities. 4. Assist the PMU in arranging the national review and training workshops on climate change mitigation measures. 5. Suggest on technical capacity building and participate in the subregional, regional and international trainings on mitigation measures analysis.
	Environmentally Sound Technologies	1. Advise on selection of priority technological needs. 2. Analyze the cost-effectiveness of the technologies and the opportunities for their application. 3. Assess the existing endogenous technologies for further promotion within the context of national circumstances. 4. Contribute substantially to the establishment of a database for ESTs, including both mitigation and adaptation technologies. 5. Identify the follow-up activities 6. Assist in arranging the national review and awareness raising workshops on ESTs and participate in the subregional, regional and international trainings on ESTs.

	Research & Systematic Observations	1. Assess the existing system for early warning on extreme weather events and methods of seasonal forecasting. 2. Analyze the existing barriers for development of observation systems and research, and identify the follow-up activities *3.* Contribute substantially to development of the *National Information Report on Research and Systematic Observation.* 4. Assist the PMU in arranging the national review and awareness raising workshops on research and systematic observation, and participate in the sub regional, regional and international trainings on the matter.
PEO Subcommittee (TEG 6)	Education, Training & Public Awareness, Information & Networking, Capacity-building	1. Compile and analyse information on activities/tasks relating to the implementation of the New Delhi work program on Article 6 of the Convention. 2. Compile and analyse information on activities/tasks relating to the implementation of the capacity-building framework of the UNFCCC. 3. Identify the needs and priorities for climate change education, training and public awareness and capacity-

		building as they relate to the other 5 TEGs. 4. Liaise and consult with the various TEGs. 5. Assist in implementation of the National Plan for Article 6 of the Convention and the UNFCCC capacity-building framework. 6. Identify technology needs for information and networking. 7. Assist the PMU in organizing workshops on ways to promote climate change education, training and public awareness. 8. Substantially contribute to chapters in the NC on (i) Education, Training and Public Awareness, (ii) Information and Networking, and (iii) Capacity-building.

Chapter 2 – Domestic measurement, reporting and verification (MRV)

2.1 Introduction to Measurement, Reporting and Verification (MRV) Systems

A national climate MRV system can be defined by the characteristics of what is measured, reported, and verified when it comes to a country's climate action under its main functional components such as mitigation and greenhouse gas emissions, adaption, and support. The interaction between system inputs and its defined outputs are critical to build understanding of emissions trends and feasible strategies and policy actions for addressing climate change. Historically since 2002, when the basis for non-Annex I reporting to the United Nations Framework Convention on Climate Change (UNFCCC) was established, developing country parties have strived to implement these systems cognisant of their nation priorities and circumstances. Today, through the Paris Agreement, defined more recently in the Glasgow Pact, Parties are required to implement the Enhanced Transparency Framework (ETF) with common reporting tables and formats (with flexibility provisions) to build mutual trust and confidence and promote the effective implementation of actions. Through this work during The Bahamas' Third National Communications/First Biennial Update Report (TNC/BUR1) cycle as well as previous and on-going climate projects, the Government of The Bahamas has positioned itself on a path towards establishing a comprehensive and all-encompassing MRV system through its National Climate Change Committee (NCCC) and intensive capacity building of local experts to meet the demands of the newer reporting requirements. Through its implementation and continued prioritization for future reporting cycles, it is envisaged that this system will measure, report, and verify the following activities and actions in adherence with the Transparency, Accuracy, Completeness, Comparability, and Consistency (TACCC) principles:

- Activities that cause climate change (Greenhouse Gas Inventory (GHGI));

- Actions taken that prevent climate change (mitigation actions and Nationally Determined Contributions (NDC) implementation progress);
- Climate change impacts and adaptation;
- Actions taken to adapt to climate change (adaptation actions and NDC implementation progress); and
- Financial and other support needed and received for undertaking actions above.

2.2 Institutional arrangements related to MRV

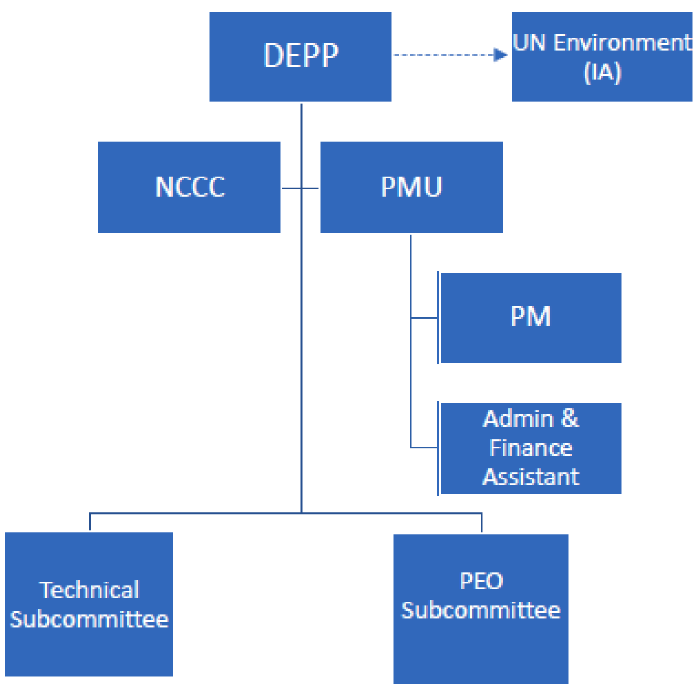
Small Island Developing States (SIDS) member countries are widely considered to be some of the first countries to experience the adverse effects of climate change though they are amongst the least responsible in terms of global GHG emissions. Recent evidence indicates that these adverse effects are already occurring in the Latin America and Caribbean (LAC) region. The Bahamas is a SIDS member country and although its overall GHG emissions profile is small, it has prioritised the need to provide the domestic and international community with the required reports highlighted in the Paris Agreement that adhere to the TACCC principles in an effort to demonstrate leadership and commitment to action to combat this global issue.

Like many other developing countries, The Bahamas faces challenges in this process due to limited human, technical and institutional capacity within their local teams. To overcome these obstacles for previous reporting (namely, the NC1 and NC2), The Bahamas engaged regional and international consultants to conduct the relevant planning and preparation activities to meet its reporting obligations.

Analysis of historical information revealed a lack of documented and archived datasets (inclusive of methodologies and expert judgement) from previous reporting events, that hindered the opportunity to improve reporting through the latest NC3/BUR1 reporting cycle. Previous reports were conducted using a decentralized, project-based MRV system.

Cognizant of the obstacles faced in previous reporting cycles and an understanding of the necessary improvements to previous institutional arrangements, The Bahamas decided to use the opportunity of the NC3 and BUR1 reporting cycle to move from a decentralized project-based system to a centralised project-based system. To achieve this goal, the Party prioritised the enhancement of technical and institutional capacity of the local team; through capacity building activities conducted by the different consultant teams during their identified tasks for the relevant reporting requirements. An example of this approach can be seen through the Greenhouse Gas Inventory (GHGI) compilation process where technical aspects led by regional consultants in a collaborative fashion with national experts simultaneously underwent targeted training. These activities included both GHG inventory compilation training and hands-on participation in data collection, and a UNFCCC quality assurance review during inventory compilation.

Figure 19: Institutional arrangements for the development of The Bahamas' Third National Communication and First Biennial Update Reports



2.3 Overall coordination of MRV

The government structures relevant to climate MRV are led by The Department of Environmental Planning and Protection (DEPP). DEPP has the role and responsibility of overseeing and convening The Bahamas National Climate Change Committee (NCCC) and the Project Management Unit (PMU), which lead in the compilation of, required reports. The PMU also oversees the implementation of procurement and deliverables produced from national, regional, and international project-based consultants. DEPP ultimately provides final validation and approval, prior to report submission to the UNFCCC.

The NCCC provides strategic level guidance on climate change related activities, policies, and plans as well as functioning as the National Project Advisory Committee for national reports to the UNFCCC or other climate entities and provides strategic direction and oversight to the implementation of the UNFCCC objectives. The NCCC is a multi-disciplinary and multi-sectoral body and as of February 2022 includes representatives from government, private and civil agencies that are guided by an agreed upon Terms of Reference.

It should be noted for historical context that the NCCC was established in 1996 by The Bahamas Environment Science and Technology (BEST) Commission while under the Office of the Prime Minister, and now chaired and led by the Department of Environmental Planning and Protection (DEPP) (formerly BEST Commission). The DEPP, apart from its role as the chair of the NCCC, is also the UNFCCC and GEF operational focal point, and coordinates the preparation and presentation of all reporting requirements to the UNFCCC.

Regionally, The Bahamas has worked with other CARICOM countries on climate MRV elements vis a vis an executed Memo of Understanding (MoU) with the Caribbean Cooperative Measurement, Reporting and Verification Hub (MRV Hub) (2019-2023), the Regional Framework for Achieving Development Resilient to Climate Change (2009-2015), and through regional Green Climate Fund (GCF) projects, such as institutionalizing a common framework for climate finance MRV (2021 – under implementation), and building capacity for regional approaches to climate action in the Caribbean (2019 – under implementation). The Bahamas has successfully engaged regional partners, namely the MRV Hub (for mitigation MRV), and the Caribbean Community Climate Change Centre (5Cs) (for finance MRV).

2.3.1 Legal arrangements for domestic MRV

The Bahamas ratified the Paris Agreement under the UNFCCC on 22nd August 2016 and further enshrined it into law in 2022 via The Climate Change and Carbon Markets Initiatives Act. The Bahamas has the responsibility to meet the climate change reporting requirements of the Paris Agreement, including the Enhanced Transparency Framework (ETF). Nationally, The Bahamas currently lacks a detailed, comprehensive, and unambiguous legal framework for national climate MRV. However, there does exist legal context that has relevance to components of climate MRV.

Within the context of climate MRV, The Bahamas has several pieces of legislation that address natural resources management and environmental protection. Table 12 identifies the existing laws and policy frameworks with a brief summary noting their key aspects in the context of climate change MRV.

Table 12*:* Existing legal arrangements that are relevant for climate MRV

Identified Law/Political Framework	Summary of Key aspects in the context of Climate Change
The National Policy for the Adaptation to Climate Change (2006)	Specifies institutional climate MRV roles and responsibilities. Namely, that the NCCC, or its successor body shall monitor implementation of the National Climate Adaptation Policy; and that Government shall review the mandate, terms of reference, and composition of the NCCC with a view to better equipping it to fulfil its monitoring role. The NCCC shall report to the Cabinet

	of Ministers through the Ambassador for the Environment and the Minister responsible on a semi-annual basis, as well as at any other time deemed necessary. The NCCC shall present to Cabinet and the House of Assembly an annual report on measures that have been undertaken to implement this policy. The policy does not specify indicators that should be monitored.
National Energy Policy (2013)	Specifies specific sector indicators that should be monitored and for which targets should be set. While the policy states that a government designated entity should monitor the policy, the designated entity, and its role in monitoring indicators or setting targets is not described within the policy.
Forestry Act (2010), Amended (2014)	Establishes the Forestry Unit and specifies that the Director of Forestry should conduct forest inventories. Forest inventories provide activity data for estimating emissions or reductions within a national GHG inventory or a mitigation assessment
Electricity Act	Establishes the organisation of The Bahamas Electricity Sector. Of relevance to the climate MRV system, it describes the process, authorization, and enforcement mechanisms for public electricity suppliers and renewable energy formulation, procurement, and approval. The Act describes the formulation of renewable electricity plans and specifies that public electricity suppliers shall develop in writing for the Utilities Regulation and Competition Authority's approval of an annual report on the accomplishments made against the approved plans. Inclusions in these plans include renewable energy policy statements, minimum percentages of electricity products from eligible renewable electricity resources, specified dates, reports, and mechanisms for review. The Utilities Regulation and Competition Authority is to approve plans as consistent with the sector policy objectives and the national energy policy.

Environmental Planning and Protection Act (2019)	Created provisions for ensuring the ease of doing responsible business by creating a streamlined process, which requires individuals to obtain environmental clearances before commencing projects. The Ministry of the Environment and Housing has published subsequent supporting regulations. Under Section 12 of the EPPA, the Ministry has issued the *Environmental Impact Assessment Regulations (EIARs) 2020.*
Statistics Act	Specifies the development of a National Statistical Strategy and National Statistical System. This system is to set standards for collecting, compiling, analysing, and publishing official statistics. The body to implement this strategy and system development will be called The Bahamas National Statistical Institute.
Climate Change and Carbon Market Initiatives Act (2022)	Codifies the Paris Agreement into law. Legal mandate outlined related to institutional arrangements between key agencies tasked with supporting climate action (i.e. the Office of the Prime Minister, Ministry of Finance and Ministry of the Environment). Establishes a national emissions registry, and outlines deadlines for reporting related to Article 6 and Article 13 of the Paris Agreement. Outlines responsibility in reporting to The Prime Minister, Ministers, and the House of Assembly. Lays down framework for regulations to further strengthen MRV and national climate change response.

The Bahamas is also party to various international multilateral environmental agreements (MEAs) including the three "Rio Conventions" - the United Nation Convention to Combat Desertification (UNCCD), the United Nation Convention on Biological Diversity (UNCBD), and the United Nation Framework Convention on Climate Change (UNFCCC). The Bahamas ratified the UNFCCC in 1994 and has also ratified the subsequent Kyoto Protocol in 1999, and the Paris Agreement in 2016.

2.3.2 Informal arrangements for domestic MRV

The Bahamas has numerous departmental strategy and planning documents are inclusive of climate MRV components. These strategies and planning documents serve as guiding documents, however, and are not necessarily indicative of formalized MRV roles or responsibilities.

2.3.3 Stakeholders involved in MRV

The Bahamas has a strong set of stakeholders involved in climate MRV. Specific roles and responsibilities for each stakeholder have not yet been established. Many of the stakeholders listed in Table 13 carry out MRV activities across multiple climate pillars and/or multiple MRV components.

Table 13*:* MRV system stakeholder list, roughly allocated across the three climate pillars

Primary climate pillar within MRV system ***Agencies may serve in multiple areas and/or sector expertise.***	**Agency or Institution**	**Sector/Expertise**
Institutional Coordination & Leadership	**Department of Environmental Planning and Protection (DEPP)**	Institutional
	National Climate Change Committee (NCCC)	Institutional
Mitigation & GHG Inventory	**Department of Agriculture, Ministry of Agriculture and Marine Resources**	Agriculture
	Bahamas Agricultural Health and Food Safety Authority (BAHFSA)	Agriculture
	Bahamas Agriculture and Marine Science Institute (BAMSI)	Agriculture

	Forestry Unit	LULUCF
	The Nature Conservancy	LULUCF
	Lands and Surveys	LULUCF
	The Bahamas National Trust (BNT)	LULUCF
	Bahamas Power and Light (BPL)	Energy
	Grand Bahama Power Company (GBPC)	Energy
	Freeport Oil Company (FOCOL)/Sun Oil Limited	Energy
	Rubis Bahamas Limited	Energy
	Sol Petroleum Bahamas Limited (ESSO)	Energy
	St. George's Cay Power Company	Energy
	Morton Salt Company - Power Company Division	Energy
	Bahamas Bureau of Standards and Quality (BBSQ)	Energy
	Utilities Regulation & Competition Authority (URCA)	Energy
	Road Traffic Department	Transport
	Engineers & Consultants Ltd	Transport
	Port Department	Transport
	Ministry of Transport and Housing	Transport
	Bahamas Maritime Authority (BMA)	Transport
	Buckeye Bahamas Hub Limited (BBH)	Transport
	Ministry of Public Works (Deputy Director of Works)	Transport
	Grand Bahama Port Authority (GBPA)	Transport

	New Providence Ecology Park	Waste
	Bahamas Waste	Waste
	Water and Sewerage	Waste
	Department of Environmental Health Services (Waste)	Waste
	Department of Environmental Health Services (National Ozone Unit)	IPPU
Adaptation	**Department of Marine Resources**	Water & Coastal Zone Resources
	University of The Bahamas, Climate Change and Adaptation Centre	Adaptation and Resilience
	Department of Gender & Family Affairs, Ministry of Social Services & Urban Development	Gender & Vulnerable Groups
	Ministry of Health and Wellness	Water & Coastal Zone Resources
	Bahamas Reef Environment Educational Foundation (BREEF)	Water & Coastal Zone Resources
	Islands Laboratory, University College London	Adaptation and Resilience
	National Emergency Management Agency (NEMA)	Adaptation and Resilience
	Disaster Reconstruction Authority (DRA)	Adaptation and Resilience
	Immediate Disaster and Emergency Assistance (IDEA) Relief	Adaptation and Resilience

	Department of Meteorology	Data and Information
	Ministry of Public Works	Urban Development & Infrastructure
Support	**Bahamas Development Bank (Climate Change/Blue Economy/Green Economy)**	Finance & Economic Development
	Central Bank of The Bahamas	Finance & Economic Development
	Ministry of Finance	Finance & Economic Development
	Prime Minister Delivery Unit	Finance & Economic Development
Crosscutting	**Bahamas Technical and Vocational Institute (BTVI)**	Education
	Sustainable Development Unit (OPM)	Finance & Economic Development
	Citizen Security and Justice Programme (CSJP) (Vulnerability/Gender)	Gender & Vulnerable Groups
	Bahamas National Statistical Institute (BNSI)	Data and Information
	Organization for Responsible Governance (ORG)	Governance

	The Bahamas Chamber of Commerce and Employers' Confederation	Finance & Economic Development
	Office of the Attorney General	Legal Affairs
	University of The Bahamas (Government and Public Policy Institute)	Education

2.4 GHG inventory, mitigation, adaptation, and support MRV

The Bahamas is working towards further developing MRV system components that move from a project-based (linear) system to an on-going, recurring system (cyclical). Until further development is completed, typical information management systems and cross-coordination of MRV work within each climate change pillar (mitigation, adaptation, support) will be limited. The system utilized for this report can be described, generally across each of the pillars, as the system utilized is the same. Future needs (described within the next section), will support the further elaboration of explicit roles and responsibilities, information collection and management, quality assurance and quality control (QA/QC) procedures, continuous standard operating procedures, documentation and archiving of data, and preparation and improvement planning documents.

2.4.1 Data collection and management

In general, data collection agreements and enforcement are not standard amongst broader climate MRV stakeholders in The Bahamas. However, there are isolated data collection mandates in the LULUCF, tourism, agriculture, energy, and transportation sectors. In general, data collection and reporting is directly linked to Ministry or project-based reporting cycles.

The primary data used in the most recent climate reporting, namely the GHG inventory, mitigation assessment, and vulnerability assessment, is done through various national statistical reports (e.g. Central Bank Annual and Quarterly Report, Customs Annual Imports Report) and through ad-hoc requests from members of the NCCC who may collect data sets through operation of agency-specific projects, research, or other mandates. These sources, combined, constitute a solid foundation of data suppliers. The Bahamas National Statistical Institute conducts labour and census surveys. These surveys are on a typical schedule but challenges have been noted in recent history. In general, data surveying and collection is further limited due to training of surveyors, human resources, and stakeholder fatigue due to lack of harmonization, synchronization, and alignment with multiple data collection requests and efforts.

Disaggregated datasets by standardized social, environmental, or economic indicators or parameters (e.g. sex-disaggregated climate data) are limited, but have improved in recent years due to stakeholder participation and international conventions (e.g. climate change, biodiversity, women's health, sustainable development goals). However, where efforts and progress have been made to improve surveys and/or data collection, the resulting data is still limited in its use.

2.4.2 Climate action development and implementation

Similar to data collection and management, mitigation and adaptation actions are developed and implemented by a range of stakeholders and government ministries. Measurement of actions from preparation, implementation, to on-going monitoring phases have yet to be formalised in The Bahamas. Currently, project-based measurement, reporting, and verification of actions are implemented at the direction of climate action funding sources. The implementation of measuring loss and damage is of high priority in The Bahamas, however MRV components have not yet been established for doing so.

2.4.3 Climate pillar sub-committees of the NCCC

In 2022, the NCCC will continue to fulfil its role with respect to the UNFCCC. Overtime, the capacity of the committee will be built to develop all chapters within the UNFCCC reports without the need for external consultants. In anticipation of trying to develop governmental structure to achieve this goal, it has created two subcommittees.

The ***first subcommittee*** is a Technical Subcommittee to provide technical expertise for the five Technical Expert Group (TEG) areas, namely the GHG Inventory, Vulnerability and Adaptation (V&A) Assessment, Mitigation Analysis, Environmentally Sound Technologies (EST), and Research & Systematic Observations (RSO). The following agencies are being recommended to be a member of this subcommittee: Bahamas National Statistical Institute, Department of Marine Resources (DMR), Department of Aviation (DOA), Ministry of Works and Utilities (MOWU) (formerly known as the Ministry of Public Works (MOPW)), Road Traffic Department, Bahamas Power and Light (BPL), and Water and Sewerage Corporation (WSC). The ***second subcommittee*** is the Public Education & Outreach (PEO) Subcommittee to be responsible for the sixth TEG area. Recommended agencies of this subcommittee are to include: Bahamas Information Services (BIS), Department of Gender & Family Affairs, Ministry of Education, University of The Bahamas (UB), Bahamas Reef Environmental Educational Foundation (BREEF), Bahamas Chamber of Commerce (BCCEC) and Bahamas Press Club. Recommended duties for each TEG are detailed in

Table 14.

Table 14: NCCC Subcommittees to support reporting across each climate pillar

Subcommittee	Expert Group	Duties
Technical Subcommittee	**Greenhouse Gas Inventory**	1. Advise on selection and application of appropriate inventory methodologies. 2. Assist in data quality assistance and key source analysis. 3. Recommend the ways of improvement of the national emission actors. 4. Contribute substantially to development of the National Inventory Report and identify the follow-up activities. 5. Assist the PMU in arrangement of the national review and training workshops on improving quality of the national GHG inventory.

Subcommittee	Expert Group	Duties
		6. Suggest on technical capacity building and participate in the sub regional, regional and international training on GHG inventory.
	Vulnerability & Adaptation Assessment	1. Advise on selection of appropriate methodologies to assess vulnerability and adaptation. 2. Oversee the development of climatic scenarios and selection of relevant methodologies. 3. Supervise/conduct an assessment of vulnerability and climate change impact. 4. Contribute substantially to development of the National Strategy on Adaptation to Climate Change and identify the follow up activities. 5. Help the PMU to organize the national review and training workshops on vulnerability and adaptation measures. 6. Suggest on capacity building and participate in the sub regional, regional and international trainings on integrated assessment modelling.
	Mitigation Analysis	1. Assist the PMU in search and choice of appropriate training courses on applying macro-economic models. 2. Advise on selection of macro-economic models for evaluating mitigation options and measures for GHG emission reduction. 3. Overview and select measures to mitigate climate change and identify the follow-up activities. 4. Assist the PMU in arranging the national review and training workshops on climate change mitigation measures. 5. Suggest on technical capacity building and participate in the sub regional, regional and international trainings on mitigation measures analysis.

Subcommittee	Expert Group	Duties
	Environmentally Sound Technologies	1. Advise on selection of priority technological needs. 2. Analyse the cost-effectiveness of the technologies and the opportunities for their application. 3. Assess the existing endogenous technologies for further promotion within the context of national circumstances. 4. Contribute substantially to the establishment of a database for ESTs, including both mitigation and adaptation technologies. 5. Identify the follow-up activities 6. Assist in arranging the national review and awareness raising workshops on ESTs and participate in the sub regional, regional and international trainings on ESTs.
	Research & Systematic Observations	1. Assess the existing system for early warning on extreme weather events and methods of seasonal forecasting. 2. Analyse the existing barriers for development of observation systems and research, and identify the follow-up activities 3. Contribute substantially to development of the National Information Report on Research and Systematic Observation. 4. Assist the PMU in arranging the national review and awareness raising workshops on research and systematic observation, and participate in the sub regional, regional and international trainings on the matter.
Public Education and	**Education, Training, & Public Awareness,**	1. Compile and analyse information on activities/tasks relating to the implementation of the New Delhi work program on Article 6 of the Convention.

Subcommittee	Expert Group	Duties
Outreach Subcommittee	**Information & Networking, Capacity Building**	2. Compile and analyse information on activities/tasks relating to the implementation of the capacity-building framework of the UNFCCC. 3. Identify the needs and priorities for climate change education, training and public awareness and capacity-building as they relate to the other 5 TEGs. 4. Liaise and consult with the various TEGs. 5. Assist in implementation of the National Plan for Article 6 of the Convention and the UNFCCC capacity-building framework. 6. Identify technology needs for information and networking. 7. Assist the PMU in organizing workshops on ways to promote climate change education, training and public awareness. 8. Substantially contribute to chapters in the NC on (i) Education, Training and Public Awareness, (ii) Information and Networking, and (iii) Capacity-building.

2.4.4 Support and climate finance MRV

The Bahamas through the GCF Readiness and Preparatory Support Programme has developed a climate finance MRV methodology and tool for tracking climate support needed and received. The feasibility study[6] conducted to develop this tool provided data for reporting support needed and received. The climate finance MRV tool has yet to be integrated with other finance systems in the Ministry of Finance.

This tool would allow for The Government of The Bahamas to:

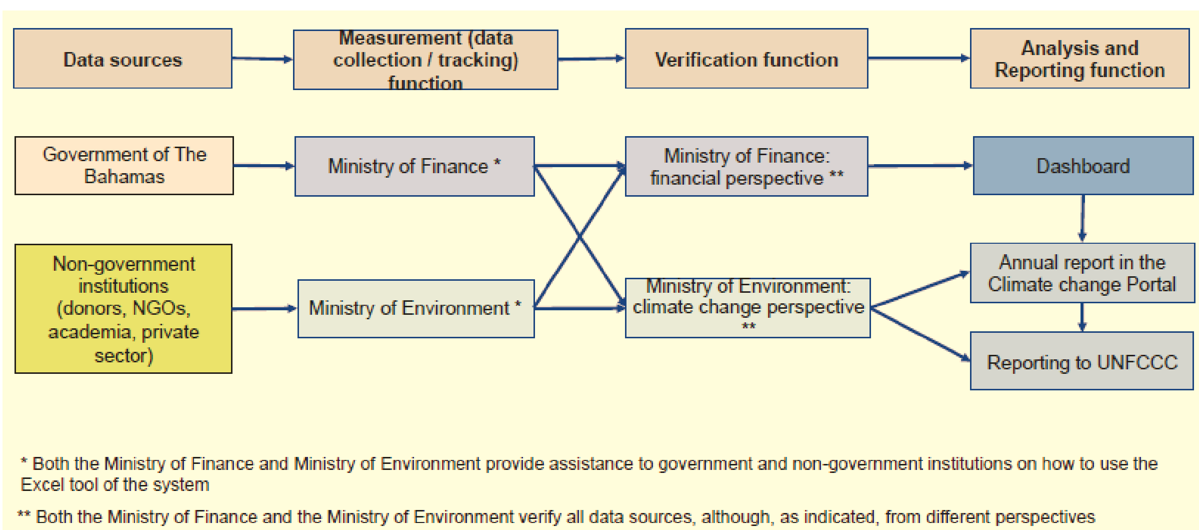
- Have a clear overview of NDC related financial flows, sources, and purposes

[6] Monitoring, Reporting and Verification System Under the GCF Readiness and Preparatory Support in The Bahamas: Feasibility Study Report (2021)

- Indicate the recipients of financial support and identify gaps in sectoral and geographical support
- Demonstrate accountability, transparency, and trust in future United Nations Framework Convention on Climate Change's (UNFCCC) negotiations and to the taxpayers of The Bahamas.
- Through the outputs of the project, the Bahamas intends to determine the following to prioritise its implementation next steps:
- The costs to implement the adaptation and mitigation actions that are outlined in the NDC, using results from a cost analysis
- The investments and finance needed to achieve The Bahamas' adaptation and mitigation priorities as outlined in the NDC

Figure 20 illustrates the proposed institutional arrangements of the climate finance MRV system.

Figure 20*:* Institutional Arrangements for proposed Climate Finance MRV as identified in Climate Finance MRV Manual



It should be noted that the climate finance MRV tool has yet to be integrated with other finance systems in the Ministry of Finance and was considered in the overall MRV assessment conducted during the BUR1 reporting cycle. Proposed institutional arrangements and barriers observed during the aforementioned process formed the baseline for analysis to prioritise recommendations for integration into future MRV system improvements.

2.5 Current progress towards establishment of a domestic MRV system

In an effort to move from a decentralized project-based system and improve transparency, The Bahamas through the TNC/BUR1 project prioritised the need to conduct an MRV system status assessment. Completed in 2022, the status described within this assessment report underscores the key premise of implementing it in the first place - that expectations based on existing decisions under the Paris Agreement will lead to increased levels of scrutiny on adherence to the TACCC principles of countries' reporting and MRV system institutional arrangements. The assessment provided an understanding of the current MRV system barriers and established a starting point for future improvement areas to be made (see Table 15).

Table 15*:* Gaps and needs of improvement identified in The Bahamas MRV system assessment

Identified Gaps	Needs for Improvement
MRV system not yet formally established	Set up MRV system with appropriate administrative capacity with focus on main data source providers involved in multiple reporting sectors.
Data collection, processing and reporting efforts need to yield better data more efficiently.	Establish and implement a sustainable MRV System with appropriate institutional, procedural, and legal arrangements with clear reporting and documentation requirements.
No official legislative or compliance mechanisms	Through the activities identified in the Capacity Building for Increased

	Transparency (CBIT)[7] project, conduct analysis of current legislation and policies and use recommendation for drafting of new policies that mandate the execution and continuity of climate-related institutional arrangements and activities that are internationally binding (example- reporting under the Paris Agreement, etc.)
No established data sharing agreements amongst stakeholders	Implement standardized operating procedures and agreements for data sharing to regularly collect data and reporting across all economic sectors
Need for greater public awareness around climate change initiatives	Conduct education and awareness campaigns from primary education level to broader public awareness campaigns. Public buy-in will foster political buy-in, which will be necessary for government stakeholders to continue their commitment to climate MRV.
Lack of Institutional and Human capacity to operate envisaged MRV System	Increase in number of staff hires, particularly full-time staff, to meet the demands of new national commitments for enhancing national climate MRV systems, and other related permanent functions such as participation in National GHG Inventory preparation,

[7] Building The Bahamas capacity in transparency for climate change mitigation and adaptation

	tracking of NDC goals, gender experts, and climate support tracking.
No established MRV QA/QC procedures	Embed QC procedures throughout the MRV system, and enact a set of QA procedures to assess the accuracy of final reports
No established MRV data archiving procedures	Embed data archiving procedures throughout the MRV system to ensure no loss of instituionalised or historical data for future Party reporting cycles
Lack of formal performance indicators to monitor mitigation and adaptation actions	Develop and track set of national MRV performance indicator to monitor the implementation and progress of mitigation and adaptation actions.
Insufficient domestic allocation for funding MRV system	Increase domestic allocation of funding to implement climate goals and monitor execution in the medium to long term

The Bahamas MRV assessment was conducted over nine months and also informed an initial “roadmap” of prioritised set of recommendations. The roadmap builds out a step-by-step process that, if implemented, will move The Bahamas towards a centralised project-based system, and then to an eventual centralised on-going system. The roadmap sets out prioritized activities across the following MRV system component areas:

- Legal framework(s)
- Institutional formal and informal procedural agreements or arrangements
- Data sources and data collection procedures
- Documentation of resource (financial and human resource) allocation
- Country-specific planning or preparation documents
- Quality assurance and quality control procedures
- Type and number of reporting documents
- Methodologies applied for estimation

- Information management and archiving procedures
- Stakeholder engagement

Furthermore, domestically, it is expected that this future MRV system will allow for the Government of The Bahamas to:

- Demonstrate transparency, accountability, and trust to the taxpayers of The Bahamas
- Determine the impacts and costs of climate change actions
- Determine the investments needed to achieve The Bahamas' adaptation and mitigation priorities
- Track progress of climate policies to improve implementation and ensure climate priorities and outcomes are achieved

Chapter 3 – National Greenhouse Gas (GHG) Inventories

Introduction

This chapter presents The Bahamas's national GHG inventory for the years 2001-2018, prepared in line with the IPCC 2006 Guidelines for national GHG inventories. The inventory scope covers the geographical borders of The Bahamas. Gases covered are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While it is assumed that emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are at least likely to occur, the necessary data to perform estimates for these gases were not available. The Bahamas intends to move towards covering these gases in future GHG inventory submissions.

The Global Warming Potential (GWP) values from the IPCC's 5th Assessment report[8] were used (see Table 16).

Table 16: Global warming potentials used

Gas	GWP
CO_2	1
CH_4 (from biogenic sources)	28
CH_4 (from fossil sources)	30
N_2O	265

3.1. Inventory preparation

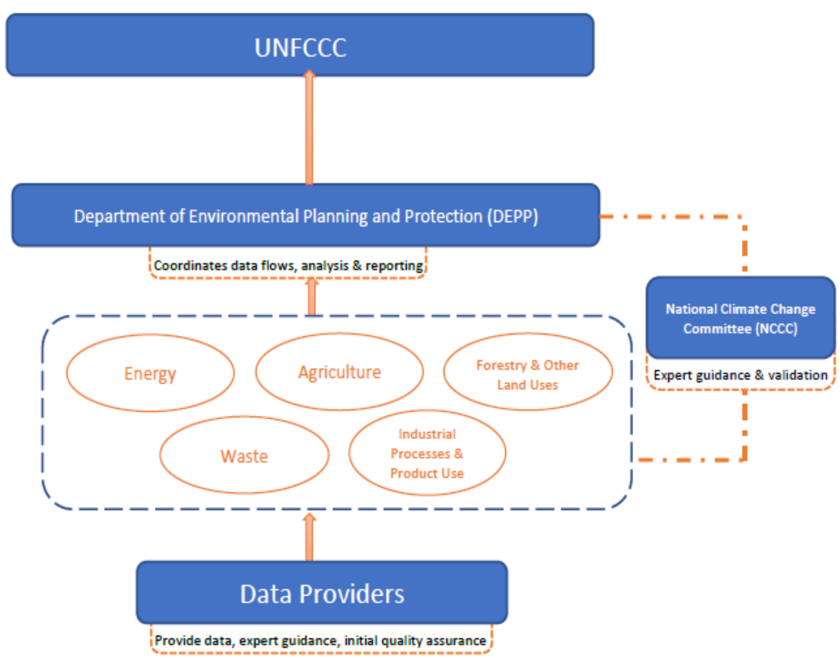
At present, The Bahamas National Climate Change Committee (NCCC) provides strategic level guidance on climate change related activities, policies, and plans, including the preparation of National Communications, Biennial Update Reports, National Inventory Reports, among others. The NCCC was established in 1996 by The Bahamas

[8] See Table 8.A.1, WG III, Chapter 8. Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Environment Science and Technology (BEST) Commission while under the Office of the Prime Minister, and now chaired and led by the Department of Environmental Planning and Protection (DEPP) (formerly BEST Commission). The Bahamas National Climate Change Committee (NCCC) consists of representatives from the government, private sector, non-governmental agencies and academic institutions.

The DEPP, apart from its role as the chair of the NCCC, is also the UNFCCC and GEF operational focal point, and coordinates the preparation and presentation of all reporting requirements to the UNFCCC. At present, the technical aspects of the preparation of the National Greenhouse Gas Inventory Report are led by regional consultants in a collaborative fashion with national experts with an aim to build national capacity. This includes both GHG inventory compilation training and hands-on participation in data collection, and quality assurance activities during inventory compilation. The institutions and roles of these actors involved are described in “Annex II - Institutions and Roles of those involved in the Preparation of The Bahamas’ NIR”. An illustration of these roles is shown below in Figure 21.

Figure 21: Institutional arrangements for the national GHG inventory preparation



3.2. Quality Assurance and Quality control

At present, The Bahamas is in the process of institutionalising its National Inventory Team and a system for quality control and quality assurance. For this inventory preparation cycle, sector level quality control checks on data being collected and estimations were made by the inventory compilers. Quality control checks were done to ensure that country estimations were developed and reported according to IPCC Good Practice Guidelines and follow the transparency, accuracy, consistency, comparability, completeness (TACCC) principles.

Existing QA/QC practices cover the following areas:

- Selection of methodologies
- Underlying assumptions of method for GHG estimation
- Selection of activity data and emission factors
- Means of data acquisition and management
- Documentation

The following quality control steps were undertaken initially by the inventory compiler, and secondarily internally reviewed by MRV Hub GHG accounting experts as a quality control check for each sector inventory. These quality control steps include:

- Check that assumptions and criteria for the selection of activity data and emission factors are documented
- Check for transcription errors in data input and reference
- Check that emissions/removals are calculated correctly
- Check that parameters and emission/removal units are correctly recorded and that appropriate conversion factors are used
- Check completeness, that estimates are reported for all categories and for all years from the appropriate base year over the period of the current inventory

In terms of quality assurance, national sector experts are increasingly being involved in data collection and understanding sector specific assumptions for methods. Other line Ministry representatives, and experts from non-governmental organizations and academia were also available for providing thorough review and assessment of the outputs from the emissions estimates and methodological assumptions.

The documentation and archiving of emissions estimates, worksheets, activity data, expert judgement and assumptions was done by the inventory compilers, and shared with the Department of Environmental Planning and Protection through a Dropbox folder, organized by all stages of the inventory cycle. This is done to ensure transparency, national ownership of data and reports, and promotes continuity of the inventory preparation for subsequent cycles.

The final stage of the inventory preparation cycle includes identification and documentation of further improvements. The current emissions inventory has already identified a range of cross-cutting improvements relating to both the emissions inventory data and the institutional arrangements, detailed in Annex II. These will be taken into account as the Government of The Bahamas continues to develop its national inventory team and system.

3.3. Description of Key Categories

A key category assessment was carried out for The Bahamas' GHG inventory estimates for the time series 2001-2018.[9] Both the level and trend assessments under approach 1 according to Volume 1, Chapter 4 of the IPCC 2006 Guidelines were conducted. The level of disaggregation chosen for the assessment was chosen according to table 4.1 of Chapter 4, Volume 1 of the IPCC 2006 Guidelines. Table 17 below presents the 13 key categories identified and indicates, whether they have been identified by the level assessment (L) and/or the trend assessment (T).

The majority of key categories identified, were identified under both level and trend assessment. They include stationary as well as mobile fuel combustion activities in the

[9] The previous National GHG Inventory of The Bahamas was published as part of The Bahamas' Second National Communication in 2014. This GHG inventory did not include a key category assessment, it is therefore not possible to assess how key categories have changed over time.

energy sector, land-based categories in the AFOLU sector (all aforementioned for CO_2) as well as solid waste disposal (for CH_4). Table 18 and Table 19 further below present the full results of the level and trend assessment.

A qualitative assessment in line with chapter 4, Volume 1 of the IPCC 2006 Guidelines considering the criteria mitigation techniques and technologies, expected growth and completeness have not led to the identification of additional key categories. At the same time, categories which could not be estimated due to lack of data have in most cases been prioritised in the improvement plan.

Table 17: Key categories identified

IPCC Category Code	IPCC Category Name	Gas	Key category related to Level (L) and/or Trend (T)
1.a.1.a.i	Electricity Generation	CO_2	L, T
1.A.2.m	Non-specified Industry	CO_2	L, T
1.A.3.b.i	Cars	CO_2	L, T
1.A.3.b.ii	Light-duty trucks	CO_2	L
1.A.3.b.iii	Heavy-duty trucks and buses	CO_2	L, T
1.A.4.a	Commercial/Institutional	CO_2	L, T
3.B.1.a	Forest land Remaining Forest Land	CO_2	L, T
3.B.1.b	Land Converted to Forest Land	CO_2	L, T
3.B.2.b	Land Converted to Cropland	CO_2	L, T
3.B.3.b	Land Converted to Grassland	CO_2	L, T

3.B.4.b	Land Converted to Wetlands	CO_2	L, T
3.B.5.b	Land Converted to Settlements	CO_2	L, T
4.A	Solid Waste Disposal	CH_4	L

Table 18: Results of the level assessment

IPCC category code	IPCC Category	Greenhouse gas	Latest year estimate in Gg CO_2-eq	Absolute value of latest year estimate	Level assessment	Cumulative value	Key category?
3.B.3.b	Land Converted to Grassland	CO2	2986.350	2986.350	0.3577	0.3577	Yes
1.a.1.a.i	Electricity Generation	CO2	1426.017	1426.017	0.1708	0.5285	Yes
3.B.4.b	Land Converted to Wetlands	CO2	550.035	550.035	0.0659	0.5943	Yes
3.B.1.b	Land Converted to Forest Land	CO2	-539.285	539.285	0.0646	0.6589	Yes
3.B.1.a	Forest land Remaining Forest Land	CO2	-503.335	503.335	0.0603	0.7192	Yes
1.A.3.b.i	Cars	CO2	380.434	380.434	0.0456	0.7648	Yes
1.A.4.a	Commercial/Institutional	CO2	354.086	354.086	0.0424	0.8072	Yes
3.B.5.b	Land Converted to Settlements	CO2	304.201	304.201	0.0364	0.8436	Yes
1.A.2.m	Non-specified Industry	CO2	282.663	282.663	0.0339	0.8775	Yes
4.A	Solid Waste Disposal	CH4	270.854	270.854	0.0324	0.9099	Yes
3.B.2.b	Land Converted to Cropland	CO2	138.313	138.313	0.0166	0.9265	Yes
1.A.3.b.ii	Light-duty trucks	CO2	131.971	131.971	0.0158	0.9423	Yes

1.A.3.b.iii	Heavy-duty trucks and buses	CO2	119.522	119.522	0.0143	0.9566	Yes
1.A.3.a.ii	Domestic Aviation	CO2	73.724	73.724	0.0088	0.9654	No
1.a.2.k	Construction	CO2	66.353	66.353	0.0079	0.9734	No
1.A.4.b	Residential	CO2	51.729	51.729	0.0062	0.9796	No
3.B.6.b	Land Converted to Other Land	CO2	42.826	42.826	0.0051	0.9847	No
4.D.1	Domestic Wastewaster Treatment and Discharge	CH4	42.565	42.565	0.0051	0.9898	No
1.A.4.c	Agriculture/Forestry/Fishing/ Fish Farms	CO2	32.061	32.061	0.0038	0.9936	No
3.C.4	Direct N2O Emissions from managed soils	N2O	7.988	7.988	0.0010	0.9946	No
1.A.3.d.ii	Water-borne navigation	CO2	5.971	5.971	0.0007	0.9953	No
1.A.3.b.i	Cars	CH4	5.435	5.435	0.0007	0.9959	No
4.D.1	Domestic Wastewaster Treatment and Discharge	N2O	5.210	5.210	0.0006	0.9966	No
1.A.3.b.i	Cars	N2O	4.655	4.655	0.0006	0.9971	No
1.a.1.a.i	Electricity Generation	N2O	3.033	3.033	0.0004	0.9975	No
3.C.5	Indirect N2O Emissions from managed soils	N2O	2.645	2.645	0.0003	0.9978	No
1.A.4.a	Commercial/Institutional	CH4	1.803	1.803	0.0002	0.9980	No
1.a.1.a.i	Electricity Generation	CH4	1.717	1.717	0.0002	0.9982	No

3.A.1	Enteric Fermentation	CH4	1.688	1.688	0.0002	0.9984	No
1.A.3.b.ii	Light-duty trucks	N2O	1.670	1.670	0.0002	0.9986	No
1.A.3.b.iii	Heavy-duty trucks and buses	N2O	1.667	1.667	0.0002	0.9988	No
1.A.3.b.ii	Light-duty trucks	CH4	1.476	1.476	0.0002	0.9990	No
2.D.1	Lubricant Use	CO2	1.085	1.085	0.0001	0.9991	No
3.A.2	Manure Management	N2O	0.918	0.918	0.0001	0.9993	No
4.C.2	Open Burning of Waste	CH4	0.857	0.857	0.0001	0.9994	No
1.A.4.a	Commercial/Institutional	N2O	0.821	0.821	0.0001	0.9995	No
4.C.2	Open Burning of Waste	CO2	0.739	0.739	0.0001	0.9995	No
1.A.2.m	Non-specified Industry	N2O	0.607	0.607	0.0001	0.9996	No
1.A.3.a.ii	Domestic Aviation	N2O	0.547	0.547	0.0001	0.9997	No
3.A.2	Manure Management	CH4	0.532	0.532	0.0001	0.9997	No
3.C.6	Indirect N2O Emissions from manure management	N2O	0.348	0.348	0.0000	0.9998	No
1.A.2.m	Non-specified Industry	CH4	0.346	0.346	0.0000	0.9998	No
1.A.3.b.iv	Motorcycles	CO2	0.310	0.310	0.0000	0.9999	No
1.A.4.b	Residential	CH4	0.195	0.195	0.0000	0.9999	No
1.A.3.b.iii	Heavy-duty trucks and buses	CH4	0.189	0.189	0.0000	0.9999	No
1.a.2.k	Construction	N2O	0.142	0.142	0.0000	0.9999	No
1.A.4.c	Agriculture/Forestry/Fishing/ Fish Farms	CH4	0.134	0.134	0.0000	0.9999	No
3.C.3	Urea application	CO2	0.11	0.111	0.0000	1.0000	No

4.C.2	Open Burning of Waste	N2O	0.088	0.088	0.0000	1.0000	No
1.a.2.k	Construction	CH4	0.081	0.081	0.0000	1.0000	No
1.A.4.c	Agriculture/Forestry/Fishing/ Fish Farms	N2O	0.071	0.071	0.0000	1.0000	No
1.A.4.b	Residential	N2O	0.053	0.053	0.0000	1.0000	No
1.A.3.d.ii	Water-borne navigation	N2O	0.041	0.041	0.0000	1.0000	No
4.C.2	Natural gas liquids transport	CO2	0.017	0.017	0.0000	1.0000	No
1.A.3.d.ii	Water-borne navigation	CH4	0.016	0.016	0.0000	1.0000	No
1.A.3.a.ii	Domestic Aviation	CH4	0.015	0.015	0.0000	1.0000	No
1.A.3.b.iv	Motorcycles	CH4	0.001	0.001	0.0000	1.0000	No
1.A.3.b.iv	Motorcycles	N2O	0.001	0.001	0.0000	1.0000	No
3.A.1	Enteric Fermentation	N2O	0.000	0.000	0.0000	1.0000	No

Table 19: Results of the trend assessment

IPCC category code	IPCC Category	Greenhouse gas	Base year estimate in Gg CO_2-eq	Absolute value of base year estimate in Gg CO_2-eq	Latest year estimate in Gg CO_2-eq	Absolute value of latest year estimate	Trend assessment	% Contribution to Trend	Cumulative value	Key category?
3.B.3.b	Land Converted to Grassland	CO2	1750.812	1750.812	2986.350	2986.350	0.127	0.268	0.268	Yes
3.B.5.b	Land Converted to Settlements	CO2	819.378	819.378	304.201	304.201	0.098	0.207	0.475	Yes
1.a.1.a.i	Electricity Generation	CO2	1527.482	1527.482	1426.017	1426.017	0.059	0.125	0.600	Yes
3.B.2.b	Land Converted to Cropland	CO2	380.163	380.163	138.313	138.313	0.046	0.097	0.698	Yes
3.B.1.a	Forest land Remaining Forest Land	CO2	-361.598	361.598	-503.335	503.335	0.031	0.065	0.763	Yes

3.B.4.b	Land Converted to Wetlands	CO2	324.778	324.778	550.035	550.035	0.023	0.048	0.812	Yes
1.A.4.a	Commercial/ Institutional	CO2	183.347	183.347	354.086	354.086	0.019	0.041	0.852	Yes
1.A.2.m	Non-specified Industry	CO2	143.274	143.274	282.663	282.663	0.016	0.034	0.886	Yes
3.B.1.b	Land Converted to Forest Land	CO2	-568.941	568.941	-539.285	539.285	0.012	0.026	0.912	Yes
1.A.3.b.iii	Heavy-duty trucks and buses	CO2	39.902	39.902	119.522	119.522	0.010	0.022	0.934	Yes
1.A.3.b.i	Cars	CO2	271.101	271.101	380.434	380.434	0.008	0.016	0.950	Yes
1.A.3.b.ii	Light-duty trucks	CO2	81.843	81.843	131.971	131.971	0.005	0.010	0.960	No
1.a.2.k	Construction	CO2	33.304	33.304	66.353	66.353	0.004	0.008	0.968	No
4.A	Solid Waste Disposal	CH4	205.783	205.783	270.854	270.854	0.003	0.007	0.975	No
1.A.3.a.ii	Domestic Aviation	CO2	75.218	75.218	73.724	73.724	0.002	0.005	0.980	No

1.A.4.b	Residential	CO2	30.023	30.023	51.729	51.729	0.002	0.005	0.985	No
1.A.4.c	Agriculture/ Forestry/ Fishing/Fish Farms	CO2	15.973	15.973	32.061	32.061	0.002	0.004	0.989	No
1.A.3.d.ii	Water-borne navigation	CO2	15.574	15.574	5.971	5.971	0.002	0.004	0.993	No
3.C.4	Direct N2O Emissions from managed soils (3)	N2O	10.508	10.508	7.988	7.988	0.001	0.001	0.994	No
2.D.1	Lubricant Use	CO2	3.754	3.754	1.085	1.085	0.000	0.001	0.995	No
3.B.6.b	Land Converted to Other Land	CO2	33.010	33.010	42.826	42.826	0.000	0.001	0.996	No
4.D.1	Domestic Wastewaster Treatment and Discharge	CH4	33.402	33.402	42.565	42.565	0.000	0.001	0.997	No

3.C.5	Indirect N2O Emissions from managed soils	N2O	3.452	3.452	2.645	2.645	0.000	0.000	0.998	No
1.A.3.b.iii	Heavy-duty trucks and buses	N2O	0.557	0.557	1.667	1.667	0.000	0.000	0.998	No
1.a.1.a.i	Electricity Generation	N2O	3.209	3.209	3.033	3.033	0.000	0.000	0.998	No
3.A.2	Manure Management	N2O	0.109	0.109	0.918	0.918	0.000	0.000	0.998	No
1.A.3.b.i	Cars	CH4	3.873	3.873	5.435	5.435	0.000	0.000	0.999	No
1.A.3.b.i	Cars	N2O	3.317	3.317	4.655	4.655	0.000	0.000	0.999	No
1.A.4.a	Commercial/ Institutional	CH4	1.043	1.043	1.803	1.803	0.000	0.000	0.999	No
1.a.1.a.i	Electricity Generation	CH4	1.816	1.816	1.717	1.717	0.000	0.000	0.999	No
1.A.3.b.ii	Light-duty trucks	N2O	1.020	1.020	1.670	1.670	0.000	0.000	0.999	No
4.D.1	Domestic Wastewaster	N2O	4.690	4.690	5.210	5.210	0.000	0.000	0.999	No

	Treatment and Discharge									
1.A.4.a	Commercial/ Institutional	N2O	0.427	0.427	0.821	0.821	0.000	0.000	0.999	No
1.A.2.m	Non-specified Industry	N2O	0.310	0.310	0.607	0.607	0.000	0.000	1.000	No
1.A.3.b.ii	Light-duty trucks	CH4	1.033	1.033	1.476	1.476	0.000	0.000	1.000	No
3.C.6	Indirect N2O Emissions from manure management	N2O	0.138	0.138	0.348	0.348	0.000	0.000	1.000	No
1.A.2.m	Non-specified Industry	CH4	0.177	0.177	0.346	0.346	0.000	0.000	1.000	No
1.A.3.a.ii	Domestic Aviation	N2O	0.559	0.559	0.547	0.547	0.000	0.000	1.000	No
1.A.3.b.iii	Heavy-duty trucks and buses	CH4	0.063	0.063	0.189	0.189	0.000	0.000	1.000	No

1.A.3.d.ii	Water-borne navigation	N2O	0.107	0.107	0.041	0.041	0.000	0.000	1.000	No
1.a.2.k	Construction	N2O	0.072	0.072	0.142	0.142	0.000	0.000	1.000	No
3.A.1	Enteric Fermentation	CH4	1.357	1.357	1.688	1.688	0.000	0.000	1.000	No
1.A.4.c	Agriculture/ Forestry/ Fishing/Fish Farms	CH4	0.067	0.067	0.134	0.134	0.000	0.000	1.000	No
1.A.4.b	Residential	CH4	0.120	0.120	0.195	0.195	0.000	0.000	1.000	No
3.C.3	Urea application	CO2	0.052	0.052	0.111	0.111	0.000	0.000	1.000	No
4.C.2	Open Burning of Waste	CH4	0.673	0.673	0.857	0.857	0.000	0.000	1.000	No
1.A.3.b.iv	Motorcycles	CO2	0.221	0.221	0.310	0.310	0.000	0.000	1.000	No
4.C.2	Open Burning of Waste	CO2	0.580	0.580	0.739	0.739	0.000	0.000	1.000	No
1.A.3.d.ii	Water-borne navigation	CH4	0.042	0.042	0.016	0.016	0.000	0.000	1.000	No
1.a.2.k	Construction	CH4	0.041	0.041	0.081	0.081	0.000	0.000	1.000	No

3.A.2	Manure Management	CH4	0.468	0.468	0.532	0.532	0.000	0.000	1.000	No
1.A.4.c	Agriculture/ Forestry/ Fishing/Fish Farms	N2O	0.036	0.036	0.071	0.071	0.000	0.000	1.000	No
1.A.4.b	Residential	N2O	0.029	0.029	0.053	0.053	0.000	0.000	1.000	No
4.C.2	Open Burning of Waste	N2O	0.069	0.069	0.088	0.088	0.000	0.000	1.000	No
1.A.3.a.ii	Natural gas liquids transport	CO2	0.011	0.011	0.017	0.017	0.000	0.000	1.000	No
1.A.3.a.ii	Domestic Aviation	CH4	0.016	0.016	0.015	0.015	0.000	0.000	1.000	No
1.A.3.b.iv	Motorcycles	CH4	0.001	0.001	0.001	0.001	0.000	0.000	1.000	No
1.A.3.b.iv	Motorcycles	N2O	0.001	0.001	0.001	0.001	0.000	0.000	1.000	No
3.A.1	Enteric Fermentation	N2O	0.000	0.000	0.000	0.000	0.000	0.000	1.000	No

3.4. Uncertainty assessment (qualitative)

This section provides an uncertainty assessment of The Bahamas' national GHG inventory at a qualitative level. The IPCC 2006 Guidelines consider a quantitative assessment good practice. Such a quantitative assessment can however only be meaningful, where estimates for the uncertainty of activity data and emission factors (or other factors/assumptions) are available. Alternatively, the IPCC 2006 Guidelines, in its sectoral chapters provides default values for the uncertainty assessment. The importance of the uncertainty assessment lies less in the overall uncertainty value for the national GHG inventory as a total for a specific year. The assessment becomes valuable once consistently produced uncertainty assessments are available for a number of GHG inventory submissions, thus allowing to understand improvements over time. Considering one specific GHG inventory submission, the assessment helps in identifying and prioritising categories with improvement potential.

Uncertainty data was not available for any activity data in The Bahamas and availability of activity data was limited. The decision was thus taken to focus the available resources on the data collection effort and filling of gaps, instead of conducting an uncertainty assessment based solely on IPCC defaults. Such an assessment would not have yielded any added value with regards to identifying and prioritising improvement potential, as a long list of improvements had already been compiled as part of the data collection process.

The following main sources of uncertainty for The Bahamas' national GHG inventory were identified:

- Related to completeness
    - Lack of information on the existence of emissions from specific IPCC categories (e.g. under category 1.A.2 Manufacture and construction, category 2.G Other product use)
    - Lack of activity data (e.g., 2.G.1 Refrigeration and air conditioning)

- Accuracy
    - Data was often available only for part of the time series making it difficult to understand the trends
    - No country-specific emission factors are available
    - National circumstances might not well or no longer align with the IPCC defaults (e.g. waste generation rates per capita, vehicle categories)
    - Information related to sector-specific assumptions is often not available (e.g. number of trips and average distances for category 1.A.3.b Road transport)

A detailed list of improvements required to reduce uncertainty related to these issues is presented in Annex II.

3.5. Improvement potential

During the compilation of The Bahamas' national GHG inventory, future improvement potential was identified and documented. Table 20 below presents the most relevant areas for improvements, while the full list of improvement options is presented in Annex II. The improvement options presented in the Annex differ in their urgency and timeframes they can be implemented in. This chapter shows the improvements deemed most relevant, as the pertain to key categories.

Table 20: Most relevant areas for improvement

Area	Most relevant areas for improvement
Cross-cutting	• Set up appropriate institutional, procedural, legal arrangements, and documentation for recurring preparation of the national GHG inventory • Appoint a national GHG inventory compilation team • Fully establish and implement QA/QC procedures for the national GHG inventory
Energy	• Ensure data on fuel imports compiled by the Central Bank of the Bahamas are complete and accurate

	• Obtain disaggregated data of fuel imports (potentially with the help of fuel distributors) by relevant subcategories, e.g. manufacture and industries (1.A.2), commercial/institutional (1.A.4.a), and residential (1.A.4.b). • Develop a national energy balance in the longer term • Collect power generation and fuel consumption from local power producers (Bahamas Power and Light, Company Ltd. Grand Bahama Power Company) • Develop country-specific emission factors • Better understand which relevant manufacture and production activities take place and collect activity data • Obtain complete activity data on vehicle population across the entire time series
IPPU	• Collect HFC and PFC import data (as substance and in products) • Assess which IPPU categories occur (e.g. electrical equipment, category 2.G.1)
AFOLU	• Develop country-specific emission factors for categories 3.B.1.a-b, 3.B.2.b, 3.b.3.b, 3.B.4.b and 3.b.5.b • Establish and validate (i.e. ground-truth) a sample of permanent plots of each land use type (at minimum the main IPCC classes, especially pine and mangrove for forest land which are prominent in the Bahamas) to improve land classification maps and remote sensing model • Determine the end use of fertilizers and other agricultural additives reported in the annually produced Customs Imports report with Agriculture experts • Conduct a survey of livestock in country, including livestock manure management practices on an annual basis, and align with National Agricultural Census cycle
Waste	• Collect information on the depth of landfills (one-time survey)

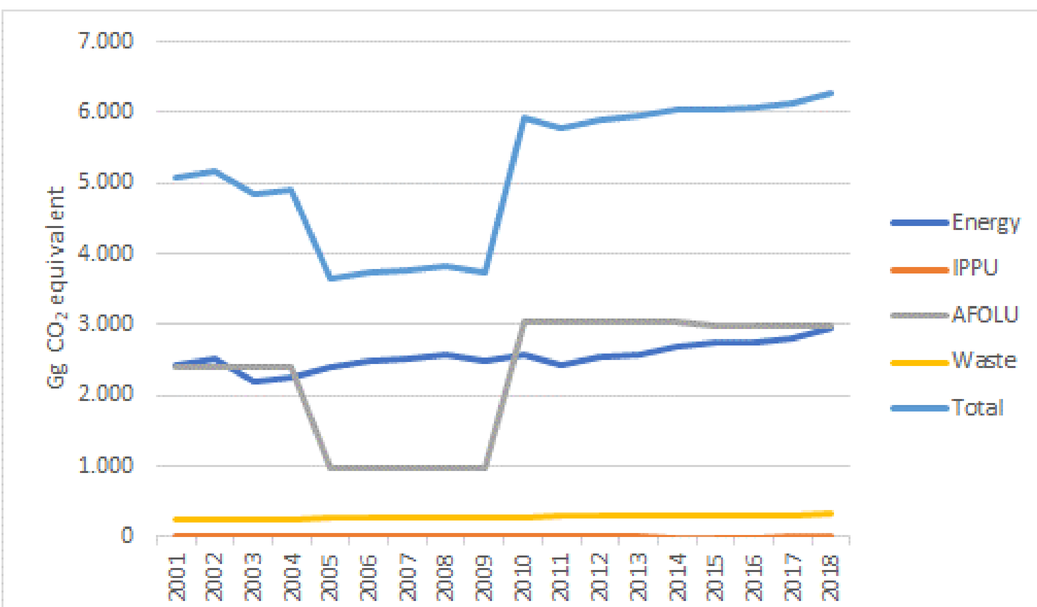
	• Assess solid waste generation and composition • Collect data from national food and beverage manufacturing companies on industrial wastewater flows

GHG emissions and removals 2001-2018

3.6. Overview

Total GHG emissions in The Bahamas rose from 5,074.09 Gg CO_2-eq in 2001 to 6,264.39 Gg CO_2-eq in 2018, which equals an increase by 23.5 cent (see Figure 22).[10] During the same time period GHG emissions from the waste sector rose by 30.6 per cent, from the AFOLU sector (including both emissions and removals) by 25.1 per cent, and from the energy sector by 21.1 per cent. IPPU sector emissions, to the extent estimated in this GHG inventory publication which covered only lubricant use[11], fell by 71.1 per cent. GHG estimates for 2001-2018 are presented in Table 21.

Figure 22: Total GHG emissions by sector 2001-2018



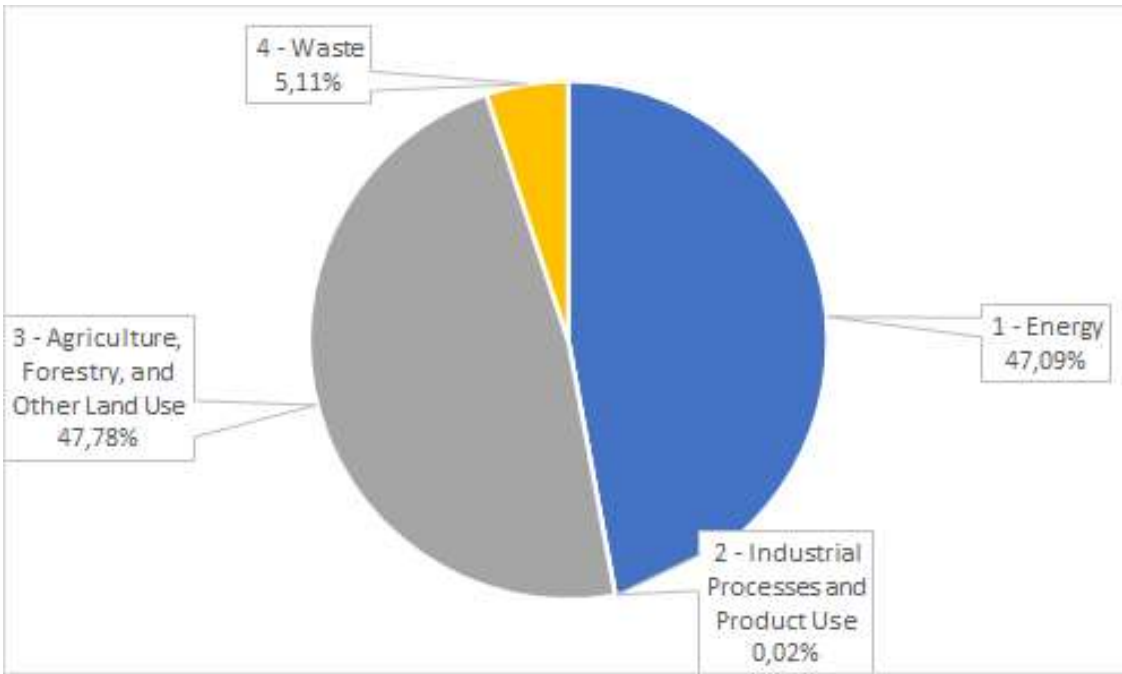
[10] The previous GHG inventory of the BAHAMAs published as part of The Bahamas Second National Communication in 2014 presented GHG emissions for the year 2000, amounting to 702.82 Gg CO_2-eq. when considering the gases CO_2, CH_4 and N_2O. These had been estimated using the IPCC Revised 1996 Guidelines for national GHG inventories and the GWPs from the IPCC's 2nd Assessment Report.

[11] Due to lack of data, GHG emissions from the use of HFCs and PFCs and of other potentially relevant sources could not be estimated. More information is provided in section 2 of this report.

Developments of and drivers for sectoral and category-level trends are presented in the forthcoming sectoral chapters (2.2 - 2.5)

The AFOLU and energy sectors dominate total national GHG emissions in The Bahamas, contributing 47.8 per cent and 47.1 per cent, respectively, to total emissions in 2018. The waste sector contributes 5.1 per cent and the IPPU sector was less than 0.1 per cent during the same year (see Figure 23).

Figure 23: Percent contribution of IPCC sectors to total GHG emissions in 2018



Total CO_2 emissions amounted to 5909.18 Gg in 2018, representing 94.3 per cent of total GHG emissions. CH_4 amounted to 11.68 Gg in 2018, representing 5.2 per cent of the total and N_2O to 0.12 Gg in 2018, representing 0.5 per cent of the total (see Figure 24).

Likely drivers to The Bahamas' GHG inventory emissions are the population and economic development. The increase in tourism has likely lead to an increase in demand on fuel and transportation, thus affecting energy sector emissions. GDP has increased by 56 per cent since 2001, the population by 27 per cent (see Figure 25).

Figure 24: Contribution of gases to total GHG emissions in 2018

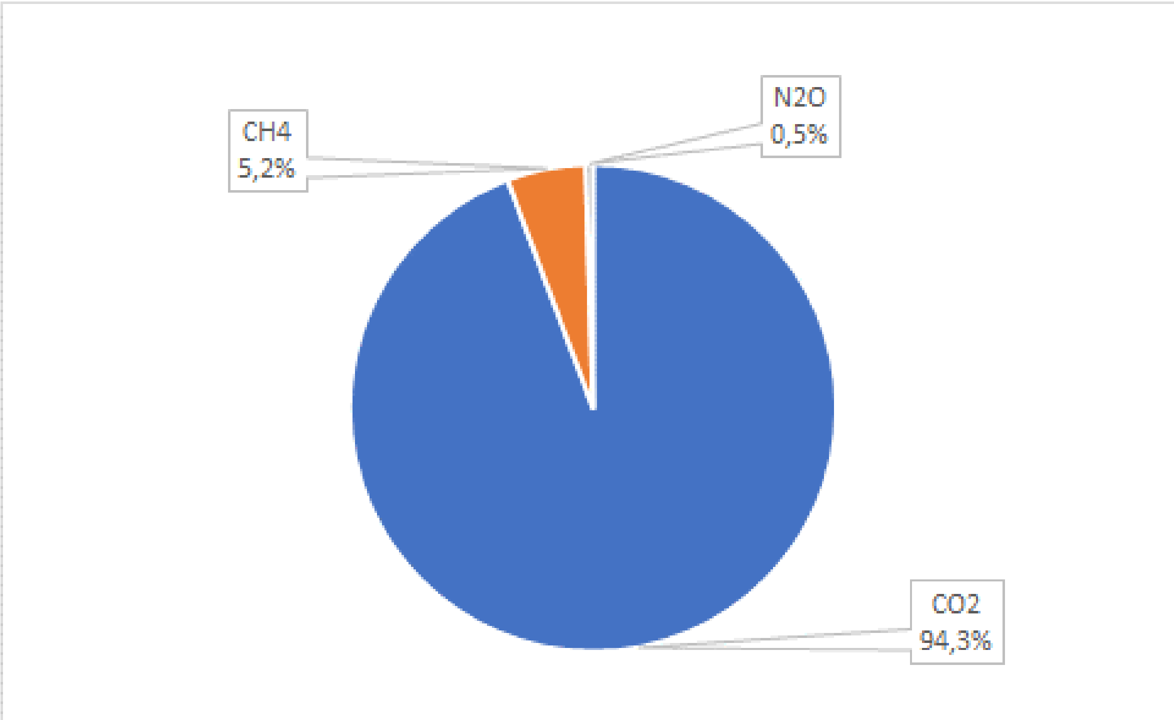
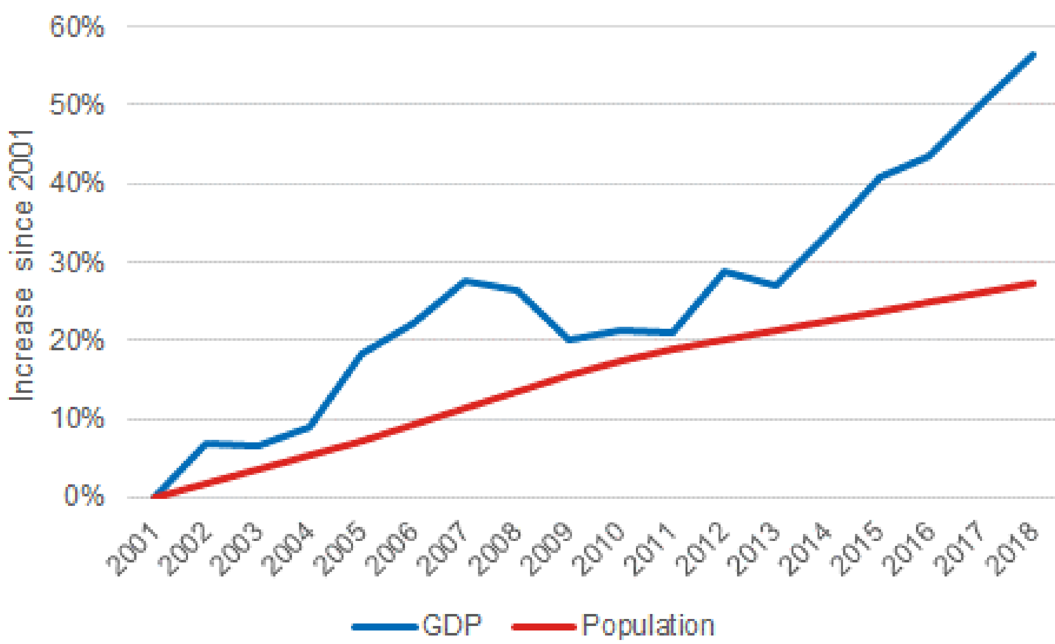


Figure 25: Increase in GDP and population in the Bahamas between 2001-2018



The GHG emissions per capita in The Bahamas was 16.24 tCO_2eq in 2018, which represents a decrease of 3.2 per cent compared to 2001.

Table 21: Total GHG emissions by sector

Categories	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change between 2001 - 2018
Total	Gg CO_2-eq.	5,077.85	5,157.60	4,852.38	4,901.25	3,640.68	3,744.15	3,765.39	3,832.61	3,738.27	5,926.03	5,771.82	5,902.51	5,941.44	6,045.44	6,053.83	6,063.13	6,115.05	6,264.31	23.4%
1 – Energy	Gg CO_2-eq.	2,435.21	2,512.78	2,207.71	2,243.39	2,407.76	2,501.62	2,517.49	2,583.99	2,485.98	2,583.91	2,427.07	2,553.17	2,588.42	2,686.94	2,752.86	2,759.77	2,805.72	2,949.58	21.1%
2 – Industrial Processes and Product Use	Gg CO_2-eq.	3.75	8.43	2.84	2.84	3.42	4.17	3.25	3.59	3.09	3.17	1.42	1.08	1.75	1.00	1.00	1.00	1.17	1.08	-71.1%

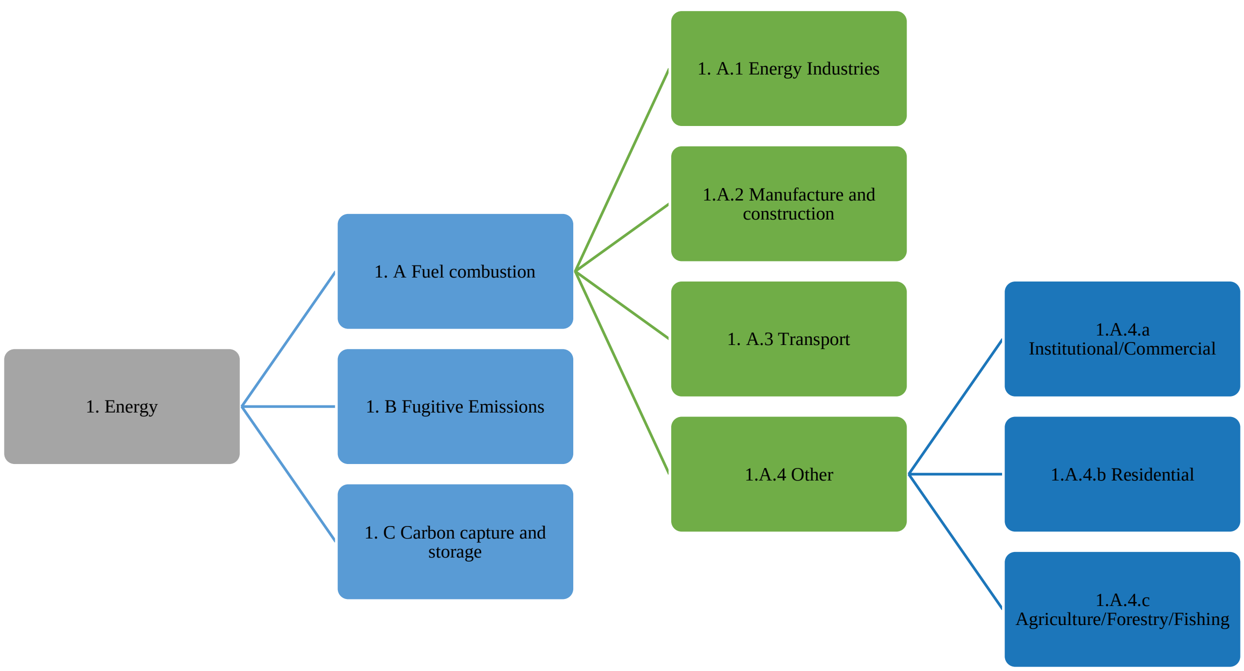
3 – Agriculture, Forestry, and Other Land Use	Gg CO_2-eq.	2,393.69	2,387.17	2,388.73	2,397.80	967.73	971.70	973.12	968.57	967.69	3,052.16	3,051.84	3,052.31	3,050.36	3,052.66	2,991.21	2,989.65	2,991.64	2,993.34	25.1%
4 – Waste	Gg CO_2-eq.	245.20	249.22	253.11	257.22	261.77	266.67	271.52	276.46	281.51	286.79	291.49	295.94	300.90	304.83	308.75	312.71	316.51	320.31	30.6%

3.7. Energy

The scope of the energy sector under the IPCC 2006 Guidelines for national GHG inventories covers a broad array of GHG emission sources. These include stationary fuel combustion (for power and heat generation, in the manufacture and construction sectors, in the residential sector, in the institutional and commercial sector as well as related to agriculture, fisheries, forestry) and fuel combustion in the transport sector. Furthermore, it includes fugitive GHG emissions from fuel production and distribution as well as GHG emissions from carbon capture and storage where such activities take place. Figure 26 provides a simplified overview of GHG emission categories in the energy sector.

In The Bahamas, most energy sector emissions stem from fuel combustion. Power generation is based on fuel oil and diesel. The Bahamas has only limited industrial activities, emissions from fuel consumption in the manufacture and industry sub-sector therefore focus on construction.

Figure 26: Categories in the IPCC sector energy



The transport sector is dominated by road transport, but also domestic aviation and domestic waterborne navigation play a role, with tourism being a strong driver for the subsector.

Emissions in the institutional/commercial subsector are also strongly influenced by tourism activity. Agriculture, fisheries and forestry only take place to a limited extent. Fuel production does not take place, however, fuel distribution does. Carbon capture and storage is not practiced.

On this basis, GHG emission estimates for the gases CO_2, CH_4, N_2O were compiled for the energy sector categories presented in
Table 22 below. These are the categories where relevant activities place in The Bahamas. Information about the activities relevant to each category (e.g., related to manufacture and construction) which are found in The Bahamas is provided from section 3.2.3.1 onwards.

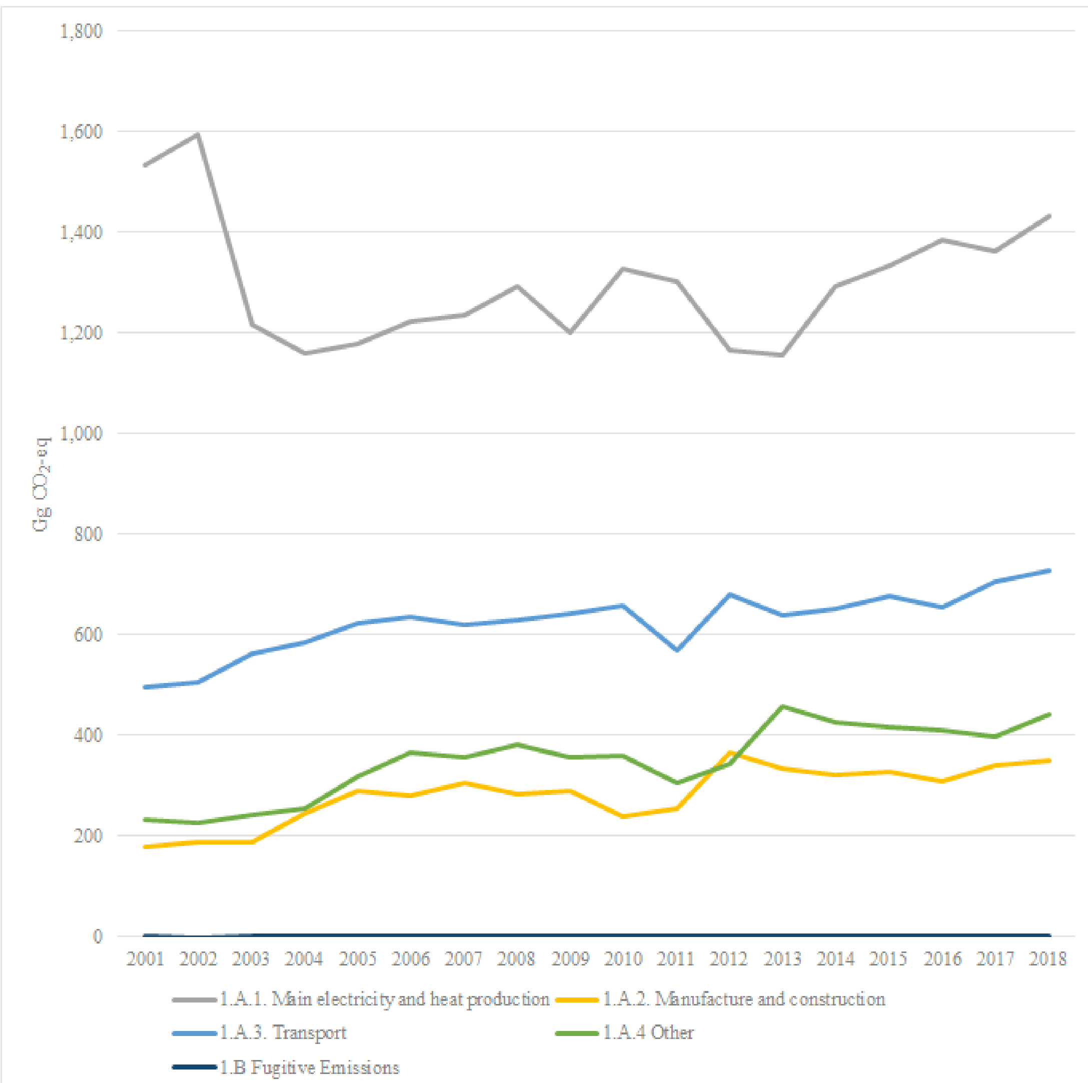
Table 22: GHG emission categories covered for the energy sector

IPCC Category	Category Name
1.A.1.a.1	Main electricity and heat production
1.A.2.	Manufacture and construction
1.A.2.k	Construction
1.A.2.m	Non-specified industry
1.A.3 Transport	
1.A.3.a. Aviation	• 1.A.3.a.i International Aviation • 1.A.3.a.i Domestic Aviation
1.A.3.b Road Transportation	• 1.A.3.b.i Cars • 1.A.3.b.i Light duty trucks • 1.A.3.b.i Heavy duty trucks and buses • 1.A.3.b.i Motorcycles
1.A.3.c. Navigation	• 1.A.3.c.i International Waterborne Navigation • 1.A.3.c.ii Domestic Waterborne Navigation
1.A.4	Other
1.A.4.a	Institutional/commercial

1.A.4.b	Residential
1.A.4.c	Agriculture/fisheries
1.B	Fugitive Emissions
1.B.2.A.iii.3	Natural Gas Liquids transport

An overview of GHG emissions in the Energy sector by category and by gas is presented in Table 23 below. Total GHG emissions in the energy sector amounted to 2435.21 Gg CO_2-eq in 2001 and 2949.58 Gg CO_2-eq in 2018, see Figure 27.

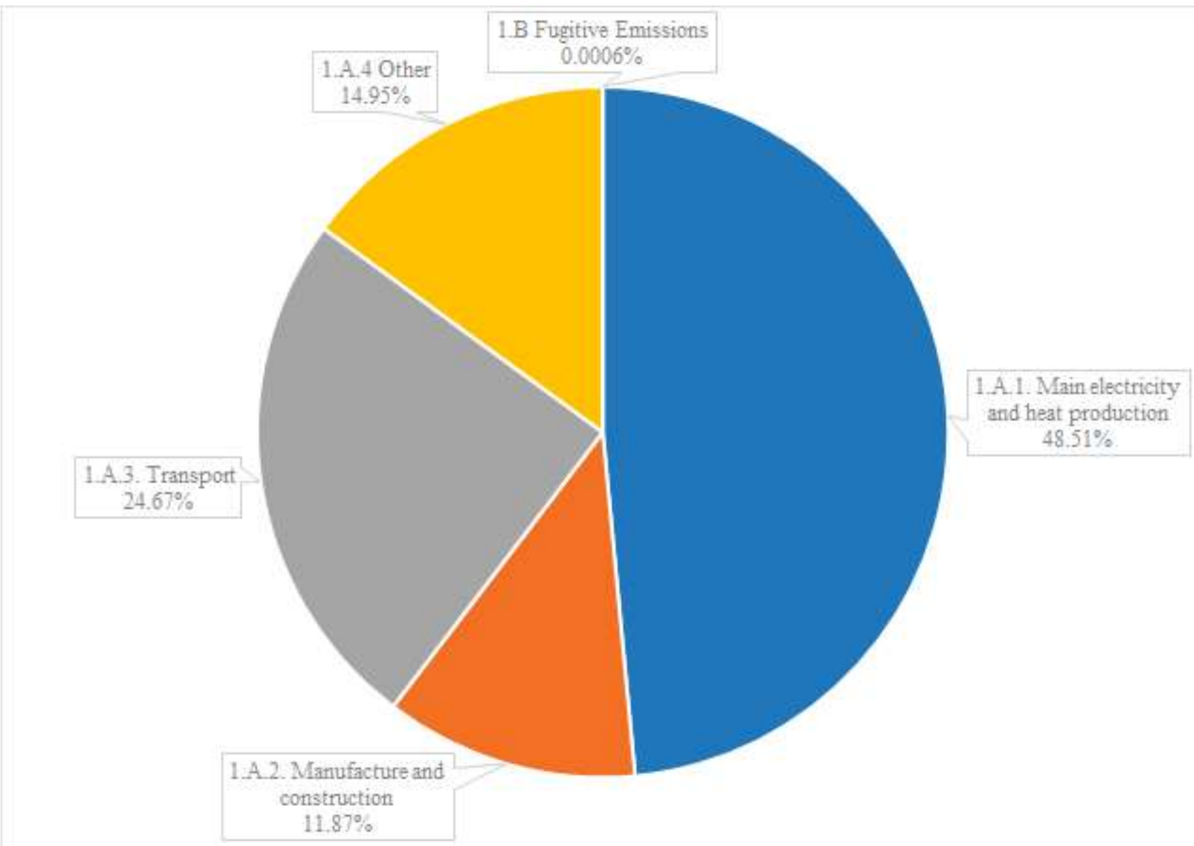
Figure 27: GHG emissions in the energy sector 2001-2018, by categories



The above information represents an increase by 21.1 per cent. In the same time frame, GDP has increased by over 60 per cent and population by nearly 30 per cent.

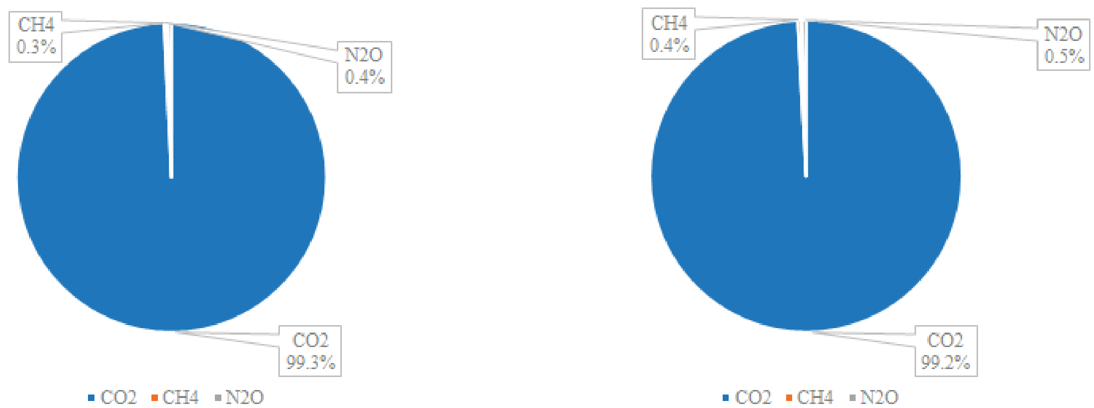
Main power and heat generation is the largest GHG emission source in the energy sector with 48.5 per cent of total emissions, followed by transport with 24.6 per cent. Manufacture and construction contributes 11.9 per cent and Other 15.0 per cent. The contribution of Fugitive Emissions category is minute with 0.0006 per cent.

Figure 28: Contribution of categories to total GHG emissions in the energy sector in 2018



Shares of the gases in total emissions have remained similar over time, around 99 per cent for CO_2 and below 1 per cent for CH_4 as well as for N_2O. Figure 29 shows the contribution of the three gases to total GHG emissions in the energy sector in 2001 as well as in 2018.

Figure 29: Contribution of gases to total GHG emissions in the energy sector in 2001 and 2018



GHG emissions for the subcategories 1.A.1 Main Electricity and Heat Production, 1.A.2 Manufacture and Construction, 1.A.3 Transport and 1.A.4 Other sector all show an increasing trend since 2011. Before, they had shown an overall slightly downward trend. For the energy sector as a whole, GHG emissions have increased by 21.1 per cent between 2001 and 2018. This includes a reduction of 6.6 per cent from Main Electricity and Heat Production, and an increase by 97.7 per cent in Manufacture and Industries, 90.8 per cent in Other and 47.2 per cent in Transport.

The increase in population as well as in GDP and related to that, tourism activity, can be deemed to have played a key role in the generally upwards moving trend since 2011. Technological change, e.g. the replacement of equipment for power generation, might potentially have played a role in reducing fuel consumption in earlier years of the time series. Data indicates that generation efficiency has considerably increased from 2003 onwards compared to 2001 and 2002. Furthermore, GDP has remained nearly stable between 2002-2004. A general decrease in fuel consumption in the sectors Transport and Other can be seen between 2009-2010. This might be related to the global financial crisis 2008-2010.

Table 23: GHG emissions in the Energy sector, by category

Category	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Difference 2018 vs 2001
1.Energy Total	Gg CO_2-eq	**2435.21**	**2512.78**	**2207.71**	**2243.39**	**2407.76**	**2427.07**	**2553.17**	**2588.42**	**2686.94**	**2752.86**	**2759.77**	**2805.72**	**2949.58**	**21.12%**	**2435.21**	**2512.78**	**2207.71**	**2243.39**	**21.1%**
1.A. Fuel combustion	Gg CO_2-eq	2435.20	2512.78	2207.70	2243.38	2407.75	2427.06	2553.16	2588.41	2686.93	2752.85	2759.76	2805.71	2949.56	21.12%	2435.20	2512.78	2207.70	2243.38	21.1%
1.A.1. Main electricity and heat production	Gg CO_2-eq	1532.51	1593.82	1217.35	1159.20	1177.49	1300.38	1165.09	1156.89	1291.53	1334.40	1383.86	1363.47	1430.77	-6.64%	1532.51	1593.82	1217.35	1159.20	-6.6%
1.A.2. Manufacture and construction	Gg CO_2-eq	177.18	188.55	187.28	245.98	290.65	253.17	365.38	335.03	320.99	327.69	309.69	339.29	350.19	97.65%	177.18	188.55	187.28	245.98	97.7%

1.A.3. Transport	Gg CO_2-eq	494.45	504.45	562.57	585.06	621.10	567.16	681.13	639.38	650.10	675.76	654.90	704.57	727.65	47.16%	494.45	504.45	562.57	585.06	47.2%
1.A.4 Other	Gg CO_2-eq	231.07	225.96	240.50	253.15	318.51	306.36	341.57	457.11	424.32	415.00	411.31	398.38	440.95	90.83%	231.07	225.96	240.50	253.15	90.9%
1.B Fugitive Emissions	Gg CO_2-eq	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	64.29%	0.01	0.01	0.01	0.01	64.3%

Table 24: Total GHG emissions in the energy sector, by gas

Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Difference 2018 vs 2001
Total	Gg CO_2-eq	2435.21	2512.78	2207.71	2243.39	2407.76	2427.07	2553.17	2588.42	2686.94	2752.86	2759.77	2805.72	2949.58	2435.21	2512.78	2207.71	2243.39	2407.76	21.1%
CO_2	Gg CO_2-eq	2417.27	2494.28	2188.64	2224.30	2387.62	2407.35	2531.11	2566.67	2664.81	2729.97	2737.12	2781.98	2924.86	21.00%	2417.27	2494.28	2188.64	2224.30	21.0%
CH_4	Gg CO_2-eq	8.29	8.50	9.16	8.73	9.06	9.11	9.75	10.06	10.19	10.53	10.50	10.88	11.41	37.59%	8.29	8.50	9.16	8.73	37.6%

N_2O	Gg CO_2-eq	9.64	10.00	9.91	10.37	11.08	10.62	12.32	11.69	11.95	12.36	12.15	12.85	13.31	38.01 %	9.64	10.00	9.91	10.37	38.01 %

3.8. IPPU

The industrial processes and product use sector covers a wide range of sources of GHG emissions. These include process (i.e., non-energy related) emissions from industrial production as well as emissions related to the use of certain products. GDP in The Bahamas focuses on the financial sector as well as on tourism, with only very limited industrial production taking place.

Data collection and consultation with experts indicates that no relevant industrial production, e.g., of cement clinker, glass, ceramics or steel takes place in The Bahamas at present. Moreover, a number of product use categories clearly occur or are likely to occur, while no data is available. These are presented in Table 25.

Table 25: Categories of the IPPU sector not estimated due to lack of data

Gas and IPCC category	IPCC category code	Likelihood of occurrence
CO_2 emissions from the use of paraffin waxes and solvent use	2.D.2, 2.D3	Likely
HFC emissions from the operation and discharge of refrigeration and air conditioning equipment	2.F.1	Emissions do occur
HFC emissions from the use of building foams, aerosols and solvents	2.F.2, 2.F.3, 2.F.4	Likely
SF_6 emissions from the operation of electrical equipment	2.G.1	Likely
N_2O emissions from the use of N_2O in hospitals	2.G.3	Likely

Due to the lack of data, GHG emissions from these categories could not be estimated. Particularly the HFC emissions from the operation and discharge of refrigeration and air conditioning equipment are likely to make a relevant contribution to The Bahamas total

GHG emissions. The collection of relevant data for the compilation of the next GHG inventory should thus be considered a priority. Annex II presents suggestions on how to retrieve relevant in the course of future GHG inventory compilations.

Emissions of product use which occur and for which data was available, relates to the use of lubricants. These emissions are presented in Table 26. This source only leads to emissions of CO_2. Emissions have decreased by over 70% over the time series, with a dip of over 50% happening between 2010 and 2011. Reasons for this development are presently unknown and should be researched as part of future GHG inventory compilations. A potential explanation could be structural changes after the economic crisis 2008-2010.

Table 26: Total GHG emissions in category 2.D.1 Lubricant use

Category	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Change 2018 vs 2001
2.D.1	Gg CO_2-eq	3.75	8.43	2.84	2.84	3.42	4.17	3.25	3.59	3.09	3.17	1.42	1.08	1.75	1.00	1.00	1.00	1.17	1.08	-71.11%

3.9. AFOLU

3.9.1. Agriculture

The agriculture sector covers a wide range of sources of GHG emissions including from livestock, crop production, fertilizer use, and soil management. The agriculture sector in The Bahamas remains a small percentage of the national GDP. These practices include small scale farming of food crops, limited livestock production throughout the islands, and more significantly, poultry egg and broiler production and soil enrichment from fertilizers. The addition of lime to agricultural soils was not estimated, as national soils are considered calcareous, and biomass burning was not estimated, as post-crop burning is not considered a common practice.

On this basis, GHG emission estimates for the gases CO_2, CH_4, N_2O were compiled for the agriculture sector categories presented in Table 27 below.

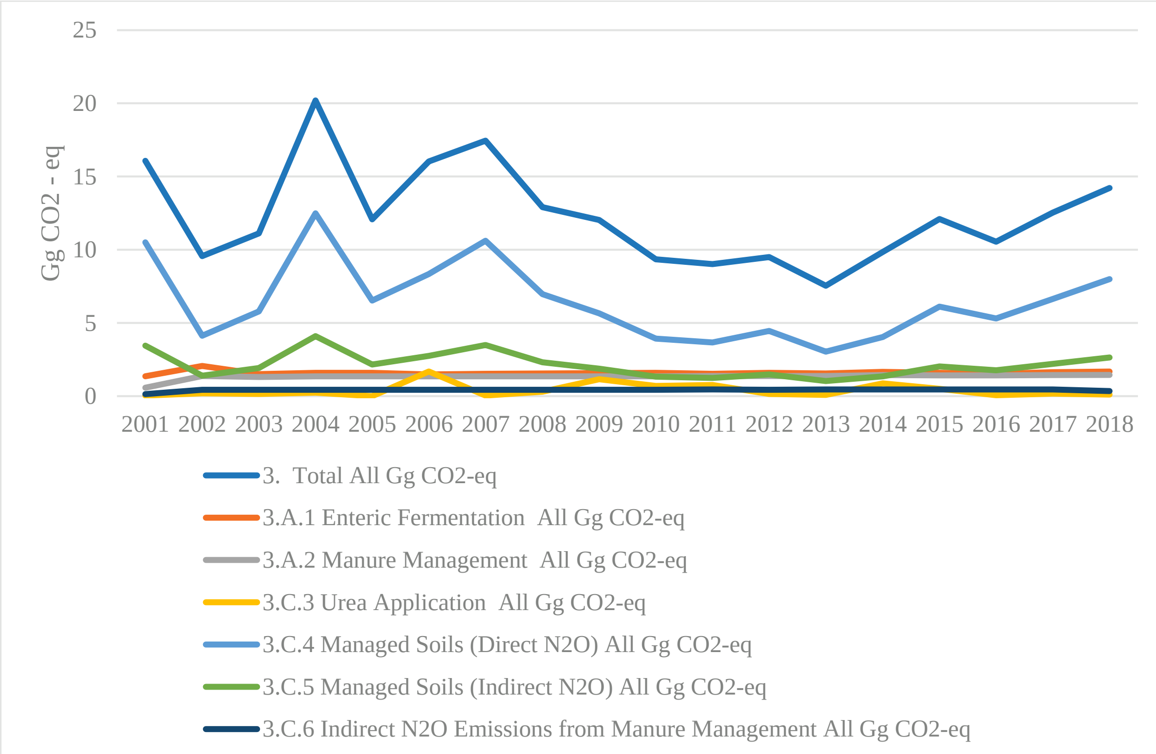
Table 27: IPCC 2006 GL categories for which Agriculture GHG emissions were estimated

IPCC Category	Category Name
3.A.1	Enteric Fermentation (CH_4)
3.A.2	Manure Management (CH_4 & Direct N_2O)
3.C.3	Urea Application (CO_2)
3.C.4	Managed Soils (Direct N_2O)
3.C.5	Managed Soils (Indirect N_2O)
3.C.6	Indirect N_2O Emissions from Manure Management

Total GHG emissions in the agriculture sector amounted to 16.08 Gg CO_2-eq in 2001 and 14.23 Gg CO_2-eq in 2018, see

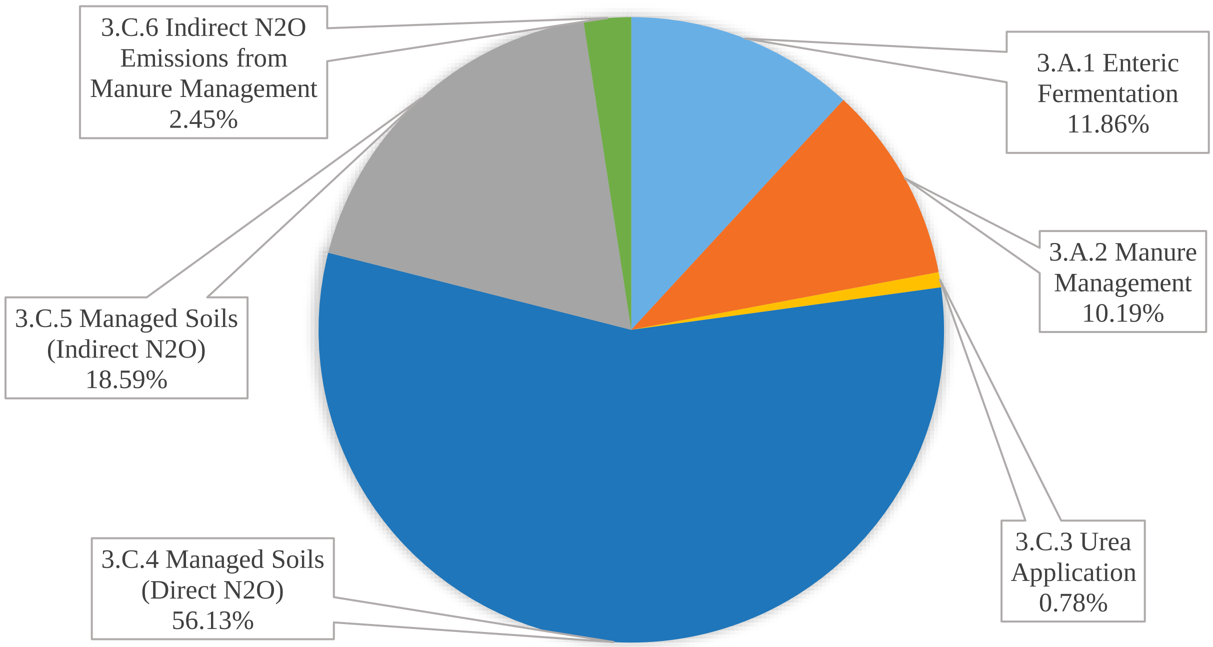
Figure 30 and Table 28. This represents a decrease by 11.54% per cent.

Figure 30: Total agriculture-sector category GHG emissions 2001-2018



Total Direct N_2O emissions on managed soils, particularly from fertilizer, was the highest contributor to sector emissions (56.13 per cent), accounting for the importation of nitrogen based fertilizers over the time series. This is followed by indirect N_2O emissions to managed soils from leaching and atmospheric volatilization from fertilizers and managed animal waste, accounting for (18.59 per cent). Emissions from enteric fermentation (livestock), 11.86 per cent, and manure management (10.19 per cent) followed. Livestock is limited in the country, and was estimated from both national and international sources, from enteric fermentation, particularly for grazing animals. Indirect N_2O emissions from manure management and urea application jointly represented about 3 per cent of sector emissions.

Figure 31: Contribution of categories to total GHG emissions in the agriculture sector in 2018



Shares of the gases in total emissions have remained similar over time, with N_2O accounting for 88.3 and 95.9 per cent in 2001 and 2018 respectively, and 11.4 and 15.6 per cent for CH_4, and for CO_2, and 0.3 and 1 per cent each both in 2001 and 2018 (see Figure 32).

Figure 32: Contribution of gases to total agriculture sector emissions in 2001 and 2018

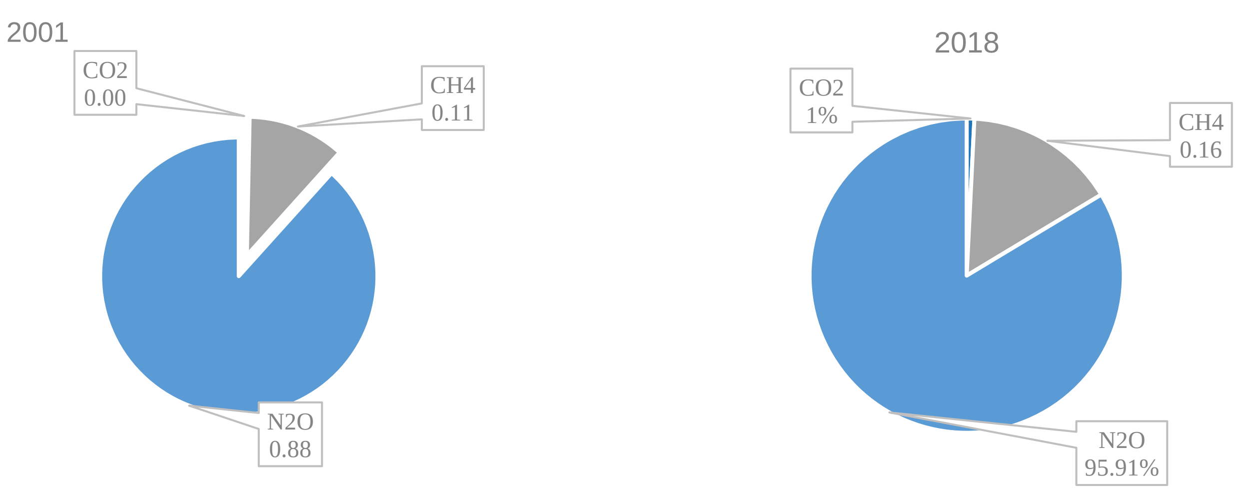


Table 28: GHG emissions in the agriculture sector, by category

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
3. Total	All	Gg CO_2-eq	**16.08**	**9.57**	**11.12**	**20.20**	**12.07**	**16.04**	**17.46**	**12.91**	**12.03**	**9.34**	**9.02**	**9.49**	**7.54**	**9.84**	**12.11**	**10.54**	**12.54**	**14.23**	-11.54%
3.A.1	All	Gg CO_2-eq	1.36	2.06	1.51	1.59	1.60	1.48	1.53	1.55	1.56	1.60	1.53	1.60	1.55	1.66	1.60	1.54	1.64	1.69	24.34%
3.A.2	All	Gg CO_2-eq	0.58	1.37	1.31	1.34	1.34	1.34	1.35	1.35	1.35	1.36	1.37	1.37	1.38	1.44	1.41	1.41	1.43	1.45	151.17%
3.C.3	All	Gg CO_2-eq	0.05	0.19	0.15	0.23	0.00	1.68	0.04	0.31	1.15	0.69	0.76	0.15	0.09	0.88	0.49	0.06	0.18	0.11	114.08%
3.C.4	All	Gg CO_2-eq	10.51	4.12	5.79	12.49	6.53	8.33	10.61	6.96	5.65	3.93	3.67	4.44	3.04	4.04	6.12	5.30	6.64	7.99	-23.99%

3.C.5	All	Gg CO_2-eq	3.45	1.40	1.92	4.10	2.16	2.75	3.49	2.31	1.88	1.32	1.24	1.49	1.03	1.36	2.03	1.77	2.20	2.65	-23.36%
3.C.6	All	Gg CO_2-eq	0.14	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.46	0.44	0.45	0.46	0.45	0.46	0.45	0.35	151.36%

Table 29: GHG emissions in the agriculture sector, by gas

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
3. Total	CO_2	Gg CO_2-eq	0.05	0.19	0.15	0.23	0.00	1.68	0.04	0.31	1.15	0.69	0.76	0.15	0.09	0.88	0.49	0.06	0.18	0.11	114.08%
3. Total	CH_4	Gg CO_2-eq	1.83	2.61	1.99	2.09	2.09	1.98	2.03	2.05	2.06	2.10	2.04	2.09	2.05	2.18	2.11	2.05	2.16	2.22	21.59%
3. Total	N_2O	Gg CO_2-eq	14.21	6.77	8.98	17.88	9.98	12.38	15.39	10.56	8.83	6.55	6.22	7.24	5.40	6.78	9.50	8.43	10.21	11.90	-16.25%

		Total	**16.08**	**9.57**	**11.12**	**20.20**	**12.07**	**16.04**	**17.46**	**12.91**	**12.03**	**9.34**	**9.02**	**9.49**	**7.54**	**9.84**	**12.11**	**10.54**	**12.54**	**14.23**	

3.9.2. Forestry and Other Land Uses

GHG emissions in the Forestry and Other Land Use sector typically come from a number of sources related to CO_2 emissions/removals from carbon stock changes in above and below-ground biomass pools of forest land, including forest land converted to other land uses such as cropland, grasslands, wetlands, and settlements. CH_4 and N_2O, and additional CO_2 emissions arise from fires and drainage of organic soils, however these emissions were not estimated due to unavailability of data on forest fires.

On this basis, GHG emission estimates for the gases CO_2 were compiled for the FOLU sector categories presented in Table 30 below.

Table 30: IPCC 2006 GL categories for which FOLU GHG emissions were estimated

IPCC Code	Category Name	
3.B.1	Forest land	3.B.1.a – Forest land Remaining Forest land 3.B.1.b – Land Converted to Forest land
3.B.2	Cropland	3.B.2.a – Cropland Remaining Cropland 3.B.2.b – Land Converted to Cropland
3.B.3	Grassland	3.B.3.a – Grassland Remaining Grassland 3.B.3.b – Land Converted to Grassland
3.B.4	Wetland	3.B.4.a – Wetlands Remaining Wetlands 3.B.4.b – Land Converted to Wetlands
3.B.5	Settlements	3.B.5.a – Settlements Remaining Settlements 3.B.5.b – Land Converted to Settlements
3.B.6	Other Land	3.B.6.a – Other land Remaining Other land 3.B.6.b – Land Converted to Other land

Total GHG emissions in the FOLU sector are dominated by the category Land conversion to Grassland in 2018, primarily from conversion from forest land to grassland. All emissions estimated from this sector were CO_2 emissions (Figure 33).

Figure 33: Contribution of categories to total FOLU GHG emissions in 2018

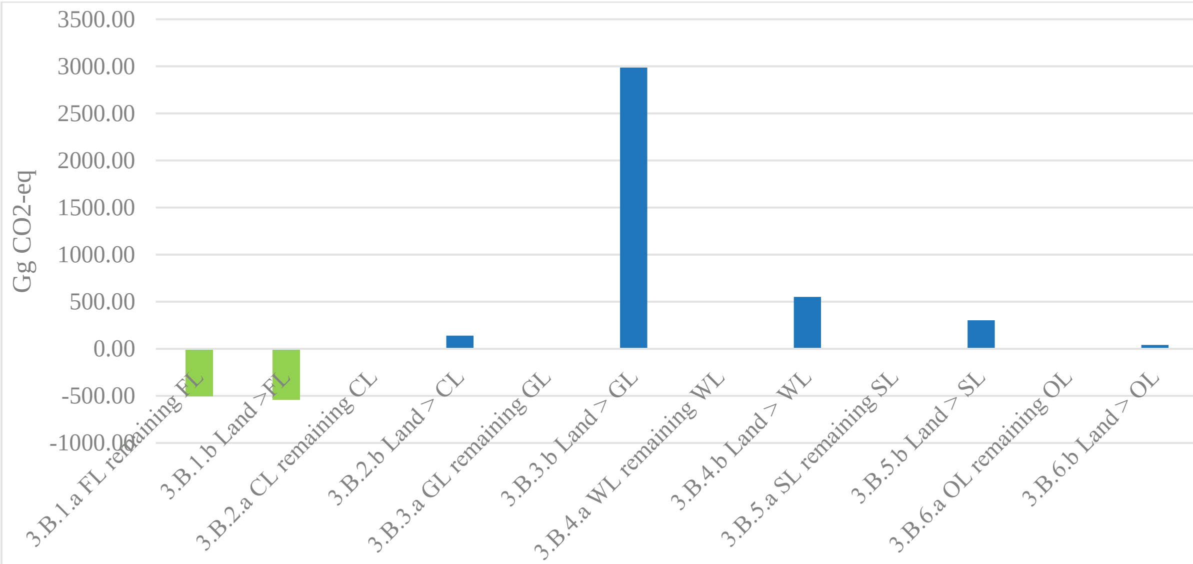
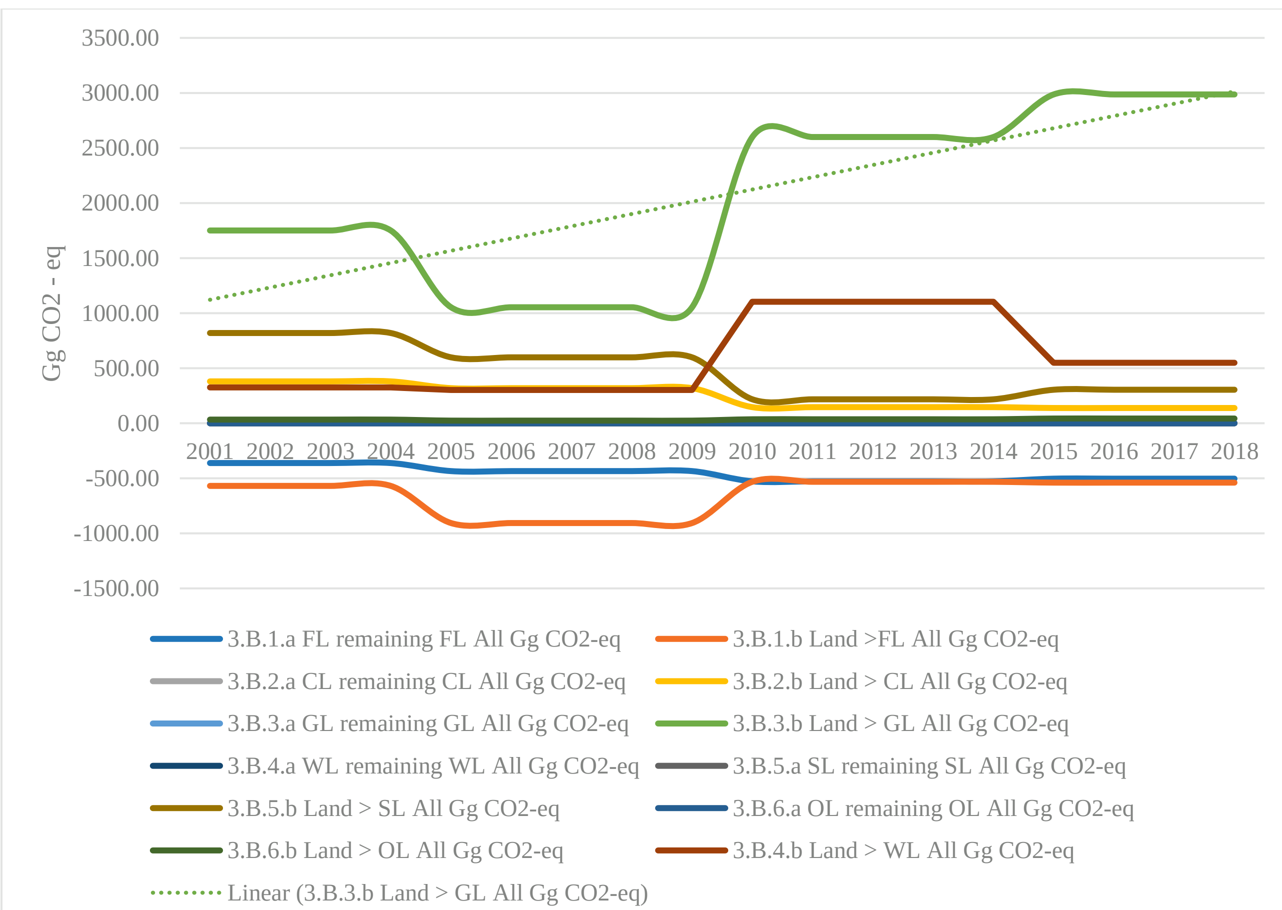


Figure 34: FOLU Sector Emissions by Category



Activity data generated from the land use change maps were multiplied with IPCC default emission factors to calculated emissions for each 5-year time interval. The yearly emissions estimated from land use change for each 5 year time interval (more information on methodology and approaches in Section 3.4.2) can be seen in Table 31 and Figure 34.

Over the time series, the trends that influence annual emissions are those with the most carbon stocks (i.e. Forest land, Grassland, and conversion to either). Lowest emissions were noted within the time period of 2005-2009 (955.66 Gg CO_2 eq yearly emissions) attributed to land conversion to forest land (more removals). This effect was noted after the passing of two hurricanes, Hurricanes Frances and Hurricane Jeanne, occurring two weeks apart in October of 2004, having severely impacted the north-western Bahamas, including Abaco, Andros, Berry, Bimini, Eleuthera, Exuma, Grand Bahama and New Providence islands (mainly forested islands). The pine forests of Grand Bahama were especially impacted with regeneration not comparable to its previous state. The effects of secondary foliage regrowth (and subsequently more removals) attributed to enhanced sinks and reduced emissions in the 2005-2010, with visual effects of this regrowth discernible by satellite imagery in the year 2010 on Grand Bahama and Abaco Islands (Figure 37).

In the following years, from 2010 to 2014 an increase in emissions in the area of 30% is noted, attributed to conversion from forestland to grassland and secondarily from a large conversion of forest land to wetlands (reduction in carbon stocks). The characteristics of these conversions require more land based studies, however the incidence of cyclical conversion of native shrubs and scrubs (classified as grasslands) to wetlands was identified as an area for future study. For more information on activity data see Section 3.4.2.

Furthermore, in more recent natural disasters, Hurricane Dorian in 2019 has demonstrated partial to severe destruction to mangroves, coral reefs, and forests of Abaco and Grand Bahama, particularly the eastern sides of Grand Bahama. Severe defoliation of pine forests on Grand Bahamas and Abaco, with moderate to severe tree uprooting and breakage in certain areas. Although previous assessments in The Bahamas indicate that ecosystems in the country have adapted over time to become resilient to tropical weather and extreme events, destruction to mangroves, coral reefs, seagrass beds and forests of Abaco and Grand Bahama, particularly the eastern sides of Grand Bahama were noted post Hurricane Dorian. Severe defoliation of pine forests on Grand Bahamas and Abaco, with moderate to severe tree uprooting and breakage in certain areas (IDB, 2019). This impact, particularly of the defoliation on Grand Bahama and Abaco can be seen on Figure 39 (Land Use Map of 2020), however the overall emissions from land use change between 2010 and 2020 were relatively constant.

Noteworthy for future improvements is the consideration of data gaps in activity data particularly from 2003 onward where Landsat 7 satellite images suffer from scan-line errors, resulting in less accurate activity data generated from Landsat 7 images.

Figure 35: Land Use Map 2000

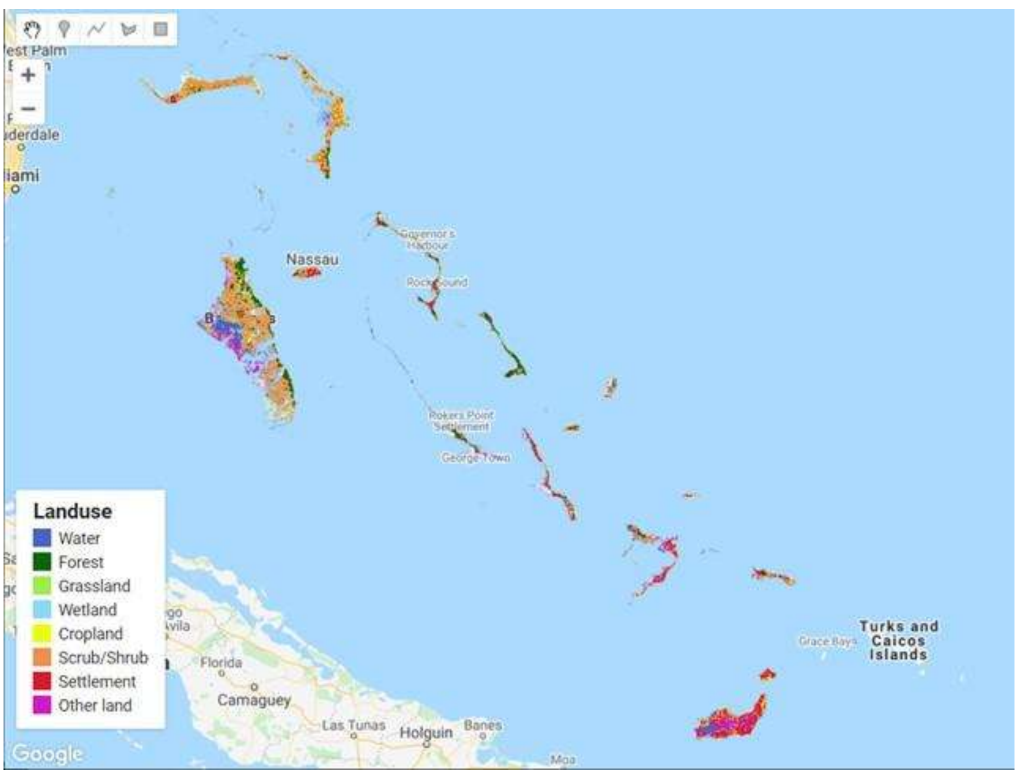


Figure 36: Land Use Map 2005

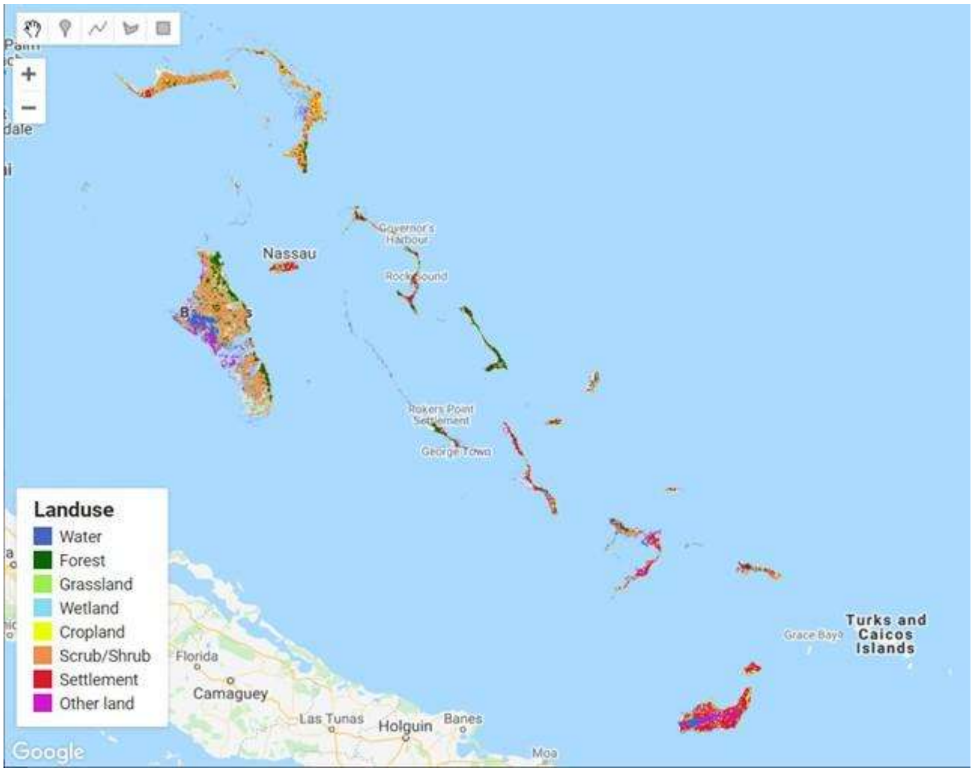


Figure 37: Land Use Map 2010

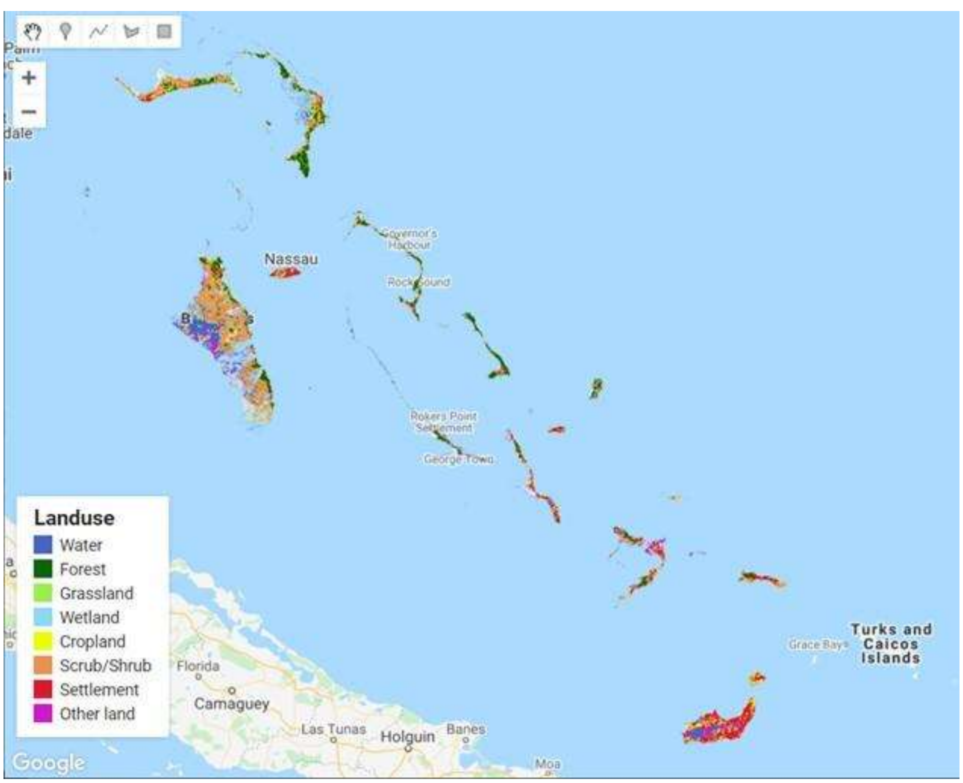


Figure 38: Land Use Map 2015

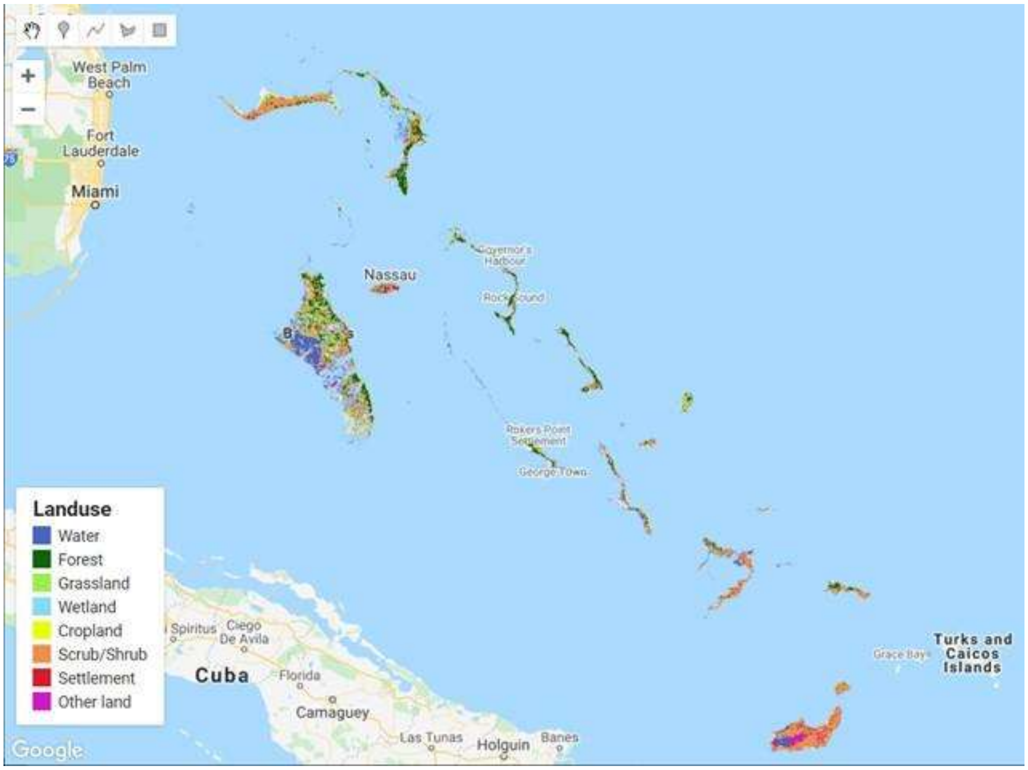


Figure 39: Land Use Map 2020

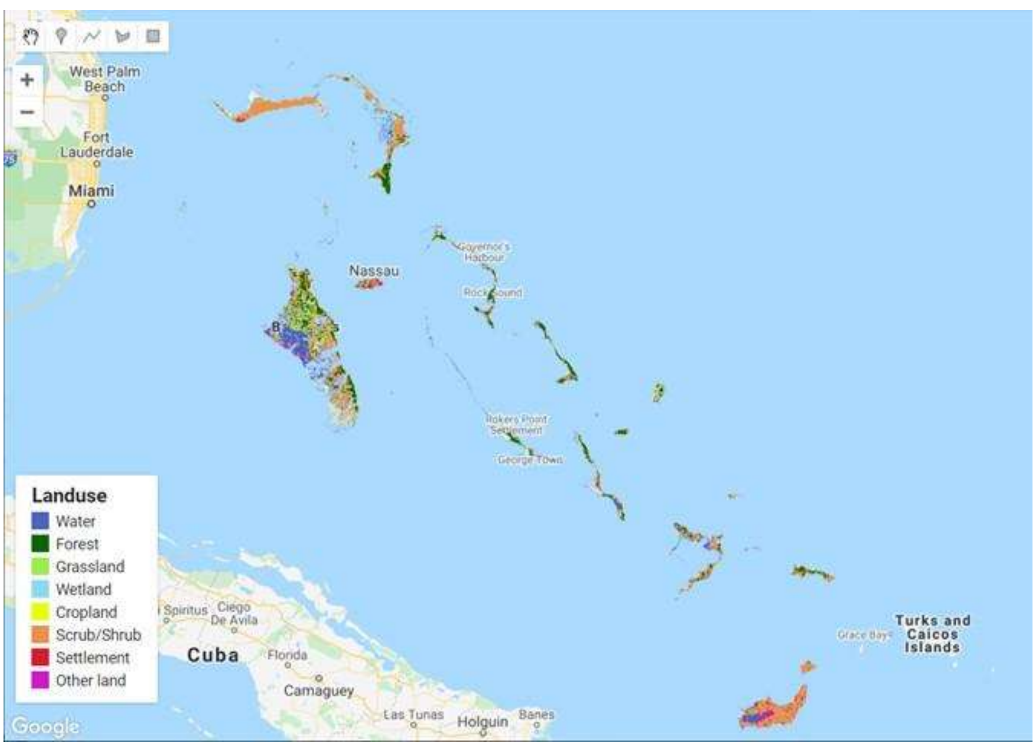


Table 31: GHG emissions in the Forestry and Other Land Use GHG sector, by category

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
3. Total	All	Gg CO_2-eq	**2377.60**	**2377.60**	**2377.60**	**2377.60**	**955.66**	**955.66**	**955.66**	**955.66**	**955.66**	**3042.82**	**3042.82**	**3042.82**	**3042.82**	**3042.82**	**2979.11**	**2979.11**	**2979.11**	**2979.11**	25.30%
3.B.1.a	All	Gg CO_2-eq	-361.60	-361.60	-361.60	-361.60	-434.70	-434.70	-434.70	-434.70	-434.70	-527.69	-527.69	-527.69	-527.69	-527.69	-503.33	-503.33	-503.33	-503.33	39.20%
3.B.1.b	All	Gg CO_2-eq	-568.94	-568.94	-568.94	-568.94	-906.32	-906.32	-906.32	-906.32	-906.32	-531.80	-531.80	-531.80	-531.80	-531.80	-539.28	-539.28	-539.28	-539.28	-5.21%
3.B.2.a	All	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3.B.2.b	All	Gg CO_2-eq	380.16	380.16	380.16	380.16	318.55	318.55	318.55	318.55	318.55	146.16	146.16	146.16	146.16	146.16	138.31	138.31	138.31	138.31	-63.62%
3.B.3.a	All	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3.B.3.b	All	Gg CO_2-eq	1750.81	1750.81	1750.81	1750.81	1053.48	1053.48	1053.48	1053.48	1053.48	2599.54	2599.54	2599.54	2599.54	2599.54	2986.35	2986.35	2986.35	2986.35	70.57%

3.B.4.a	All	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3.B.4.b	All	Gg CO_2-eq	324.78	324.78	324.78	324.78	302.22	302.22	302.22	302.22	302.22	1103.24	1103.24	1103.24	1103.24	1103.24	550.03	550.03	550.03	550.03	69.36%
3.B.5.a	All	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3.B.5.b	All	Gg CO_2-eq	819.38	819.38	819.38	819.38	598.61	598.61	598.61	598.61	598.61	217.44	217.44	217.44	217.44	217.44	304.20	304.20	304.20	304.20	-62.87%
3.B.6.a	All	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3.B.6.b	All	Gg CO_2-eq	33.01	33.01	33.01	33.01	23.83	23.83	23.83	23.83	23.83	35.94	35.94	35.94	35.94	35.94	42.83	42.83	42.83	42.83	29.74%

Table 32: GHG emissions in the Forestry and Other Land Use GHG sector, by gas

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
3. Total	CO_2	Gg CO_2-eq	2377.60	2377.60	2377.60	2377.60	955.66	955.66	955.66	955.66	955.66	3042.82	3042.82	3042.82	3042.82	3042.82	2979.11	2979.11	2979.11	2979.11	25.30%
3. Total	CH_4	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3. Total	N_2O	Gg CO_2-eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		Total	**2377.60**	**2377.60**	**2377.60**	**2377.60**	**955.66**	**955.66**	**955.66**	**955.66**	**955.66**	**3042.82**	**3042.82**	**3042.82**	**3042.82**	**3042.82**	**2979.11**	**2979.11**	**2979.11**	**2979.11**	

3.10. Waste

GHG emissions in the waste sector typically come from a number of sources related to the treatment of solid waste as well as the management of wastewater. With regards to solid waste, solid waste disposal (i.e., landfilling of solid waste) and, to a small extent, open burning of waste, take place in The Bahamas. One landfill is currently being converted to a managed form, while the remaining landfills are unmanaged. Biological treatment of solid waste does not take place. Large scale waste incineration does not take place in The Bahamas according to available information and expert judgement. The incineration of hazardous waste at smaller facilities, e.g. in hospitals, might take place according to expert judgement. Information on amounts of hazardous waste and treatment approaches could not be obtained, this is clearly an area for improvement.

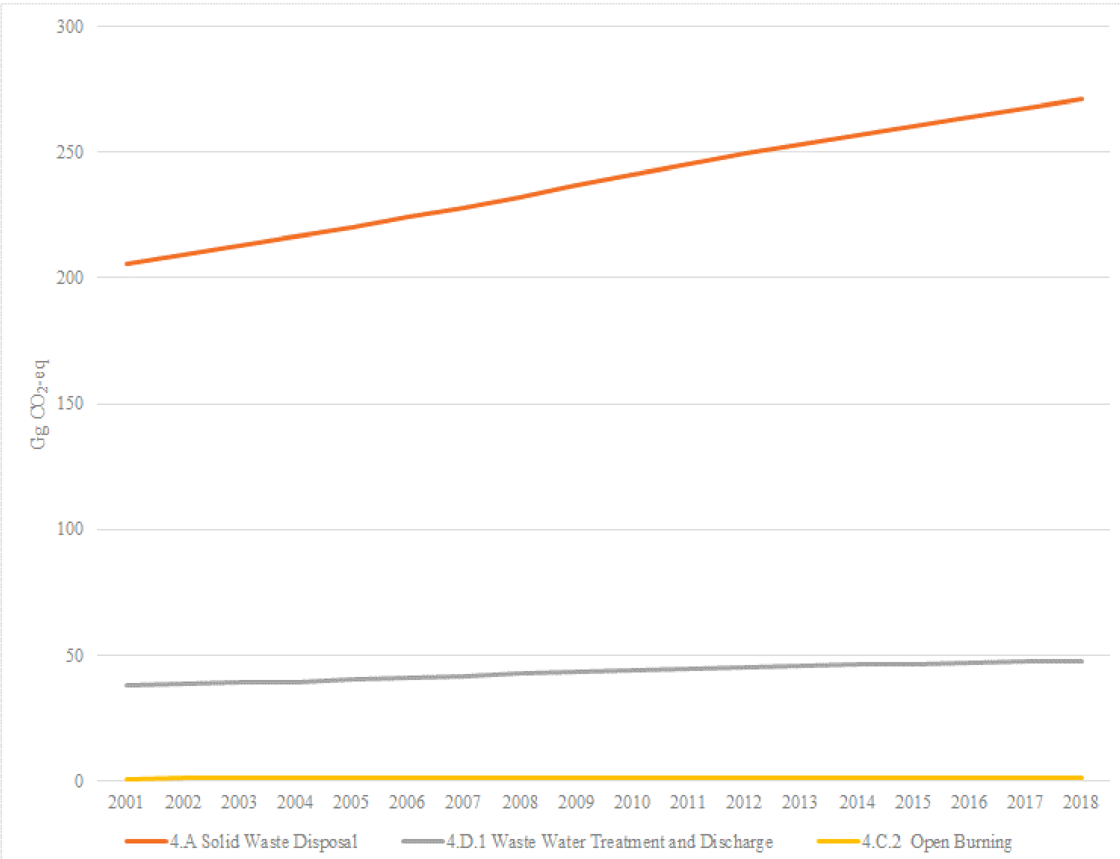
On this basis, GHG emission estimates for the gases CO_2, CH_4, N_2O were compiled for the waste sector categories presented in Table 33 below.

Table 33: IPCC 2006 GL categories for which Waste GHG emissions were estimated

IPCC Category	Category Name
4.A	Solid Waste Disposal
4.C.2	Open burning of waste
4.D.1	Domestic Wastewater Treatment and Discharge

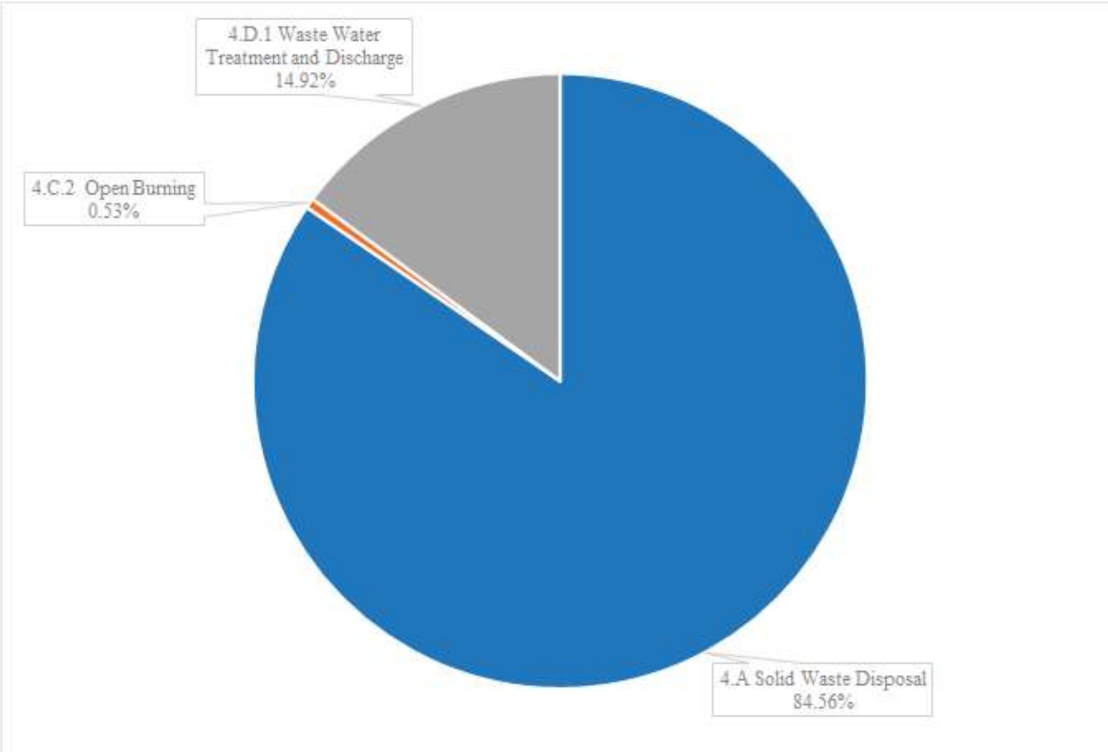
Total GHG emissions in the waste sector amounted to 245.20 Gg CO_2-eq in 2001 and 320.31 Gg CO_2-eq in 2018, see Figure 40 and Table 34. This represents an increase by 30.6 per cent. It is important to note that the calculation has heavily relied on IPCC default values and assumptions (e.g., waste generation rate, waste composition), so that the current estimations mainly reflect The Bahamas' population increase over the time series. Information indicating technological change and change in treatment approaches (e.g., moving from shallow to deep landfills over time) was not available. Generally, the increase in GDP and also tourism activity are likely to influence GHG emission developments in the waste sector, but are currently not reflected in the calculation. Annex II suggests improvements which would allow considering these drivers in the future.

Figure 40: Total GHG emissions in the waste sector 2001-2018, by categories



Total GHG emissions in the waste sector are dominated by the category solid waste disposal contributing 84.6 per cent in 2018. Wastewater treatment and discharge contribute 14.9 per cent and 0.5 per cent, see Figure 41. Between 2001 and 2018, the three subcategories show an upward trend with similar growth rates. GHG emissions from solid waste disposal grew by 31.6 per cent, from wastewater treatment and discharge by 27.4 cent and from open burning by 25.4 per cent.

Figure 41: Contribution of categories to total GHG emissions in 2018 in the waste sector



CH_4 dominates the waste sector with 98.1 per cent of sectoral emissions in 2018 and 97.8 in 2001. N_2O only contributes 1.7 per cent in 2018 and 1.9 per cent in 2001 and CO_2 only contributes 0.2 per cent in both years.

Figure 42: Contribution of gases to total waste sector emissions in 2001 and 2018

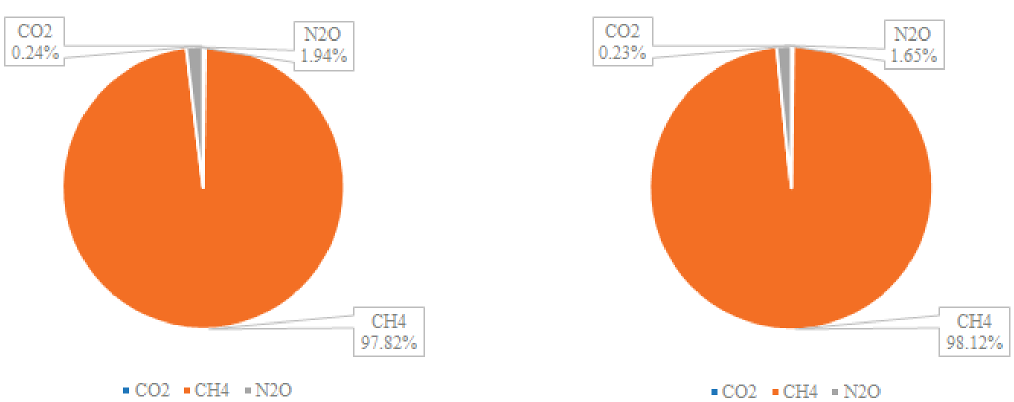


Table 34: GHG emissions in the waste sector 2001-2018, by category

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
4. Total	All	Gg CO_2-eq	245.20	249.22	253.11	257.22	261.77	266.67	271.52	276.46	281.51	286.79	291.49	295.94	300.90	304.83	308.75	312.71	316.51	320.31	30.6%
4.A	All	Gg CO_2-eq	205.78	209.13	212.62	216.27	220.07	224.02	228.10	232.32	236.62	240.94	245.20	249.32	253.25	256.98	260.56	264.04	267.46	270.85	31.6%
4.C.2	All	Gg CO_2-eq	1.32	1.34	1.37	1.39	1.42	1.45	1.47	1.50	1.53	1.55	1.57	1.59	1.60	1.62	1.63	1.65	1.67	1.68	27.4%
4.D.1	All	Gg CO_2-eq	38.09	38.74	39.12	39.56	40.28	41.20	41.95	42.64	43.37	44.29	44.72	45.03	46.05	46.23	46.55	47.02	47.38	47.77	25.4%

Table 35: GHG emissions in the waste sector 2001-2018, by gas

IPCC Category	Gas	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Increase 2018 vs 2001
4. Total	All	Gg CO_2-eq	245.20	249.22	253.11	257.22	261.77	266.67	271.52	276.46	281.51	286.79	291.49	295.94	300.90	304.83	308.75	312.71	316.51	320.31	30.6%
4.A	CO_2	Gg CO_2-eq	0.58	0.59	0.60	0.61	0.62	0.63	0.65	0.66	0.67	0.68	0.69	0.70	0.70	0.71	0.72	0.72	0.73	0.74	27.4%
4.C.2	CH_4	Gg CO_2-eq	239.86	243.78	247.88	252.18	256.65	261.29	266.09	271.01	275.99	280.91	285.69	290.26	294.59	298.72	302.70	306.59	310.45	314.28	31.0%
4.D.1	N_2O	Gg CO_2-eq	4.76	4.85	4.63	4.43	4.50	4.74	4.78	4.79	4.86	5.20	5.11	4.98	5.60	5.40	5.33	5.39	5.33	5.30	11.3%

Approaches

3.11. Overview

Table 36 and Table 37 below present an overview on methodological tiers and data sources used for The Bahamas national GHG inventory. Generally, Tier 1 approaches were used. The Bahamas intends to move to Tier 2 over time for the categories identified as key (see section 3.3. for the key category analysis and Annex III for the improvement plan)

Detailed information on activity data, data sources, emission and other calculation factors as well as assumptions are presented by IPCC category from section 3.2 onwards.

Table 36: Activity data and emission factor tiers used for The Bahamas national GHG inventory emission estimates

IPCC Category	Category Name	Specific IPCC Categories estimated for The Bahamas	Activity Data Tier	Emission Factor Tier
1.A.1	Energy Industries	1.A.1.a.1 Main electricity and heat production	1	D
1.A.2	Manufacture and construction	1.a.2.f Construction 1.A.2.m Non-specified Industries	1	D
1.A.3.	Transport	1.A.3.a.i International aviation 1.a.3.a.ii Domestic Aviation 1.A.3.b.i Cars 1.A.3.b.ii Light duty vehicles 1.a.3.b.iii Heavy duty vehicles and buses 1.a.3.b.iv Motorcycles	1	D

1.A.4.a	Other	1.A.4.a Institutional/Commercial 1.A.4.b Residential 1.A.4.c Agriculture/Fisheries/Forestry	1	D
1.B.	Fugitive emissions	1.B.2.a.iii.3 Natural gas liquids transport	1	D
3.A.1	Enteric Fermentation	3.A.1.a – Cattle 3.A.1.a.i – Dairy Cows 3.A.1.a.ii – Other Cattle 3.A.1.c – Sheep 3.A.1.d – Goats 3.A.1.f – Horses 3.A.1.g – Mules and Asses 3.A.1.h – Swine	1	D
3.A.2	Manure Management	3.A.2.a – Cattle 3.A.2.a.i – Dairy Cows 3.A.2.a.ii – Other Cattle 3.A.2.c – Sheep 3.A.2.d – Goats 3.A.2.f – Horses 3.A.2.g – Mules and Asses 3.A.2.h – Swine 3.A.2.j – Poultry	1	D
3.B.1	Forest land	3.B.1.a – Forest land Remaining Forest land 3.B.1.b – Land Converted to Forest land	1	D
3.B.2	Cropland	3.B.2.a – Cropland Remaining Cropland	1	D

		3.B.2.b – Land Converted to Cropland		
3.B.3	Grassland	3.B.3.a – Grassland Remaining Grassland 3.B.3.b – Land Converted to Grassland	1	D
3.B.4	Wetland	3.B.4.a – Wetlands Remaining Wetlands 3.B.4.b – Land Converted to Wetlands	1	D
3.B.5	Settlements	3.B.5.a – Settlements Remaining Settlements 3.B.5.b – Land Converted to Settlements	1	D
3.B.6	Other Land	3.B.6.a – Other land Remaining Other land 3.B.6.b – Land Converted to Other land	1	D
3.C.3	Urea Application		1	D
3.C.4	Direct N_2O Emissions from managed soils		1	D
3.C.5	Indirect N_2O Emissions from managed soils (3)		1	D

3.C.6	Indirect N_2O Emissions from Manure Management		1	D
4.A.	Municipal Solid Waste		1	D
4.C	Incineration and open burning	4.C.2 Open burning	1	D
4.D.1	Domestic Wastewater Treatment and Discharge		1	CS, D

Table 37: Overview of key data sources used for The Bahamas national GHG inventory estimates

IPCC Category	Key sources of activity data	Key sources of emission factors and other calculation factors
1. A. Energy	• Central Bank of The Bahamas • Energy Balance (2010-2012) • Power generators: Bahamas Power and Light, Company Ltd. Grand Bahamas Power Company • Fuel Distributors: Rubis	IPCC 2006 Guidelines
2. Industrial Processes and Product Use	• Central Bank of The Bahamas	IPCC 2006 Guidelines

3. AFOLU	• FAO Livestock data • Customs import data on livestock • Customs import data on urea and fertilizers • Landsat 7 and 8 satellite data from Google Earth • ESRI Land Cover Map 2020	IPCC 2006 Guidelines
4.A Waste	• UN Population data • FAO protein consumption data • Regional Sanitation Study (PAHO, 2012) • IPCC 2006 waste generation default data and waste composition default data	IPCC 2006 Guidelines

3.12. Energy

3.12.1. Overview - Activity data and emission factors

Table 38 presents the key data sources available for the estimation of energy sector emissions in The Bahamas.

Table 38: Key data sources and information covered by each source

Source	Fuels	Years covered	Scope	Reference

Central Bank of The Bahamas	propane, motor gasoline, aviation gasoline, Kerosene, Bunker C (a type of fuel oil), gas oil (also referred to as diesel), lubricants and others	1990-2021	Total national consumption of each fuel	Bahamas Central Bank, Quarterly Statistical Digests[12]
Energy Balance	Firewood, LPG, Gasoline Alcohol, Jet Fuel Kerosene, Diesel Oil, Fuel Oil, Charcoal, Non-Energy	2010-2012	Total national consumption of each fuel	OLADE (Latin American Energy Organisation) (2015); The Bahamas. Energy Balances 2010-2012; http://biblioteca.olade.org/opac-tmpl/Documentos/old0348.pdf
Bahamas Power and Light Company Ltd.	Fuel oil, diesel	2000-2020	Consumption of fuels for power generation in The Bahamas excluding Grand Bahama.	Private communication from Rochelle McKinney, Bahamas Power and Light

[12] The Quarterly Statistical Digests prepared by the CBB can be found here: https://www.centralbankbahamas.com/publications/qsd.

Grand Bahamas Power Company	CO_2 emissions from fuel oil as well as from diesel consumption	2016-2020	Power generation for Grand Bahama	Private communication from Garelle Hudson, Grand Bahamas Power Company
Rubis (a fuel distributor) [13]	Sales of Aviation gasoline, aviation jet fuel, unleaded gasoline, diesel, kerosene. Unleaded gasoline and diesel were differentiated by sales to retail clients and to commercial/industrial clients	2010-2019		Private communication from Kirk Johnson , Rubis

The Central Bank of The Bahamas (CBB) compiles a quarterly overview of oil imports for domestic consumption, including international bunkers (the fuels not consumed by The Bahamas themselves, but consumed for international aviation and international waterborne navigation). Such information covered the whole time series 2001-2018 and includes the following fuels: propane, motor gasoline, aviation gasoline, Kerosene, Bunker C (a type of fuel oil), gas oil (also referred to as diesel), lubricants and others. International bunkers are not differentiated by fuel type. The CBB data does not differentiate by fuel use, e.g., whether diesel is consumed for road transport or for diesel generators used by commercial ventures like hotels.

[13] Further fuel distributors exist, e.g. SOL Group, Freeport Oil Company, from which no data was available at the time of compiling this document.

OLADE has prepared an energy balance for the years 2010-2012. The energy balance (EB) presents fuel consumption by activity. These activities show good alignment with the categories of the IPCC 2006 Guidelines. Annex III shows how the fuels and activities in the energy balance were mapped against the categories in the IPCC 2006 Guidelines.

Comparing CBB and EB fuel consumption values, the CBB data values were often lower than EB values for the timeframe 2010-2012. While potential reasons for this discrepancy were assessed, it was not possible to find evidence pointing to specific reasons, e.g., data used and assumptions made in compiling the EB or completeness of the CBB dataset. Only for the particular case of fuel oil the EB mentions that a fuel distributor indicated that the CBB data does not consider data from all fuel distributors and might thus be lower than the real consumption. Of course, this situation related to 2010-2012, and there was no data available allowing to understand whether the situation might have changed today.

Disaggregated (bottom-up) fuel consumption at category level was available only to a limited extent, e.g., information related to fuel consumption for power generation from BPL and GBPC, fuel sales to retail as well as commercial industrial clients from Rubis.

In order to estimate total fuel consumption, the data sources which are of national origin and cover the whole time series were preferred. These are CBB and BPL. Only where these were not sufficient or seemed incomplete, EB data was used to fill gaps. Table 39 presents the approaches used to estimate overall fuel consumption for each fuel.

Allocation of fuel consumption to the various IPCC categories was performed using the average shares of each activity in total fuel consumption for the years 2010-2012 from the EB.

Table 39: Approaches for the estimation of fuel consumption

Fuel	Estimation of overall consumption	Clarifications
Aviation Gasoline	Value presented by the CBB statistics	EB presents gasoline and aviation gasoline aggregated into one

		category, while CB statistics present them separately
LPG	Value presented by the CBB statistics	The CB statistics present no LPG but “propane”, while the EB mentions “LPG”, which is in most cases a mix of propane and butane. Based on experience in the region it was assumed the CB data related to LPG as well.
Gasoline	Value presented by the CBB statistics	
Diesel	EB data was used for 2010-2012 and extrapolated for 2001-2009 and 2013-2018 using The Bahamas’ GDP as driver	CBB diesel consumption fluctuates strongly and in no relation to GDP or population over the time series. Additionally, in 2010-2015 the CBB diesel consumption is slightly lower than the consumption reported by BPL, which only accounts for the consumption for power generation, but not for consumption under the other activities like transport. This indicates that the data might be incomplete.
Fuel oil	BPL fuel oil consumption values were scaled up by the average difference between BPL and EB values (2010-2012) in %.	CBB fuel oil consumption fluctuates strongly and in no relation to GDP or population over the time series, frequently being considerably lower than the fuel oil consumption reported by BPL, which accounts for the consumption for power generation, but not other activities like transport

		and industry. However, according to the EB, consumption for power generation accounts for over 98 per cent of total fuel oil consumption.
Firewood	Average consumption for the timeframe 2010-2012 in TJ/ capita rural population is calculated using EB 2010-2012 values, total population numbers (UN projections) and the share of rural population (World Bank). This value is extrapolated over the remainder of the timeframe using rural population as driver.	CBB statistics do not include firewood consumption, only the EB provides this value.
Charcoal	Total consumption from the EB 2010-2012, for the remainder of the time series GDP is used as driver for the charcoal consumption in the institutional/commercial sector and population for the charcoal consumption in the residential sector.	CBB statistics do not include charcoal consumption. The EB contains charcoal consumption and indicates the consumption takes place in the residential as well as in the institutional/commercial sector.
Kerosene	CBB data	

Table 40 presents the fuels allocated to the various IPCC categories based on information in the CBB and the EB.

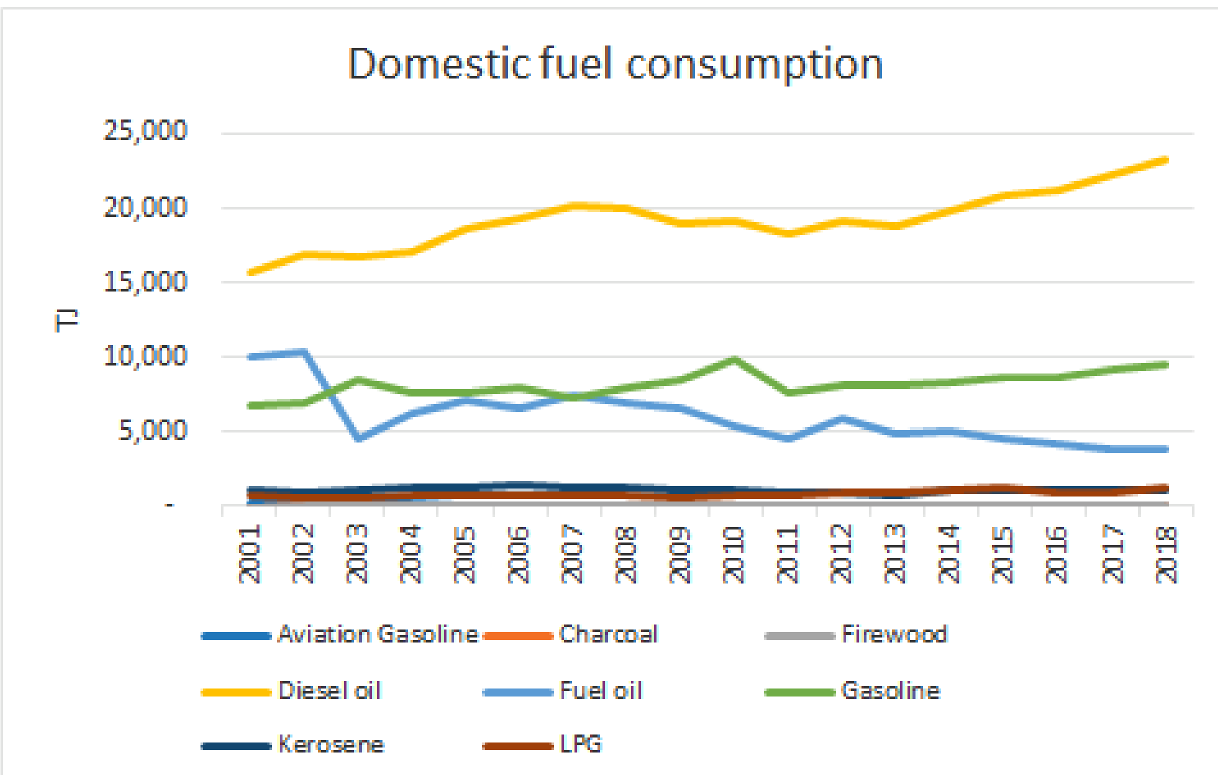
Table 40: Matching of fuels and activities in the energy balance to the categories in the IPCC 2006 Guidelines

	Firewood	LPG	Aviation Gasoline	Gasoline	Jet Fuel /Kerosene	Diesel Oil	Fuel Oil	Charcoal
1.A.1.a.1 Main electricity and heat production						X	X	
1.A.2. Manufacture and construction		X		X		X	X	
1.A.3.a. Aviation		X			X			
1.A.3.b Road Transportation				X		X		
1.A.3.c. Navigation							X	

1.A.4.a Institutional/ commercial	**-**	**X**		**X**	**-**	**X**	**-**	**X**
1.A.4.b Residential	**X**	**X**		**X**	**X**	**X**	**-**	**X**
1.A.4.c Agriculture/fisheries	**-**	**-**		**X**	**-**	**X**	**-**	**-**

Estimated domestic fuel consumption is presented in Figure 43.

Figure 43: Domestic fuel consumption 2001-2018



The following chapters provide additional information on the national circumstances relevant for each category, data available and used as well as assumptions made with regards to the GHG estimations. The estimated GHG emissions by category in CO_2-eq. are presented in Annex I, fuel consumption by category in Annex II.

Emissions of CO_2, CH_4 and N_2O in the energy sector were estimated by using a Tier 1 approach. Activity data (fuel consumption by fuel type) was multiplied by fuel-specific default emission factors taken from the IPCC 2006 GL.

Table 41 below presents the sources of the emission factors used for the estimations. The specific emission factors used for each IPCC category are presented in the subchapters on the specific IPCC categories.

Table 41: Sources of emission factors used for The Bahamas national GHG inventory

IPCC Category	Category Name	Source of CO_2 emission factors (IPCC 2006 GL)	Source of CH_4 and N_2O emission factors (IPCC 2006 GL)
1.A.1.a.1	Main electricity and heat production	Volume 2, chapter 2, Table 2.2	Volume 2, chapter 2, Table 2.2
1.A.1.k	Construction		Volume 2, chapter 2, Table 2.3
1.A.2.m	Non-specified industry		Volume 2, chapter 2, Table 2.3
1.A.3.a.	Aviation		Volume 2, chapter 2, Table 3.6.5
1.A.3.b	Road transport		Volume 2, chapter 3, Table 3.2.2
1.A.3.c	Navigation		Volume 2, chapter 3, Table 3.5.4

1.A.4.a	Institutional/commercial		Volume 2, chapter 2, Table 2.4
1.A.4.b	Residential		Volume 2, chapter 2, Table 2.5
1.A.4.c	Agriculture/fisheries		Volume 2, chapter 2, Table 2.5
1.B.2.a.iii.3	Natural gas liquids transport	Volume 2, chapter 4, Table 4.24, Table 4.2.4	Volume 2, chapter 4, Table 4.24, Table 4.2.4 (N_2O only)

3.12.2. Reference approach

The Reference Approach is a top-down approach, using a country's energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuels. The IPCC 2006 GL states that is good practice to apply both a sectoral approach and the reference approach to estimate a country's CO_2 emissions from fuel combustion and to compare the results of these two independent estimates. The detailed approach to calculating the Reference approach can be found in Vol. 2 Chapter 6 of the IPCC 2006 Guidelines[14].
In the case of The Bahamas, the reference approach does not provide an estimate which is independent from the estimate of the sectoral approach.

This is because the sectoral approach was not calculated based on real category-specific demands, but overall fuel consumption per fuel type, allocated to IPCC categories based on the information available. Therefore, the reference approach and the sectoral approach are both based on the same total fuel consumption per fuel. The calculation of the reference approach and the sectoral approach was nevertheless carried out as a quality control measure.

Table 42 below shows the emission levels in Gg CO_2 in the reference and the sectoral approach yield the same results.

[14] See https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_6_Ch6_Reference_Approach.pdf.

Table 42: Results of the Reference approach and comparison with sectoral approach

Item	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aviation Gasoline	Gg CO_2-eq	11	9	10	6	6	2	0	3	3	3	3	5	4	4	3	4	3	3
Charcoal	Gg CO_2-eq	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Firewood	Gg CO_2-eq	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
Diesel oil	Gg CO_2-eq	967	1,033	1,032	1,053	1,144	1,182	1,235	1,224	1,161	1,174	1,352	1,416	1,396	1,468	1,547	1,576	1,650	1,720
Fuel oil	Gg CO_2-eq	772	803	353	480	547	506	568	540	511	412	351	454	376	387	347	324	293	296

Gasoline	Gg CO_2 -eq	566	578	701	635	626	657	605	660	703	818	624	672	665	680	716	711	755	786
Kerosene	Gg CO_2 -eq	65	58	66	75	79	89	81	77	65	67	61	62	50	64	69	63	69	71
LPG	Gg CO_2 -eq	31	21	23	30	27	28	29	31	23	29	27	33	38	40	47	36	36	52
Total CO_2 emissions – Reference approach	Gg CO_2 -eq	2,412	2,502	2,183	2,279	2,429	2,464	2,518	2,534	2,466	2,503	2,416	2,641	2,529	2,644	2,730	2,714	2,807	2,928
Total CO_2 emissions – Sectoral approach (incl. biomass – related	Gg CO_2 -eq	2,417	2,508	2,188	2,284	2,435	2,469	2,523	2,540	2,472	2,509	2,422	2,647	2,535	2,650	2,736	2,720	2,813	2,934

memo items)																			
Difference between Reference approach and sectoral approach	Gg CO_2 -eq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Difference between Reference approach and sectoral approach (incl. biomass-related memo items)	Gg CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.12.3. Category-specific information

3.12.3.1. Main electricity and heat production – Category 1.A.1.a.i

Power generation in The Bahamas is in the hand of two power supply companies: The state-owned Bahamas Power and Light (Company Ltd. BPL) and The Grand Bahamas Power Company. The latter services Grand Bahama Island only, whereas BPL services the remaining major islands, (with the exception of Spanish Wells, Eleuthera and Inagua). Both companies generate electricity using fuel oil and diesel. Total power generation for The Bahamas is not available other than for the years 2010-2012 from the energy balance. From BPL, power generation was available for the years 2001-2013 only.[15] While it is known that autoproducers of power exist in The Bahamas, for example using diesel-fueled generators, no data was available to estimate emissions from the related fuel consumption under category 1.A.1.a.i. It is understood that emissions from this fuel consumption are included under category 1.A.4. Other.

Fuel consumption was available for BPL over the whole time series, but only from 2016 onwards from The Grand Bahamas Power Company. Activity data is presented in Table 45 further below.

Table 43: Emission factors used for category 1.A.1.a.i Main electricity and heat production

Fuel Type	Unit	CO_2	CH_4	N_2O
Diesel oil	kg gas /TJ	74,100	3	0.6
Fuel oil	kg gas /TJ	77,400	3	0.6

3.12.4. Manufacturing Industries and Construction (Category – 1.A.2)

With the large focus on financial services and tourism, industrial activity in The Bahamas is limited. Examples include mining (actually quarrying of aragonite, a type of limestone), construction and mixing of cement. Production of clinker does however not take place.

[15] Power generation from the IEA database (https://www.eia.gov) was compared to available power generation and found to differ strongly, e.g. IEA generation values were 45.2 per cent below reported BPL generation in 2001, 33.6 per cent in 2008 and 6.5 per cent in 2013.

The energy balance provides information on fuel consumption related to the two activities "industry" and "construction". Under Category 1.A.2 Manufacturing Industries and Construction, the IPCC 2006 Guidelines include a list of subcategories. One of the subcategories is construction (1.A.2.f); the list does however not include a category named "industry" (as listed in the EB). It is our understanding that "industry" as described in the EB could in theory include fuel consumption from any of the categories under 1.A.2 applicable for The Bahamas, except for construction. The decision was thus taken to allocate the fuel consumption under the activity "industry" in the EB to the IPCC category 1.A.2.m Non-specified industry.

Information in the EB on fuel consumption from mining is included in the activity "agriculture, fishing, mining" and could not be disaggregated due to lack of information. Emissions from fuel combustion from mining are therefore reported as part of category 1.A.4.c.

Activity data is presented in Table 46 for construction and Table 47 for non-specified industries further below.

Table 44: Emission factors used for category 1.A.2 Manufacturing and construction

Fuel Type	Unit	CO_2	CH_4	N_2O
Diesel oil	kg gas /TJ	74,100	3	0.6
Fuel oil	kg gas /TJ	77,400	3	0.6
Gasoline	kg gas /TJ	69,300	3	0.6
Kerosene	kg gas /TJ	71,500	3	0.6
LPG	kg gas /TJ	63,100	1	0.1

Table 45: Activity data for category 1.A.1.a.i Main electricity and heat production

Fuel type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	10,425	10,843	11,719	9,259	8,625	9,790	9,122	10,258	9,408	12,416	12,861	9,682	10,601	12,262	13,375	14,340	14,471	15,339
Fuel oil	TJ	9,754	10,144	4,456	6,063	6,905	6,386	7,168	6,816	6,457	5,209	4,432	5,735	4,749	4,892	4,379	4,092	3,704	3,739

Table 46: Activity data for category 1.A.2.f Construction

Fuel type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	169	199	142	319	438	397	485	403	403	221	346	607	530	486	483	446	502	507
Gasoline	TJ	280	286	345	312	307	320	294	322	343	399	305	329	325	333	350	347	369	384
LPG	TJ	22	14	16	20	19	19	20	21	16	20	18	22	26	28	33	25	25	35

Table 47: Activity data for category 1.A.2.m Non-specified industry

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	719	847	602	1354	1863	1686	2063	1712	1711	938	1471	2578	2253	2063	2051	1893	2132	2153
Fuel oil	TJ	22	23	10	14	16	15	16	16	15	12	10	13	11	11	10	9	8	9
Gasoline	TJ	1191	1214	1467	1324	1305	1362	1251	1369	1459	1696	1295	1398	1381	1414	1487	1477	1567	1630
LPG	TJ	91	61	66	87	80	81	85	90	66	84	77	95	110	117	138	105	105	150

3.12.5. Transport (Category 1.A.3)

3.12.5.1. Domestic Aviation (Category – 1. A. 3.a.ii)

Both domestic as well as international flights take place in / from The Bahamas. This category covers only domestic flights, i.e., flights which both start and land in The Bahamas. International flights are covered in section 3.2.6.2.

Flight data could not be obtained for domestic flights. The CBB dataset lists the consumption of aviation gasoline as well as Kerosene for domestic uses. It was assumed that all domestic aviation gasoline consumption takes place in the aviation sector. The EB, which only covers domestic use, indicates Kerosene consumption in the transport sector, which was assumed to be for domestic flights, and further use in the residential sector, which was assumed to be for lighting purposes. Consumption of aviation gasoline was taken from the CBB data. Kerosene for domestic flights was calculated by taking total Kerosene consumption from the CBB dataset and allocating the total consumption to the activities “transport” and “residential” as in the EB.

Table 48: Emission factors used for category 1.A.3.a.i domestic aviation

Fuel Type	Unit	CO_2	CH_4	N_2O
Aviation gas	kg gas /TJ	70,000	0.5	2
Kerosene	kg gas /TJ	71,500	0.5	2

3.12.6. Road Transport (Category – 1. A. 3.b)

Gasoline and diesel are the fuels consumed under this category. While a small amount of biodiesel is currently produced and consumed in the transport sector in The Bahamas, this activity has only started in 2019.

Gasoline consumption data was estimated using the CBB dataset. Registration of data for road vehicles was obtained from The Bahamas’ Department of Transport and compared with data from the energy balance for the year 2012. The Department of Transport has started digitizing registration data from 2016 onwards. Not all islands have digitized their systems. The islands which have to date, however, cover about 95% of The Bahamas' inhabitants. Registration numbers in 2016 and 2017 are considerably higher than in 2018-2021, however considerably lower than in 2012, see Table 49 below. While the general difference between 2016-2021 values to the 2012 value might indicate that the datasets provided contain only new registrations, this does not explain the differences between values for 2016/2017 and 2018-2021. On this basis, total numbers of vehicles and numbers per vehicle type could not be calculated.

Table 49: Vehicle registration numbers

Source	Year	Passenger cars	Light duty trucks	Heavy duty trucks / buses	Motorcycles	Total number of vehicles
EB	2012	134,039	4,578	841	877	140,335
Department of Transport	2016	43,439	3,875	90	25	47,429[16]
	2017	56,629	5,612	2,581	1,207	66,029
	2018	16,807	1,094	557	459	18,917
	2019	14,001	752	483	199	15,435
	2020	13,321	853	927	256	15,357
	2021	16,041	1,248	1,170	583	19,040[11]

For the time being, fuel consumption per vehicle type (cars, light duty trucks, heavy duty vehicles, motorcycles) was calculated using a total number of vehicles obtained from CEIC Data[17], standard distances driven per vehicle type and standard fuel efficiencies per vehicle type, typical fuels used. Only the average shares of vehicle types was derived from the vehicle registration numbers presented in Table 49. The assumptions used for the allocation of fuel consumption to the vehicle types

[16] Data from 2016 and 2021 did not cover the whole year, but only October 20-December 31 for 2016, and January 1-May 1 for 2021. Numbers presented have been scaled up assuming an equal activity in registration for the remainder of the year as during the time period for which data was available.
[17] https://www.ceicdata.com/en/indicator/bahamas/motor-vehicle-registered

are presented in Table 50. The resulting fuel consumption per vehicle type over the time series are presented in Table 54, Table 55,

Table 56, and Table 57 further below. The emission factors used are presented in Table 51. For gasoline, CH4 and N2O emission factors in the IPCC 2006 Guideline are related to vehicle technologies. No information on vehicle technologies per vehicle type was available for cars, LDV and motorcycles using gasoline. As CH4 and N2O emissions from these vehicle categories are not key categories, these emissions were calculated using the emission factors for “gasoline uncontrolled”, as a conservative approach in line with Figure 3.2.3 of Volume 2, Chapter 3 of the IPCC 2006 Guidelines.

Table 50: Assumptions used for the allocation of fuel consumption to the subcategories

Information	Unit	Passenger cars	Light duty trucks	Heavy duty trucks / buses	Motorcycles
Share of vehicle type	%	87.9%	7.4%	3.2%	1.5%
Fuel used	N/A	Gasoline	80% Gasoline 20% Diesel	Diesel	Gasoline
Distance driven per year	km	15500	35000	20000	1000

Table 51: Emission factors used for category 1.A.3.b Road Transport

			Default Emission Factor [kg/TJ]		
Fuel type	Representative vehicle category	Subcategory	CO_2	CH_4	N_2O

Motor Gasoline	Uncontrolled	Cars	69300	33	3.2
Motor Gasoline	Uncontrolled	LDV	69300	33	3.2
Motor Gasoline	Uncontrolled	Motorcycles	69300	10	0.96
Gas/Diesel Oil			74100	3.9	3.9

3.12.6.1. Domestic Waterborne Navigation (Category – 1. A. 3.c.ii)

Detailed data about The Bahamas fleet of waterborne vessels (e.g., mailboats, tourism, private cruising) was not available. It was assumed that smaller vessels consume gasoline, larger vessels diesel or fuel oil and that thus a share of the overall gasoline, diesel and fuel oil consumption might be attributable to domestic waterborne navigation. There was however no information available allowing to split fuel consumption for domestic waterborne navigation from total gasoline and total diesel consumption in The Bahamas. Such consumption could thus not be allocated to domestic waterborne navigation and is reported under road transport.

The amount of fuel oil in domestic waterborne navigation was estimated based on data obtained from BPL and the allocation of fuel oil consumption to activities in the EB. According to the EB, about 98% of fuel oil consumption is related to power generation, while the remainder is related to transport. It was assumed any consumption of fuel oil under the transport activity in the EB is for domestic waterborne navigation.

Activity data is presented in
Table 61 further below. Emission factors are presented in Table 52.

Table 52: Emission factors used for the category 1.A.3.c.ii domestic waterborne navigation

Fuel Type	Unit	CO_2	CH_4	N_2O
Fuel oil	kg gas /TJ	77400	7	2

Table 53: Activity data for category 1.A.3.a.ii Domestic Aviation

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aviation Gasoline	TJ	153	133	138	92	87	31	5	41	41	41	41	66	56	61	46	56	46	41
Kerosene	TJ	902	807	913	1047	1102	1231	1119	1069	902	930	841	857	696	891	963	880	958	991

Table 54: Activity data for category 1.a.3.b.i Cars

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Gasoline	TJ	3,912	4,007	4,861	4,413	4,353	4,588	4,235	4,607	4,909	5,715	4,355	4,685	4,635	4,742	5,000	4,958	5,274	5,490

Table 55: Activity data for category 1.A.3.b.ii Light duty trucks

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	145	171	122	273	376	340	416	346	345	189	297	521	455	417	414	382	430	435
Gasoline	TJ	1026	1051	1275	1157	1142	1203	1110	1208	1287	1499	1142	1228	1215	1243	1311	1300	1383	1440

Table 56: Activity data for category 1.A.3.b.iii heavy duty vehicles and buses

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	538	634	451	1014	1395	1263	1545	1283	1282	702	1102	1931	1688	1546	1536	1418	1597	1613

Table 57: Activity data for category 1.A.3.b.iv Motorcycles

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Gasoline	TJ	3	3	4	4	4	4	3	4	4	5	4	4	4	4	4	4	4	4

Table 58: Activity data for category 1.A.3.c.ii Domestic waterborne navigation

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fuel oil	TJ	201	209	92	125	142	132	148	141	133	107	91	118	98	101	90	84	76	77

3.12.6.2. International Bunkers (Categories – 1. A. 3.a.ii and 1. A. 3.c.i)

The CB statistical data provides information on foreign bunkers throughout the whole time series. The data is presented in barrels and not disaggregated by fuel type. The Bahamas' Second national communication as submitted to the UNFCCC (2NC) indicates that a statistical assessment was conducted for 1990, 1994 and 2000 to disaggregate the data into the following: (i) gasoline for motor vehicles and small boats; (ii) jet fuel for aircraft; and (iii) gas oil for larger marine transport vessels leaving The Bahamas. While no detailed overview of international flights could be obtained at the time, there is a general understanding, that there is international air traffic involving small aircraft using aviation gasoline between The Bahamas and other countries, e.g., the US. The international bunkers fuel consumption should thus likely also include aviation gasoline from international flights. GHG emissions from the consumption of aviation gasoline for such international flights could not be estimated due to lack of data.

The 2NC does present CO_2 emissions for the categories international aviation and international navigation, but does not provide insight into the shares of gasoline and fuel oil consumed under international navigation. As a conservative approach, it was thus assumed that CO_2 emissions from international navigation resulted solely from fuel oil. This means, overestimating the consumption of fuel oil and underestimating the consumption of gasoline in international waterborne navigation.

Using IPCC default factors and the CO_2 emissions from international aviation and international navigation for the years 1990, 1994 and 2000 in the 2NC, fuel consumption of kerosene and fuel oil were estimated. The average share of each fuel type in the total fuel consumption in energy units was calculated, amounting to 56% for Kerosene and 44% for fuel oil. These shares were multiplied by the CB statistical data for international bunkers to estimate kerosene and fuel oil consumption for international bunkers over the time series. Activity data are shown in Table 60 and Table 61 below.

Table 59: GHG emission factors (defaults) used for international bunkers

			International aviation		International navigation	
Fuel Type	Unit	CO_2	CH_4	N_2O	CH_4	N_2O
Fuel oil	kg gas /TJ	77,400			7	2
Kerosene	kg gas /TJ	71,500	0.5	2		

Table 60: Activity data for category 1.A.3.a.i International aviation

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Kerosene	TJ	14999	15043	7207	8689	7934	10480	12711	10439	8548	8463	9467	12743	10877	9690	7720	7849	8774	9473

Table 61: Activity data for category 1.A.3.c.i International waterborne navigation

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fuel oil	TJ	12496	12533	6004	7239	6610	8731	10590	8697	7121	7050	7887	10616	9061	8073	6431	6539	7310	7892

3.12.6.3. Other transportation (Category 1.A.3.e)

Emissions from pipeline transport do not occur in The Bahamas. Emissions from the Off-road use of vehicles are included in the emissions under road transport (category 1.A.3.e.ii). Emissions from mobile combustion related to fishing are very likely to occur, however, fuel consumption (e.g. diesel, gasoline) for this specific activity was not available. This fuel consumption is included in the fuel consumption for road transport.

3.12.6.4. Other (Category 1.A.4.)

The IPCC category Other contains three subcategories:

- 1.A.4.a Institutional/Commercial
- 1.A.4.b Residential
- 1.A.4.c Agriculture, Forestry, Fisheries.

Fuel consumption per subcategory and type was, with the exception of firewood and charcoal, calculated by calculating total consumption for each fuel as indicated in section 3.2.1 above and allocating fuel use to categories as indicated in the EB.

Consumption of firewood and charcoal was not available from the CBB dataset, however from the EB. The EB indicates a small amount of firewood is used in the residential sector. It was assumed that this is a practice typical for rural areas. On this basis, average firewood consumption per capita of rural population was calculated for 2010-2012 and extrapolated over the time series using rural population as driver.

For charcoal, EB 2010-2012 values were split over the categories institutional / commercial and residential based on the information in the EB. Charcoal use in the category institutional commercial, which is assumed to take place mainly in the services and tourism sector, was extrapolated over the timeline using GDP. Charcoal use in the category residential was extrapolated over the timeline using population development.

GHG emission factors used for the three sub-categories are presented in Table 62.

Table 62: Emission factors used for the categories institutional/commercial, residential, agriculture/fisheries/forestry

Fuel Type	Unit	CO_2	CH_4	N_2O
Charcoal	kg gas /TJ	112,000	200	1
Firewood	kg gas /TJ	112,000	300	4
Diesel oil	kg gas /TJ	74,100	10	0.6
Gasoline	kg gas /TJ	69,300	10	0.6
Kerosene	kg gas /TJ	71,500	10	0.6
LPG	kg gas /TJ	63,100	5	0.1

Activity data are shown below in Table 63 for Commercial / Institutional, Table 64 for Residential and Table 65 for Agriculture / Forestry / Fisheries.

Table 63: Activity data for category 1.A.4.a Commercial /institutional

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Charcoal	TJ	9	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Firewood	TJ	29	29	30	30	31	31	32	32	33	33	34	34	34	34	34	35	35	35
Diesel oil	TJ	930	1096	779	1753	2411	2182	2669	2216	2215	1213	1904	3337	2916	2670	2654	2450	2759	2787
Gasoline	TJ	1541	1571	1899	1713	1689	1762	1619	1772	1888	2195	1676	1810	1787	1830	1924	1911	2028	2109
LPG	TJ	54	36	39	51	47	48	50	53	39	49	45	56	65	69	81	62	62	88

Table 64: Activity data for category 1.a.4.b Residential

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Charcoal	TJ	6	6	6	6	7	7	7	7	7	7	7	7	8	8	8	8	8	8
Diesel oil	TJ	42	50	35	80	110	99	121	101	101	55	87	152	133	121	121	111	125	127
Gasoline	TJ	70	71	86	78	77	80	74	81	86	100	76	82	81	83	87	87	92	96
Kerosene	TJ	7	6	7	8	8	9	8	8	7	7	6	6	5	7	7	6	7	7
LPG	TJ	331	219	238	314	288	294	307	324	241	303	279	344	400	423	501	380	380	543

Table 65: Activity data for the category 1.A.4.c Agriculture/Fisheries/Forestry

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Diesel oil	TJ	85	100	71	159	219	198	243	201	201	110	173	303	265	243	241	223	251	253
Gasoline	TJ	140	143	173	156	154	160	147	161	172	200	152	165	162	166	175	174	184	192

3.12.7. Fugitive Emissions (Category 1.B)

3.12.7.1. Natural Gas liquids transport (Category 1.B.2.a.iii.3)

Fuel production does not take place in The Bahamas. Fuel distribution of oil products and LPG however does. The IPCC 2006 guidelines indicate that low levels of emissions from CO_2 and N_2O might occur from the distribution of LPG, but that no emissions might occur from the distribution of oil products. Emissions from the distribution of LPG were estimated based on total LPG consumption for The Bahamas, based on the CBB dataset. The GHG emission factors used for this category are presented in Table 66.

Table 66 Emission factors used for category 1.B.2.a.iii.3 Natural Gas liquids transport

Gas	Unit	Value
CO_2	Gg per 1000 m3 LPG	0.00043
N_2O	Gg per 1000 m3 LPG	0.0000000022

Table 67: Activity data for the category 1.B.2.a.iii.3 Natural Gas liquids transport

Fuel Type	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
LPG	1000 barrels	154	102	111	146	134	137	143	151	112	141	130	160	186	197	233	177	177	253

3.13. IPPU

3.13.1. Lubricant use (category 2.D.1)

The Central Bank of The Bahamas (CBB) compiles a quarterly overview of oil imports for domestic consumption which includes the category “lubricants and other” and provides a time series from 2001-2018.

The IPCC 2006 GL indicate that only CO_2 emissions occur from lubricant use, but not N_2O or CH_4 emissions. The CO_2 emissions arise from the oxidation of the lubricants during use. Emissions were estimated using the carbon content of the lubricants and a default factor for oxidation during use provided by the IPCC 2006 GL.

Table 68: Factors used for the estimation of GHG emissions under category 2.D.1 Lubricant use

Factor	Unit	Value	Source
Carbon content of lubricants	t/TJ	20	V3, Ch5, Table 5.2
Oxidation during use (ODU) factor	N/A	0.2	V2, Ch1, table 1.4

Lubricant consumption in 2001-2018 is presented in Table 69

Table 69: Lubricant consumption, activity data for category 2.1 Lubricant use

Activity data	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Lubricant consumption	TJ	255.97	574.51	193.40	193.40	233.22	284.41	221.84	244.59	210.47	216.15	96.70	73.95	119.45	68.26	68.26	68.26	79.64	73.95

3.14. AFOLU

3.14.1. Agriculture

3.14.1.1. 3.A.1 and 3.A.2 Enteric Fermentation and Manure Management

The livestock values were obtained from both National Customs Imports report for livestock, in addition to FAOStat. Cattle (meat)[18], swine, sheep, goats and poultry data[19] were obtained from FAOStat, and horses, mules and asses were obtained from national sources in annual customs reports. Livestock production is generally limited in The Bahamas, with the exception of poultry[20].Livestock activity data can be seen in Table 71.

Some of the assumptions[21] applied to these categories include:

- Cattle population was assumed to be 5% dairy cow, 95% other (meat)
- Manure management practices for population of cattle, sheep, goats, horses, asses and mules is 98%open range/paddock, 2% dry lot
- Manure management practices for population of swine is 90% dry lot and 10% liquid slurry
- Manure management practices for population of poultry is 100% poultry manure with litter

Table 70 shows the default values from Volume 4, Chapter 10 of the IPCC 2006 Guidelines with regards to enteric fermentation and manure management.

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[18] Cattle production is not a large industry in the Bahamas, therefore values for meat production were used, which represents the majority of the industry according to expert judgement. Future data validation of this sector was prioritized.
[19] Poultry livestock includes eggs and laying hens, however further assessments should prioritize obtaining national figures for broiler production, which has an established industry.
[20] Generally, livestock production data is not readily available at the national level, therefore there was a heavy reliance on the use of international data from FAOStat.
[21] Assumptions applied were collected based on expert judgement from agricultural experts from the Ministry of Agriculture

Table 70: Factors used for the estimation of GHG emissions under category 3.A.1 and 3.A.2 Enteric Fermentation and Manure Management

Species/Livestock category	Emission factor for Enteric Fermentation ((kg head-1 yr-1)	Emission factor for Manure Management (kg head-1 yr-1)
Dairy Cows	72	2
Other Cattle	56	1
Sheep	5	0.2
Goats	5	0.22
Horses	18	2.19
Mules and Asses	10	1.2
Swine	1	2
Poultry	0	0.02
Source	IPCC 2006 GL, Vol 4, Tables 10.10 and 10.11	IPCC 2006 GL, Vol 4, Tables 10.14 – 10.16

Table 71: Livestock Activity Data, 2001-2018

Species/ Livestock category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dairy Cows	6	8	8	8	8	5	5	6	6	5	5	6	6	6	6	5	5	5
Other Cattle	114	143	152	157	157	100	95	107	106	95	100	107	108	106	105	103	102	101
Sheep	1600	1830	1950	2000	2000	1700	2000	2000	2000	2000	2000	2024	2042	2045	2063	2091	2120	2142
Goats	5300	5450	5550	5700	5700	5800	6000	6000	6000	6000	6000	6172	6173	6103	6127	6089	6113	6147
Horses	15	1216	12	2	8	50	28	27	45	162	7	49	24	152	107	6	13	264
Mules and Asses[22]	59	0	0	255	255	0	0	0	0	0	0	0	65	229	97	75	390	100
Swine	6300	6250	6400	6500	6500	6500	6600	6600	6600	6600	6600	6680	6802	7046	6919	6966	7023	7059
Poultry (laying hens, eggs, in shell)	120000	123000	125000	128000	128000	130000	113000	113000	113000	113000	140000	113000	114000	113000	115000	115000	109000	114000

[22] The fluctuation of mules and asses over the time series requires detailed assessment of historical data which was not feasible for the preparation of this GHG Inventory, and is a noted improvement for subsequent reports.

3.14.1.2. 3.C.3 Urea Application

Activity data is derived from annual imports of urea fertilizer from the Customs Annual report. This can be seen in Table 72. The emission factor CO_2 emissions for urea fertilization, which is equivalent to the carbon content of urea on an atomic basis (20% for $CO(NH_2)_2$) in Table 73.

Table 72: Annual Urea Import[23], 2001-2018

Year	Urea Data- Customs Imports (tonnes)
2001	71
2002	261
2003	210
2004	314
2005	0
2006	2297
2007	54
2008	416
2009	1563
2010	946
2011	1040
2012	207
2013	116
2014	1200
2015	674
2016	83
2017	239
2018	152

[23] The fluctuations in urea import data (e.g. 0 tonne in 2005) requires detailed assessment of historical data, which was not feasible for the preparation of this GHG Inventory. It is a noted improvement for subsequent reports.

Table 73: Factors used for the estimation of GHG emissions under category 3.C.3 Urea Application

Emission factor ([tonnes of C (tonne of urea)$^{-1}$])
0.2

3.14.1.3. 3.C.4 and 3.C.5 Managed Soils (Direct and Indirect N2O)

This subcategory accounts for direct N_2O emissions from synthetic fertilizer, dung and urine from manure on grazed soils, as well as indirect N_2O emissions from leaching/runoff and atmospheric deposition of volatilised nitrogen from managed soils. The activity data for livestock, and assumptions for the fraction of total manure deposited on soils are those referred to in Section 3.4.1.1 (Enteric Fermentation and Manure Management) and Table 71. The activity data of nitrogen based fertilizer was obtained from national Customs import data, see Table 74.

The emission factors for direct N_2O emissions from synthetic fertilizer as well as from urine and dung N deposited on pasture, range and paddock can be seen in Table 75. The emission factors for indirect N_2O emissions from N_2O emission from N leaching and runoff and atmospheric volatilization can be seen in Table 76.

Table 74: Activity Data for Nutrient Nitrogen from Fertilizer for Agriculture (tonnes)

Year	Nutrient Nitrogen N from Fertilizer for Agriculture (tonnes)
2001	14,566
2002	4,548
2003	7,561
2004	17,341
2005	8,029

2006	10,288
2007	13,087
2008	8,282
2009	6,093
2010	3,770
2011	3,712
2012	4,851
2013	2,997
2014	3,907
2015	6,858
2016	5,516
2017	6,697
2018	8,747

Table 75: Emission factors for 3.C.4 direct N_2O emissions from synthetic fertilizer and urine and dung on grazed soils

Anthropogenic N input type	**Emission factor for N_2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals** ***[kg N_2O-N (kg N input)-1]***	**Emission factor for N_2O emissions from N inputs** ***[kg N_2O-N (kg N input)-1]***
Cattle, Poultry and Pigs, and Sheep	0.02	-
Sheep and Other Animals	0.01	-
Synthetic Fertilizers	0.01	0.01
Source	IPCC 2006 GL, Vol 4, Chapt 11, Table 11.1	

Table 76: Emission factors for 3.C.5 indirect N_2O emissions on managed soils

Fraction of all N additions to managed soils that is lost through leaching and runoff	Emission factor for N_2O emission from N leaching and runoff	Fraction of applied organic N fertilizer materials (F_{ON}) and of urine and dung N deposited by grazing animals (F_{PRP}) that volatilizes	Emission factor for N_2O emission from atmospheric deposition of N on soils and water surfaces
[kg N (kg of N additions)$^{-1}$]	[kg N_2O-N (kg N leaching and runoff)$^{-1}$]	(kg NH_3-N + NO_x-N) (kg of N applied or deposited)$^{-1}$	(kg N_2O-N) (kg NH_3-N + NO_x-N volatilized)$^{-1}$
$Frac_{LEACH-(H)}$	**EF**	**$Frac_{GASM}$**	**EF**
0.3	0.0075	0.2	0.01
Source	IPCC 2006 GL, Vol 4, Chapt 11, Table 11.3		

3.14.1.4. 3.C.6 Indirect N2O Emissions from Manure Management

This category involves the determination of indirect N_2O emissions from manure management. Emissions reported under category concern only the N_2O emissions from manure produced in animal houses, and then stored temporarily and/or processed before being transported elsewhere. The source categories include swine and poultry. The emission factors used for this category as seen in Table 77 below. Activity data for this sector for livestock can be seen in Table 71 further above.

Table 77: Emission Factors for Indirect N_2O Emissions from Manure Management

Species/Livestock category 2	Total nitrogen excretion for the MMS (kg N yr-1)	Emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces [kg N_2O-N (kg NH3-N + Nox-N volatilised)-1]
Swine	0.48	0.01
Poultry	0.4	0.01
Source	IPCC 2006 GL, Vol 4, Table 10.22	IPCC 2006 GL, Vol 4, Table 11.3

3.14.2. Forestry and Other Land Uses (Category 3.C)

Methodology used for time series analysis of satellite data to generate activity data

The Bahamas, like many developing countries, does not have a regular forest inventory data or land use mapping necessary to generate activity data for calculating GHG emissions from the FOLU sector. To address this issue Landsat satellite data was used to generate activity data using Google Earth Engine platform for the inventory period 2000 to 2020. Landsat images from 2000, 2005, 2010, 2015 and 2020 were classified into six IPCC land use classes, Forestland, Grassland, Cropland, Wetland, Settlement and Other land. IPCC default emission factors were used to calculate GHG emission for each of four time periods: 2000-2005, 2005-2010, 2010-2015 and 2015-2020. For this inventory, all lands were considered as managed land, classified as crown lands.

Classification of Satellite Imagery

It is a challenge to obtain cloud free satellite images over the Caribbean countries, The Bahamas is no exception. Therefore, cloud filtering and masking functions were used to mask out (remove) cloud and cloud shadows. Only cloudless composite images covering the country were used in this analysis. For this reason, the total land area varies for each

5 year period because of unclassified pixels which may be due to cloud and cloud shadows or absence of satellite data for a portion of the country. Activity data for Landsat images 2000 to 2010 were collected using Landsat 7 satellite and images from 2010 to 2020 were collected using Landsat 8 satellite. These two satellites have slightly different band combinations, therefore, separate classification models were developed for Landsat 7 and Landsat 8 to generate classified maps. The training points for each of six IPCC land classes were collected by sampling a global map of land use/land cover (LULC) published by ESRI[24]. The forest definition is same as the training data which came from ESRI Land Cover 2020, whereby forest is captured as trees >= 15 m.

The global land cover map was derived from ESA Sentinel-2 imagery at 10m resolution. It is a composite of LULC predictions for 10 classes throughout the year in order to generate a representative snapshot of 2020. A stratified random sampling was used to collect training data for 8 classes[25]: 1) Water, 2) Forest, 3) Grassland, 4) Wetland, 5) Cropland, 6) Scrub/Shrub, 7) Settlement and 8) Other land.

A total of 809 training points were collected, 70% of points were randomly selected from each land use type to train classification model using "Random Forest" algorithm in the

[24] https://www.arcgis.com/home/item.html?id=d6642f8a4f6d4685a24ae2dc0c73d4ac

[25] Definitions: 1. Water- Areas where water was predominantly present throughout the year; may not cover areas with sporadic or ephemeral water; contains little to no sparse vegetation, no rock outcrop nor built up features like docks; examples: rivers, ponds, lakes, oceans, flooded salt plains.

2. Trees- Any significant clustering of tall (~15-m or higher) dense vegetation, typically with a closed or dense canopy; examples: wooded vegetation, clusters of dense tall vegetation within savannas, plantations, swamp or mangroves (dense/tall vegetation with ephemeral water or canopy too thick to detect water underneath).

3. Grassland - Open areas covered in homogenous grasses with little to no taller vegetation; wild cereals and grasses with no obvious human plotting (i.e., not a plotted field);

4. Flooded vegetation Areas of any type of vegetation with obvious intermixing of water throughout a majority of the year; seasonally flooded area that is a mix of grass/shrub/trees/bare ground; examples: flooded mangroves, emergent vegetation, rice paddies and other heavily irrigated and inundated agriculture.

5. Cropland - Human planted/plotted cereals, grasses, and crops not at tree height; examples: corn, wheat, soy, fallow plots of structured land.

6. Scrub/shrub - Mix of small clusters of plants or single plants dispersed on a landscape that shows exposed soil or rock; scrub-filled clearings within dense forests that are clearly not taller than trees; examples: moderate to sparse cover of bushes, shrubs and tufts of grass, savannas with very sparse grasses, trees or other plants

7. Settlement - Human made structures; major road and rail networks; large homogenous impervious surfaces including parking structures, office buildings and residential housing; examples: houses, dense villages / towns / cities, paved roads, asphalt

8. Other land - Areas of rock or soil with very sparse to no vegetation for the entire year; large areas of sand and deserts with no to little vegetation; examples: exposed rock or soil, desert and sand dunes, dry salt flats/pans, dried lake beds, mines.

Google Earth Engine. Remaining 30% points were used to validate the model. The model developed using Landsat 7 satellite data from 2020 was applied to Landsat 7 images from 2000, 2005 and 2010 to generate land use maps for 2000, 2005 and 2010. The same training data and procedure was used to build and validate Landsat 8 classification model using Landsat 8 satellite data from 2020. The model was then applied to 2015 to generate land use maps for 2015 and 2020. Table 78 below outlines the activity data from land use classifications from 2000 to 2020. A more detailed breakdown of land use between individual land use categories (land use matrices) for each 5 year interval from 2000-2020 can be seen in Annex V.

The CO_2 emission factors used for this category are presented in Table 79.

Table 78: Activity data for Land Use Classifications, 2000-2020 (ha).

Land Use (ha)	2000-2005	2005-2010	2010-2015	2015-2020
Forest remaining Forest	174,695	210,014	254,936	243,171
Land converted to Forest	87,564	144,763	80,390	88,664
Grassland remaining Grassland	304,151	269,032	278,697	374,237
Land converted to Grassland	142,646	107,834	220,502	139,809
Cropland remaining Cropland	16,657	16,832	3,333	2,976
Land converted to Cropland	56,364	51,321	14,665	15,507
Wetland remaining Wetland	15,502	17,064	13,051	27,961
Land converted to Wetland	52,713	47,258	66,044	47,017
Settlement remaining Settlement[26]	63,590	59,560	25,517	17,702
Land converted to Settlement	66,370	66,339	21,407	24,394
Other land remaining Other land	54,111	43,985	28,451	32,929

[26] It seems unlikely that this land use decreased over time. This might be attributable to limited resolution of the satellite imagery and has been identified as an area of improvement, see Annex III.

Land converted to Other land	22,180	12,987	22,449	16,575
Unclassified Area	331,456	341,010	358,558	357,059
Total Area (ha)	**1,388,000**	**1,388,000**	**1,388,000**	**1,388,000**

Figure 44 below shows the total land area for each land use classification for the period of 2000 to 2020. Each land use represents the sum of land use type remaining and the area converted to each land use type (e.g.: Forestland = Forestland remaining Forestland + Land Converted to Forestland). Over the time series, The Bahamas highest land use category was grassland accounting for 50% of classified land, including both pastureland and shrubland/scrubland (prevalent native species being low-scrubby coppice), followed by Forest Land which represented 32%of total area.

Figure 44: Land Use Types in 2015-2020

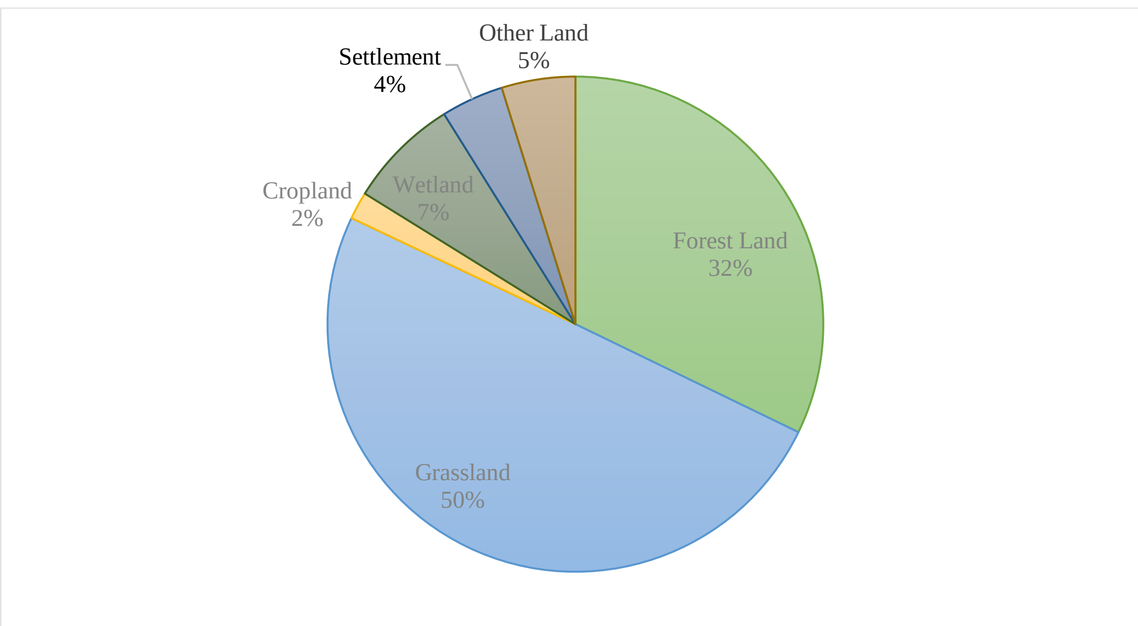

Table 79: Emission factors used for Land Use (Category 3.C)

Land use category	Carbon stock (tC/ha)	Source
Forest land[27] [Table 4.7, (AGB+BGB)*0.47]	62.04	IPCC 2006, GL, Vol. 4, Table 4.7 (above ground biomass)
Non-forest land		IPCC 2006, GL, Vol. 4, Table 6.4 (biomass stocks present on grassland, after conversion from other land use)
Grassland (Table 6.4)	4.09	
Cropland	0.00	
Wetland	0.00	
Settlement	0.00	
Other land	0.00	
Land Converted to Forest Land (Table 4.9)		
Forest growth in 5 years for trees <20 yrs		IPCC 2006, GL, Vol. 4, Table 4.9 (above-ground net biomass growth in natural forests)
Land converted to forest (2.26 tC/ha/yr)	11.28	
Forest Land Remaining Forest Land (Table 4.9)		
Forest growth in 5 years for trees >=20 yrs		
Forest Land Remaining Forest Land 0.56 tC/ha/yr)	2.82	

[27] Dominant forest type in the Bahamas is pine forest

3.15. Waste

3.15.1. Solid Waste (Category 4.A)

Over the duration of the time series, solid waste was collected and landfilled in unmanaged landfills (open dumps) with a depth of generally more than 5 meters, according to expert judgement. The landfill on New Providence, now called New Providence Ecology Park – NPEP was converted into a managed landfill from 2019, the process was finalised in early 2020. At the time data collection took place (Q2 2021) methane capture was planned to start later the same year, once a critical mass of methane capture had been reached. From 2015-2019 landfill fires were reported, which could be extinguished by mid-2019. Open burning of waste is practiced on smaller islands, where no waste collection system exists. Detailed information on which islands these are, were not available.

Only limited waste management data is available in The Bahamas at present. For the NPEP amounts landfilled of roughly 250-300 kt waste per year were estimated for the timeframe March 2019 – March 2020 based on truck numbers and loading volumes, as scales were to be installed only from roughly mid-2021 onwards. Considering New Providence's population at the time, this amount of waste is largely in line with the default value for MSW generation per capita for The Bahamas provided in the IPCC 2006 Guidelines.

Source separation of waste does not take place in The Bahamas. NPEP started diverting gardening waste as well as construction debris for the purposes of recycling from mid-2020 onwards. Since that time, composting of gardening waste takes place. In the future, diversion of food waste for composting is planned. Generally, waste composition data is not available for The Bahamas.

Methane emissions from landfilling were estimated using a Tier 1 approach which uses the first order decay model [reference to IPCC 2006 GL providing more information on the model]. Waste generation was calculated using 1950-2018 population data[28] and a waste generation default value of 950 kg / cap and year (see Volume 5, Chapter 2, Table 2A.1 of the IPCC 2006 GL).[29] In line with IPCC default, it was assumed that 70% of this waste is landfilled (see Volume 5, Chapter 2, Table 2A.1 of the IPCC 2006 GL). Table 86 further below shows the estimated waste amounts landfilled in 2001-2018. Default values from table 2.3 of Volume 5, Chapter 2 of the IPCC 2006 Guidelines were used with regards to waste composition, see Table 80.

Table 80: Assumptions for waste composition

Food	Garden	Paper	Wood	Textile	Nappies	Plastics, other inert	Total
%	%	%	%	%	%	%	(=100 %)
47 %	0%	17%	2%	5%	0%	29%	100%

Potentially landfilling of sludge from wastewater treatment plants also takes place in The Bahamas. Information on sludge was, however, not available.

Industrial waste is assumed to be collected and processed as part of municipal solid waste.

3.15.2. Open burning (Category A.C.2)

No information was available on the share of waste openly burned and the islands where such open burning might be a common practice. Based on expert judgement, 2% of total population is assumed to use open burning as waste management measure. This level of open burning is also assumed to cover landfill fires as reported for NPEP. The waste amounts assumed to be openly burned are presented further down in Table 87. It was

[28] Taken from UN World Population prospects, https://population.un.org/wpp/Download/Files/1_Indicators%20(Standard)/EXCEL_FILES/1_Population/WPP2019_POP_F01_1_TOTAL_POPULATION_BOTH_SEXES.xlsx

[29] Population numbers used do not include tourism. Waste generation might therefore potentially be underestimated.

assumed that the composition of the waste burned is the same as for the waste landfilled, see section 3.15.1.

CO_2, CH_4 and N_2O emissions from open burning were estimated using a Tier 1 methodology whereby the amount of waste openly burned is multiplied by an emission factor (CH_4, N_2O) or a combination of factors (CO_2) specific to each gas (see Volume 5, Chapter 5 of the IPCC 2006 Guidelines for national GHG inventories). The estimation approach for N_2O and CO_2 requires the amount of waste openly burned on a dry matter basis, while the one for CH_4 refers to wet matter. Table 81 presents the dry matter content for different waste types.

Table 81: Waste composition default data and default factors for the estimation of CO_2 emissions from fossil carbon in open burning and sources of default data in the IPCC 2006 Guidelines.

Source of factor	**table 2.3 of Volume 5, Chapter 2 of the IPCC 2006 Guidelines**	**Volume 5, Chapter 2, Table 2.4**			**Volume 5, chapter section 5, Table 5.2**	**Volume 5, chapter 5.2.1.1**
Type of waste	Share in MSW	Dry matter content	Fraction of carbon in dry matter	Fraction of fossil carbon in total carbon	Oxidation factor	Conversion factor 44/12
		%	%	%	%	
Food	47%	40	38	0	58	3.666667
Paper	17%	90	46	1	58	3.666667

wood	2%	85	50	0	58	3.666667
textile	5%	80	50	20	58	3.666667
plastics	29%	100	75	100	58	3.666667

Table 82: Open burning default factors for CH_4 and N_2O from open burning

Gas	CH_4 emission factor data	N_2O emission factor data
Source of default factor	EF taken from V5, Ch5, p. 5.20	EF taken from V5, Ch5, table 5.6
Unit	g CH_4 / t MSW (wet matter)	g N_2O/t waste (dry matter)
Value	6500	150

3.15.3. Domestic wastewater treatment and discharge (Category 4.D.1)

Domestic wastewater management across 700 islands and cays of The Bahamas is challenging. For this reason, The Bahamas has the highest usage of septic tanks in the region, accounting for 81% of its population (PAHO, 2012). Other domestic wastewater is managed through access to a centralized sewerage system (16%), and through pit latrines ~5%).

At present, industrial sources of wastewater are not accounted for due to limited knowledge of production values in the country for the rum and beer production sector, as well as fish and conch processing and packaging facilities.

Emissions of CO_2, CH_4 and N_2O were estimated for the category 4.D.1 Domestic Wastewater and were based on a Tier 1 approach. CH_4 emissions from domestic wastewater were estimated using a Tier 1 methodology using a combination of both default values for EFs and AD, and country specific activity data, see Table 83 and Table 84. CH_4 production depends primarily on the amount of degradable organic material in the wastewater, the temperature and the type of treatment system. Activity data includes the total amount of organically degradable material in the wastewater estimated from population data, biological oxygen demand EFs, and correction factor for industrial BOD into sewers (see Table 83). N_2O emissions were estimated using Tier 1 methods for total amount of nitrogen in effluent, accounted from annual per capita protein consumption (see Table 85).

Table 83: Domestic Wastewater Defaults for CH_4 emissions from domestic wastewater and for estimation of Organically Degradable Material in Domestic Wastewater.

Type of treatment or discharge	Maximum methane producing capacity (kg$_4$/kgBOD)	Methane correction factor for each treatment system (MCF)	EF (kg CH_4/ kg BOD)		Degradable organic component (kg BOD/cap/yr)	Correction factor for industrial BOD discharged in sewers' (I)
Latrine	0.6	0.1	0.06		14.6	1
Centralized, aerobic treatment plant (overloaded)	0.6	0.3	0.18			
Septic System	0.6	0.5	0.3			
Sea, River and Lake Discharge	0.6	0.1	0.06			

Table 84: Values for Urbanisation and Degree of Utilisation of Domestic Wastewater Treatment, discharge or Pathway for CH_4 emissions from domestic wastewater

Urbanization (Fraction of Population)			**Degree of utilization of Discharge Pathway by income group**		
Rural	Urban-high	Urban-low	Rural, Urban-high and Urban low income		
			Septic Tank	Sewer (Centralized, aerobic treatment plant)	Latrine
0.16	0.25	0.59	0.81	0.13	0.06
Source: IPCC 2006 Defaults, Table 6.5 (LAC, Brazil)[30]			**Source: National Data, PAHO (2012)**		

Table 85: Emission Factors to estimate indirect N_2O from Wastewater

Nitrogen in Effluent EF	**Fraction of nitrogen in protein**	**Fraction of non-consumption protein**
(kg N_2O-N/kg N)	(kg N/kg protein)	(-)
0.005	0.16	1.1
Source: IPCC 2006 Defaults		

[30] This default was closest to characteristics of urbanization distribution in the Bahamas than other regional defaults

Table 86: Amounts of solid waste deposited, activity data for category 4.A Solid Waste

Activity data	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Solid waste deposited	Gg	201.24	204.59	208.23	212.06	216.03	220.14	224.36	228.55	232.49	236.04	239.12	241.78	244.17	246.47	248.85	251.32	253.87	256.45

Table 87: Solid waste openly burned, activity data for category 4.C Open Burning

Activity data	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Solid waste openly burned	Gg	287.49	292.28	297.47	302.95	308.62	314.48	320.52	326.50	332.12	337.19	341.60	345.40	348.81	352.10	355.50	359.03	362.67	366.36

Table 88: Amounts of organically degradable material in wastewater, activity data for category 4.D.1 Domestic Wastewater

Activity data	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Organically degradable material in wastewater	kg BOD/yr	4418222.8	4491836	4571683.4	4655852.4	4742941	4833082	4925879	5017743	5104218	5182153	5249839	5308326	5360667	5411242	5463408	5517778	5573623	5630300

Chapter 4 – Mitigation actions and their effects, including associated methodologies and assumptions (BUR)

4.1. Introduction

The Commonwealth of The Bahamas, similar to the rest of the Caribbean islands, contributes very little to global GHG emissions (0.01%). Nevertheless, the Government of The Commonwealth of The Bahamas (GOB), conscious of the country's vulnerability as a small island developing state (SIDS) to climate change, in particular, extreme weather events, has demonstrated its commitment to combating climate change through implemented and planned actions covering the energy and forestry sectors at the national level.

This chapter presents The Bahamas' mitigation analysis and describes the mitigation actions in the five IPCC sectors of Energy, Industrial Processes and Product Use (IPPU), Agriculture, Land Use and Land Use Change and Forestry (LULUCF) and Waste. Due to the vast number of mitigation actions in the Energy sector, these have been disaggregated into Energy Demand, Electricity Generation and Transport sub-sectors.

The proposed mitigation actions for the assessment were based on desk reviews and consultations with a broad range of key stakeholders from both the public and private sectors in The Bahamas. The mitigation actions presented are in various stages of planning, preparation, and execution. The mitigation assessment provides a justified evidence base to The Bahamas for prioritising actions and registering the party’s mitigation actions through the Nationally Appropriate Mitigation Action (NAMA) registry (or other climate change support mechanisms) in order to source financing for either implementation or further preparation. The chapter is organised into the following sections:

- Section 4.2: National Policies
- Section 4.3: Measures to Reduce GHG Emissions (Mitigation Actions)
- Section 4.4: GHG Emissions Projections

- Section 4.5: Barriers and Challenges to Implementation and Methods to Improve The Modelling

4.2. National Policies and Measures to Reduce GHG Emissions

4.2.1. National Policies

The Bahamas has recognised the critical role that the adverse effects of climate change play with regards to its future and highlights it as a cross-cutting challenge. As a vulnerable SIDS, the impacts of climate change are further heightened in The Bahamas by geographical location (tropical belt), topography (dispersion of islands, limited land masses), environmental conditions (high temperatures, sea-level rise, flooding, tropical cyclones) and others (Bahamas, 2015). This is despite the fact that The Bahamas contributes very little to global greenhouse gas emissions. As a result, The Bahamas' mitigation actions are enshrined within the sustainable development context. This ensures that the mitigation actions contribute to reducing emissions as well as the achievement of national economic and development goals. The Bahamas has continuously updated its many policies, plans, strategies, and initiatives to address climate change over the years. A list of the significant policies related to mitigation is highlighted in Table 89 below.

Table 89: Significant National Policies, Plans, Strategies, and Initiatives

Significant National Policies, Plans, Strategies, and Initiatives
Significant Policies and Plans
The Bahamas First and Second National Communications (2001 and 2015)
The Bahamas National Energy Policy (2013 -2033)
The Bahamas Intended National Determined Contribution (2015)

Significant National Policies, Plans, Strategies, and Initiatives
The Bahamas Building Code – 3rd edition – Ministry of Works and Utilities (2003)
The Bahamas Power and Light requirement for grid interconnection of small-scale renewable energy generation systems
Grand Bahama Power Company rules and regulations for renewable generation systems
The Civil Aviation Authority Bahamas Environmental Regulation (CAR ENV 2021)
National Policy for the Adaption to Climate Change (2005)
The Forestry Act (Amended 2014) and Forestry Regulations (2014)
Draft Vehicle Emissions Bill (2013)
Electricity Act (Renewable Energy) (Amended 2015)
Elimination of tariffs on solar panels, inverters, and LED appliances
Major Initiatives
Building the Bahamas Capacity in Transparency for climate change mitigation and adaptation (GEF) Project information
Pine Island – Forest Mangrove Innovation and Integration (Grand Bahama, New Providence, Abaco, and Andros) GEF – Project Identification document and Project Identification form
Meeting the Challenge of 2020 in the Bahamas (GEF) Project identification form
Promoting Sustainable Energy in the Bahamas – Final Draft September 2010 – Fichtner Report

Significant National Policies, Plans, Strategies, and Initiatives
The Commonwealth of The Bahamas Conditional Credit Line for Investment Projects (CCLIP) Advancing Renewable Energy in The Bahamas and Reconstruction with Resilience in the Energy Loan Proposal – IADB document
Reconstruction with Resilience in the Energy Sector in The Bahamas – Loan Contract - IADB
The Bahamas Power System Stability Study for the Implementation of a Higher Renewable Energy Penetration Level (2018)
Developing a national framework for the standardisation of stalls and procedures for a climate-smart street-side vendor throughout The Bahamas (2021)
Pilot Programme to outfit Government built homes with solar water heaters and solar panels
The Caribbean Hotel Energy Efficiency and Renewable Energy Action – Advanced Program (CHENACT-AP)
The Bahamas REEF Environment Educational Foundation
Major Strategies/Targets
30% economy-wide reduction in GHG emission when compared to BAU
30% renewables in the energy mix by 2030

4.2.1.1. Energy Policies

The Bahamas has adopted its National Energy Policy (NEP) 2013 – 2033 (Government of The Bahamas, 2013). The NEP central vision is to ensure that by 2033, The Bahamas has a modern, diversified, and efficient energy sector. This will provide Bahamians with affordable energy supplies and long-term energy security balanced with enhancing international competitiveness and sustainable prosperity.

The NEP Strategic Framework places priority on six key areas:

1. Security of energy supply through diversification of fuels;
2. Modernising the country's energy infrastructure;
3. Development of renewable energy sources such as solar, ocean energy, biofuels, waste-to-energy, and wind
4. Energy conservation and efficiency;
5. Development of a comprehensive governance/regulatory framework to support the advancement of the energy sector to be effectively able to facilitate the introduction of renewables and the diversification of fuels; and
6. Eco-efficiency in the manufacturing, agricultural and tourism sectors, and Government as leaders in energy conservation and the use of renewable energy.

The NEP is a long-term and strategic policy and contains four inter-related goals, each with specific strategies. The goals and related strategies are outlined in Table 90 below.

Table 90: Goal and Strategies from The Bahamas Energy Policy 2013-2033

Goal	Description	Strategies related to goal
Goal 1	Bahamians will become well aware of the importance of energy conservation, use energy wisely and continuously pursue opportunities for improving energy efficiencies, with key economic sectors embracing eco-efficiency	Strategies relevant to Households and Businesses related to Information, Education and Training, and Demonstration
		Strategies related to Government as a leader in energy conservation and efficiency
		Strategies related to Private Sector and Industry
		Strategies related to the Transport Sector and Buildings
		Strategies related to Legislation

Goal	Description	Strategies related to goal
Goal 2	The Bahamas will have a modern energy infrastructure that enhances energy generation capacity and ensures that energy supplies are safely, reliably, and affordably transported to homes, communities, and the productive sectors on a sustainable basis	Strategies related to Energy Generation and Distribution Infrastructure
		Strategies related to Energy Diversification
Goal 3	The Bahamas will become a world leader in the development and implementation of sustainable energy opportunities and continuously pursues a diverse range of well-researched and regulated, environmentally sensitive and sustainable energy programmes, built upon our geographical, climatic, and traditional economic strengths	Strategies related to the economic, infrastructural, and planning conditions that will ensure the sustainable development of all of The Bahamas' renewable energy resources
		Strategies related to the introduction of key policy instruments (financial and fiscal) for the promotion of renewable energy
		Strategies related to the development of a dynamic legislative and regulatory environment, responsive to growth and development in the renewable energy sector
		Strategies related to enhancing technical capacity and public awareness of renewable energy through effective support for training programmes, information

Goal	Description	Strategies related to goal
		dissemination and ongoing communication by the Government
		Strategies related to sustained research and development (R&D) and innovation in existing and emerging RETs
Goal 4	The Bahamas will have dynamic and appropriate governance, institutional, legal, and regulatory framework advancing future developments in the energy sector underpinned by high levels of consultation, citizen participation and public-private sector partnerships	Key actions are outlined in the NEP.

In addition, The GOB has reconfirmed its commitment to energy security as a priority and ensuring reliable, affordable, sustainable energy sources, including a national target to achieve a minimum of 30% renewables in the energy mix by 2030.

4.2.1.2. Nationally Determined Contribution

The Commonwealth of The Bahamas submitted its Intended Nationally Determined Contribution (iNDC) to the UNFCCC as part of its Paris Agreement commitments in 2015 (The Government of Bahamas, 2015) and ratified the agreement on 22 August 2016, which then became its Nationally Determined Contribution (NDC), and a revised and updated NDC in November 2022. The Bahamas 2015 NDC indicated a mitigation target of an economy-wide reduction of GHG emissions of 30% when compared to its Business as Usual (BAU) scenario by 2030. In addition, the document noted that the Government defined the policy framework for a low carbon development plan through the National Energy Policy, which sets a national target to achieve a minimum of 30% renewables in the energy mix by 2030 and allow for a 10% Residential Energy Self Generation Programme within the year. The target will also be achieved through the forestry sector by reducing GHG emissions from land degradation and deforestation through the establishment of a permanent forest estate, 20% of which is designated into either one of three categories (forest reserves, protected forests and conservation forests) under the Forestry Act. These forestry sector GHG emission reductions have the potential to increase carbon sequestration of approximately 5,661.077 GgCO_2-eq across several pine islands in The Bahamas, according to The Bahamas submitted NDC.

The targets were conditional on access to required technologies, energy efficiency and conservation measures appropriate for The Bahamas, as well as economic growth and socio-economic progress. The costs for implementing the NDC targets were anticipated to be met through multilateral and bilateral support from various sources. However, The Bahamas is recognised as a high-income country according to the world bank ratings and has limited access to grant and concessional financing.

4.3. Measures to Reduce GHG emissions

The measures to reduce The Bahamas' GHG emissions were assessed based on national circumstances, sustainable development goals, and national development priorities. The mitigation actions consider various aspects, including economic, social, environmental and GHG reductions capabilities. The actions are in various stages of planning, preparation and implementation. These actions were verified through multiple stakeholder engagements, including workshops, bilateral meetings, and surveys.

A review of The Bahamas’ existing climate change policies, sectoral action plans, strategies, and development priorities, as highlighted in the previous section, was undertaken to determine an initial list of mitigation actions. This list was further refined through stakeholder engagements. As a result, a total of forty-one (41) mitigation actions were identified for The Bahamas. These mitigation actions/strategies are divided into the following categories: Energy Demand, Electricity Generation, Transport, Agriculture, Land Use, Land Use Change and Forestry, Industrial Processes and Product Use and Waste. The following section describes each action included in the mitigation strategy by sector.

4.3.1. Description of Mitigation Measures

Due to challenges with data collection and access to information, only the major islands of The Bahamas were considered in these mitigation actions. Table 91 shows the number of mitigation actions by sector. These mitigation actions have been enhanced from the Second National Communication (SNC) or are newly proposed actions. The energy sector contains over 80% of the mitigation actions identified as priority areas for the GOB.

Table 91: Distribution of Mitigation Actions by Sector

Sector	Number of Mitigation Strategies
Energy Demand	13
Electricity Generation	14
Transport	7
Industrial Processes and Product Use (IPPU)	1
Agriculture	1
Land Use, Land Use Change and Forestry	3
Waste	2
Total	41

The description and status of each mitigation action are included in Sections 4.3.1.1 – 4.3.1.6**.**

4.3.1.1. Energy Demand

The mitigation actions identified in the Energy demand subsector are mainly based on the strategies identified in The Bahamas NEP 2013-2033. This subsector covers end-use consumption in the residential, commercial, tourism, industry and streetlighting areas. This sector does not include strategies and actions related to electricity generation and transport. Mitigation actions for energy demand primarily relate to affected changes in the end-use of electricity and fossil fuels. This includes changes in fuel and equipment used for cooling, refrigeration, cooking, appliance use, water heating, lighting and policies that would affect such changes. A total of **thirteen (13) mitigation actions** related to the **Energy Demand Subsector** were identified:

Table 92: Mitigation Action 1 - Adoption and Implementation of revised building code for all new buildings and renovations.

Name of the mitigation action					
Adoption and Implementation of revised building code for all new buildings and renovations.					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Department of Physical Planning, Ministry of Works and Utilities, Building Control	2020-2025	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To adopt and implement the revised building codes for all new construction and renovations					
Brief description					
The Bahamas currently has a building code from 2003. The revised building code is expected to improve the minimum standards, provisions, and requirements for safe and stable building design and construction methods. Improving building design can reduce the energy demand and enhance resilience. The adoption and implementation of this revised building code will assist in the reduction of emissions for commercial and residential buildings. The revision of the building code is currently ongoing, with several stakeholder workshops and webinars. The revised building code is expected to cover the entire Commonwealth of The Bahamas except for the Port area in Grand Bahama Island. In the 2013-2033 Energy Policy, the need to encourage the integration of renewable energy in building design the physical planning process is highlighted. This is encouraged to be integrated using an appropriately revised building code (Ministry of the Environment and Housing, 2013). In addition, The Bahamas is also currently in the process of adopting the regional Energy Efficiency Building Code.					
Steps to achieve mitigation action:					

1. Revised building code completed. 2. Adoption and Implementation of revised building code. 3. Public Awareness and Education on the revised building. 4. Training of practitioners on revised building code.
Estimated outcomes and estimated emission reductions
By 2030, the energy demand has decreased, and resilience increased due to the implementation of the revised building code and the regional energy efficiency building code. The estimated avoided GHG emissions related to the implementation of this action is 22.6 GgCO_2-eq by 2030.
Methodologies and assumptions
It is assumed that the adoption and implementation of The Bahamas revised building code will reduce energy used for cooling and lighting by 25% in the new residential and commercial buildings. One thousand one hundred thirty-two new residential (1132) buildings per year are assumed, with an average annual electricity consumption of 1835 kWh/household for lighting and 2618 kWh/household for air conditioning (AC). One hundred and ten (110) new commercial buildings per year are assumed, 86% of which are non-governmental. The average floor space is assumed as 1455 m^2/building, with an average annual electricity consumption of 31.2 kWh/m^2 for lighting and 58.13 kWh/m^2 for AC. It is assumed that all new residential and commercial buildings will have air conditioning systems. This revised building code will impact the new construction of residential and commercial buildings between 2024 and 2030.
Progress indicators
new and renovated buildings implemented using regional energy efficiency building and revised building codes. # education and awareness programs conducted on regional energy efficiency and revised building code. # practitioners trained in the revised building code and regional energy efficiency building code.
International Market Mechanisms
None

Table 93: Mitigation Action 2 - Energy Audits for all Government occupied buildings in New Providence

Name of the mitigation action					
Energy Audits for all Government occupied buildings in New Providence					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Department of Physical Planning,	2020 - 2025	Energy Demand	New Providence	Carbon Dioxide

	Ministry of Works and Utilities, Bahamas Power and Light				(CO_2), Methane (CH_4), Nitrous Oxide (N_2O)

Objective of the mitigation action
To conduct energy audits for all Government occupied buildings in New Providence.
Brief description
Energy audits are instrumental in the identification of energy efficiency options for buildings. This is an enabling measure for the introduction of energy efficiency building measures.
Steps to achieve mitigation action:
1. Identify buildings to be audited. 2. Develop terms of reference for audits. 3. Undertake audits of the identified buildings.
Estimated outcomes and estimated emission reductions
By 2025, mitigation measures for all government occupied buildings identified, including schools in New Providence. This action is not expected to have emission reduction potential but will help identify and quantify specific energy efficiency measures and potential reductions.
Methodologies and assumptions
This action is preparatory for actual retrofits. The buildings identified are expected to be occupied for the long term. The measures identified are also expected to be combined into specific mitigation actions for the buildings identified. This action will not be modelled.
Progress indicators
government buildings in New providence audited. # of audit reports received
International Market Mechanisms
None

Table 94: Mitigation Action 3 - Energy Audits for all existing hotels and industrial facilities and implementation of some measures.

Name of the mitigation action					
Energy Audits for all existing hotels and industrial facilities					
Status	**Lead Agency/Agencies**	**Duration**	**Sector and subsector**	**Scope**	**GHGs covered**
Ongoing	Ministry of Tourism, Investments & Aviation, The	2020 - 2025	Energy Demand	National	Carbon Dioxide (CO_2),

	Bahamas Chamber Of Commerce and Employers Confederation, Bahamas Power and Light				Methane (CH_4), Nitrous Oxide (N_2O))

Objective of the mitigation action
To conduct energy audits for all existing hotels and industries and implementation of some measures.
Brief description
Energy audits are instrumental in the identification of energy efficiency and renewable energy options for buildings. The tourism sector is a key economic factor in The Bahamas, and hotels play a critical role in energy consumption. This is an enabling measure for the introduction of energy efficiency building measures. Initial energy efficiency measures and energy audits have been undertaken for some hotels and potential measures are estimated in the mitigation analysis.
Steps to achieve mitigation action:
1. Identify buildings to be audited. 2. Develop terms of reference for audits. 3. Undertake audits of the identified buildings.
Estimated outcomes and estimated emission reductions
By 2025, mitigation measures for hotels and industrial facilities identified. The avoided GHG emissions by 2030 in the ambitious scenario is estimated at 74.6 $GgCO_2$-eq for replacement of diesel generators and 61.3 $GgCO_2$-eq for implementation improvements in energy intensity in the industry sector. The combined effect of these two measures would result in 135.9 $GgCO_2$-eq of avoided GHG emissions.
Methodologies and assumptions
This action is preparatory for actual retrofits. The measures identified are also expected to be combined into specific mitigation actions for the facilities identified. In the modelling an ambitious mitigation scenario was developed and proposed measured were modelled for the hotel and industrial sector. It was assumed that currently diesel is used in backup generators that provide distributed electricity in some of the service sector facilities. In this ambitious scenario, the distributed solar PV systems will displace 30% of the diesel used in the service sector. In addition, the industrial sector will experience a reduction in energy intensity by 2% annually compared to the 0.5% reduction modelled for the baseline and mitigation scenarios.
Progress indicators
hotels and industrial facilities audited. # of audit reports received
International Market Mechanisms
None

Table 95: Mitigation Action 4 - Lighting Retrofits for all Government occupied buildings in New Providence

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Lighting Retrofits for all Government occupied buildings in New Providence</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsect or</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Ongoing</td><td>Department of Physical Planning, Ministry of Works and Utilities, Ministry of Environment and Natural Resources</td><td>2020-2030</td><td>Energy Demand</td><td>New Providence</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To undertake comprehensive lighting retrofits for all Government occupied buildings in New Providence. To reduce energy demand and emissions in Government buildings in New Providence. To improve energy efficiency in Government occupied buildings in New Providence.</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The adoption of lighting retrofits is usually seen as a quick and low-cost energy efficiency measure in buildings. This energy efficiency measure will help reduce the energy demand in government buildings. This measure is expected as one of the first results of the energy audits. Lighting retrofits have been conducted for some government buildings in New Providence. A detailed accounting of these retrofits needs to be completed.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Identify current lighting technology in government buildings.
2. Baseline assessment can be done with energy audits.
3. Identify suitable replacement technology replacement.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Reduction in energy demand in Government buildings in New Providence. The estimated avoided GHG emissions are 8.2 $GgCO_2$-eq by 2030.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">The assumption is that fluorescent lights in buildings are being replaced with LEDs, leading to a 60% reduction in electricity consumption for lighting in Government buildings. This reduction can be further enhanced with additional measures proposed from the energy audits. Approximately, 14% of all buildings in New Providence are Government occupied, which represent 402 buildings. The retrofits are implemented starting in 2020 and reach 100% by 2030.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># buildings retrofitted for lighting.
and type of lights replaced</td></tr>
</table>

International Market Mechanisms
None

Table 96: Mitigation Action 5 - Public Awareness Campaign for energy efficiency and energy conservation

Name of the mitigation action					
Public Awareness Campaign for energy efficiency and energy conservation					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Environment and Natural Resources, Bahamas Power and Light, University of the Bahamas, The Bahamas Chamber Of Commerce and Employers Confederation	2022-2033	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To encourage the public to adopt energy efficiency and energy conservation measures.					
Brief description					
Public Education and awareness are important mechanisms to reduce emissions. Education and awareness of the public on energy-efficient equipment available to encourage an increase in uptake and measures to conserve energy to reduce consumption. A comprehensive education and awareness plan to be developed.					
Steps to achieve mitigation action:					
1. Develop comprehensive education and awareness plan for energy efficiency and energy conservation. 2. Identify baseline for current energy efficiency uptake and energy conservation measures. 3. Continuous monitoring and reporting.					
Estimated outcomes and estimated emission reductions					
Increase uptake of energy-efficient equipment and reduce energy consumption.					
Methodologies and assumptions					
Public Awareness and Education on energy efficiency will increase the penetration of energy-efficient equipment in both the residential and commercial sectors. This action was not modelled as a single strategy due to the lack of disaggregated data of end-uses in The Bahamas.					
Progress indicators					

% per cent increase in the purchase of energy-efficient equipment. % reduction in energy demand
International Market Mechanisms
None

Table 97: Mitigation Action 6 - Streetlighting retrofits

Name of the mitigation action					
Streetlighting retrofits					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Bahamas Power and Light Company, Grand Bahama Power Company	2020-2033	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To undertake lighting retrofits to reduce energy consumption and emissions from streetlights					
Brief description					
Retrofits of streetlights through the replacement of commonly high-pressure sodium bulbs to either LED or solar lights to help reduce energy consumption. The streetlight project is currently ongoing.					
Steps to achieve mitigation action:					
1. Identify suitable replacement of lights for different areas. 2. Complete a replacement plan for the lights. 3. Implementation of light replacement.					
Estimated outcomes and estimated emission reductions					
Reduction in streetlighting energy demand and reduced emissions. The estimated avoided GHG emissions by 2030 are 18.5 $GgCO_2$-eq.					
Methodologies and assumptions					
Assumed that current streetlights in The Bahamas will be replaced either by 100% more efficient solar lights or 60% more efficient LED lights. There are approximately 46,000 streetlights in The Bahamas, including high-pressure sodium (HPS), mercury vapour, metal halide, incandescent, LED, and solar. Streetlights are assumed to be on for 12 hours per day. 24% of the existing lights are LED, and less than 1% is solar. Starting in 2020 and by 2025, all other lights (estimated as 35,000 250 W lights) will be replaced by 70 W LED lights.					
Progress indicators					
# of Lights and type of lights retrofitted					
International Market Mechanisms					
None					

Table 98: Mitigation Action 7 - Increase solar water use by 40% for The Bahamas

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Increase solar water heaters use by 40% for The Bahamas</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Ministry of Environment and Natural Resources</td><td>2022-2030</td><td>Energy Demand</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the uptake of solar water heaters by 20%</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">Replacement of electrical and LPG water heaters with solar water heaters will help reduce energy consumption and emissions.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Develop a plan to increase solar water heater installation.
2. Increase awareness of solar water heaters.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Reduction in energy consumption for water heating. The estimated avoided GHG emissions are 34.5 $GgCO_2$-eq.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">It is assumed that the current uptake of solar water heaters is 5%, and an increase in use of solar water heaters of 40% is expected by 2030. Of the current 115660 households, 60% use water heaters. The average annual energy consumption of water heaters is 1890 kWh/household. There are currently 3946 commercial buildings with an average floor space of 1455 m^2/building. 10% of commercial buildings use water heaters with an average annual energy consumption of 2.15 kWh/m^2. Currently, water heating is mainly electric or with LPG. Only 5% of water heaters are solar.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># of new solar water heaters installed.
% percentage increase in solar water heaters</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 99: Mitigation Action 8 - Introduce incentives for solar water heater installation

Name of the mitigation action					
Introduce incentives for solar water heater installation					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Finance, Ministry of Environment and Natural Resources	2022-2025	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To promote and increase the uptake of solar water heaters					
Brief description					
The introduction of incentives will encourage the uptake of solar water heaters. This action is an enabling action to the mitigation action 7.					
Steps to achieve mitigation action:					
1. Identify suitable incentives for solar water heater installation. 2. Develop a list of incentives for solar water heater installation.					
Estimated outcomes and estimated emission reductions					
Reduction in energy consumption for water heating. The estimated GHG emissions are bundled with mitigation action 7.					
Methodologies and assumptions					
The introduction of incentives for solar water heater installation will increase the use of solar water heaters. This action was not modelled as single mitigation strategy but is assumed to be incorporated into the modelling of mitigation action 7 as an enabling factor to increase the installation and adoption of solar water heaters.					
Progress indicators					
# concessions processed for solar water heaters					
International Market Mechanisms					
None					

Table 100: Mitigation Action 9 - Energy Labelling program for all appliances

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Energy Labelling program for all appliances</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Bahamas Bureau of Standards and Quality</td><td>2022-2025</td><td>Energy Demand</td><td>National</td><td>Carbon Dioxide (CO_2)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To provide a clear and simple indication of energy efficiency of appliances and inform consumers</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">Mandatory labelling standards to inform consumers on the energy efficiency of appliances. The Bahamas, as part of CARICOM, is involved in the CARICOM Regional Energy Efficiency Labelling Scheme. This scheme is being piloted in four countries, but others will be able to join and learn from the lessons learnt.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Identify appliances to be included in the labelling programme.
2. Identify the types of suitable labels for each appliance.
3. Develop an energy labelling programme.
4. Implement the energy labelling programme.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase uptake of energy-efficient equipment and reduce energy consumption.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">Energy labelling will give consumers a more informed decision when purchasing products and coupled with public awareness and education, will assist in the shift to more energy-efficient equipment.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># labelling standards developed,
% percentage increase in appliances with energy labels</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 101: Mitigation Action 10 - Establish finance mechanism to increase access to low-interest loans for EE and RE measures

Name of the mitigation action					
Establish finance mechanism to increase access to low-interest loans for EE and RE measures					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Finance, The Bahamas Development Bank, Ministry of Environment and Natural Resources	2022-2025	Energy Demand	National	N/A
Objective of the mitigation action					
To establish a finance mechanism to increase access to low-interest loans for energy and energy-efficient measures					
Brief description					
This finance mechanism is expected to facilitate the sourcing of low-cost development funds for productive enterprises for energy and energy efficiency projects. This will allow both businesses and residents to access low-interest loans to finance energy and energy-efficient projects through the establishment of a special fund.					
Steps to achieve mitigation action:					
1. Identify the most suitable financing mechanism to implement this arrangement. 2. Identify available funding. 3. Develop terms of reference and operating procedures for the financing mechanism. 4. Implement and promote funding availability.					
Estimated outcomes and estimated emission reductions					
Increase access to loans for renewable energy and efficiency projects—indirect emission reduction potential.					
Methodologies and assumptions					
The introduction of the facility will encourage the uptake of renewable energy and energy-efficient equipment.					
Progress indicators					
financing mechanism established, # of application to receive financing, # of loans approved					
International Market Mechanisms					
None					

Table 102: Mitigation Action 11- Energy Efficient Standards for air conditioning systems

Name of the mitigation action					
Energy Efficient Standards for air conditioning systems					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Bahamas Bureau of Standards and Quality	2022-2025	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To encourage the shift to more energy-efficient air conditioning systems					
Brief description					
Mandatory standards for air conditioning will encourage the adoption of more energy-efficient equipment. A shift to more energy-efficient air conditioning systems will reduce energy consumption and long-term costs to the consumers. In addition, seawater district cooling is practised in some hotels in the Bahamas, a technology that can significantly reduce emissions from the cooling sector.					
Steps to achieve mitigation action:					
1. Identification of suitable standards for air conditioning systems. 2. Development of implementation and enforcement plan.					
Estimated outcomes and estimated emission reductions					
Increase uptake of energy-efficient air conditioners. The estimated avoided GHG emissions by 2030 is 109.6 $GgCO_2$-eq for use of more efficient air conditioning systems. In the ambitious scenario, the use of sea water cooling in hotels is expected to have a reduction in GHG emissions by 6.2 $GgCO_2$-eq.					
Methodologies and assumptions					
The adoption of standards will improve the energy efficiency of the equipment purchased. Number of households are currently 115660, the number of commercial buildings are currently 3946 with an average floor space of 1455 m2/building. Approximately 60% of households in The Bahamas have AC, with an average annual electricity consumption for AC of 2618 kWh/household. All commercial buildings have AC, with an average annual electricity consumption for AC of 58.13 kWh/m2. The standards are assumed to consider a 30% increase in efficiency by 2030. In the ambitious scenario, the adoption of seawater cooling in hotels was modelled for more efficient cooling. Currently, there are approximately 300 hotels in The Bahamas, with an average of 3425 m2/building and average annual electricity consumption for cooling of 50.4 kWh/m2. By 2030, 20% of all hotels will implement sea water cooling. This technology reduces energy consumption for cooling by 80%.					
Progress indicators					
% percentage increase in energy-efficient appliances on island					

Number of new hotels using seawater cooling technology
International Market Mechanisms
None

Table 103: Mitigation Action 12 - Promotion of Energy Efficiency in Water production

Name of the mitigation action					
Promotion of Energy Efficiency in Water production					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Water and Sewage Corporation	2022-2033	Energy Demand	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To improve energy efficiency in the water sector.					
Brief description					
Water production in The Bahamas is a high energy-intensive process (reverse osmosis). The introduction of energy-efficient measures will reduce energy costs and reduce emissions. The Bahamas is constantly seeking methods to improve energy efficiency in water production.					
Steps to achieve mitigation action:					
1. Identify areas for energy-efficient measures. 2. Implement energy-efficient measures and replace inefficient equipment.					
Estimated outcomes and estimated emission reductions					
Reduction in energy intensity for water production, thereby reducing emissions.					
Methodologies and assumptions					
Due to constraints with energy consumption data in the water production process, this action was not modelled.					
Progress indicators					
% per cent reduction in energy demand in the water sector					
International Market Mechanisms					
None					

Table 104: Mitigation Action 13 - Five (5) carbon-neutral Marine Protected Area facilities (photovoltaic substitute for diesel generators)

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Five (5) carbon-neutral Marine Protected Area facilities (photovoltaic substitute for diesel generators)</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsect or</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Ongoing</td><td>DEPP, Bahamas National Trust, Department of Marine Resources</td><td>2017-2030</td><td>Energy Demand</td><td>Exuma Cays, West Andros, New Providence</td><td>Carbon Dioxide equivalent (CO_2-eq)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To demonstrate the viability of photovoltaic systems in creating carbon-neutral facilities</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">Substituting diesel generators for photovoltaic systems will demonstrate the social, environmental, and economic feasibility of climate change mitigation through implementing innovative carbon-neutral solutions that will contribute to the effective management of marine protected areas and reduce risks associated with the use of diesel, such as “pollution/storage”. Diesel fuel requires the storage of bulk fuels on the islands and the transfer of fuel from bulk storage to monthly storage for daily use. This storage and transfer increase the risk of a spill into the water or ground resources of the park. The proposed sites are (i) Visitors Centre for Warderick Wells (ECLSP), (ii) West Andros Fee collection booth, (iii) Bonefish Pond high visibility demo, pilot. Meeting the Challenge of 2020 in the Bahamas is an ongoing project that is currently funded by the GEF.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Collect and verify baseline information at each of the sites.
2. Design renewable energy systems for each site.
3. Develop terms of reference for the service.
4. Contract service providers.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Reduced emissions for three sites identified. Estimated total GHG emissions reduction is 3.5 Gg CO_2-eq.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">Solar PV systems will be installed to completely replace the diesel generators at the facility. The assumption is that each location currently has a 100kW generator in use. Each gallon of diesel fuel produces, on average, 10,084 g of CO_2. 60 kW Diesel Generator at ¾ load fuel consumption = 5.8 gallon/hr32. By 2030, 5x100 kW generators at 75% load factor and 25% efficiency will be replaced by PV systems.</td></tr>
</table>

Progress indicators
# of kW of PV systems installed. # emissions reductions of CO_2-eq.
International Market Mechanisms
None

4.3.1.2. *Electricity Generation*

The electricity generation sector covers the electricity supply from centralised and distributed generation, policies to enhance mitigation strategies for electricity generation and plans to improve electricity supply. This sector encompasses all fuels combusted for electricity generation. These mitigation actions include renewable energy generation, renewable energy assessments and improvement in the transmission and distribution network. A shift to more renewables in the energy generation subsector will significantly reduce total national GHG emissions.

The GOB has made efforts to increase its energy security by including in its NDCs specific targets for renewable energy penetration and developing The Bahamas National Energy Policy. A major strategy in The NEP is the diversification of energy. Furthermore, with the Inter-American Development Bank's (IDB) support, approval was given for a USD 170 million Conditional Credit Line for Investment Project (CCLIP). This project is expected to advance the deployment of renewable energy in The Bahamas. In addition, several renewable energy systems have been installed on some of the smaller islands in The Bahamas, including but not limited to, Over Yonder Cay with a 1MW solar facility, 300kW wind facility and 6MW battery bank, Chub Cay with 4MW solar plant and a 2MW battery bank and Ragged Island with the installation of a 390kW solar system and 1.26MWh battery storage system.

A total of **fourteen (14) mitigation actions** related to the **Electricity Generation Subsector** were identified.

Table 105: Mitigation Action 14 - Assessment of Renewable Energy Potential Across all occupied Islands

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Assessment of Renewable Energy Potential Across all occupied Islands</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Ministry of Environment and Natural Resources, Bahamas Power and Light, Grand Bahama Power Company, Morton Salt Company</td><td>2022-2025</td><td>Electricity Generation</td><td>National</td><td>N/A</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To undertake a complete assessment of the renewable energy potential across The Bahamas.</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared a target of 30% renewables in electricity generation by 2030. An assessment of renewable energy potential will help identify possible locations for renewable energy projects and/or interventions</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Develop terms of reference for the assessment.
2. Identify renewable energy that will be assessed.
3. Source funding to conduct an assessment.
4. Contract services for assessment.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Renewable energy potential is identified, and projects are developed based on the assessment. The emission reduction potential will be determined upon completion of the assessment.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">The assumption is that The Bahamas has an abundance of renewable energy potential, but the exact size, location and type of the renewable energy potential has not been completed. This action is an enabling activity and is not modelled. It will help to further refine mitigation action for the electricity generation subsector in the future.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># of assessments completed per technology</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030

Name of the mitigation action					
30% Renewables on each major island by 2030					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Environment and Natural Resources, Bahamas Power and Light, Grand Bahama Power Company	2022 - 2030	Electricity Generation	Grand Bahama, New Providence , Family Islands	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. 30% renewable energy is proposed on the major islands, New Providence, Grand Bahama, and the Family Islands as a group. This is currently ongoing. The Ministry of Environment and Natural Resources is currently undertaking assessments to develop the best course of action.					
Steps to achieve mitigation action:					
1. Projects identified to increase renewable energy penetration.					
Estimated outcomes and estimated emission reductions					
Increased renewable energy penetration. An estimated reduction in emissions of 412.6 $GgCO_{2}$-eq is estimated.					
Methodologies and assumptions					
The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. To achieve 30% in renewable energy penetration, the following was modelled 174MW of Solar PV systems, 30kW of OTEC, 15MW of Waste to Energy and 20MW of wind. This was a bundled mitigation scenario that incorporated the several mitigation actions numbered; 16-21, 23,24,26 and 27.					
Progress indicators					
# kW of installed renewable energy systems # of GHG emissions avoided					
International Market Mechanisms					
None					

Table 107: Mitigation Action 16 - 3MW Solar farm in Grand Bahama

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">3MW Solar farm in Grand Bahama</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Grand Bahama Power Company</td><td>2020-2025</td><td>Electricity Generation</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the penetration of renewable energy by 30% by 2030</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction. This project has been planned by GBPC; the site has been identified.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Installation of the system</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># kW of installed solar PV system</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 108: Mitigation Action 17- 3MW of distributed generation in Grand Bahama through the Renewable Energy Rider programme

Name of the mitigation action					
3MW of distributed generation in Grand Bahama through the Renewable Energy Rider program					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Grand Bahama Power Company	2016-2025	Electricity Generation	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction. This includes renewable energy systems installed for residential and commercial buildings that are grid-connected in Grand Bahama. The renewable energy rider (RER) introduced by the Grand Bahama Power Company allows for customers to connect up to 150kW of wind power or solar system through distributed generation to the grid. The systems are allowed to be sized to produce 1.5 times the average monthly consumption up to a limit of 150kW.					
Steps to achieve mitigation action:					
1. Promotion of benefits of distributed solar systems for customers.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.					
Methodologies and assumptions					
The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.					
Progress indicators					
# kW of installed renewable energy systems					
International Market Mechanisms					
None					

Table 109: Mitigation Action 18 - Additional 30MW of Solar PV Installed

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Additional 30MW of Solar PV Installed</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Proposed</td><td>Ministry of Environment and Natural Resources, Bahamas Power and Light</td><td>2022-2030</td><td>Electricity Generation</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the penetration of renewable energy by 30% by 2030</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Identification of suitable locations for projects.
2. Full project proposals developed.
3. Funding identified to implement projects.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6"># kW of installed solar PV systems</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 110: Mitigation Action 19 - Installation of 20MW of wind power Installed

Name of the mitigation action					
Installation of 20MW of wind power Installed					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Idea	Ministry of Environment and Natural Resources, Bahamas Power and Light	2022-2030	Electricity Generation	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction.					
Steps to achieve mitigation action:					
1. Identification of suitable locations for projects. 2. Full project proposals developed. 3. Funding identified to implement projects.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030					
Methodologies and assumptions					
The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030					
Progress indicators					
# kW of installed wind power systems					
International Market Mechanisms					
None					

Table 111: Mitigation Action 20 - Installation of 10MW of distributed generation on rest of islands

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Installation of 10MW of distributed generation on rest of islands</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Ongoing</td><td>Bahamas Power and Light, Ministry of Environment and Natural Resources</td><td>2017-2030</td><td>Electricity Generation</td><td>Family Islands</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the penetration of renewable energy by 30% by 2030</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction. This includes renewable energy systems installed for residential and commercial buildings that are grid-connected in the Family Islands. Bahamas Power and Light (BPL) has established a small-scale renewable generation (SSRG) programme.
Abaco, Eleuthera and Exuma:
For residential customers, the capacity limit is 3kW + Average Customer Demand with a ceiling limit of 50kW. For commercial customers, the limit is 25kW + average customer demand with a ceiling of 50kW. The maximum allowed capacity is 500kW.
Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay (Exuma):
For residential customers, the capacity limit is 2kW + Average Customer Demand with a ceiling limit of 30kW. For commercial customers, the limit is 15kW + average customer demand with a ceiling of 30kW. The maximum allowed capacity is 250kW.
All other Family Islands:
For residential customers, the capacity limit is 1kW + Average Customer Demand with a ceiling limit of 10kW. For commercial customers, the limit is 5kW + average customer demand with a ceiling of 10kW. The maximum allowed capacity is 25kW.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Promotion of benefits of distributed solar systems for customers.
2. Studies to enable the increase in the allowable limits.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.</td></tr>
</table>

Methodologies and assumptions
The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.
Progress indicators
kW of installed solar PV system
International Market Mechanisms
None

Table 112: Mitigation Action 21 - Upgrade incentives for renewable energy systems

Name of the mitigation action					
Upgrade incentives for renewable energy systems					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Finance, Ministry of Environment and Natural Resources	2022-2030	Electricity Generation	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. The upgrade of incentives will encourage the installation and implementation of renewable energy systems.					
Steps to achieve mitigation action:					
1. Identify areas where upgrades to incentives are possible. 2. Develop a plan to upgrade incentives. 3. Prepare necessary documents for approval of upgrade of incentives.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. No direct GHG emission reductions were estimated from this mitigation action.					
Methodologies and assumptions					
Assumption that the upgrade of incentives would increase the use of renewable energy systems. This action is considered an enabling factor to accelerate the adoption of renewables, as identified in Table 32.					
Progress indicators					
# of upgrade of incentives approved					
International Market Mechanisms					
None					

Table 113: Mitigation Action 22 - Integrated resource and resilience plan for Grand Bahama Power Company and Bahama Power and Light

Name of the mitigation action					
Integrated resource and resilience plan for Grand Bahama Power Company and Bahama Power and Light					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Newly Proposed	Bahamas Power and Light, Grand Bahama Power Company, Ministry of Environment and Natural Resources	2022-2025	Electricity Generation	Grand Bahama, New Providence, Family Islands	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To identify the best mix of renewable energy systems to increase resilience, energy independence and maintain low system costs					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Integrated Resource and Resilient Plans (IRRP) will identify how the country can supply its electricity needs in the future. This will take into consideration the goals and renewable energy resource assessments conducted. The Bahamas has been impacted by several hurricanes over the years. Resource and resilience planning is something that is being discussed at various levels to be implemented. As a member of CARICOM, the Council for Trade and Economic Development (COTED) has highlighted the need for all members to undertake IRRPs.					
Steps to achieve mitigation action:					
1. Prepare terms of reference. 2. Source funding for integrated resource and resilience plans.					
Estimated outcomes and estimated emission reductions					
Identification of suitable renewable energy mix. This action is not expected to have emission reduction potential but will help identify and quantify specific renewable energy installations and potential reductions					
Methodologies and assumptions					
The integrated resource and resilience plans are undertaken by each power provider to improve planning for renewable energy introduction and improve resilience. Assumption that integrated resource and resilience plan will provide a comprehensive overview of necessary upgrades, improvements and additions to the systems required in each time frame. It will also help identify the best mix of renewables for The Bahamas.					
Progress indicators					

# of integrated resource and resilience plans undertaken
International Market Mechanisms
None

Table 114: Mitigation Action 23 - 10 MW of installed distributed generation through a Renewable Energy Rider for Bahamas Power and Light (BPL) customers in New Providence

Name of the mitigation action					
10 MW of installed distributed generation through a Renewable Energy Rider for Bahamas Power and Light (BPL) customers in New Providence					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Bahamas Power and Light. Ministry of Environment and Natural Resources	2017-2024	Electricity Generation	New Providence	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction. This includes renewable energy systems installed for residential and commercial buildings that are grid-connected in New Providence and excludes the 1.2MW identified through the Solar Assessment report. Bahamas Power and Light (BPL) has established a small-scale renewable generation (SSRG) programme. New Providence: For residential customers, the capacity limit is 5kW + Average Customer Demand with a ceiling limit of 100kW. For commercial customers, the limit is 50kW + average customer demand with a ceiling of 100kW. The maximum allowed capacity is 10MW.					
Steps to achieve mitigation action:					
1. Promotion of benefits of distributed solar systems for customers.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.					
Methodologies and assumptions					

The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.
Progress indicators
kW of installed solar PV system
International Market Mechanisms
None

Table 115: Mitigation Action 24 - Installation of approximately 1.2MW of distributed generation on 9 Government Facilities

Name of the mitigation action					
Installation of approximately 1.2MW of distributed generation on 9 Government Facilities					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Ministry of Environment and Natural Resources	2019-2030	Electricity Generation	New Providence	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description					
The Bahamas energy mix is currently dominated by fossil fuels. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal as well as significantly assist in achieving emission reduction. This project was identified through the solar assessment report. The Ministry of Environment and Natural Resources has undertaken a detailed design of PV systems at the various locations and estimated the capacity of the system possible at each location. Funding for the project needs to be sourced in order to commence implementation.					
Steps to achieve mitigation action:					
1. Preparation of terms of reference for service contracts. 2. Source funding for the installation of the system. 3. Engage with BPL for interconnection agreements.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. Reduction in emissions at the public buildings. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030.					
Methodologies and assumptions					
The following is assumed for this project; 1.2 MW will consist of the following: Roof-mounted systems: 12.0 kW at the House of Assembly and Senate Buildings. 51.0 kW at C.I. Gibson Senior High School; 56.1 KW at Uriah McPhee Primary School. 83.1 kW at Doris Johnson Senior High School. 136.2 kW at T.G. Glover Primary School. 76.5 kW at Customs Headquarters.					

73.2 kW at the Ministry of Education Building. 167.1 kW at C.V. Bethel Senior High School. Carport Systems: 475.5 kW at the Office of the Prime Minister. The following rates were assumed for the project: 1. $2.50/W for PV system under 20kW (roof-mounted). 2. $2.25/W for PV systems between 21kW and 100kW (roof-mounted). 3. $2.00/W for PV systems over 100kW (roof-mounted). 4. $5.00/W for carport port systems. The total cost of the installation is estimated at $3.78 Million dollars (BSD)
Progress indicators
#kW of installed solar PV system on public institutions.
International Market Mechanisms
None

Table 116: Mitigation Action 25 - Reduce Transmission and Distribution losses by 2%

Name of the mitigation action					
Reduction Transmission and Distribution losses by 2%					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Bahamas Power and Light	2022-2030	Electricity Generation	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the energy efficiency of the transmission and distribution system by reducing losses					
Brief description					
Reducing transmission and distribution losses reduces the amount of electricity to meet demand. Capital investments are required in transmission equipment and meters.					
Steps to achieve mitigation action:					
1. Necessary upgrades to transmission and distribution systems to be assessed and implemented.					
Estimated outcomes and estimated emission reductions					
Improved energy efficiency in the transmission and distribution system. Estimated GHG emissions reduction of 32.4 GgCO_2-eq.					
Methodologies and assumptions					
Assumed that reduction by 2% of losses in transmission and distribution is achieved by 2030, and further reduction is achieved by 2050. The average T&D losses in the Bahamas will be reduced from 10% in 2018 to 8% by 2030.					
Progress indicators					
% reduction in transmission and distribution losses					
International Market Mechanisms					
None					

Table 117: Mitigation Action 26 - Pilot Project for a 30kW OTEC Plant

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Pilot Project for a 30kW OTEC Plant</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Ministry of Environment and Natural Resources</td><td>2022-2030</td><td>Electricity Generation</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the penetration of renewable energy by 30% by 2030</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">The Bahamas is currently in discussions with CARICOM, CCRREE, CCCCC and SIDS DOCK to develop a pilot OTEC plant. However, OTEC is still seen as being in its experimental stage globally. Still, The Bahamas has a reverse geothermal energy profile, and it may be possible to obtain the necessary temperature difference for OTEC from deep wells rather than cold seawater.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Undertake necessary feasibility study
2. Drill wells and build plant</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase renewable energy penetration. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6">#kW of OTEC produced</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 118: Mitigation Action 27 - Installation of 15MW Waste to Energy

Name of the mitigation action					
Installation of 15MW Waste to Energy					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Ministry of Environment and Natural Resources/ Department of Environment Health Services/ Bahamas Power and Light	2020-2030	Electricity Generation	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase the penetration of renewable energy by 30% by 2030					
Brief description and activities planned under the mitigation action					
Fossil fuels currently dominate the Bahamas energy mix. The Bahamas has declared 30% renewables in electricity generation by 2030. Installation of renewable energy systems will help achieve this goal and significantly assist in achieving emission reduction. The proposal is currently being developed to be submitted to the Green Climate Fund for assessment and funding					
Steps to achieve mitigation action:					
1. Complete and submit the proposal to Green Climate Fund for assessment and funding. 2. Prepare relevant documents for the implementation of the project.					
Estimated outcomes and estimated emission reductions					
Increase renewable energy penetration. Improved waste management. Reduction in land required for waste. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030					
Methodologies and assumptions					
The utility grids are able to handle the increase in renewables without undergoing major upgrades to their system. Bundled with other renewable energy actions, refer to Table 106: Mitigation Action 15 -30% Renewables on each major island by 2030					
Progress indicators					
#kW of installed waste to energy plant. # of kg of waste processed through the plant.					
International Market Mechanisms					
None					

4.3.1.3. Transport

From the latest National Inventory Report of The Bahamas, the transport sector remains the second-largest GHG emitting subsector for Energy in The Bahamas. The majority of these emissions are estimated from road transport. Since 2013, The Bahamas has drafted regulations to limit vehicle emissions for road transport. These regulations highlight the maximum emissions standards for vehicles by type and model year (Environment Health (Vehicle Emissions) Regulations, 2013). In addition, the NEP identifies specific strategies for the transport sector, some of which are incorporated in the mitigation actions.

Significant gaps in data and information on energy usage, total number, and types of vehicles in The Bahamas still exist. As a result of this lack of data, the mitigation actions in the transport sector are related to changes in energy use in passenger road vehicles only because sufficient data is available for this subset of vehicles. Mitigation actions for marine, aviation and freight sectors are not included. Historical information on total fuel and the number and type of vehicles was estimated based on available local, regional, international data, and expert reviews.

The mitigation actions in the transport sector include electrification of the transport fleet, improvement in public transit and improvement in vehicle efficiency standards. A total of **seven (7) mitigation actions** related to the **Transport subsector** were identified.

Table 119: Mitigation Action 28 - Standards implemented for vehicle fuel efficiency

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Standards implemented for vehicle fuel efficiency</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>The Bahamas Bureau of Standards and Quality</td><td>2022-2025</td><td>Transport</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To encourage the uptake of more energy-efficient vehicles</td></tr>
<tr><th colspan="6">Brief description and activities planned under the mitigation action</th></tr>
<tr><td colspan="6">Improved fuel efficiency reduces the demand for fuel in vehicles and therefore reduce the consumption of fossil fuels.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Develop fuel efficiency standards for vehicles.
2. Adopt and implement efficiency standards.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Increase efficiency of vehicles, improve vehicle fuel economy.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">Due to a lack of data related to the standard, this mitigation was not modelled.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6">fuel efficiency standard for vehicles developed.
% increase in vehicle fuel economy.</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 120: Mitigation Action 29 - Improved Incentives for electric vehicle

Name of the mitigation action					
Improved Incentives for electric vehicle					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Finance, Ministry of Environment and Natural Resources	2022-2025	Transport	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To encourage the purchase of electric vehicles					
Brief description					
Improved incentives for electric vehicles will enhance the attractiveness of electric vehicles for the public, increase the purchase of electric vehicles, and reduce fossil fuel consumption. The Bahamas currently has incentives on electric vehicles with import duties reduced to 10% for vehicles with a landing price of $50,000 (BSD). These incentives need to be revised to encourage increased uptake of electric vehicles.					
Steps to achieve mitigation action:					
1. Incentives revised, and proposed changes included. 2. Incentives approved and implemented.					
Estimated outcomes and estimated emission reductions					
Increased uptake of electric vehicles. This mitigation action is considered an enabling activity and does not contribute directly to emissions reduction.					
Methodologies and assumptions					
Improved incentives will encourage the increased adoption of electric vehicles. Therefore, it is considered an enabling activity for the adoption of electric vehicles.					
Progress indicators					
improved incentives developed. % increase of electric vehicles from the implementation of improved incentives					
International Market Mechanisms					
None					

Table 121: Mitigation Action 30 - Assessment of Government vehicles and program for replacement of suitable vehicles to electric vehicles

Name of the mitigation action					
Assessment of Government vehicles and program for replacement of suitable vehicles to electric vehicles					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Planned	Ministry of Finance, Ministry of Environment and Natural Resources	2022-2025	Transport	National	N/A
Objective of the mitigation action					
To identify suitable electric vehicle replacement in the Government fleet					

Brief description
To effectively conduct a transition to electric vehicles and prevent stranded assets, a fleet assessment should be conducted. This fleet assessment will identify suitable electric vehicle replacement for internal combustion engine (ICE) vehicles and create a plan for replacement based on age and use of vehicles
Steps to achieve mitigation action:
1. Obtain inventory of government vehicle fleet. 2. Conduct an assessment of vehicle fleet, noting the age and mileage of the vehicle, use suitable replacement electric vehicles and expected year of replacement. This assessment should also include associated costs and emission reduction potential.
Estimated outcomes and estimated emission reductions
Government vehicle transition plan developed.
Methodologies and assumptions
A thorough assessment of vehicles in the Government fleet will be conducted and suitable replacement vehicles identified. The plan will be developed for the transition of ICE vehicles to electric vehicles. The assumption is that the government fleet has suitable replacement electric vehicles, and vehicles are constantly being upgraded, and therefore they can be transitioned to electric vehicles.
Progress indicators
Assessment completed. Vehicle transition plan for government fleet developed
International Market Mechanisms
None

Table 122: Mitigation Action 31 - Introduction of electric vehicles to Government Fleet

Name of the mitigation action					
Introduction of electric vehicles to Government Fleet					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Ministry of Finance, Ministry of Environment and Natural Resources	2019 - 2030	Transport	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase penetration of electric vehicles in the government fleet					
Brief description					
Based on the vehicle transition plan developed, The Government of The Bahamas will begin the implementation of the transition. Through the office of the Prime Minister, the Government of the Bahamas began a pilot project in 2016 with the leasing of 12 electric vehicles. The lease was renewed, and vehicles replaced in 2020, but no further initiatives have been undertaken in the Government.					
Steps to achieve mitigation action:					
1. Procurement plan for transition to electric vehicles					
Estimated outcomes and estimated emission reductions					
Reduction in emissions in the transport sector through increased electric vehicles; Reduction energy demand for government fleet. The estimated emissions reductions were bundled with mitigation action 33; refer to Table 124: Mitigation Action 33 - Increase sales of electric vehicles to 35%.					
Methodologies and assumptions					
This action was assumed to be incorporated within mitigation action 33; refer to Table 124: Mitigation Action 33 - Increase sales of electric vehicles to 35%.					

Progress indicators
Government Internal Combustion Engine (ICE) vehicles transitioned to electric vehicles
International Market Mechanisms
None

Table 123: Mitigation Action 32 - Installation of charging stations for electric vehicles

Name of the mitigation action					
Installation of charging stations for electric vehicles					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Ministry of Environment and Natural Resources	2019 - 2030	Transport	National	N/A
Objective of the mitigation action					
To increase penetration of electric vehicles					
Brief description					
Proper infrastructure such as charging stations need to be installed to transition to electric vehicles. This is an enabling factor to the increasing penetration of electric vehicles and eases customer range anxiety. The Government of the Bahamas currently has one level 3 charger installed at the Thomas A. Robinson Sports Stadium from the Abu Dhabi Caribbean Renewable Energy Fund; another 12 chargers are located at business locations included The National Art Gallery of The Bahamas (NAGB) and over 100 personal charging stations have been installed in New Providence. The installation of charging stations is currently ongoing.					
Steps to achieve mitigation action:					
1. Identify suitable location and type of chargers required for installation. 2. Develop terms of reference for service providers and the use of charging stations. 3. Procure and install charging stations.					
Estimated outcomes and estimated emission reductions					
Increase penetration of electric vehicles. This action is not expected to have emission reduction potential but will help increase the penetration of electric vehicles on the islands					
Methodologies and assumptions					
Geographic wide installation of electric chargers. The installation of electric chargers geographic wide will increase the penetration of electric vehicles on the island.					
Progress indicators					
# of charging station installed					
International Market Mechanisms					
None					

Table 124: Mitigation Action 33 - Increase sales of electric vehicles to 35%

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Increase sales of electric vehicles to 35% and hybrid vehicles to 15% by 2030</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Ongoing</td><td>Ministry of Finance, Ministry of Environment and Natural Resources</td><td>2016 - 2030</td><td>Transport</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To increase the sale of electric vehicles by 35% by 2030.
To increase energy efficiency in the transport sector.
To reduce emissions in the transport sector.</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">Adoption of electric vehicles simultaneous with the transition to renewables will help reduce fossil fuel consumption in the transport sector. The Bahamas currently has approximately 7% electric vehicles share of the new car sales locally. There is one EV company, but other local importers are on the island. In addition, the government began a pilot project in 2016 to introduce electric vehicles in the government fleet.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Increase public awareness of electric vehicles.
2. Encourage sales of electric vehicles by retailers.
3. Implementation of actions related to incentives and installation of charging stations</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Reduction in emissions in the transport sector through an increase in electric and hybrid vehicles. The total GHG emission reduction potential is estimated at 1.1 $GgCO_2$-eq by 2030.</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">Electric vehicles are assumed to represent 35% of the sales of vehicles by 2030. This represents an electric vehicle stock share of 13% by 2030. Hybrid vehicles are assumed to represent 15% of the sales by 2030. This corresponds to a vehicle stock share of 5%. Only road transport vehicles were considered in this methodology.</td></tr>
<tr><th colspan="6">Progress indicators</th></tr>
<tr><td colspan="6">% of vehicles sales are electric</td></tr>
<tr><th colspan="6">International Market Mechanisms</th></tr>
<tr><td colspan="6">None</td></tr>
</table>

Table 125: Mitigation Action 34 - Promotion of the use of Public Transport

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">Promotion of the use of Public Transport</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Planned</td><td>Ministry of Transport and Housing</td><td>2022 - 2030</td><td>Transport</td><td>National</td><td>Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O))</td></tr>
</table>

Objective of the mitigation action
To increase the use of public transport. To increase energy efficiency in the transport sector. To help reduce commute times by reducing the number of private vehicles on the road.
Brief description
Increased access to public transportation and increased reliability may help reduce the use of private vehicles, causing a modal shift and thereby reducing the fossil fuel consumption in the transport sector and assisting in traffic management. The public transportation system requires reform as well to encourage public use. Gender-sensitive training was recommended during the stakeholder workshop for bus drivers.
Steps to achieve mitigation action:
1. Development of comprehensive public transit strategy to increase use. 2. Training for bus drivers to improve the service provided to the public including, but not limited to gender sensitivity. 3. Incentives to encourage public transports to improve the transport system. 4. Public education and awareness to encourage the use of the public transportation system.
Estimated outcomes and estimated emission reductions
Increase use of public transportation. Reduced commute time. Reduced emissions for the transport sector. The estimated GHG emissions reduction potential is 12.9 GgCO_2-eq by 2030.
Methodologies and assumptions
The number of public transits trips will increase and reduce the distance travelled using personal vehicles. The shift of demand from private passenger vehicles to public transit vehicles. After 2025, the number of private cars will stop growing due to the increased availability of public transport. Private cars are assumed to drive 14484 km/vehicle per year and have an average of 1.5 passengers per car. The avoided passenger kilometres from the private cars are assumed to be absorbed by buses with an average occupancy rate of 21 passengers per vehicle and an annual mileage of 40000 km per vehicle.
Progress indicators
minutes of reduced commute times, # reduced private vehicles on the road during peak hours
International Market Mechanisms
None

4.3.1.4. Industrial Processes and Product Use (IPPU)

The Industrial Processes and Product Use (IPPU) Sector includes anthropogenic emissions from industry productions processes that are not related to or as a result of fuel combustion. Based on stakeholder consultations and data collection efforts, there does not appear to be industrial production in The Bahamas that leads to significant industrial processes GHG emissions. The only direct GHG emissions are related to hydrofluorocarbons (HFCs) imported into The Bahamas through the stock of refrigerators and air conditioners that contain HFCs and bulk imports used to recharge refrigeration and air conditioning products. Although it is known amongst experts in the country that HFCs exist on the islands, there is a significant lack of data and information on the exact amount.

The Bahamas is actively preparing to implement the Kigali amendment to the Montreal Protocol, which will phase down the consumption of HFCs in the case of The Bahamas.

As a result, mitigation action for the IPPU sector is related to the phase-down of HFCs due to The Bahamas eventual ratification of the Kigali Amendment.

The latest GHG Inventory does not include estimates for this sector due to lack of data, and as a result, baseline emissions for this sector were unavailable. **One (1) mitigation action** related to **IPPU Sector** was identified and is outlined below.

Table 126: Mitigation Action 35 - 20% Phase-Out of HFC

<table>
<tr><th colspan="6">Name of the mitigation action</th></tr>
<tr><td colspan="6">20% Phase Out of HFC</td></tr>
<tr><th>Status</th><th>Lead Agency/Agencies</th><th>Duration</th><th>Sector and subsector</th><th>Scope</th><th>GHGs covered</th></tr>
<tr><td>Preparation</td><td>Ozone Unit, Department of Environmental Health Service</td><td>2022-2030</td><td>Industrial Processes and Product Use (IPPU)</td><td>National</td><td>hydrofluorocarbons (HFCs)</td></tr>
<tr><th colspan="6">Objective of the mitigation action</th></tr>
<tr><td colspan="6">To reduce the use of HFC refrigerants</td></tr>
<tr><th colspan="6">Brief description</th></tr>
<tr><td colspan="6">Encouraging alternatives to HFC refrigerants through ratification of Kigali Amendment and improving energy efficiency in the sector. The Government of The Bahamas is preparing the necessary instruments and planning its execution of national requirements in support of the ratification of the Kigali Amendment. The Government is conducting activities needed to enhance its capacity within the refrigeration and air conditioning servicing sector through the management (use, storage, transportation, and disposal) of current-controlled substances and the introduction of alternative sources. Additionally, the strengthening of existing regulatory import/export licensing systems for substances including hydrofluorocarbons (HFCs) and hydrofluorocarbon alternatives are being assessed to maintain a registry and provide a proper management system for these products.</td></tr>
<tr><th colspan="6">Steps to achieve mitigation action:</th></tr>
<tr><td colspan="6">1. Facilitation and support of the ratification of the Kigali Amendment.
2. Establishment of an overall national policy framework to address the hydrofluorocarbon phase-down process.
3. Creation of coordination mechanisms to highlight gaps and determine capacity needs to support the Kigali Amendment implementation.
4. Technical assistance for safe adoption of alternative HFC technologies with the local market.
5. Revisions to the current licensing and data reporting systems to include hydrofluorocarbons (HFCs).
6. Baseline data and information compiled on the existing hydrofluorocarbon products and information on alternative options available to support the phase-down plan.
6. Education and awareness throughout the public and private sectors on the ratification and implementation of the Kigali Amendment.</td></tr>
<tr><th colspan="6">Estimated outcomes and estimated emission reductions</th></tr>
<tr><td colspan="6">Reduced GHG emissions and increased energy efficiency in the sector</td></tr>
<tr><th colspan="6">Methodologies and assumptions</th></tr>
<tr><td colspan="6">The assumption is a 20% phase-down of HFC use by 2030. Assumption is that each year from the implementation, a fraction of the imported HFCs will be replaced by</td></tr>
</table>

alternative refrigerants, which are estimated to have at least a 90% lower global warming potential than HFCs. Due to data constraints the GHG emissions related to this mitigation was not estimated And thus, this mitigation action was not modelled.
Progress indicators
% reduction in the importation of HFC's
International Market Mechanisms
None

4.3.1.4.1. Agriculture

The Bahamas agricultural activities contribute to GHG emissions through a range of different processes. Based on the latest national inventory estimates, methane (CH_4) and nitrous oxide (N_2O) are the major contributors to GHG emissions in this sector.

Mitigation in the agriculture sector comes from improved sequestration through the sustainable practices of agroforestry. In the Pine-Island Forest/Mangrove Innovation and Integration (Grand Bahama, New Providence, Abaco and Andros) project, one component is sustainable agroforestry practices, funded by the GEF. Under the Ministry of Agriculture, more agroforestry projects are currently being developed, but planning is in the very early stages. **One (1) mitigation action** related to **Agriculture Sector** was identified and is outlined below.

Table 127: Mitigation Action 36 - Sustainable agroforestry practices in Andros, Grand Bahama, Acklins, Crooked Island, Planna and Samana Cays

Name of the mitigation action					
Sustainable agroforestry practices in Andros, Grand Bahama, Acklins, Crooked Island, Planna and Samana Cays by 2025					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Ministry of Agriculture, Marine Resources and Family Island Affairs	2015 - 2025	Agriculture	Andros, Grand Bahama, Acklins and Crooked Island	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase emission sinks in the agriculture sector. To improve biodiversity in selected areas. To increase the use of agroforestry management practices among coastal communities.					
Brief description					
The Pine-Island project will target non-timber forest products with a multi-pronged approach to improving livelihoods while ensuring the sustainability of the resources. Two projects areas were selected as Palm cultivation on Andros and Grand Bahama and sustainable Cascarilla cultivation on Acklins and Crooked Island. Integrating natural biodiversity, species and trees with crops and livestock will increase emission sinks from native trees, less fertiliser use, increase habitat and build resilience against one-off diseases. Under the Pine Islands project – Forest/Mangrove Innovation and Integration (Grand Bahama, New Providence, Abaco, and Andros), these measures have been identified, and sites have been assessed. During the stakeholder workshops, the importance of consultation with the existing farmers is essential to the success of the project.					

Steps to achieve mitigation action:
1. Public consultation with existing farmers. 2. Native palm cultivation to support indigenous craft industry on Andros and Grand Bahama 3. Sustainable agroforestry practices for Cascarilla bark cultivation and processing of Cascarilla oil in Acklins and Crooked Islands
Estimated outcomes and estimated emission reductions
Increased sequestration potential for emissions. Due to data constraints on the hectares of land to be converted and the sequestration potential, this mitigation action was not modelled.
Methodologies and assumptions
With a view towards preserving biodiversity, a technical guide will be developed for the identification and utilization of degraded forest lands for sustainable oil palm expansion and a site selection guide for identifying high potential areas for sustainable palm oil. Furthermore, through the development of alternative livelihoods, including agroforestry and non-timber forest products, pressure on forest resources will be relieved while providing opportunities for the generation of income in remote coastal communities hard hit by the economic downturn and loss of tourism revenues.
Progress indicators
Ha of agricultural lands converted to agroforestry
International Market Mechanisms
None

4.3.1.5. Land use, Land Use Change and Forestry (LULUCF)

Land Use, Land Use Change and Forestry (LULUCF) covers removals by sinks on managed lands and protected areas. The LULUCF sector includes estimates of emissions and removals of GHGs associated with the increase or decrease of carbon in living biomass; this occurs as land-use changes occur over time. The Bahamas lies within the tropical belt, and therefore its Forestry sector is prone to extreme weather-related events such as intense Hurricanes and other factors, including illegal harvesting. As a result, emissions in the sector fluctuate, which makes it difficult to project and estimate potential future emissions and removals. Despite these many challenges, The Bahamas Forestry Department continues the efforts to improve the data for the LULUCF sectors; efforts are on the way to establishing permanent plots to monitor growth rates and carbon sequestration rates. **Three (3) mitigation actions** related to **LULUCF Sector** were identified and are outlined below.

Table 128: Mitigation Action 37 - Conservation and Sustainable management practices and the establishment of a Forestry Estate on Abaco, Andros, Grand Bahamas and New Providence

Name of the mitigation action					
The establishment of a Forestry Estate on 283,750.18 hectares (20% of the total land cover of The Bahamas) comprised of areas to be established as: Conservation Forests (149, 396.99 hectares), Forest Reserves (96,542.61 hectares), and Protected Forests (37,810.58 hectares) on Abaco, Andros, Grand Bahamas and New Providence by 2025					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered

Ongoing	Forestry Unit	2015 - 2025	Land use, Land Use Change and Forestry	Grand Bahama, New Providence, Abaco, and Andros	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To improve the sustainable management practices of existing and new forest reserves. To increase emission sinks. To improve biodiversity in the selected area.					
Brief description					
The Pine Island project seeks to innovate community management plans for newly gazetted forest areas. Natural biodiversity, species and trees with crops and livestock will increase emission sinks from native trees, reduce fertiliser use, increase habitat and build resilience against one-off disease. Under the Pine Islands – Forest/Mangrove Innovation and Integration (Grand Bahama, New Providence, Abaco, and Andros), these measures have been identified, and sites have been assessed.					
Steps to achieve mitigation action:					
1. Establishment of a forestry assessment and monitoring system. 2. Integration of sustainable land-use and sustainable forest management principles into national land-use planning through development.					
Estimated outcomes and estimated emission reductions					
Increased sequestration potential. The estimated GHG emission reduction is 381.151 $GgCO_2$-eq.					
Methodologies and assumptions					
Annual carbon savings by the benefit of the project through integration of forest domain into land-use planning improved forest management. The avoided deforestation together with mangrove rehabilitation efforts is estimated to reduce up to 381.151 $GgCO_2$- eq. This data was entered into the model as recommended by the project.					
Progress indicators					
# of ha of reforested areas in degraded areas					
International Market Mechanisms					
None					

Table 129: Mitigation Action 38 - Reestablishment & Rehabilitation of 50 ha of Davis Creek, Andros Ecosystem

Name of the mitigation action					
Reestablishment & Rehabilitation of 50 ha of Davis Creek, Andros Ecosystem					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Ongoing	Forestry Unit	2015-2025	Land Use, Land-use Change and Forestry	Davis Creek, Andros	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To increase emission sinks; to rehabilitate and re-establish Davis Creek in Andros					
Brief description					

Reestablishment and rehabilitation of Davis Creek in Andros will improve sequestration potential. Under the Pine Islands project – Forest/Mangrove Innovation and Integration (Grand Bahama, New Providence, Abaco, and Andros), these measures have been identified, and sites have been assessed.
Steps to achieve mitigation action:
1. Rehabilitation of Mangrove Ecosystem in Davis Creek, Andros and increase carbon sequestration up to 14,563 tCO_2-eq.
Estimated outcomes and estimated emission reductions
Increased sequestration potential. The estimated GHG emission reduction is 14.563 $GgCO_2$-eq.
Methodologies and assumptions
According to recent studies, mangroves contain an average of 1,023 tonnes of carbon per hectare. This model will pilot restoration efforts for up to 50 hectares across a potential 500 hectares of mangrove forest, increasing carbon sequestration up to 14.563 $GgCO_2$-eq. This data was entered into the model as recommended by the project.
Progress indicators
# of ha of seagrass beds, reefs, mangroves protected and rehabilitated
International Market Mechanisms
None

Table 130: Mitigation Action 39 - Sustainable Land Use practices to result in zero emissions in the LULUCF Sector by 2045

Name of the mitigation action					
Sustainable Land Use practices to result in zero emissions in the LULUCF Sector by 2045					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Newly Proposed	Ministry of Environment and Natural Resources, Forestry Unit	2022-2030	LULUCF	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To reduce emissions from the LULUCF Sector					
Brief description					
The Bahamas LULUCF sector contributes more than 45% of the total emissions. This action is considered ambitious owing to the various challenges posed to the LULUCF sector.					
Steps to achieve mitigation action:					
National plan developed to reduce emissions in the LULUCF sector Improved data collection of the LULUCF sector					
Estimated outcomes and estimated emission reductions					
Increased sequestration potential. Estimated GHG emissions reduction of 1,324.0 Gg CO_2- eq. and 2979.1 Gg CO_2-eq by 2045.					
Methodologies and assumptions					
In the ambitious scenario: sustainable land-use practices will result in zero emissions from the LULUCF sector by 2045					
Progress indicators					
Reduction in emission in the LULUCF Sector					
International Market Mechanisms					
None					

4.3.1.6. Waste

The waste sector includes emissions from solid waste disposal and wastewater treatment. The Bahamas recently changed ownership of the New Providence Sanitary Landfill from the Department of Environmental Health Services to the New Providence Ecology Park (NPEP) in 2019. Although the NPEP is only on one island, it is estimated that it handles close to eighty per cent (80%) of the waste in The Bahamas. The NPEP has remediated the existing dumpsite and significantly reduced subsurface fires. The plans are to implement modern waste handling practices, including environmental monitoring, upgrade to collect landfill gas, expand composting and recycling systems. Historical data for the site before 2019 is very limited and therefore hinders the selection of mitigation actions.

Currently, close to twenty per cent (20%) of the waste stream is diverted to composting at the NPEP, of which sixteen per cent (16%) is green waste, and four per cent (4%) is construction debris. The expectation is that within 3-5 years, all organic waste, which is about thirty per cent (30%) of the total waste stream, will be diverted to composting.

The NPEP also plans to introduce a recycling facility at the current location. The recycling facility will be able to sort and shred plastics, aluminium, and cardboard, to name a few. It is estimated that more than nine per cent (9%) of the total waste stream is plastics. The Government has recently included a recycling programme to their list of initiatives. The recycling facility and programme coupled with the composting programme will significantly reduce waste directed to the landfill.
Mitigation in the waste sector comes from waste management, composting practices, and recycling programmes. **Two (2) mitigation actions** related to **Waste Sector** were identified and is outlined below.

Table 131: Mitigation Action 40 - Development of a waste management system to include composting systems

Name of the mitigation action					
Development of a waste management system to include composting systems					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Newly Proposed	Ministry of Environment and Natural Resources, Department of Environmental Health Services	2022-2030	Waste	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To improve waste management and encourage composting in an effort to reduce waste to the landfill					
Brief description					
Composting breaks down food and green waste for soil creation. This reduces the amount of organic waste going into landfills. Good composting practices assist in minimising GHG emissions. This proposed action is modelled after other Caribbean islands mitigation action for waste					
Steps to achieve mitigation action:					

1. Develop a comprehensive education and awareness plan;
Estimated outcomes and estimated emission reductions
Reduced waste to the landfill, reduction in emissions in the waste sector.
Methodologies and assumptions
Waste management and composting will reduce the amount of organic waste landfills, thereby reducing emissions. However, due to limited data availability, this action was not modelled. The Bahamas is currently working on improving their data collection in the waste sector.
Progress indicators
% increase in composting systems
International Market Mechanisms
None

Table 132: Mitigation Action 41 - Introduction of a National Recycling Programme

Name of the mitigation action					
Introduction of a National Recycling Programme					
Status	Lead Agency/Agencies	Duration	Sector and subsector	Scope	GHGs covered
Newly Proposed	Ministry of Environment and Natural Resources, Department of Environmental Health Services	2022-2030	Waste	National	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O)
Objective of the mitigation action					
To reduce waste at the landfill					
Brief description					
Recycling is the reprocessing of materials (mainly used) into new products. This programme will help reduce the waste entering the landfills, reduce consumption of raw materials, reduce energy usage and GHG emissions. It is a key component to waste management practices.					
Steps to achieve mitigation action:					
Development of recycling strategy Development of public awareness strategy Implementation of the two strategies developed.					
Estimated outcomes and estimated emission reductions					
Reduced waste to the landfill, reduction in emissions in the waste sector. Behavioural change to waste sorting.					
Methodologies and assumptions					
A recycling programme will enhance the behavioural change for recycling. The assumption made is waste originally destined for the landfill will be diverted to the recycling facility.					
Progress indicators					
Amount of waste diverted from the landfill					
International Market Mechanisms					
None					

4.3.2. International Market Mechanisms

The Bahamas is a non-Annex 1 Party to the Kyoto Protocol, and was therefore eligible to participate in the Clean Development Mechanism (CDM). However, The Bahamas currently has no projects registered with the CDM or other international markets.

Following the conclusion of negotiations on Article 6 of the Paris Agreement, specifically the Glasgow Climate Pact and Sharm-el-Sheikh Implementation Plan, highlighted the need to encourage small and micro business in the mechanism, particularly in the least developed countries and small island developing states.

The Government of The Bahamas has indicated a strong interest in pursuing suitable, beneficial projects in the International Markets, and has put in place legislation and is advancing institutional arrangement to participate in Article 6 Cooperative Approaches and Voluntary Carbon Markets.

4.4. GHG Emissions Projection

4.4.1. Overview of methodology

The analysis of the GHG mitigation potential in The Bahamas was developed using the Low Emissions Analysis Platform[31] (LEAP), a software tool developed by the Stockholm Environment Institute (SEI) and widely used for energy policy analysis and climate change mitigation assessments. LEAP is an integrated, scenario-based modelling tool that can be used to quantify energy consumption and production and resource extraction in all sectors of the economy and under different scenarios. In addition, it allows for the consideration of both sources and sinks of GHG from the energy sector and the non-energy sector.

The model for The Bahamas developed in LEAP simulates the evolution of energy demand and supply in the country, as well as the emissions corresponding to the energy and non-energy sectors, and the mitigation potential of a series of sectoral measures. The model covers The Bahamas as a whole, with a regional resolution for the three major island groupings: New Providence, Grand Bahama, and The Family Islands. It covers the period from 2010 to 2050, with projections starting in 2019, as the inventory data was only available up to 2018. The 2000-2018 period provides historical context, reflects the most recent economic, demographic and energy statistics in The Bahamas, and has been calibrated to closely match the most recent GHG inventory (within 0.4% of total emissions).

The prospective period (2019-2050) uses GDP and population growth projections as the main drivers of energy demand, and to the extent possible, captures the estimated economic impact of COVID-19. Energy consumption has been disaggregated by sector and fuel, including residential, transportation, industrial, services, and agriculture. Projections are based on historical energy balances, trends, and expected economic and demographic growth. The transport sector has been supplemented by a more detailed stock-turnover analysis that represents the stock and sales of different types of vehicles.

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[31] https://leap.sei.org/

The model represents power generation in terms of capacity expansion and dispatch of power plants and transmission and distribution losses on the supply side. The non-energy sector encompasses these emission categories from the inventory: fugitive emissions, industrial processes, product use (IPPU), agriculture, land use and land-use change (LULUCF), non-CO_2 sources on land, and waste.

Three future scenarios were developed to assess GHG mitigation potential: a baseline and two mitigation scenarios as described further below. Emissions were projected for each of the three scenarios, and the results were compared under the various scenarios. The mitigation effects reported in this chapter are based on comparing the baseline scenario to the mitigation scenarios.

The three scenarios developed for The Bahamas are:

- **Baseline:** Illustrates where emissions for The Bahamas are headed, assuming current trends in demographic and macroeconomic drivers, as well as in sectoral energy intensity. It also assumes modest energy efficiency improvements, which can be expected even in the absence of government policies.
- **Mitigation:** It uses the same macroeconomic and demographic assumptions as the baseline and explores the implementation of a set of mitigation actions and measures as highlighted in section 4.2.1.1 - 4.2.1.2**,** which were assessed for data availability and applicability for mitigation modelling. Actions are mainly concentrated in the energy and LULUCF sectors and were modelled either as single strategies or bundled with similar strategies. On top of these actions, this scenario considers the additional buildup of solar PV to meet the 30% renewable target from the NDC by 2030. However, results indicate that this was not enough to reach the NDC's 30% GHG reduction target by 2030.
- **Ambitious Mitigation:** It includes the same assumptions and mitigation actions as above but also explores further solar PV development, higher integration of electric vehicles, zero emissions from the LULUCF sector by 2045, and other additional mitigation measures in various sectors. This scenario meets the 30% renewable and 30% GHG reduction targets from the NDC by 2030 (as seen in sections 4.3.1.1 – 4.3.1.6).

By building the model for The Bahamas' mitigation assessment analysis within LEAP, the model is readily available for future updated mitigation assessments. In addition, in-country experts were trained on using LEAP to ensure that the government institutionalises the capacity to use the model.

A stakeholder validation workshop was held to review and validate the assumptions, analysis, and conclusions of The Bahamas Mitigation Assessment with LEAP. The model was updated to reflect feedback from the stakeholder validation workshop.

4.4.2. Baseline Scenario Description

The baseline scenario corresponds to the counterfactual scenario used to compare emissions and to estimate the mitigation potential of the modelled actions. The baseline scenario explicitly does not consider the targets, goals, and projects of the mitigation strategy; rather, the scenario reflects a continuation of existing trends and modest energy efficiency improvements and shifts in technologies that are expected to happen even in the absence of new policies.

In the baseline, future emissions are estimated based on the modelling of the energy demand, supply and non-energy sectors, which in turn are driven by historical trends and by projected macroeconomic indicators, such as population, number of households, GDP, and GDP per capita. The same macroeconomic drivers are used for the baseline and the mitigation scenarios.

Based on projections from United Nations World Population Prospects (United Nations-World Population Prospects, 2021), the total population in The Bahamas will grow from 393 thousand in 2020 to 427 thousand in 2030 and 463 thousand in 2050 (Figure 45a). The total number of households will grow from 117 thousand in 2020 to 161 thousand by 2050 (Figure 45b). In terms of economic growth, near term projections from the International Monetary Fund (IMF) World Economic Outlook were used until 2025 (IMF WEO, 2021). These projections consider the impacts of COVID-19 on GDP (Figure 46), where a decrease of 16.6% in the GDP for 2020 was estimated. From 2025 to 2050, national-level GDP growth rates from the Shared Socioeconomic Scenarios database (SSP2="Middle of the Road") were used (Keywan Riahi et al, 2017). The same GDP growth rates were used for all island groups.

Figure 45: Population (a) and household (b) trends to 2050

(a) Population (b) Households

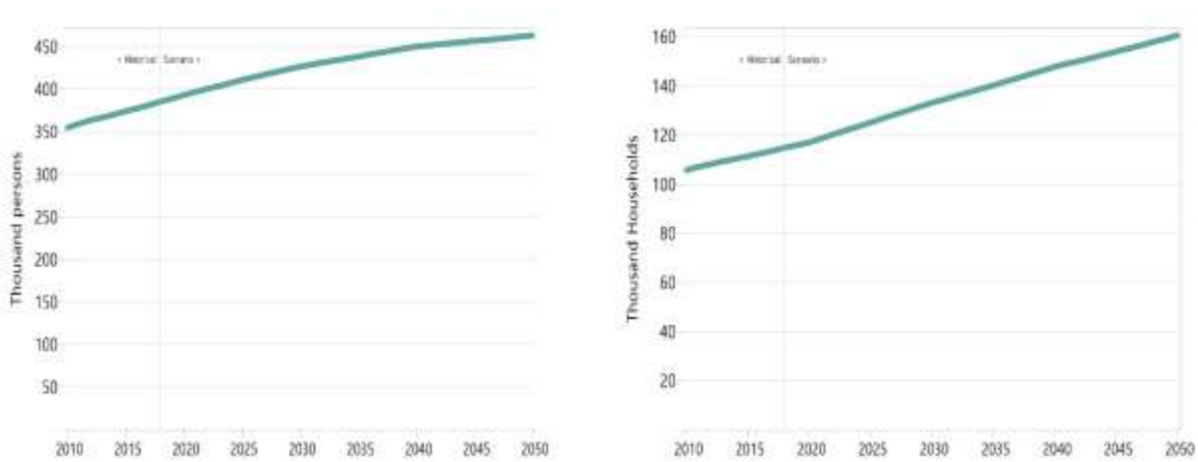
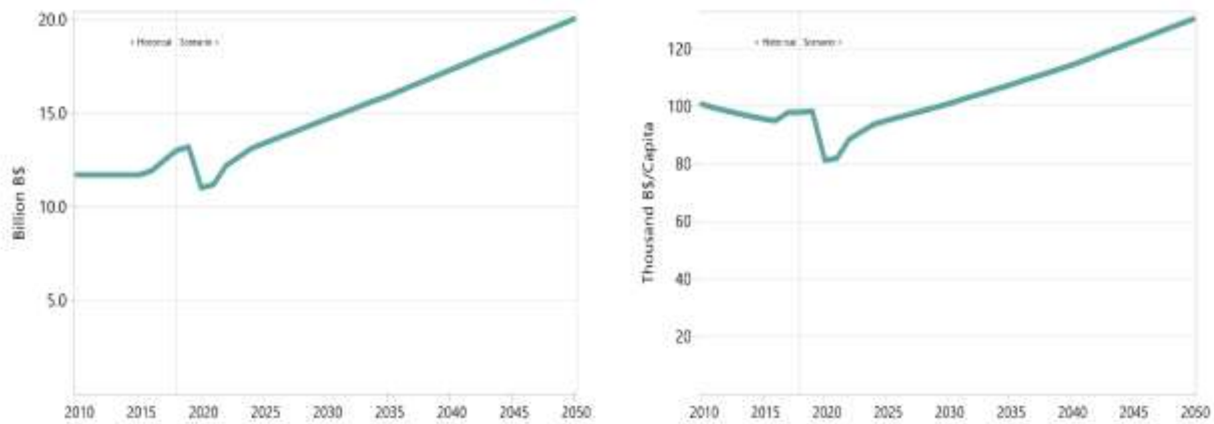


Figure 46: GDP (a) GDP per capita (b) trends to 2050

(a) GDP (b) GDP per capita



Baseline GHG emissions for all sectors, gases and regions are shown in Figure 47 to Figure 49. Total GHG emissions for 2010 and 2018 were estimated at approximately 6133.2 GgCO_2-eq and 6144.3 GgCO_2-eq, respectively. For the prospective period, the baseline presented corresponds to the best available realistic projection of future emissions based on current trends and market influences. The key driver used for the baseline GHG emissions projections in the majority of the sectors is GDP except residential demand, which is the number of households; waste, which is the population; and the LULUCF sector, which is estimated to remain constant through the projections at 2979.1 GgCO_2-eq. The final energy intensity for all sectors is expected to decline by 0.5% annually. Projected GHG emissions in the residential sector are expected to increase by 9.3% from 2018 to 2030. In the services sector and industrial sector, the projected GHG emissions are expected to increase by 6% from 2018 to 2030. The road transport and waste sector projected GHG emissions are expected to increase by 7% and 10.6%, respectively, from 2018 to 2030.

The total projected emissions reach approximately 6364.7 GgCO_2-eq in 2030 and 7173.5 GgCO_2-eq in 2050. As observed, LULUCF is an important net emitter of CO_2 and is responsible for more than 45% of the total emissions. From the energy sector, electricity generation and transportation are the most carbon-intensive sectors, contributing to 23% and 13% of the total emissions in 2030. Around 94% of the total emissions correspond to CO_2 (Figure 48), and it is estimated that New Providence contributes to 70% of the total emissions in The Bahamas (Figure 49).

Figure 47: Projected GHG emissions in the baseline by sector

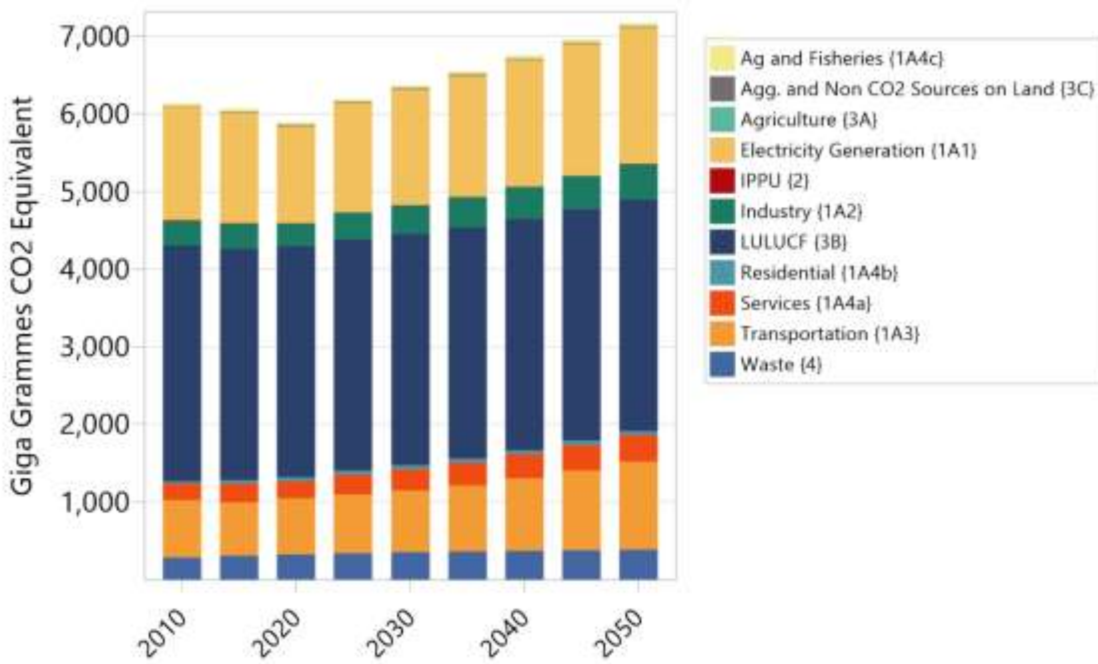


Figure 48: Projected GHG emissions in the baseline by gas

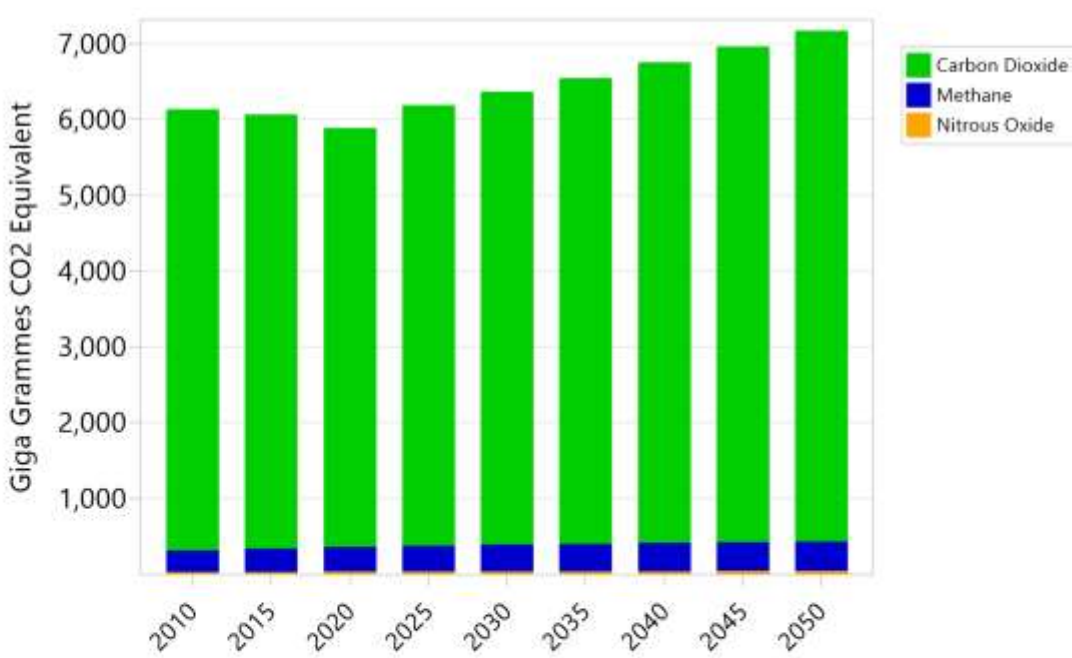
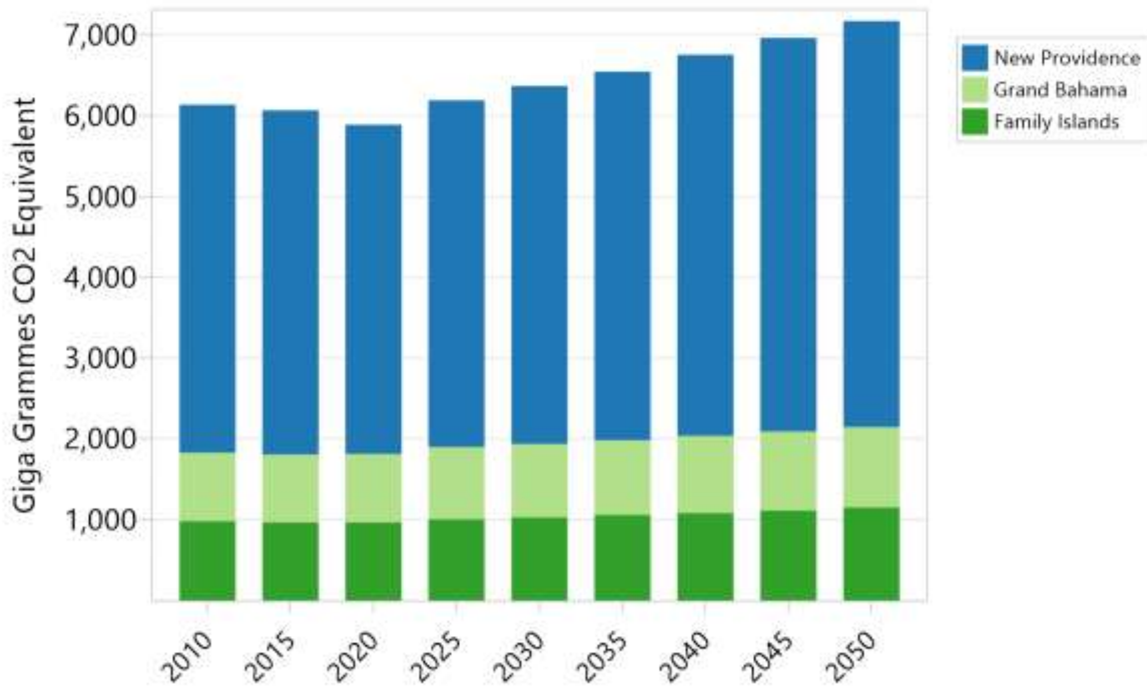


Figure 49: Projected GHG emissions in the baseline by region



4.4.3. Mitigation Scenarios(s) Description

4.4.3.1. GHG Emissions Projection Assumptions, by Sector

4.4.3.1.1. Energy Demand

The estimates of historical total energy consumption were mainly based on data obtained from The Bahamas' most recent inventory up to 2018. The data sources include 2010-2012 energy balances from the Latin American Energy Organisation (OLADE) (Latin American Energy Organisation (OLADE), 2015), The Central Bank of The Bahamas, Power Generators and Fuel Distributors - Rubis. A historical profile for fuel consumption in The Bahamas was developed using these data sets.

The historical energy consumption trends, together with key demographic and macroeconomic drivers, were used to project future energy demands by sector. The lack of more recent energy balances and the limited data available on energy end-use by sector limited the ability to conduct a bottom-up analysis of energy demand in The Bahamas. Therefore, the energy demand projections were only disaggregated by sector and fuel, and the policy measures in the residential, commercial and services sectors were represented as expected gradual energy savings, estimated outside of LEAP based on the technical characteristics, uptake rates, and other assumptions as described below in Table 133.

Table 133: Assumptions for mitigation actions in the residential, commercial and services sectors

Modelled action	Description	Main assumptions
Revised building codes	Adoption and implementation of a	- The implementation of the revised code will reduce energy used for cooling and lighting

Modelled action	Description	Main assumptions
	Revised Building Code that will impact all new construction of residential and non-government buildings between 2024 and 2030.	by 25% in the new residential and commercial buildings. - 1132 new residential buildings per year are assumed, with average annual electricity consumption of 1835 kWh/household for lighting and 2618 kWh/household for air conditioning (AC). - 110 new commercial buildings per year are assumed, 86% of which are non-governmental. The average floor space is assumed as 1455 m^2/building, with average annual electricity consumption of 31.2 kWh/m^2 for lighting and 58.13 kWh/m^2 for AC. It is assumed that all new residential and commercial buildings will have AC.
Government building lighting retrofits	Lighting Retrofits for all government occupied buildings in New Providence.	- Approximately 14% of all buildings in New Providence are Government occupied, which represent 402 buildings. - The shift towards more efficient lighting will result in savings of 60% of the electricity used for lighting in these buildings. The retrofits are implemented starting in 2020 and reach 100% by 2030.
Street lighting retrofits	Streetlighting retrofits by 2033.	- There are approximately 46,000 streetlights in The Bahamas, including high-pressure sodium (HPS), mercury vapour, metal halide, incandescent, LED, and solar. - Streetlights are assumed to be in use for 12 hours per day. - 24% of the existing lights are LED, and less than 1% are solar. Starting in 2020 and by 2025, all other lights (estimated as 35,000 250 W lights) will be replaced by 70 W LED lights.
Solar water heaters	Increase adoption of solar water heaters by 40% for the Bahamas by 2030.	- Of the current 115,660 households, 60% use water heaters. The average annual energy consumption of water heaters is 1890 kWh/household. - There are currently 3946 commercial buildings with an average floor space of 1455

Modelled action	Description	Main assumptions
		m^2/building. 10% of these buildings use water heaters with an average annual energy consumption of 2.15 kWh/m^2. - Currently, water heating is mainly electric or fueled with LPG. Only 5% of water heaters are solar. - By 2030, 40% of all water heaters will be solar
Efficient AC	Energy Efficient Standards for air conditioning systems by 2025.	- Same number of households, commercial buildings, and floor space as described above. - 60% of households have AC, with an average annual electricity consumption for AC of 2618 kWh/household. - All commercial buildings have AC, with an average annual electricity consumption for AC of 58.13 kWh/m^2. - The standards are assumed to consider a 30% increase in efficiency by 2030. In the ambitious scenario, the adoption of seawater cooling in hotels was modelled for more efficient cooling. - Currently, there are approximately 300 hotels in The Bahamas, with an average of 3425 m^2/building and an average annual electricity consumption for cooling of 50.4 kWh/m^2. - By 2030, 20% of all hotels will implement sea water cooling. - This technology reduces energy consumption for cooling by 80%.
Carbon neutral marine protected area facilities	Five (5) carbon-neutral Marine Protected Area facilities (photovoltaic substitute for diesel generators) by 2030.	- By 2030, 5x100 kW generators at 75% load factor and 25% efficiency will be replaced by PV systems

Modelled action	Description	Main assumptions
Distributed PV to replace diesel generators	Energy Audits for All existing Hotels and Industrial facilities by 2025. In addition, two actions were implemented 1. A fraction of the backup diesel generators in the service sector will be replaced by distributed solar PV systems. 2. Energy intensity improvements in the industrial sector.	For the ambitious scenario, in addition to the energy audits, some mitigation actions are considered. This includes the replacement of diesel generators with PV systems and a reduction in the energy intensity for the industrial sector. Currently, diesel is used in backup generators that provide distributed electricity in some of the service sector facilities. - In the ambitious mitigation scenario, by 2030, distributed solar PV systems will displace 30% of the diesel used in the service sector. - In the baseline and mitigation scenarios, energy intensity in industry decreases 0.5% per year. - In the ambitious mitigation scenario, energy intensity in the industry decreases by 2% per year.

4.4.3.1.2. Electricity Generation

The electricity generation assumptions determine the underlying GHG emissions from the supply and production of electricity. Data on electricity sales by sector was very limited and therefore constrained the ability to calibrate the energy supply from the model to observed historical data. Nevertheless, the LEAP model estimates projected electricity requirements and power generation capacity and dispatch from different types of power plants in each major island group.

In 2018, there were 767 MW of installed electricity generation capacity in The Bahamas, all of which corresponded to thermal power plants running on diesel and residual fuel oil. Based on the information provided by BPL, the transmission and distribution (T&D) losses in the BPL operated grid are estimated at 10.88%. The average T&D losses in the country are assumed to be 10% for the 2018-2030 period. In terms of generation capacity, the baseline scenario assumes that all additional capacity requirements are met by diesel generators.

The main assumptions for the renewable energy supply and T&D losses under different scenarios are described below in Table 134.

Table 134: Assumptions for mitigation actions in the power generation sector

Modelled action	Description	Main assumptions
T&D loss reduction	Reduction in the Transmission & Distribution losses in The Bahamas of 2 percentage points by 2030	The average T&D losses in the Bahamas will be reduced from 10% in 2018 to 8% by 2030.
Renewable power generation	Integration of renewable power generation in The Bahamas	- In the mitigation scenarios, the following renewable generation capacity is added to the system: • 3 MW utility-scale PV in Grand Bahama by 2025 • 3 MW distributed PV in Grand Bahama by 2025 • 30 MW of PV split among regions by 2026 • 20 MW of wind among regions by 2030 • 30 kW of OTEC by 2030 • 15 MW of Waste to Energy • 10MW distributed PV in New Providence by 2024 • 10 MW distributed PV on Family Islands by 2030 • 1.2 MW of distributed generation on 9 Government Facilities 117 MW of additional solar PV capacity were added to the system in both the mitigation and ambitious mitigation scenarios to meet the NDC goal of 30% renewable generation by 2030.

The following Table 135 shows the expected generation capacity by type in key years under each of the modelled scenarios. Note that a fraction of the existing thermal capacity in the ambitious mitigation scenario is expected to retire after 2030, approximately 24%. However, this thermal capacity is only fractionally replaced by renewables because the reserve margin in The Bahamas will be sufficient to meet the anticipated demand.

Table 135: Expected Installed Capacity by Type in Baseline and Mitigation Scenarios

Scenario	Year	Thermal (MW)	Solar PV (MW)	OTEC (MW)	MSW (MW)	Wind (MW)	Total (MW)
Baseline	2018	767.2	-	-	-	-	767.2
	2025	845.2	-	-	-	-	845.2
	2030	845.2	-	-	-	-	845.2
	2050	845.2	-	-	-	-	845.2
Mitigation	2018	767.2	-	-	-	-	767.2
	2025	845.2	87	-	-	-	932.2
	2030	845.2	174	0.03	15	20	1054.2
	2050	845.2	174	0.03	15	20	1054.2
Ambitious mitigation	2018	767.2	-	-	-	-	767.2
	2025	845.2	87	-	-	-	932.2
	2030	845.2	174	0.03	15	20	1054.2
	2050	645.83	204	0.03	15	20	884.9

Table 136: Expected Electricity Generation by Type in Baseline and Mitigation Scenarios

Scenario	Year	Thermal (GWh)	Solar PV (GWh)	OTEC (GWh)	MSW (GWh)	Wind (GWh)	Total (GWh)
Baseline	2018	2062.6	-	-	-	-	2062.6
	2025	2100.9	-	-	-	-	2100.9
	2030	2221.2	-	-	-	-	2221.2
	2050	2629.2	-	-	-	-	2629.2
Mitigation	2018	2062.6	-	-	-	-	2062.6
	2025	1765.6	228.6	-	-	-	1994.2
	2030	1366.8	457.3	0.2	105.1	52.6	1981.9
	2050		457.3	0.2	105.1	52.6	2441.1
Ambitious mitigation	2018	2062.6	-	-	-	-	2062.6
	2025	1767.0	228.6	-	-	-	1995.7
	2030	1377.4	457.3	0.2	105.1	52.6	1992.6
	2050	1891.4	536.1	0.2	105.1	52.6	2585.4

4.4.3.1.3. Transport

The historical energy consumption in the transportation sector was based on The Bahamas most recent inventory up to 2018 and was disaggregated by mode (road, domestic aviation, and domestic maritime navigation) and fuel. This information was supplemented by vehicle registration information to develop a stock turnover model in

LEAP for road transport. The stock and sales data from the vehicle registration information was calibrated to allow the bottom-up fuel consumption projections to align with historical transport sector energy requirements. The resulting stock turnover model represents the future stocks and sales of different types of passenger and freight vehicles, including cars, motorcycles, golf carts, minibuses, buses, taxis, trucks and other miscellaneous equipment.

Based on this model, the total stock of road vehicles, including passenger and freight, grows from 136 thousand in 2018 to 150 thousand in 2030, which is equivalent to an annual growth rate of 0.82%. In 2018, hybrid and electric vehicles (EV) represented less than 1% of the total vehicle stock in The Bahamas. In the baseline, hybrid and EVs represent around 8% of car sales between 2018-2030, which results in the stock of hybrid and EVs increasing to 4% of the total stock by 2030.

The electrification of vehicles was modelled in the mitigation and ambitious mitigation scenarios, using a different set of assumptions regarding the share of hybrid and EV sales, as described in Table 137 below. The resulting share in the total stock of vehicles is also indicated.

Table 137: Assumptions for mitigation actions related to the electrification of vehicles

Scenario	**Description**	**Baseline**	**Mitigation**	**Ambitious mitigation**
Share of sales of EVs in 2030	Increase sales of electric vehicles to 35% and hybrid vehicles to 15% by 2030	3.8%	35%	50%
Share sales of hybrids in 2030		3.8%	15%	40%
Resulting share of EVs in total 2030 stock		2%	13%	16%
Resulting share of hybrids in total 2030 stock		2%	5%	11%

In addition to the higher integration of hybrid and electric vehicles, the mitigation assessment also considered the impact of increasing public transport to offset growth in car sales. The main assumptions used to model this mitigation action are described below.

Table 138: Assumptions for public transport mitigation action

Modelled action	Description	Main assumptions
Public transport offsetting growth in cars	Promotion of the use of Public Transport by 2033	- After 2025, the number of private cars will stop growing due to the increased availability of public transport. - Private cars are assumed to drive 14,484 km/vehicle per year and have an average of 1.5 passengers per car. The avoided passenger kilometres from the private cars are assumed to be absorbed by buses with an average occupancy rate of 21 passengers per vehicle and an annual mileage of 40,000 km per vehicle.

4.4.3.1.4. Land Use and Land Use Change and Forestry (LULUCF)

The LEAP model includes the historical non-energy sector emissions from the most recent emissions inventory up to 2018. From 2019 onwards, GDP is used as the key driver to project future emissions for the non-energy subsectors, with the exception of emissions from LULUCF and non-CO_2 sources on land, which are projected to remain constant and waste, which used population as the key driver. The following table describes the main assumptions for the mitigation actions modelled for this sector.

Table 139: Assumptions for mitigation actions in the LULUCF sector

Modelled action	Description and main assumptions
Sustainable management practices	The establishment of a Forestry Estate on 283,750.18 hectares (20% of the total land cover of The Bahamas) comprised of areas to be established as: Conservation Forests (149, 396.99 hectares), Forest Reserves (96,542.61 hectares), and Protected Forests (37,810.58 hectares) on Abaco, Andros, Grand Bahamas and New Providence which will avoid up to 381.151GgCO_2-eq by 2025.
Davis Creek rehabilitation	Reestablishment and rehabilitation of 50 ha of Davis Creek, Andros Ecosystem, which will increase carbon sequestration up to 14.6 GgCO_2e by 2025.
Zero LULUCF emissions by 2045	In the ambitious scenario: sustainable land-use practices will result in zero emissions from the LULUCF sector by 2045.

4.4.3.1.5. IPPU, Agriculture, Waste

There are four (4) mitigation actions for IPPU, Agriculture and Waste Sectors. Due to data constraints in the baseline, these four mitigation actions were not modelled. The Bahamas is working on improvements in their data collection methods and procedures, and it intends to model these mitigation actions for these sectors in coming years.

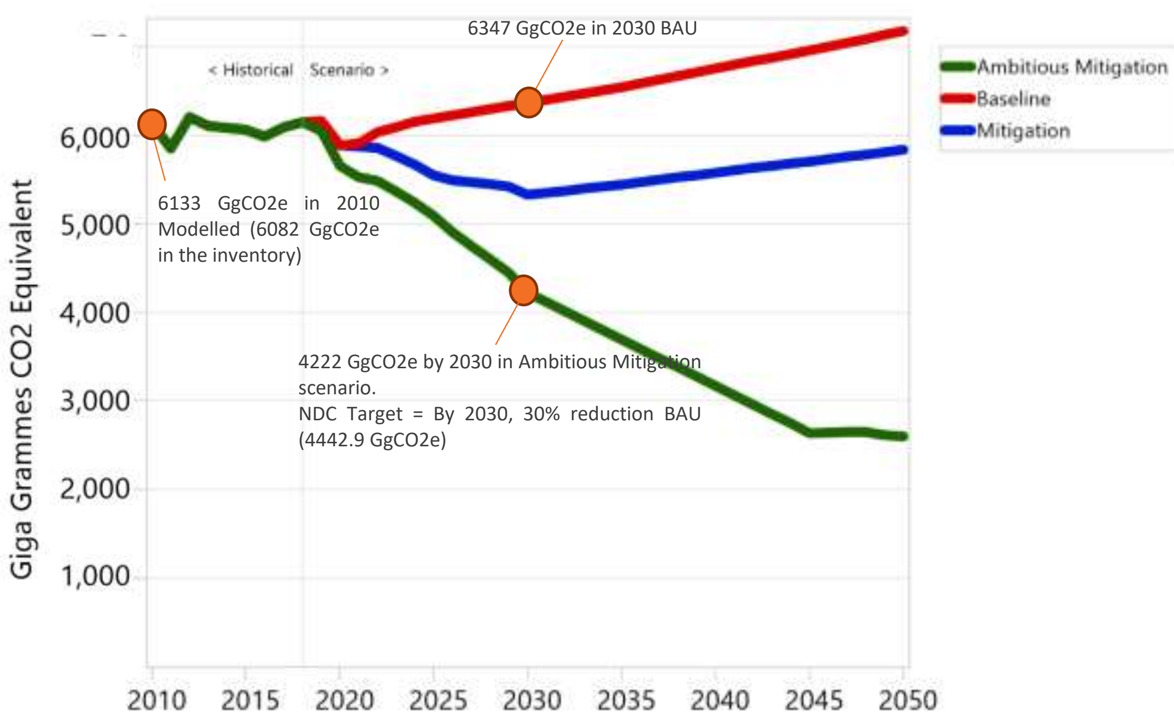
4.4.4. GHG Emission Projection Results

As discussed above, two mitigation scenarios were modelled, which have the same demographic and macroeconomic assumptions as the baseline, and consider a series of mitigation actions as highlighted in 4.2.1.1 - 4.2.1.2, as well as additional measures in order to reach the NDC targets of 30% renewable generation by 2030 (Mitigation scenario) and an economy-wide reduction of GHG emissions of 30% when compared to its Business as Usual (BAU) scenario by 2030 (Ambitious mitigation scenario).

Figure 50 shows the results of the total emissions in the three modelled scenarios, as well as the 2010 emissions[32], 2030 emissions in the baseline and the NDC target for 2030 as reference.

Figure 51 shows the total emissions by sector in 2010, 2030 and 2050 for the three scenarios. Figure 52 shows the current and projected shares of fossil-based and renewable power generation in the three scenarios.

Figure 50: Projected total emissions in The Bahamas under three scenarios



[32] The Bahamas NDC is expressed both as relative to BAU and relative to 2010 baseline emissions

Figure 51*:* Projected total emissions by sector under three scenarios

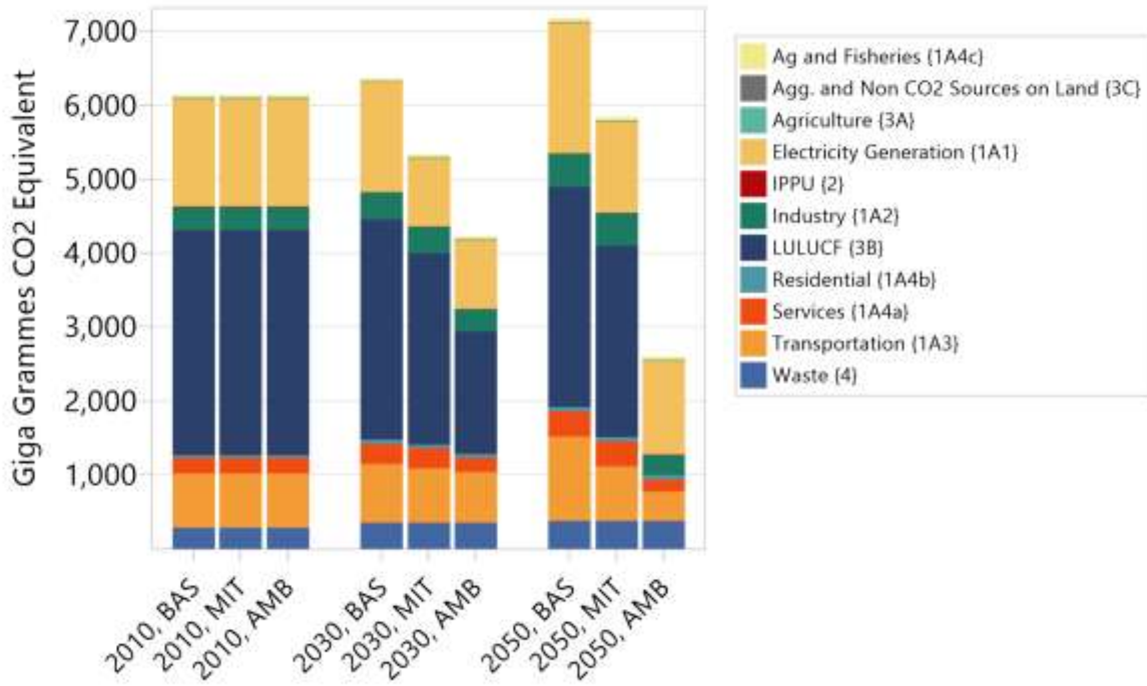
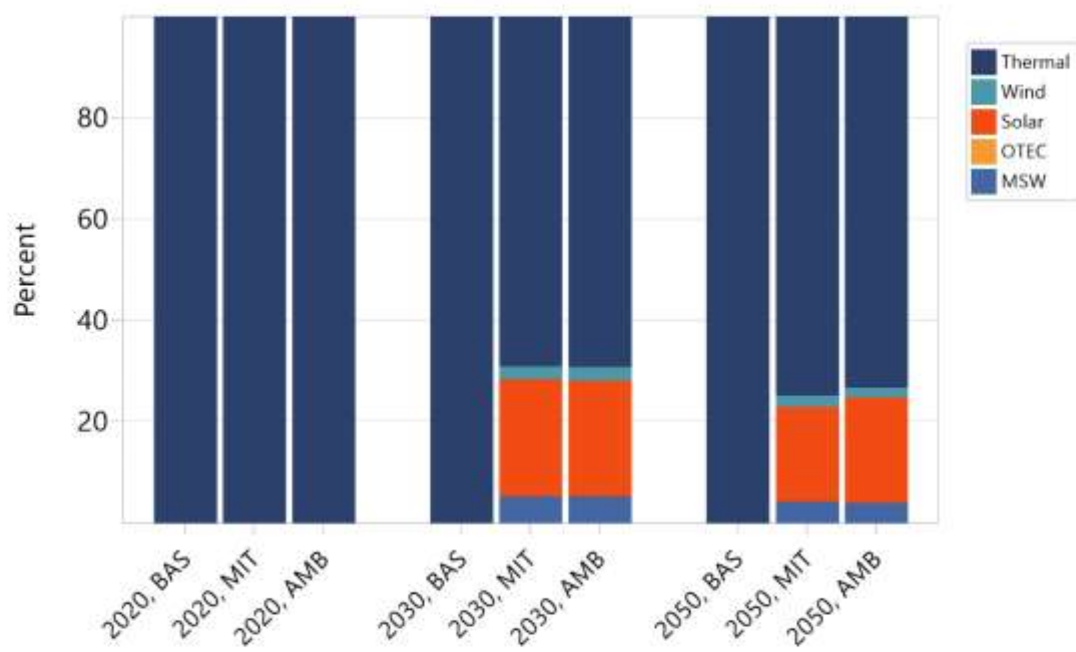
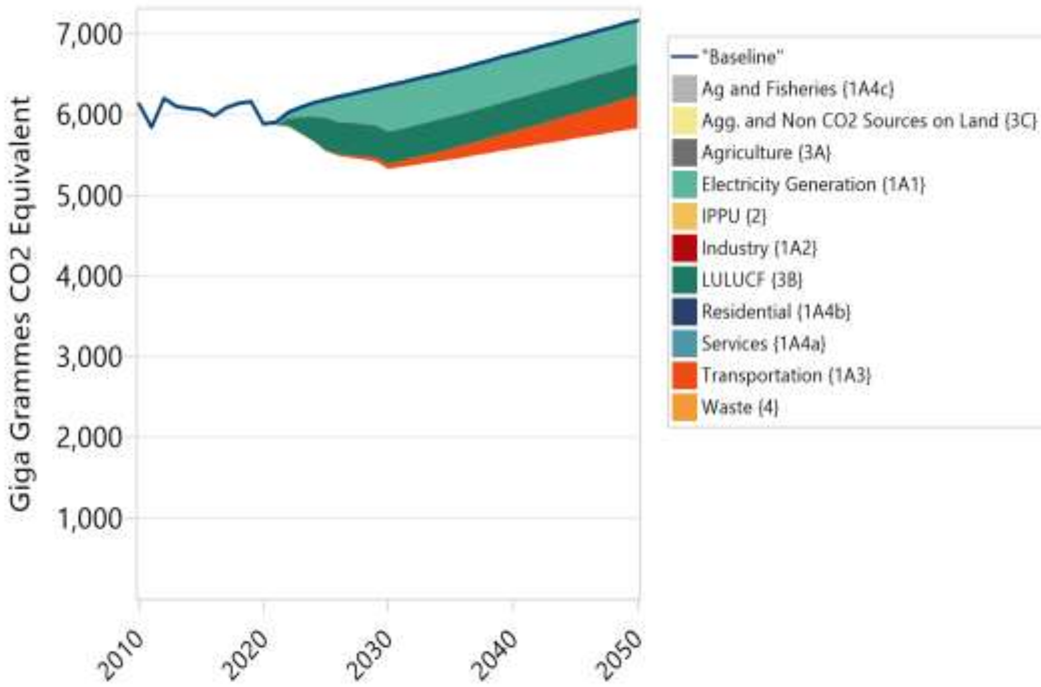


Figure 52*:* Current and projected share of thermal fossil-based and the renewable generation under three scenarios



In the mitigation scenario, the installed renewable capacity by 2030, which includes 174 MW of solar, results in 31% of the total generation coming from renewable sources, therefore meeting the NDC target of 30% renewable generation by 2030. However, in terms of total emissions, the mitigation scenario projects 5,328.8 $GgCO_{2}$-eq by 2030, which corresponds to a 16% reduction from the 2030 baseline value of 6,364.7 $GgCO_{2}$-eq. Therefore, the mitigation actions considered under this scenario are not sufficient to meet the overall target of a 30% reduction by 2030 from the NDC. After 2030, the total emissions in the mitigation scenario continue to increase over time. Figure 53 shows the emission reductions by sector in the mitigation scenario compared to the baseline scenario, where it can be seen that electricity generation is the largest contributor to the mitigation potential, followed by LULUCF and the transport sector.

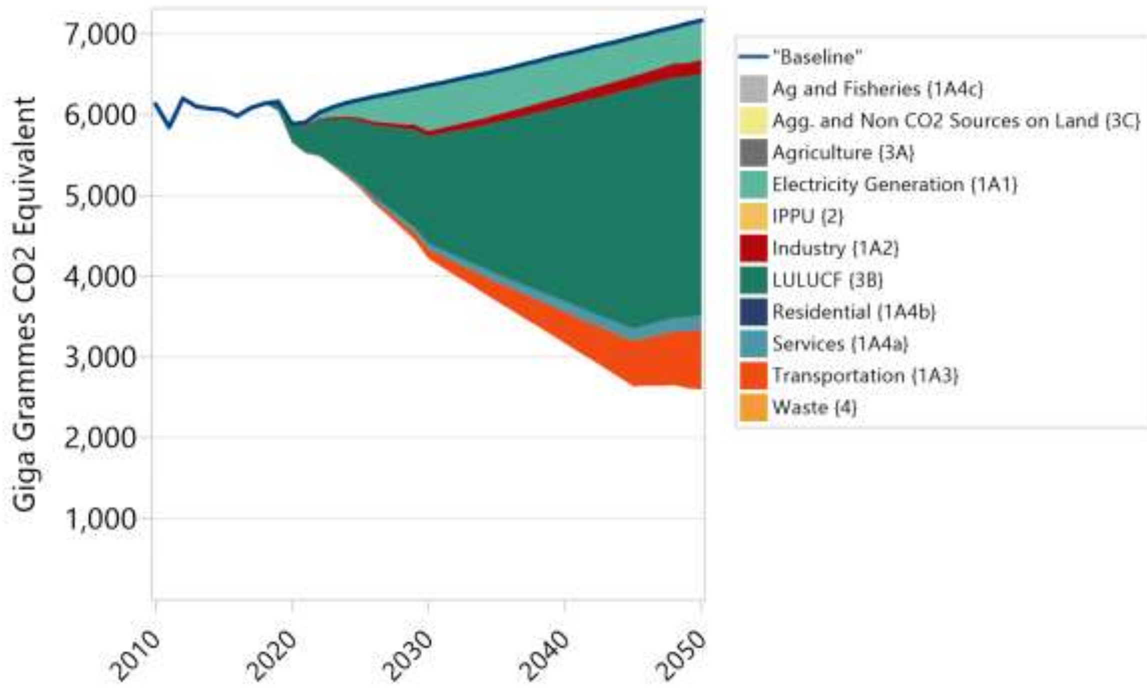
Figure 53: Projected emission reductions by sector in the mitigation scenario compared to the baseline



The ambitious mitigation scenario explores additional measures required to achieve both NDC targets: 30% renewable generation by 2030, and 30% reduction in total GHG emissions in 2030 compared to baseline/BAU value. As described previously, the additional measures include the replacement of diesel generators by PV in the commercial sector, seawater cooling in hotels, energy efficiency in industry, more ambitious electrification of the transport sector, and reaching net-zero emissions from LULUCF by 2045.

Under the ambitious mitigation scenario, total emissions in 2030 reach 4,222.0 $GgCO_2$-eq, corresponding to a 33% reduction compared to BAU values. After 2030, total emissions continue to decrease, reaching 2,598.0 $GgCO_2$-eq in 2050 (63% reduction compared to BAU of 2050). Additionally, 30% of the total electricity generation in 2030 comes from renewable sources. Therefore, this scenario meets the two mitigation targets from the NDC. From Figure 51 and Figure 54, it can be observed that reaching net-zero emissions in the LULUCF sector plays a major role in achieving the NDC targets.

Figure 54: Projected emission reductions by sector in the ambitious mitigation scenario compared to the baseline



4.4.4.1. Summary of GHG Reductions

For reference purposes, Figure 55 shows the difference in total direct GHG emissions that result from the individual implementation of each one of the modelled measures by 2030 compared to the baseline scenario.

Table 140 shows the total net mitigation by measure for 2030 and 2050. Although these results provide an overview of the magnitude of mitigation potential from each measure, it should be noted that interactions exist between measures, so the mitigation that results from implementing multiple measures may not necessarily be the sum of those individual measures. For example, when considered alone, the electrification of vehicles results in an increase in emissions from the power generation sector and a reduction in emissions from the transport sector due to the higher efficiency of electric vehicles compared to internal combustion engines (ICEs). Even though the net result is lower emissions than in the baseline, the overall mitigation potential is very limited if the electricity generation continues to be entirely based on fossil fuels. However, if the electrification of vehicles were to be implemented in parallel to increasing the share of renewables in the power generation sector, the mitigation potential would be significantly augmented.

Figure 55: Emission differences that result from the individual implementation of each modelled action in 2030 compared to the baseline

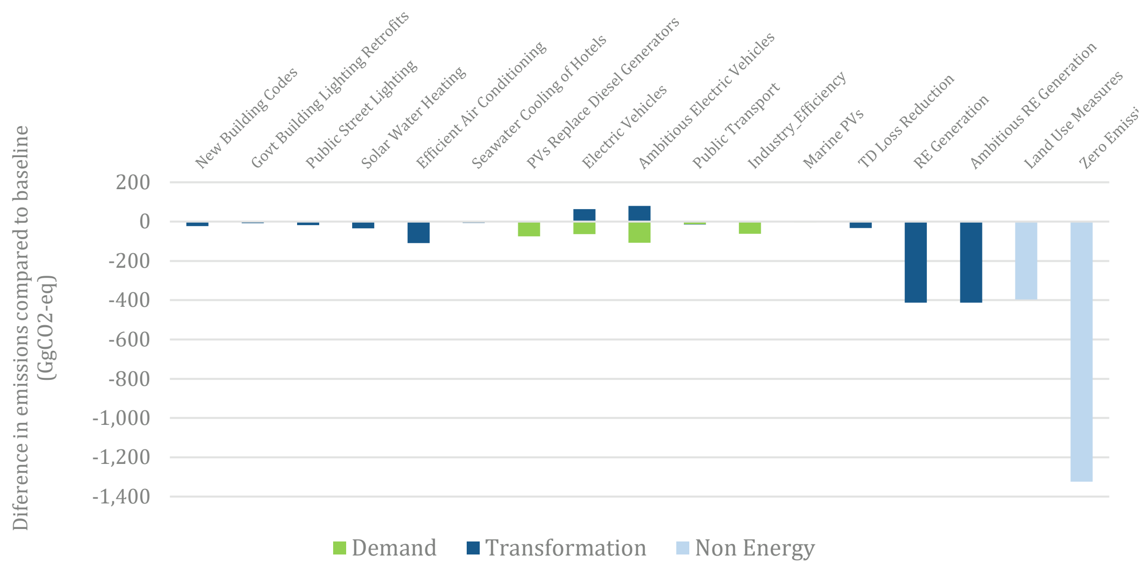


Table 140: Avoided emissions from the individual implementation of each modelled action compared to the baseline

Sector	Mitigation action	Avoided emissions compared to baseline (GgCO₂e avoided)	
		2030	2050
Energy demand in Residential, commercial and services sectors	New Building Codes	-22.6	-22.6
	Govt Building Lighting Retrofits	-8.2	-8.2
	Public Street Lighting	-18.5	-18.4
	Solar Water Heating	-34.5	-64.0
	Efficient Air Conditioning	-109.6	-145.8
	Seawater Cooling of Hotels	-6.2	-15.4
	PVs Replace Diesel Generators	-74.6	-177.6
	Energy Audits & Implementation of improve energy intensity	-61.3	-175.2
Transport	Electric Vehicles	-1.1	-195.2
	Ambitious Electric Vehicles	-29.0	-361.0
	Public Transport	-12.9	-123.6
	Marine PVs	-3.5	-3.5
Power generation	TD Loss Reduction	-32.4	-74.9
	RE Generation	-412.6	-412.6

Sector	Mitigation action	Avoided emissions compared to baseline ($GgCO_2e$ avoided)	
		2030	2050
	Ambitious RE Generation	-412.6	-429.4
LULUCF	Land Use Measures	-395.7	-395.7
	Zero Emissions from Land Use	-1,324.0	-2,979.1

4.5. Barriers and Challenges to Implementation and Methods to Improve The Modelling

A summary of the main barriers and challenges to conducting the mitigation assessment and estimate barriers to the implementation of the mitigation are highlighted below. These barriers were verified during the stakeholder workshop as part of the Mitigation Assessment:

4.5.1. Barriers and Challenges

- Lack of Adequate Data - Data quality and availability were identified as the main challenges throughout the development of the model. Insufficient data will result in limited accuracy in the modelling and also create major challenges for monitoring, verification and reporting in the future.
- Willingness to supply data to relevant authorities. This creates a lack of transparency, and it is closely aligned to the issues noted in the first bullet point.
- Political Will – Implementing mitigation actions requires broad political support and effective planning to maximise opportunities. Therefore, it is essential that sensitisation and education of high-level decision-makers to the climate change needs are sustained.
- Weak Governance – Although the mitigation actions are clearly identified under separate sectors, the Governance of some of these actions are not always clearly defined across Ministries and Departments. It is important that coordination through the National Climate Change Committee, which consist of people from various ministries are continued to minimise this challenge.
- High Capital Costs – Renewable Energy Initiatives normally require high capital costs. Although The Bahamas is considered a high-income country, the unique challenges of SIDS need to be taken into consideration. It is essential that access to climate finance grants and low-interest loans be made available to SIDS to help reduce the costs of implementation.
- Technology Suitability/Availability – The Bahamas, in its mitigation assessment, have proposed some common technologies and others that are still in their infancy. In addition, The Bahamas archipelago is vast and therefore, it is essential that studies and testing be conducted in various regions in The Bahamas to identify the

most suitable technology for each territory based on national circumstances. Furthermore, it is essential that capacity building in the suitable technologies be conducted for the sustainability of implementation.

- Natural Disasters – The Bahamas lies within the tropical belt and is the direct path of hurricanes and tropical storms, with the latest being Nicole (2022), Isaias (2020), Dorian (2019), Irma (2017), Matthew (2016). Hurricane Dorian was the strongest to hit The Bahamas, causing major destruction not only to livelihood but to the forested areas. With increasing global warming, it is expected that extreme weather events will become more frequent and intensify. This creates a major challenge for the implementation of the mitigation action of net zero emissions in the LULUCF sector by 2045. Major efforts are required by the Forestry Unit to monitor effects from natural disasters versus human-induced deforestation to distinguish between the two activities.
- Land Availability – The Bahamas has limited surface area and therefore, there is a need to balance the enhancement and protection of the LULUCF sector as well as increasing renewable energy penetration through the installation of solar PV systems. Land-use zoning and innovative use of solar PV systems will be of critical importance.

4.5.2. Key Needs for Improving Modelling

- Improvement in data collection, having more disaggregated and updated data for energy consumption and production in The Bahamas would allow for more detailed modelling of the energy sector and its GHG emissions. This would create a more transparent assessment of mitigation actions in this sector, which for the purpose of this study were mainly estimated outside of the main modelling framework.
- Assessment of data transparency issues and development of agreements to facilitate data sharing among institutions, for example, by anonymizing data (e.g. sharing semi-aggregate information by power plant type instead of by individual facilities so that interests of private companies are protected while also contributing to the public knowledge).
- Improvement in the baseline projections for the LULUCF sector. Better data collection in the LULUCF sector will allow for improvement in the assessments of the trends and the baseline emissions for the LULUCF sector.
- The LEAP model can be a useful tool for monitoring the implementation of projects. Therefore, further examination of the model needs to be conducted and adequately skilled persons identified for monitoring the implementations projects and updating the LEAP model.

Chapter 5 – Constraints, gaps and related financial, technical and capacity needs, including information on support received for preparation and submission on BUR

5.1. Constraints, gaps, and prioritized needs

In its previous submissions to the UNFCCC (FNC, SNC, and NDC), The Bahamas has identified data gaps and transparency issues that have hindered complete and accurate reporting. Lack of timely improvement and the detailed modalities, procedures, and guidelines (MPGs) that elaborate the enhanced reporting requirements under the ETF has guided the Government of The Bahamas to identify the following during the TNC/BUR1 reporting process:

- Constraints and gaps in GHG inventory, mitigation, adaptation, and climate finance reporting
- Prioritised needs and improvements to facilitate improved reporting for future cycles in adherence with the TACCC principles

The following Table 141 and Table 142 provides a summary of observed constraints and gaps provided by the relevant compilation teams and validated by in-country stakeholders as well as identified prioritised needs.

Table 141: Constraints and gaps by reporting type

Reporting Type	Constraints and gaps observed during TNC/BUR1 reporting process
GHG Inventory	**Lack of adequate data** – Data quality and availability from national sources for key emitting sectors were main challenges for estimating emissions and removals for this GHG inventory. **Limited coordination for GHG inventory cycle** – The institutional and legal arrangements for coordinating timely GHG Inventory reports was noted as a limiting factor in this reporting cycle, while noting that efforts have been made to identify roles and responsibilities of coordinating entity, data providers, and sector experts. **Capacity constraints in applying GHG inventory methodologies** – The lack of technical capacity was noted and affected the overall flow of information from data collection, to emissions estimations, and then to reporting.

	Limited understanding of all GHG emitting activities in the country – A clear understanding of all emitting categories was difficult to determine during the data collection process, however as capacity increases in understanding the scope and necessity of reporting, this is expected to improve. **Lack of archiving from previous reporting cycles** – The data, methods, and calculations from previous GHG Inventories has not been successfully documented, requiring all new efforts to source historical data for its time series
Mitigation	**Lack of adequate data** - Data quality and availability were identified as the main challenges throughout the development of the model. Insufficient data will result in limited accuracy in the modelling and also create major challenges for monitoring, verification and reporting in the future. **Willingness to supply data** to relevant authorities which creates a lack of transparency. **Intra-ministerial coordination and communication** - Although the mitigation actions are clearly identified under separate sectors, the Governance of some of these actions were not always clearly defined across Ministries and Departments. It is important that continued efforts of coordination through the National Climate Change Committee, which consist of persons from various ministries to minimise this challenge. **High capital costs** – Renewable energy initiatives normally require high capital costs. Although The Bahamas is considered a high-income country, the unique challenges of SIDS need to be taken into consideration. It is essential that access to climate finance grants and low-interest loans be made available to SIDS to help reduce the costs of implementation.

	Technology suitability/availability – The Bahamas, in its mitigation assessment, have proposed some common technologies and others that are still in their infancy. In addition, The Bahamas archipelago is vast and therefore, it is essential that studies and testing be conducted in various regions in The Bahamas to identify what is most suitable for each territory based on national circumstance. In addition, capacity building in the technologies identified as most suitable is important for the sustainability of implementation. **Data transparency issues** – There is a lack of development and implementation of agreements to facilitate data sharing among institutions.
Adaptation	**Stakeholders with technical capacity constraints,** both in terms of human resource numbers, and ability to meet the technical demands for consistent V&A reporting. **Intra-organizational/inter-organization coordination and communication** - Lack of coordination across ministries, local government, private sector, academia, NGOs and other stakeholders who participate in climate change actions across all sectors. **Lack of regulatory framework to support and promote** V&A data collection, tracking, monitoring, reporting and dissemination, resulting in gap in data and knowledge needed to inform policy and decision making **Lack of key equipment** to support V&A MRV due to high costs for procurement, implementation and ongoing use, supply chain matters, etc. **Lack of adequate data** - Data quality and availability were identified as a challenge throughout the development of impact chains/models **High capital costs** – Adaptation initiatives can cost even more than mitigation initiatives to implement. With The Bahamas classification as a high-income country is a major barrier in access to capital, therefore, its unique

	challenges of SIDS need to be taken into consideration. It is essential that access to climate finance grants and low-interest loans be made available to SIDS to help reduce the costs of implementation.
MRV Assessment	**Intra-organizational coordination and communication** - Lack of coordination across ministries, local government, private sector, and other stakeholders who participate in climate change actions across all sectors. **Need for greater public awareness** around climate change initiatives through planned education and awareness campaigns from primary education to broader public awareness campaigns. **Limited staff**, particularly full-time staff, to keep up with the demands of new national commitments for enhancing national climate MRV systems, and other related permanent functions such as participation in National GHG Inventory preparation, tracking of NDC goals, gender experts, climate support tracking. **Lack of adequate funding** to implement climate goals and monitor execution in the medium to long term. **Limited legislation or compliance mechanisms** in place to mandate the execution and continuity of climate related activities that are internationally binding (reporting under the Paris Agreement, Montreal Protocol, etc.) **Stakeholder hesitation** in participation in meeting nationally determined climate change goals as a result of limited incentives offered to the private sector and other significant stakeholders. **Difficulty in collecting data** and reporting across all sectors, as data is not collected for the purpose of reporting on climate change indicators

Table 142: Identified prioritized needs by reporting type

Reporting Type	Prioritised Needs identified during TNC/BUR1 reporting process
GHG Inventory	Set up appropriate institutional, procedural, legal arrangements, and documentation for recurring preparation of the national GHG inventory. Appoint a national GHG inventory compilation team. Fully establish and implement QA/QC procedures for the national GHG inventory. Fully establish data collection and archiving procedures for the national GHG inventory.
Adaptation	Assessment of data transparency issues and development of agreements to facilitate data sharing among institutions Improve intersectoral linkages between sectors (public and private) to avoid duplication of efforts, this will help to take advantage of common challenges and opportunities: i.e. improvement in data collection, disaggregation, usefulness, and implementation of adaptation initiatives Training and increased capacity of individuals across agencies, particularly those highlighted in priority adaptation areas, to ensure they understand role in the national (cyclical) adaptation MRV process, and support future reporting efforts Advancing a national climate research agenda to support the availability of recent (up-to-date) data is available for modelling and adaptation MRV purposes Enhanced legislative agenda, including regulations and policies for land use and conservation to improve efficacy in planned adaptation interventions
Mitigation	Improvement in data collection, having more disaggregated and updated data for energy consumption and production in The Bahamas would allow for more detailed modelling of the energy sector and its GHG emissions. This would create a more transparent assessment of mitigation actions in this sector, which for the purpose of this study were mainly estimated outside of the main modelling framework. Assessment of data transparency issues and development of agreements to facilitate data sharing among institutions,

	for example, by anonymizing data (e.g. sharing semi-aggregate information by power plant type instead of by individual facilities so that interests of private companies are protected while also contributing to the public knowledge). Improvement in the baseline projections for the LULUCF sector. Better data collection in the LULUCF sector will allow for improvement in the assessments of the trends and the baseline emissions for the LULUCF sector. The LEAP model can be a useful tool for monitoring the implementation of projects. Therefore, further examination of the model needs to be conducted and adequately skilled persons identified for monitoring the implementations projects and updating the LEAP model.
MRV Assessment	Ensure that all relevant government agencies are involved in the inventory process. Initiate appropriate legislation to facilitate access to data and data collection. Contact the main industries in the country and open a communication channel for data collection/exchange, considering the confidentiality option. Establish a process to ensure a common understanding of data needs and a consensus on data to use. Organise enough joint meetings between all parties to ensure a good and common understanding of the data needs and communication throughout the inventory process. Produce meeting reports explaining the objectives and the conclusions and include a link in the NIR as a reference of these activities. Set up a national inventory management system, that includes the procedural arrangements to produce the inventory in timely manner.

	Set up a National GHG Inventory Management System, that includes legal arrangements for inventory planning, preparation, and management.

5.2.1. Progress towards addressing constraints and gaps

The Bahamas has made progress towards addressing constraints and gaps since submission of its SNC (See Table 143). The identified next steps for the future reporting cycle provide an overview of the outstanding needs for human resource development, research, monitoring and evaluation, technology transfer, and broader domestic MRV system infrastructure development.

Table 143: Progress made from SNC to TNC

Gaps identified in SNC	Progress identified during TNC/BUR1	Identified next steps for future reporting cycle
High Capital Costs/ Lack of access to funding	Scoping and set-up of initial framework for climate finance MRV though the GCF Readiness and Support Programme to improve transparency in reporting and improve chances of climate funding	Building on the outputs of the MRV GCF Readiness project- The Bahamas will continue to address data gaps in financial flows and address barriers outlined in the feasibility study produced as an output.
Lack of Awareness/knowledge and skills	Capacity building activities undertaken by local stakeholders in the fields of GHG inventory, mitigation and MRV	Continuation of planned capacity building within the scope of persons identified for GHG, Mitigation, Adaptation and Finance technical working groups
Availability and Suitability of Technology	Conducting country driven Technology Needs Assessment (TNA) in prioritised sectors	Implement action plan of the TNA based on final outputs (2023 completion)
Applicable laws and regulation to allow for IPPs	-	Conduct analysis of current legislation and policies through CBIT and use recommendation for drafting of new policies that mandate the execution and continuity of climate-

		related institutional arrangements and activities that are internationally binding.
Lack of incentives	-	-
Data gaps in particularly the transport sector	Identified and engaged key stakeholders in the transportation sector, and identified main data sources for improvement	Bottom-up data collection activities through customs, licensing, and fuel providers
Establishing a measurement, reporting and verification (MRV) mitigation system for The Bahamas	Conducted an MRV Assessment during the TNC/BUR1 reporting cycle and indicated prioritised actions to implement an integrated National MRV System comprising all reporting sectors	Set up an integrated National MRV System comprising all reporting sectors, that includes legal arrangements for inventory planning, preparation, and management.
Updating of the information relevant for the reporting on Mitigation actions.	Scoping of potential mitigation actions as well as compilation into a mitigation action database	Improvements in data collection and archiving system to capture historic and current mitigation activities, including a monitoring system for tracking of mitigation actions
Provision of training to build or improve the capacities of the relevant stakeholders to complete all or portions of the research, assessments, studies, inventories, and any other capacities required for reporting requirements taking into consideration the new	Capacity building activities undertaken by local stakeholders in the fields of GHG inventory, mitigation and MRV. Stakeholders were trained not just in technical elements of the reporting requirements but procedural elements as well to increase institutionalised memory of local stakeholders/experts	Continued capacity building training of relevant stakeholders involved in the TNC/BUR1 compilation and review process.

reporting requirements
of the Paris Agreement.

5.2. Technology needs

The Technology Needs Assessment (TNA) is a country-driven process that allows the unique opportunity for Parties to track their needs for new technologies, capacity building, skills, and equipment necessary to reduce the vulnerability of sectors and livelihoods attributed to climate change as well as to mitigate GHG emissions. The assessment facilitates the implementation of prioritised climate technologies as well as sustainable development through a portfolio of environmentally sustainable technology (EST) projects and programmes.

Cognisant of these benefits as well as the support provided through the process to implement a Party's commitment to the Paris Agreement and revision of NDCs (Phase IV), the Government of The Bahamas submitted its endorsement letter to the GEF in October 2019 for inclusion in the latest project phase.

As highlighted in its first NDC, The Bahamas has identified potential adaptation actions in the sectors of agriculture, tourism, health and water resource management as well as the commitment through mitigation actions to reduce its GHG emissions by 30% when compared to its Business as Usual (BAU) scenario by 2030.

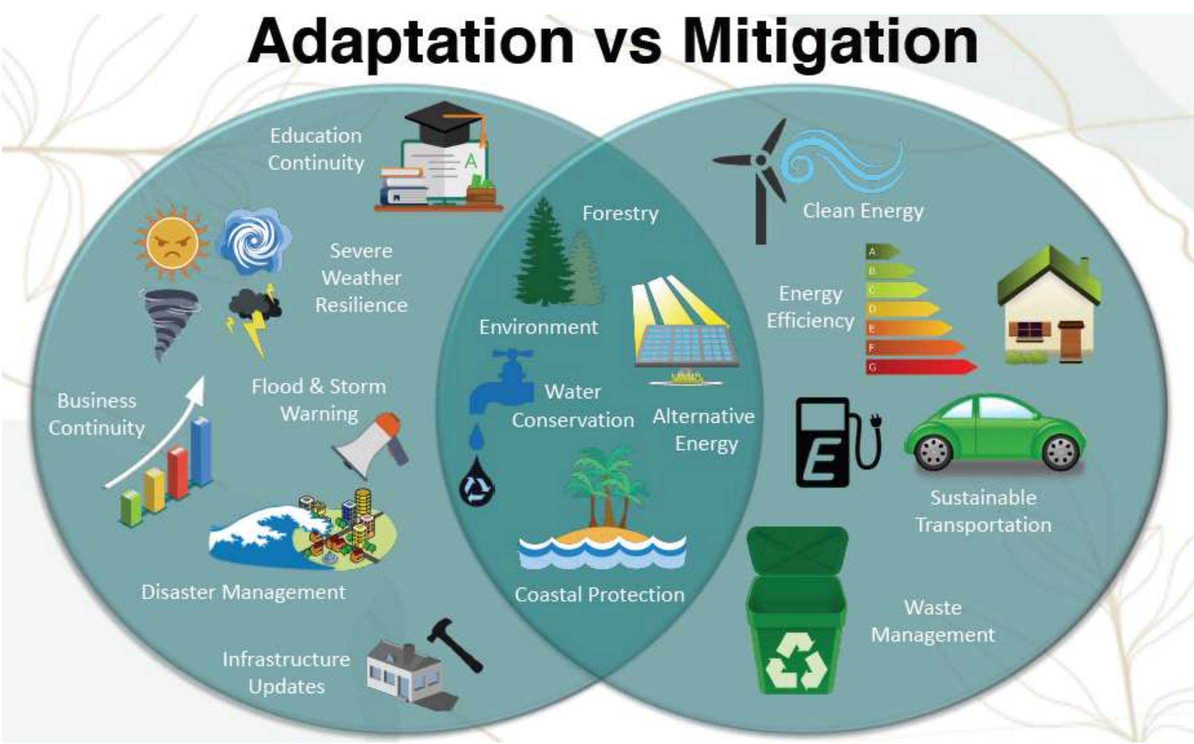
To achieve these goals, The Bahamas will require external support I the forms of investment, finance, capacity building and technology development and transfer in its efforts to prioritise greater implementation of renewable energy sources and to adapt to the negative impacts of climate change. The Bahamas TNA process started in October 2020 and is scheduled to be completed by 2023 with activities being conducted simultaneously with the TNC/BUR1 reporting process.

During the initial activities of the assessment, The Bahamas conducted multi-criteria analysis, reviewed existing planning documents, and engaged stakeholders to prioritise specific sectors to identify technologies for market analysis and eventual inclusion in the National Technology Action Plan (output). Rationale for the chosen sectors as presented by the Bahamas are highlighted in Table 144 and displayed within Figure 56 as an illustration of the integrated nature of intended adaptation and mitigation measures.

Table 144: Rationale for chosen priority areas (as presented during TNA inception workshop)

Identified Priority Area	Rationale
Waste (Mitigation)	One of the largest sources of GHG emissions in the country, probability to increase after climate disasters, need to upscale interventions (especially in an island context)
Forestry (Mitigation)	Significant GHG sink, under threat from climate change and destructive human activities
Meteorology (Adaptation)	Need for accurate forecasting for protection of population and adaptation planning
Education (Adaptation)	Climate change (including disasters) have significantly interrupted the formal education sector, public education and outreach required to enhance climate action

Figure 56: Integrated nature of adaptation and mitigation measures



Through the inception workshop and accompanying stakeholder surveys, The Bahamas formed both adaptation and mitigation working groups that include government public entities, private entities, and academia (gender balanced). Based on SNC submissions, and other key national climate documents, Table 145 through Table 148 are the initial list of technologies under consideration for analysis and review by conducting country interviews and utilizing expert judgement by the aforementioned working groups. It should be noted that due to the stage reached in the assessment process and at the time of writing, the initial lists presented are not exhaustive and may be revised or adapted in future reporting cycles according to the final outputs of the completed TNA process.

Table 145: Initial working group technologies list for Meteorology (Adaptation)

Identified Technology	Specific Name of Technology (If known)	Orgware/Software/Hardware
Coastal Mapping	Lidar Survey	Hardware
Storm Surge Mapping	Lidar Survey	Hardware
Land Survey	Lidar Survey	Hardware
Flood Hazard Mapping	Lidar Survey SLOSH: Sea Lake and Overland Surges from Hurricanes	Hardware
Flood Warning System	-	Orgware
Forecasting and early warning systems	-	Hardware/Orgware
Climate Modelling with Machine Learning/Deep Learning	Python	Software
Climate Forecasting with Machine Learning/Deep Learning	Python	Software
Severe Weather Monitoring and Data Collection	Lightening detector	Hardware/Software
Open water weather monitoring	Fixed weather buoys and drifting weather buoys	Hardware
Air Quality Monitoring	Air pollution Sensor	Hardware
Automatic Weather Stations	-	Hardware/Software
Precipitation Monitoring	Optical and acoustic rain gauge	Hardware
Tide Monitoring	Tide Gauge	Hardware

Table 146: Initial working group technologies list for Education (Adaptation)

Identified Technology	Orgware/Software/Hardware
Trauma Support Programmes	Orgware/Software

Infrastructure Assessment and Upgrades	Orgware/Software
Wireless Network	Orgware/Software
Alternative Energy- Solar	Orgware/Software/Hardware
Rainwater Harvesting and Distribution Systems	Orgware/Software/Hardware
Solar Water Heating	Orgware/Software/Hardware
Curriculum: National adoption of swimming programme	Orgware
Curriculum: Assessment, enhancement of Disaster Preparedness Programme	Orgware/Software
Curriculum: Inclusion of Meteorology, Oceanography, Environmental Studies at undergrad and graduate level	Orgware/Software
Curriculum: Assessment and expansion/enhancement of climate change programmes at the primary and secondary school level	Orgware/Software

Table 147: Initial working group technologies list for waste (Mitigation)

Identified Technology	Orgware/Software/Hardware
Sargassum Seaweed Reuse/Disposal - sustainable Livelihood project	Hardware/Software
Conch Shell Reuse/Disposal - sustainable livelihood project	Hardware/Software
Landfill disposal	Hardware
Waste-energy Technology	Hardware
Waste Incineration	Hardware
Waste Biological Treatment bio-digestor	Hardware
Effluent disposal methods - deep disposal well regulations	Hardware/Software
Alternatives to Cultural Waste Burial/ Open Burn Methods	Software/Orgware
Composting of Organic Waste	Hardware

Table 148: Initial working group technologies list for forestry and other land use (Mitigation)

Identified Technology	Orgware/Software/Hardware
Develop Protection and conservation methods	Orgware/Software
Sustainable Management of the Resources	Software
Forest Restoration Efforts	Hardware/Software
Wood based bio-energy technology	Hardware
Alternative land/property development clearing	Hardware/Software
Tree ordinance/ Replant Initiatives	Orgware/Software
Programme of work relating to ecosystem management	Orgware/Software
National Forestry Estate- Forest Reserves, Protected Forests, and conservation of forests	Software
Sustainable Livelihoods Pilot Projects - indigenous craft industry on Andros and Cascarilla Bark Cultivation/ Processing of Cascarilla Oil in Acklins/ Crooked Islands	Hardware/Software
Management Regime for ecologically important watersheds	Orgware/Software

5.3. Support needed

An assessment and quantification of support needed has not yet been conducted for the prioritized needs identified during the TNC/BUR1 reporting cycle for The Bahamas. Across all areas of climate MRV in The Bahamas, technology transfer, capacity-building, and financial support is needed as soon as possible.

5.4. Support received

As highlighted in the climate finance section of the domestic MRV chapter, The Bahamas through the GCF Readiness and Preparatory Support Programme, engaged in a project to develop a national database system for the MRV of financial investments with specific emphasis on identified actions in the Party's NDC.

Previous reporting and analysis of relevant climate change documents in The Bahamas indicated that there was no clear indication of climate finance inflows as this data was previously collected on a project-by-project basis in an ad-hoc manner. Priority was given to the following tasks in an effort to track historical data flows and provide a baseline for future climate finance reporting improvements in adherence to the TACCC principles:

- Clear overview of NDC related financial flows, sources, and purposes
- Indication of the recipients of the financial support and identification of data gaps

After extensive analysis of readily available documentation and a data collection mission in-country (inclusive of stakeholder interviews), The Bahamas was able to provide an initial mapping of climate finance recipients, mobilising entities and support received values (USD) for the time period 2010-2020. It should be noted that due to data gaps from stakeholders as well as the need to improve on the outputs of the project, that the information provided in Table 149 **through** Table 152 has not yet been validated and will be improved upon in future reporting cycles. Financial information by year was also not readily available and the project team was not able to disaggregate the total figures for the timeseries on a year-by-year basis.

Table 149 provides the sources of climate funds disaggregated by global and regional support as well as multilateral, bilateral, international NGO, and private sector funding.

Table 149: Sources of climate funding disaggregated by region and type (2010-2020)

Type		Name of Institution
Global	Multilateral	United Nations Development Programme (UNDP) (own funds and GEF funds) United Nations Environment (own funds and GEF and GCF funds) Food and Agriculture Organisation of the United Nations (FAO) International Fund for Agricultural Development (IFAD) World Health Organisation (WHO) through the Pan-American Health Organisation (PAHO) United Nations Industrial Development Organization (UNIDO) World Bank (WB) International Finance Corporation (IFC) World Meteorological Organisation (WMO) Global Environment Facility (GEF) Small Grants Programme (SGP) Bahamas Green Climate Fund (GCF) European Investment Bank (EIB)
		Japanese International Cooperation Agency (JICA)

Type		Name of Institution
Global	Bilateral	German Development Bank (KfW) German Development Agency (GIZ) United Kingdom's Department for International Development (DFID) United States Agency for International Development (USAID) Government of Italy Government of the United Arab Emirates
Global	International NGO	International Union for the Conservation of Nature (IUCN)
Global	Private Sector	US-based foundations Bahamas Chamber of Commerce and Employers' Confederation (BCCEC) Bahamas Hotel and Tourism Association (BHTA) Grand Bahama Power Company St. Georges Cay Power Company Ltd. Bahama Solar Sustainable Energy Ltd. Green Revolution Green Bahamas Company Ltd. Bahamas Energy Solutions Enviro Technologies Ltd.
Regional	Multilateral	Inter-American Development Bank (IDB) Caribbean Development Bank (CDB) Caribbean Community Climate Change Centre (5Cs) (own funds and GCF funds) Caribbean Community (CARICOM) Organization of American States (OAS) Economic Commission for Latin America and the Caribbean (ECLAC)
Regional	International NGO	Inter-American Institute for Cooperation on Agriculture (IICA)

Table 150 provides a summary of the financial inflows based on the disaggregated information available in Table 149. Values for private-sector financing have been removed from global support as there was insufficient information to include in the global support totals with GEF and GCF funds currently accounted for under UNDP and UNEP categorisations.

Table 150: Summary of The Bahamas climate finance inflows (2010-2020)

Sources				
Scale	**Type**	**Sum of Total**	**Sum of Adaptation**	**Sum of Mitigation**
Global	Bilateral	$ -	$ -	$ -
	International NGO	$ 50,000	$ 25,000	$ 25,000
	Multilateral	$ 96,136,919	$ 1,615,311	$ 94,521,609
Global Total		**$ 96,186,919**	**$ 1,640,311**	**$ 94,546,609**
Regional	International NGO	$ 247,911	$ 92,842	$ 155,069
	Multilateral	$ 7,348,754	$ 2,074,655	$ 5,274,100
Regional Total		**$ 7,596,665**	**$ 2,167,496**	**$ 5,429,169**
Domestic	Private sector	**$ 51,249,999**	**$ 10,400,000**	**$ 40,849,999**
Overall Total		**$ 155,033,583**	**$ 14,207,807**	**$ 140,825,777**

Table 151 and Table 152 provide the institutions that mobilise resources from international climate change funds in The Bahamas.

Table 151: Mobilising entities in The Bahamas (2010-2020)

Type of Institution	Name of Institution
Global / Multilateral / United Nations	United Nations Development Programme (UNDP) United Nations Environment Food and Agriculture Organisation of the United Nations (FAO) International Fund for Agricultural Development (IFAD) World Health Organisation (WHO) through the Pan-American Health Organisation (PAHO) United Nations Industrial Development Organization (UNIDO)
Regional	Caribbean Community Climate Change Centre
National	Ministry Of Environment and Housing

Table 152: Financial flows disaggregated by mobilising entity (2010-2020)

Entity Mobilising Funds			
Name of Institution	**Total**	**Adaptation**	**Mitigation**
United Nations Development Programme (UNDP)	$ 9,999,999.00	$ -	$ 9,999,999.00
United Nations Environment	$ 85,296,321.00	$ 800,000.00	$ 84,496,321.00
Food and Agriculture Organisation of the United Nations (FAO)	$ -	$ -	$ -
International Fund for Agricultural Development (IFAD)	$ 1,355.00	$ 1,355.00	$ -
World Health Organisation (WHO) through the Pan-American Health Organisation (PAHO)			$ -
United Nations Industrial Development Organization (UNIDO)	$ -	$ -	$ -
World Meteorological Organisation (WMO)	$ 789,222.00	$ 789,222.00	$ -
Caribbean Community Climate Change Centre (5Cs)	$ 1,163,677.20	$ 1,020,335.80	$ 143,341.40
Ministry of Environment and Housing	$ 56,558,325.00	$ 11,679,162.50	$ 44,879,162.50
Total	$ 153,808,899.20	$ 14,290,075.30	$ 139,518,823.90

5.4.1. Support received for the preparation of BUR1

The Bahamas received multilateral financial support from the GEF in 2019 in the amount of 852,0000 (USD) to develop its first BUR (in addition to its Third National Communication). The funding was administered through the Global Environment Facility (GEF) with the United Nations Environment Programme (UNEP) having the responsibility as the implementing agency, and the Department of Environmental Planning and Protection (formerly known as The Bahamas Environment, Science and Technology (BEST) Commission) serving on behalf of the Government of The Bahamas, as the executing agency. The funding was used to contract the Caribbean Cooperative MRV Hub, Greenhouse Gas Management Institute, SEV Consulting Group, University College London, Factor Integral Services Limited, and two independent consultants. Moreover, the National Project Coordinator and external auditor would have also been contracted with this funding to ensure successful implementation and fiscal management of the BUR1 project.

5.5. Data and information gaps and needs for improvement of reporting

The Government of The Bahamas has prioritised improvements in its climate finance MRV for the next reporting cycle. The financial flow tables presented in this chapter have been presented in an effort to improve transparency in reporting, though the Party is cognisant that more efforts need to be made to comprehensively mapping and validating financial flows to The Bahamas. Furthermore, a list of climate change projects and allocation of support across these projects remains a prioritised improvement for The Bahamas. Improvements in charting public, domestic, international, and private financial flows in The Bahamas is an on-going exercise, noting that understanding these flows facilitates financial planning and resource mobilization to meet The Bahamas' international commitments on climate mitigation and adaptation.

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Annexes: Related to Greenhouse Gas (GHG) Inventories

Annex I - GHG emission tables

Table 153: Total GHG emissions 2001-2010

Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total National Emissions and Removals	5077.85	5157.60	4852.38	4901.25	3640.68	3744.15	3765.39	3832.61	3738.27	5926.03
1 - Energy	2435.21	2512.78	2207.71	2243.39	2407.76	2501.62	2517.49	2583.99	2485.98	2583.91
1.A - Fuel Combustion Activities	2435.20	2512.78	2207.70	2243.38	2407.75	2501.61	2517.48	2583.98	2485.97	2583.90
1.A.1 - Energy Industries	1532.51	1593.82	1217.35	1159.20	1177.49	1223.71	1234.82	1291.91	1200.84	1327.57
1.A.1.a - Main Activity Electricity and Heat Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.i - Electricity Generation	1532.51	1593.82	1217.35	1159.20	1177.49	1223.71	1234.82	1291.91	1200.84	1327.57
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.iii - Heat Plants	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.b - Petroleum Refining	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

1.A.1.c.i - Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c.ii - Other Energy Industries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2 - Manufacturing Industries and Construction	177.18	188.55	187.28	245.98	290.65	279.34	304.83	283.12	288.83	239.32
1.A.2.a - Iron and Steel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b - Non-Ferrous Metals	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c - Chemicals	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d - Pulp, Paper and Print	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.e - Food Processing, Beverages and Tobacco	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.f - Non-Metallic Minerals	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.g - Transport Equipment	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h - Machinery	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.i - Mining (excluding fuels) and Quarrying	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.j - Wood and wood products	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.k - Construction	33.42	35.57	35.52	46.65	55.13	52.99	57.82	53.70	54.80	45.41
1.A.2.l - Textile and Leather	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.m - Non-specified Industry	143.76	152.98	151.76	199.33	235.52	226.35	247.01	229.43	234.04	193.91
1.A.3 - Transport	494.45	504.45	562.57	585.06	621.10	634.05	620.64	627.34	641.82	658.85
1.A.3.a - Civil Aviation	75.79	67.53	75.51	81.90	85.55	90.82	80.99	79.90	67.87	69.87

1.A.3.a.ii - Domestic Aviation	75.79	67.53	75.51	81.90	85.55	90.82	80.99	79.90	67.87	69.87
1.A.3.b - Road Transportation	402.93	420.56	479.88	493.39	524.42	532.94	528.10	536.45	563.54	580.58
1.A.3.b.i - Cars	278.29	285.02	345.83	313.91	309.67	326.41	301.26	327.72	349.22	406.55
1.A.3.b.i.1 - Passenger cars with 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii - Light-duty trucks	83.90	87.60	99.83	102.89	109.50	111.21	110.33	111.95	117.57	120.85
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses	40.52	47.72	33.93	76.34	105.00	95.05	116.26	96.52	96.47	52.85
1.A.3.b.iv - Motorcycles	0.22	0.23	0.28	0.25	0.25	0.26	0.24	0.26	0.28	0.32
1.A.3.b.v - Evaporative emissions from vehicles	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.b.vi - Urea-based catalysts	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.c - Railways	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.d - Water-borne Navigation	15.72	16.35	7.18	9.77	11.13	10.29	11.55	10.99	10.41	8.40

1.A.3.d.i - International water-borne navigation (International bunkers) (1)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.d.ii - Domestic Water-borne Navigation	15.72	16.35	7.18	9.77	11.13	10.29	11.55	10.99	10.41	8.40
1.A.3.e - Other Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e.i - Pipeline Transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.e.ii - Off-road	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1.A.4 - Other Sectors	231.07	225.96	240.50	253.15	318.51	364.50	357.19	381.60	354.47	358.16
1.A.4.a - Commercial/Institutional	184.82	184.85	198.20	197.87	258.36	305.49	293.81	320.30	297.46	304.43
1.A.4.b - Residential	30.17	23.72	24.98	32.53	33.10	33.05	35.02	35.04	30.03	31.58
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	16.08	17.39	17.32	22.75	27.05	25.97	28.36	26.26	26.98	22.15
1.A.5 - Non-Specified	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B - Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1.B.1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 - Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1.B.2.a - Oil	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1.B.2.a.iii.3 - Transport	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1.B.2.b - Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

1.B.3 - Other emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.C - Carbon dioxide Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 - Industrial Processes and Product Use	3.75	8.43	2.84	2.84	3.42	4.17	3.25	3.59	3.09	3.17
2.A - Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.B - Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use (6)	3.75	8.43	2.84	2.84	3.42	4.17	3.25	3.59	3.09	3.17
2.D.1 - Lubricant Use	3.75	8.43	2.84	2.84	3.42	4.17	3.25	3.59	3.09	3.17
2.D.2 - Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.D.3 - Solvent Use (7)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D.4 - Other (please specify) (3), (8)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E - Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.G - Other Product Manufacture and Use	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE
2.G.1 - Electrical Equipment	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE

2.G.1.a - Manufacture of Electrical Equipment	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.G.1.b - Use of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.G.1.c - Disposal of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.G.2 - SF6 and PFCs from Other Product Uses	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.G.3 - N2O from Product Uses	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.G.4 - Other (Please specify) (3)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 - Agriculture, Forestry, and Other Land Use	2393.69	2387.17	2388.73	2397.80	967.73	971.70	973.12	968.57	967.69	3052.16
3.A - Livestock	1.93	3.43	2.82	2.94	2.94	2.82	2.89	2.91	2.91	2.96
3.A.1 - Enteric Fermentation	1.36	2.06	1.51	1.59	1.60	1.48	1.53	1.55	1.56	1.60
3.A.2 - Manure Management	0.58	1.37	1.31	1.34	1.34	1.34	1.35	1.35	1.35	1.36
3.B - Land	2377.60	2377.60	2377.60	2377.60	955.66	955.66	955.66	955.66	955.66	3042.82
3.B.1 - Forest land	-930.54	-930.54	-930.54	-930.54	-1341.03	-1341.03	-1341.03	-1341.03	-1341.03	-1059.49
3.B.1.a - Forest land Remaining Forest land	-361.60	-361.60	-361.60	-361.60	-434.70	-434.70	-434.70	-434.70	-434.70	-527.69

3.B.1.b - Land Converted to Forest land	-568.94	-568.94	-568.94	-568.94	-906.32	-906.32	-906.32	-906.32	-906.32	-531.80
3.B.1.b.i - Cropland converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.ii - Grassland converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iii - Wetlands converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iv - Settlements converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.v - Other Land converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2 - Cropland	380.16	380.16	380.16	380.16	318.55	318.55	318.55	318.55	318.55	146.16
3.B.2.a - Cropland Remaining Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b - Land Converted to Cropland	380.16	380.16	380.16	380.16	318.55	318.55	318.55	318.55	318.55	146.16
3.B.2.b.i - Forest Land converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.ii - Grassland converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.B.2.b.iii - Wetlands converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.iv - Settlements converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.v - Other Land converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3 - Grassland	1750.81	1750.81	1750.81	1750.81	1053.48	1053.48	1053.48	1053.48	1053.48	2599.54
3.B.3.a - Grassland Remaining Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b - Land Converted to Grassland	1750.81	1750.81	1750.81	1750.81	1053.48	1053.48	1053.48	1053.48	1053.48	2599.54
3.B.3.b.i - Forest Land converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.ii - Cropland converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iii - Wetlands converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iv - Settlements converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.v - Other Land converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4 - Wetlands	324.78	324.78	324.78	324.78	302.22	302.22	302.22	302.22	302.22	1103.24

3.B.4.a - Wetlands Remaining Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.i - Peatlands remaining peatlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.ii - Flooded land remaining flooded land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b - Land Converted to Wetlands	324.78	324.78	324.78	324.78	302.22	302.22	302.22	302.22	302.22	1103.24
3.B.4.b.i - Land converted for peat extraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.ii - Land converted to flooded land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.iii - Land converted to other wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5 - Settlements	819.38	819.38	819.38	819.38	598.61	598.61	598.61	598.61	598.61	217.44
3.B.5.a - Settlements Remaining Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b - Land Converted to Settlements	819.38	819.38	819.38	819.38	598.61	598.61	598.61	598.61	598.61	217.44
3.B.5.b.i - Forest Land converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.B.5.b.ii - Cropland converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iii - Grassland converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iv - Wetlands converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.v - Other Land converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6 - Other Land	33.01	33.01	33.01	33.01	23.83	23.83	23.83	23.83	23.83	35.94
3.B.6.a - Other land Remaining Other land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b - Land Converted to Other land	33.01	33.01	33.01	33.01	23.83	23.83	23.83	23.83	23.83	35.94
3.B.6.b.i - Forest Land converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.ii - Cropland converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iii - Grassland converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iv - Wetlands converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.B.6.b.v - Settlements converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate sources and non-CO2 emissions sources on land (2)	14.15	6.14	8.30	17.26	9.13	13.21	14.58	10.01	9.12	6.38
3.C.1 - Emissions from biomass burning	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.C.2 - Liming	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.3 - Urea application	0.05	0.19	0.15	0.23	0.00	1.68	0.04	0.31	1.15	0.69
3.C.4 - Direct N2O Emissions from managed soils (3)	10.51	4.12	5.79	12.49	6.53	8.33	10.61	6.96	5.65	3.93
3.C.5 - Indirect N2O Emissions from managed soils	3.45	1.40	1.92	4.10	2.16	2.75	3.49	2.31	1.88	1.32
3.C.6 - Indirect N2O Emissions from manure management	0.14	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
3.C.7 - Rice cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.8 - Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D - Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.1 - Harvested Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 - Waste	245.20	249.22	253.11	257.22	261.77	266.67	271.52	276.46	281.51	286.79
4.A - Solid Waste Disposal	205.78	209.13	212.62	216.27	220.07	224.02	228.10	232.32	236.62	240.94

4.B - Biological Treatment of Solid Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4.C - Incineration and Open Burning of Waste	1.32	1.34	1.37	1.39	1.42	1.45	1.47	1.50	1.53	1.55
4.C.1 - Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4.C.2 - Open Burning of Waste	1.32	1.34	1.37	1.39	1.42	1.45	1.47	1.50	1.53	1.55
4.D - Wastewater Treatment and Discharge	38.09	38.74	39.12	39.56	40.28	41.20	41.95	42.64	43.37	44.29
4.D.1 - Domestic Wastewaster Treatment and Discharge	38.09	38.74	39.12	39.56	40.28	41.20	41.95	42.64	43.37	44.29
4.D.2 - Industrial Wastewater Treatment and Discharge	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4.E - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items										
1.A.3.a.i - International aviation (International bunkers)	1080.62	1083.8	519.225	626.017	571.601	755.03	915.785	752.082	615.814	609.6922
1.A.3.d.i - International water-borne navigation (International bunkers)	976.426	979.294	469.16	565.655	516.485	682.228	827.483	679.565	556.436	550.9042

Table 154: Total GHG emissions 2011-2018

Categories	2011	2012	2013	2014	2015	2016	2017	2018
Total National Emissions and Removals	5771.82	5902.51	5941.44	6045.44	6053.83	6063.13	6115.05	6264.31
1 - Energy	2427.07	2553.17	2588.42	2686.94	2752.86	2759.77	2805.72	2949.58
1.A - Fuel Combustion Activities	2427.06	2553.16	2588.41	2686.93	2752.85	2759.76	2805.71	2949.56
1.A.1 - Energy Industries	1300.38	1165.09	1156.89	1291.53	1334.40	1383.86	1363.47	1430.77
1.A.1.a - Main Activity Electricity and Heat Production	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.i - Electricity Generation	1300.38	1165.09	1156.89	1291.53	1334.40	1383.86	1363.47	1430.77
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.iii - Heat Plants	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.b - Petroleum Refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	NO	NO	NO	NO	NO	NO	NO	NO

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.A.1.c.i - Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c.ii - Other Energy Industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2 - Manufacturing Industries and Construction	253.17	365.38	335.03	320.99	327.69	309.69	339.29	350.19
1.A.2.a - Iron and Steel	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b - Non-Ferrous Metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c - Chemicals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d - Pulp, Paper and Print	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.e - Food Processing, Beverages and Tobacco	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.f - Non-Metallic Minerals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.g - Transport Equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h - Machinery	NO	NO	NO	NO	NO	NO	NO	NO

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.A.2.i - Mining (excluding fuels) and Quarrying	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.j - Wood and wood products	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.k - Construction	48.07	69.40	63.66	60.98	62.27	58.85	64.50	66.58
1.A.2.l - Textile and Leather	IE	IE	IE	IE	IE	IE	IE	IE
1.A.2.m - Non-specified Industry	205.10	295.98	271.38	260.02	265.42	250.84	274.79	283.62
1.A.3 - Transport	567.16	681.13	639.38	650.10	675.76	654.90	704.57	727.65
1.A.3.a - Civil Aviation	63.46	66.46	54.11	68.51	72.64	67.34	72.24	74.29
1.A.3.a.ii - Domestic Aviation	63.46	66.46	54.11	68.51	72.64	67.34	72.24	74.29
1.A.3.b - Road Transportation	496.56	605.42	577.62	573.70	596.06	580.96	626.36	647.33
1.A.3.b.i - Cars	309.81	333.26	329.69	337.32	355.73	352.70	375.15	390.52
1.A.3.b.i.1 - Passenger cars with 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii - Light-duty trucks	103.59	126.56	120.68	119.80	124.44	121.25	130.75	135.12

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses	82.91	145.34	126.99	116.31	115.62	106.73	120.15	121.38
1.A.3.b.iv - Motorcycles	0.25	0.27	0.26	0.27	0.28	0.28	0.30	0.31
1.A.3.b.v - Evaporative emissions from vehicles	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.b.vi - Urea-based catalysts	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.c - Railways	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.d - Water-borne Navigation	7.14	9.24	7.66	7.89	7.06	6.60	5.97	6.03
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.d.ii - Domestic Water-borne Navigation	7.14	9.24	7.66	7.89	7.06	6.60	5.97	6.03

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.A.3.e - Other Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e.i - Pipeline Transport	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.e.ii - Off-road	IE	IE	IE	IE	IE	IE	IE	IE
1.A.4 - Other Sectors	306.36	341.57	457.11	424.32	415.00	411.31	398.38	440.95
1.A.4.a - Commercial/Institutional	252.08	267.35	383.92	351.62	336.62	342.79	325.55	356.71
1.A.4.b - Residential	30.74	40.13	42.08	43.00	48.18	39.80	41.27	51.98
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	23.53	34.09	31.10	29.70	30.19	28.73	31.56	32.27
1.A.5 - Non-Specified	NO	NO	NO	NO	NO	NO	NO	NO
1.B - Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
1.B.1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 - Oil and Natural Gas	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
1.B.2.a - Oil	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
1.B.2.a.iii.3 - Transport	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
1.B.2.b - Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.B.3 - Other emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO
1.C - Carbon dioxide Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO
2 - Industrial Processes and Product Use	1.42	1.08	1.75	1.00	1.00	1.00	1.17	1.08
2.A - Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO
2.B - Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use (6)	1.42	1.08	1.75	1.00	1.00	1.00	1.17	1.08
2.D.1 - Lubricant Use	1.42	1.08	1.75	1.00	1.00	1.00	1.17	1.08
2.D.2 - Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE
2.D.3 - Solvent Use (7)	NO	NO	NO	NO	NO	NO	NO	NO
2.D.4 - Other (please specify) (3), (8)	NO	NO	NO	NO	NO	NO	NO	NO
2.E - Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NE	NE	NE	NE	NE	NE	NE	NE

Categories	2011	2012	2013	2014	2015	2016	2017	2018
2.G - Other Product Manufacture and Use	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE
2.G.1 - Electrical Equipment	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE
2.G.1.a - Manufacture of Electrical Equipment	NO	NO	NO	NO	NO	NO	NO	NO
2.G.1.b - Use of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE
2.G.1.c - Disposal of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE
2.G.2 - SF6 and PFCs from Other Product Uses	NO	NO	NO	NO	NO	NO	NO	NO
2.G.3 - N2O from Product Uses	NE	NE	NE	NE	NE	NE	NE	NE
2.G.4 - Other (Please specify) (3)	NO	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NO	NO	NO	NO	NO	NO
3 - Agriculture, Forestry, and Other Land Use	3051.84	3052.31	3050.36	3052.66	2991.21	2989.65	2991.64	2993.34
3.A - Livestock	2.90	2.96	2.94	3.10	3.01	2.95	3.07	3.14

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.A.1 - Enteric Fermentation	1.53	1.60	1.55	1.66	1.60	1.54	1.64	1.69
3.A.2 - Manure Management	1.37	1.37	1.38	1.44	1.41	1.41	1.43	1.45
3.B - Land	3042.82	3042.82	3042.82	3042.82	2979.11	2979.11	2979.11	2979.11
3.B.1 - Forest land	-1059.49	-1059.49	-1059.49	-1059.49	-1042.62	-1042.62	-1042.62	-1042.62
3.B.1.a - Forest land Remaining Forest land	-527.69	-527.69	-527.69	-527.69	-503.33	-503.33	-503.33	-503.33
3.B.1.b - Land Converted to Forest land	-531.80	-531.80	-531.80	-531.80	-539.28	-539.28	-539.28	-539.28
3.B.1.b.i - Cropland converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.ii - Grassland converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iii - Wetlands converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iv - Settlements converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.v - Other Land converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.B.2 - Cropland	146.16	146.16	146.16	146.16	138.31	138.31	138.31	138.31
3.B.2.a - Cropland Remaining Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b - Land Converted to Cropland	146.16	146.16	146.16	146.16	138.31	138.31	138.31	138.31
3.B.2.b.i - Forest Land converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.ii - Grassland converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.iii - Wetlands converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.iv - Settlements converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.v - Other Land converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3 - Grassland	2599.54	2599.54	2599.54	2599.54	2986.35	2986.35	2986.35	2986.35
3.B.3.a - Grassland Remaining Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b - Land Converted to Grassland	2599.54	2599.54	2599.54	2599.54	2986.35	2986.35	2986.35	2986.35

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.B.3.b.i - Forest Land converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.ii - Cropland converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iii - Wetlands converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iv - Settlements converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.v - Other Land converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4 - Wetlands	1103.24	1103.24	1103.24	1103.24	550.03	550.03	550.03	550.03
3.B.4.a - Wetlands Remaining Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.i - Peatlands remaining peatlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.ii - Flooded land remaining flooded land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b - Land Converted to Wetlands	1103.24	1103.24	1103.24	1103.24	550.03	550.03	550.03	550.03
3.B.4.b.i - Land converted for peat extraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.B.4.b.ii - Land converted to flooded land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.iii - Land converted to other wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5 - Settlements	217.44	217.44	217.44	217.44	304.20	304.20	304.20	304.20
3.B.5.a - Settlements Remaining Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b - Land Converted to Settlements	217.44	217.44	217.44	217.44	304.20	304.20	304.20	304.20
3.B.5.b.i - Forest Land converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.ii - Cropland converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iii - Grassland converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iv - Wetlands converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.v - Other Land converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6 - Other Land	35.94	35.94	35.94	35.94	42.83	42.83	42.83	42.83

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.B.6.a - Other land Remaining Other land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b - Land Converted to Other land	35.94	35.94	35.94	35.94	42.83	42.83	42.83	42.83
3.B.6.b.i - Forest Land converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.ii - Cropland converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iii - Grassland converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iv - Wetlands converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.v - Settlements converted to Other Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate sources and non-CO2 emissions sources on land (2)	6.12	6.53	4.60	6.74	9.10	7.59	9.47	11.09
3.C.1 - Emissions from biomass burning	NE	NE	NE	NE	NE	NE	NE	NE
3.C.2 - Liming	NO	NO	NO	NO	NO	NO	NO	NO

Categories	2011	2012	2013	2014	2015	2016	2017	2018
3.C.3 - Urea application	0.76	0.15	0.09	0.88	0.49	0.06	0.18	0.11
3.C.4 - Direct N2O Emissions from managed soils (3)	3.67	4.44	3.04	4.04	6.12	5.30	6.64	7.99
3.C.5 - Indirect N2O Emissions from managed soils	1.24	1.49	1.03	1.36	2.03	1.77	2.20	2.65
3.C.6 - Indirect N2O Emissions from manure management	0.46	0.44	0.45	0.46	0.45	0.46	0.45	0.35
3.C.7 - Rice cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.8 - Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D - Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.1 - Harvested Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 - Waste	291.49	295.94	300.90	304.83	308.75	312.71	316.51	320.31
4.A - Solid Waste Disposal	245.20	249.32	253.25	256.98	260.56	264.04	267.46	270.85

Categories	2011	2012	2013	2014	2015	2016	2017	2018
4.B - Biological Treatment of Solid Waste	NO	NO	NO	NO	NO	NO	NO	NO
4.C - Incineration and Open Burning of Waste	1.57	1.59	1.60	1.62	1.63	1.65	1.67	1.68
4.C.1 - Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO
4.C.2 - Open Burning of Waste	1.57	1.59	1.60	1.62	1.63	1.65	1.67	1.68
4.D - Wastewater Treatment and Discharge	44.72	45.03	46.05	46.23	46.55	47.02	47.38	47.77
4.D.1 - Domestic Wastewaster Treatment and Discharge	44.72	45.03	46.05	46.23	46.55	47.02	47.38	47.77
4.D.2 - Industrial Wastewater Treatment and Discharge	NO	NO	NO	NO	NO	NO	NO	NO
4.E - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items								
1.A.3.a.i - International aviation (International bunkers)	682.02	918.05	783.60	698.12	556.18	565.48	632.14	682.47

Categories	2011	2012	2013	2014	2015	2016	2017	2018
1.A.3.d.i - International water-borne navigation (International bunkers)	616.26	829.53	708.04	630.80	502.55	510.95	571.19	616.67

Table 155: GHG emissions in 2018

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)				Total Emissions
Categories	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2	CO2 Equivalents (Gg)
Total National Emissions and Removals	5909.26	11.68	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	6264.31

1 - Energy	2928.14	0.38	0.05						NE	NE	NE	NE	2949.58
1.A - Fuel Combustion Activities	2928.12	0.38	0.05						NE	NE	NE	NE	2949.56
1.A.1 - Energy Industries	1426.02	0.06	0.01						NE	NE	NE	NE	1430.77
1.A.1.a.i - Electricity Generation	1426.02	0.06	0.01						NE	NE	NE	NE	1430.77
1.A.2 - Manufacturing Industries and Construction	349.02	0.01	0.00						NE	NE	NE	NE	350.19
1.A.2.k - Construction	66.35	0.00	0.00						NE	NE	NE	NE	66.58
1.A.2.m - Non-specified Industry	282.66	0.01	0.00						NE	NE	NE	NE	283.62
1.A.3 - Transport	711.93	0.24	0.03						NE	NE	NE	NE	727.65
1.A.3.a Aviation	73.72	0.00	0.00						NE	NE	NE	NE	74.29
1.A.3.a.ii - Domestic Aviation	73.72	0.00	0.00						NE	NE	NE	NE	74.29
1.A.3.b - Road Transportation	632.24	0.24	0.03						NE	NE	NE	NE	647.33
1.A.3.b.i - Cars	380.43	0.18	0.02						NE	NE	NE	NE	390.52
1.A.3.b.ii - Light-duty trucks	131.97	0.05	0.01						NE	NE	NE	NE	135.12
1.A.3.b.iii - Heavy-duty trucks and buses	119.52	0.01	0.01						NE	NE	NE	NE	121.38
1.A.3.b.iv - Motorcycles	0.31	0.00	0.00						NE	NE	NE	NE	0.31
1.A.3.c Water-borne Navigation	5.97	0.00	0.00						NE	NE	NE	NE	6.03
1.A.3.d.ii - Domestic Water-borne Navigation	5.97	0.00	0.00						NE	NE	NE	NE	6.03
1.A.4 - Other Sectors	441.16	0.07	0.00						NE	NE	NE	NE	440.95
1.A.4.a - Commercial/Institutional	358.25	0.06	0.00						NE	NE	NE	NE	356.71
1.A.4.b - Residential	50.84	0.01	0.00						NE	NE	NE	NE	51.98

1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	32.06	0.00	0.00						NE	NE	NE	NE	32.27
1.B - Fugitive emissions from fuels	0.02	0.00	0.00						NE	NE	NE	NE	0.02
1.B.2 - Oil and Natural Gas	0.00	0.00	0.00						NE	NE	NE	NE	0.02
1.B.2.a.iii.3 - Transport	0.02	0.00	0.00						NE	NE	NE	NE	0.02
2 - Industrial Processes and Product Use	1.17	0.00	0.00						NE	NE	NE	NE	1.08
2.D - Non-Energy Products from Fuels and Solvent Use	1.17	0.00	0.00						NE	NE	NE	NE	1.08
2.D.1 - Lubricant Use	1.17								NE	NE	NE	NE	1.08
3 - Agriculture, Forestry, and Other Land Use	2979.22	0.08	0.04						NO	NO	NO	NO	2993.34
3.A - Livestock	0.00	0.08	0.00						NO	NO	NO	NO	3.14
3.A.1 - Enteric Fermentation		0.06							NO	NO	NO	NO	1.69
3.A.2 - Manure Management		0.02	0.00						NO	NO	NO	NO	1.45
3.B - Land	2979.11	0.00	0.00						NO	NO	NO	NO	2979.11
3.B.1 - Forest land	-1042.62								NO	NO	NO	NO	-1042.62
3.B.1.a - Forest land Remaining Forest land	-503.33								NO	NO	NO	NO	-503.33
3.B.1.b - Land Converted to Forest land	-539.28								NO	NO	NO	NO	-539.28
3.B.2 - Cropland	138.31								NO	NO	NO	NO	138.31
3.B.2.b - Land Converted to Cropland	138.31								NO	NO	NO	NO	138.31
3.B.3 - Grassland	2986.35								NO	NO	NO	NO	2986.35

3.B.3.b - Land Converted to Grassland	2986.35								NO	NO	NO	NO	2986.35
3.B.4 - Wetlands	550.03		0.00						NO	NO	NO	NO	550.03
3.B.4.b - Land Converted to Wetlands	550.03		0.00						NO	NO	NO	NO	550.03
3.B.5 - Settlements	304.20								NO	NO	NO	NO	304.20
3.B.5.b - Land Converted to Settlements	304.20								NO	NO	NO	NO	304.20
3.B.6 - Other Land	42.83								NO	NO	NO	NO	42.83
3.B.6.b - Land Converted to Other land	42.83								NO	NO	NO	NO	42.83
3.C - Aggregate sources and non-CO2 emissions sources on land	0.11	0.00	0.04						NO	NO	NO	NO	11.09
3.C.1 - Emissions from biomass burning	NE	NE	NE						NE	NE	NE	NE	NE
3.C.2 - Liming	0.00								NO	NO	NO	NO	0.00
3.C.3 - Urea application	0.11								NO	NO	NO	NO	0.11
3.C.4 - Direct N2O Emissions from managed soils			0.03						NO	NO	NO	NO	7.99
3.C.5 - Indirect N2O Emissions from managed soils			0.01						NO	NO	NO	NO	2.65
3.C.6 - Indirect N2O Emissions from manure management			0.00						NO	NO	NO	NO	0.35
3.C.7 - Rice cultivation		NO							NO	NO	NO	NO	NO
3.C.8 - Other (please specify)		NO	NO						NO	NO	NO	NO	NO
3.D - Other	NO	NO	NO						NO	NO	NO	NO	NO

3.D.1 - Harvested Wood Products	NO								NO	NO	NO	NO	NO
3.D.2 - Other (please specify)	NO	NO	NO						NO	NO	NO	NO	NO
4 - Waste	0.74	11.22	0.02						NO	NO	NO	NO	320.31
4.A - Solid Waste Disposal	0.00	9.67	0.00						NO	NO	NO	NO	270.85
4.C - Incineration and Open Burning of Waste	0.74	0.03	0.00						NO	NO	NO	NO	1.68
4.C.2 - Open Burning of Waste	0.74	0.03	0.00						NO	NO	NO	NO	1.68
4.D - Wastewater Treatment and Discharge	0.00	1.52	0.02						NO	NO	NO	NO	47.77
4.D.1 - Domestic Wastewater Treatment and Discharge	0.00	1.52	0.02						NO	NO	NO	NO	47.77
Memo Items													
1.A.3.a.i – International aviation (International bunkers)	677.31	0.00	0.02						NE	NE	NE	NE	682.47
1.A.3.d.i - International water-borne navigation (International bunkers)	610.83	0.06	0.02						NE	NE	NE	NE	616.67

Annex II Institutions and Roles of involved in the Preparation of The Bahamas' NIR

Inventory Phase	Sector	Institution and Contacts	Roles
Planning	Crosscutting	• Department of Environmental Planning and Protection	Coordinating and policymaking authority with respect to environment and climate change in the Bahamas. Overseeing the entire national inventory process from the early stages of data collection through processing and reporting. This includes liaising with data providers, and identifying members of the National Inventory Team and coordinating their capacity building
Data Collection	Energy	• Ministry of the Environment and Housing • Central Bank of the Bahamas • National (reports)	Provides information on GHG emissions associated with electricity generation, national fuel consumption data,

Inventory Phase	Sector	Institution and Contacts	Roles
		• Bahamas Power and Light Company Ltd. • Bahamas National Statistical Institute (reports) • Grand Bahama Power Company • Ministry of Transport and Local Government • Port Department • Ministry of Transport and Local Government (Port Department) • Department of Statistics • Road Traffic Department • Road Traffic Department (Family Islands) • Rubis Bahamas Ltd. • Grand Bahama Port Authority • Bahamas Maritime Authority	energy balance, and vehicle registration data.
	Agricultur e	• Department of Agriculture, Ministry of Agriculture and Marine Resources • Bahamas Agricultural Health and Food Safety Authority • Customs Department (Reports) • Caribbean Agriculture and Research Institute	Provides data and technical support when compiling GHG emissions for agriculture Provides technical support when compiling GHG emissions for land Provides maps for the land sector

Inventory Phase	Sector	Institution and Contacts	Roles
		• Forest and Agriculture Organization (FAO) (reports)	
	Forestry	• Forestry Unit • Bahamas National Trust • Bahamas Reef Environment Educational Foundation (BREEF) • The Nature Conservancy • Perry Institute for Marine Science • University of Bahamas, Climate Change and Adaptation Centre • Forest and Agriculture Organization (FAO) (reports)	
	Waste	• Bahamas Waste Limited • New Providence Ecological Park (NPEP) • The Bahamas Water and Sewerage Corporation • Department of Environmental Health Services • UN Statistics (reports)	Provides information on the waste sector Provides statistical parameters that can be applied when estimating GHG emissions from the waste sector Provides information on the country's wastewater treatment works.

Inventory Phase	Sector	Institution and Contacts	Roles
	Industrial Processes and Pro duct Use	• Ozone Unit, Department of Environmental Health Services (DEHS) • Ministry of Works	Provide GHG information for the IPPU sector, particularly on refrigerants
Preparation	Sectors and Crosscutting	• Caribbean Cooperative MRV Hub Greenhouse Gas Management Institute • Support of National Experts and Data Providers	Provide Capacity to National members of the NIT to take on hands on role in preparation of National Greenhouse Gas Inventories Collecting and evaluating data Selection of methodological approaches Estimation of emissions Assessment of uncertainty and analysis of key categories preparation of inventory report
Quality Control	Crosscutting	• External MRV Hub and GHGMI experts	Review of estimations by experts not involved in the compilation of greenhouse gases

Inventory Phase	Sector	Institution and Contacts	Roles

Quality Assurance/ Review	All Sectors	• Sectoral Experts, and Data Providers including
		• Department of Environmental Planning and Protection
		    ○ Nikita Charles Hamilton
		    ○ Larissa Cartwright
		• Department of Meteorology
		    ○ Jeffrey Simmons
		• University of The Bahamas
		    ○ Dr. George Odhiambo
		• Bahamas Power and Light Company Ltd.
		    ○ Rochelle J McKinney
		    ○ Andrew Bastian
		• Grand Bahama Power Company
		    ○ Garelle Hudson
		• Rubis Bahamas Ltd.
		    ○ Kirk Johnson
		• Department of Agriculture
		    ○ Gina Pierre
		• Forestry Unit
		    ○ Danielle Hanek
		• Bahamas National Trust
		    ○ Giselle Deane
		• The Nature Conservancy
		    ○ Shenique Albury
		    ○ Marcia Musgrove
			Review National Circumstances of methods, approaches and assumptions
			
			Formal and informal technical reviews of National Inventory Report

Inventory Phase	Sector	Institution and Contacts	Roles

		• Department of Environmental Health Services
		   ○ Ryan Perpall
		   ○ Launa Williams
		• New Providence Ecological Park (NPEP)
		   ○ Jamie Strachan
		• The Bahamas Water and Sewerage Corporation
		   ○ John Bowleg	

Validate	Sectors and Crosscutting	• National Climate Change Committee	Provide oversight on the compilation of the report, including reviewing and providing inputs on technical information, in order to ensure the reports reflect the national circumstances. Validates the final NIR before submission to the Cabinet
		• Cabinet	Provides final approval of NIR, BURs, etc. before submission to the UNFCCC
Management	Crosscutting	• Department of Environmental Planning and Protection	Documentation, archiving, reviewing, checking and evaluation of planned improvements and data collected

Inventory Phase	Sector	Institution and Contacts	Roles
			Submission of final report to the UNFCCC Review of necessary inventory improvements and archiving

Annex III Details of the improvement plan

N°	CRF code	Identified issues for Improvements	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
G1	n.a.	Set up appropriate institutional, procedural, legal arrangements and documentation for the preparation of the national GHG inventory	In order for the GHG inventory to be sustainable appropriate institutional, procedural, legal arrangements and documentation are needed	2022-2023	High
G2	n.a.	Fully establish and implement QA/QC procedures for the national GHG inventory	QA procedures are to be embedded into the MRV system, while the set of QC procedures should ensure the accuracy of the GHG inventory estimates	2022-2023	High
G3	1.A.1	Quality and completeness of CBB data is unclear	Together with CBB staff, understand how data is collected and whether it covers all relevant activities (e.g., all fuel imports)	2022-2023	High
G4	1.	Develop a national energy balances	Create a Task Force with the national actors related to fuel statistics, to assess the steps to define the institutional, procedural	2023-2025	High

			(including the mechanism to collect information) and legal arrangements to build annual energy balances of The Bahamas, including all populated islands, taking into account national circumstances.		
E1	1.A.1	Data could not be obtained from all fuel distributors	Contact fuel distributors and, in close alignment with the assessment of the CBB data, consider obtaining detailed data annually from fuel distributors where appropriate (avoid double effort with existing customs / CBB data collection)	2022-2023	High
E2	1.A	No country-specific emission factors for fuel consumption available	As the categories 1.A.1.a.i, 1.a.2.m, 1.A.3.b.i-iii, and 1.A.4.a are key categories with regards to CO_2, country-specific emission factors should be developed to allow moving to a Tier 2 approach. As a first step, however, we suggest that the a	2023-2025	Low

			thorough data collection approach is established.		
E3	1.A.1	Incomplete BPL fuel consumption and power generation time series	Collect historic fuel and diesel oil consumption as well as power generation from BPL, GBPC and, if possible, from other smaller power generators on the private islands, ideally back to 2001.	2022-2023	High
E4	1.A.2	Unclear, which activities under manufacture and construction take place	Assess company registers, work with business associations	2022-2023	Mediu m
E5	1.A.3. a	No information on whether aviation gas is also used for international flights and if so, what amounts	Obtain information on fuels sold to airports, from airports themselves or fuels distributors	2022-2023	Mediu m
E6	1.A.3. b	Car registration numbers fluctuate strongly over time	Assess registration data from the transport department, understanding reasons for data fluctuations, improve data where necessary	2022-2023	High
E7	1.A.3. b	Limited information on car population	Assess improved registration data to understand fuel to understand shares of	2022-2023	High

			vehicle types and assess to which extent these fit the IPCC vehicle categories. The motor technologies would also be helpful to understand, but are of lower relevance, as 1.A.3.b is not a key category for N_2O and CH_4.		
E8	1.A.3.b	No information on number of car trips and average distances per trip available	Conduct a study to develop estimates for number of car trips and average distances per trip	2023-2024	Medium
E9	1.A.3.c	No information on fuel consumption for domestic waterborne navigation is available	Assess whether information can be obtained from fuel distributors (potentially as share of fuel consumption reported to the CBB)	2023-2024	Medium
E10	1.A.3.a.i and 1.A.3.c.i	Information on consumption of bunker fuels reported by CBB only as total in TJ, not by fuel type and by area of consumption	Work with CBB and fuel distributors to obtain the consumption of bunker fuels in a disaggregated manner	2022-2023	Medium
I1	2.D	There is no activity data available on non-energy products from fuel and solvent use	Work with customs, industry associations to understand import and use of lubricants, paraffin	2023-2024	Low

		from the use of paraffin waxes and solvents use. Also, lubricant use shows a steep decrease in activity data by over 70% between 2001 and 2018. There is also indication that recollected lubricants are used as fuels under category 1.A.2. Where this was the case, the resulting emissions would have to be reallocated from category 2.D.1 to 1.A.2	waxes and solvents. According to experts lubricants are collected, stored at BPL and treated outside of the Bahamas, so they can be reused. This could potentially explain some of the reduction in lubricant consumption. As GHG emissions from these categories are typically low, these improvements are considered less urgent.		
I2	2.F	Information on the import and consumption of HFCs/ PFCs/SF6 is not available	Work with customs to obtain past import data of HFC and PFC species and of equipment already containing HFCs and PFCs. The National Ozone Office will be able to view future imports of ozone depleting substances through a single window system at the customs which is	2022-2023	High

			currently being implemented. Consider, pesticides / insecticides as a potentially large source of HFC emissions (use as propellant).		
I3	2.F	There is no information on the amount of HFCs/PFCs banked in The Bahamas	Conduct a study together with customs, the National Ozone Officer and the importers/distributors of refrigeration and air conditioning equipment.	2023-2024	High
I4	2.G.	There is no information on the amount of N_2O consumed in The Bahamas	Work with customs to obtain data on N_2O imports and uses. Assess whether N_2O is produced in The Bahamas and production amounts.	2023-2024	Low
I5	2.G.	Experts indicated that at least BPL uses electrical equipment containing SF_6, however such data was not available at the time of the assessment.	Work with BPL and GBPC to understand amounts of SF6 banked and consumption of SF_6 during maintenance (where appropriate). Obtain data on SF_6 imports from customs for validation.	2022-2024	Medium
A1	3.A.1	Livestock data is very limited, not readily available on an annual basis	Work with customs import reports and Agriculture Field officers to collect and validate livestock data	2022-2023	Medium

A2	3.B	Satellite images for 2003 onwards suffer from scan-line error due to failure of on-board scanning instrument resulting in strips of data-gaps. and 2010 contains noise and errors which significantly affects the LULUCF emission estimates for the period 200-2005; 2005-2010 and from 2010-2015	Make plans to establish permanent sampling plots in the main land use categories to improve field training points for land classification map	2022-2023	High
A3	3.B	No country specific emission factors available for land use categories	Categories 3.B.1.a-b, 3.B.2.b, 3.b.3.b, 3.B.4.b and 3.b.5.b are key categories with regards to CO_2. Conduct field survey and measurements to develop country specific emission factors will help improve accuracy of GHG emissions. Generating emission factors for forest, grasslands and wetlands with woody should be made priority.	2022-2024	High

A4	3.B	No digital land use maps available with IPCC land use categories	Conduct training with those with ground knowledge of the country and some GIS expertise will help The Bahamas to calculate emissions for future reporting requirements to produce land use information based on 20 years period	2022-2023	High
A5	3.C.1	Data on biomass burning of crop residues is not available, only anecdotally referenced that 30% of farmers practice slash and burn in the absence of mechanization.	Work with Agriculture Department and field officers to get an appropriate sample of areas where biomass burning occurs to improve non CO_2 emissions estimates.	2022-2023	Medium
A6	3.C.2	Agricultural lime application is not estimated as soils are calcareous, however customs report indicates yearly imports.	Verify with Customs on end usage of lime that is imported, and include this category in the next cycle.	2022-2023	High
A7	3.C.6	Manure management practices of different	Conduct a survey of livestock manure	2022-2023	Medium

		types of livestock is not well documented	management practices to improve accuracy of estimates		
W 1	4.A	There is no information on the depth and size of landfills in The Bahamas, no information on solid waste generation and composition.	Conduct a study assessing waste generation (including from tourism) and composition and providing an overview on the depth and size of landfills in The Bahamas allowing to move to a Tier 2 approach over time. Category 4.A is a key category with regards to CH_4.	2022-2023	High
W 2	4.D	There is no information on industrial wastewater from companies in The Bahamas, no information on solid waste generation and composition.	Map industries, and engage stakeholders early on to provide data, and secure buy-in for wastewater discharge.	2022-2023	High
W 3	4.C	There is anecdotal evidence that open burning of waste takes place in smaller islands of The Bahamas, but no information amounts	Conduct a study assessing open burning practices	2023/2024	Medium

		burned and type of waste burned			
W 4	4.B	There is no information on whether incineration of waste takes place (e.g. in industrial facilities or hospitals)	Approach Bahamas Waste and industry associations about incineration of hazardous and other wastes. Late in the GHG inventory compilation process an expert indicated that Pharmachem in Grand Bahama burn hazardous liquid chemical waste and that other industrial facilities operate smaller incinerators. Conduct a study assessing waste management practices at hospitals	2023/2024	Medium

Annex IV Matching fuels and activities in the energy balance with the IPCC categories

OLADE has prepared an energy balance for the years 2010-2012. The energy balance (EB) presents fuel consumption by activity. These activities mostly show good alignment with the categories of the IPCC 2006 Guidelines. Table 156 shows how the fuels and activities in the energy balance were mapped against the categories in the IPCC 2006 Guidelines. Empty cells in the table indicate that the specific fuel/activity combination did not occur, e.g. there was no firewood consumption in industry.

Table 156: Matching of fuels and activities in the energy balance to the categories in the IPCC 2006 Guidelines

Activity	Fuel consumption							
	Firewood	LPG	Gasoline Alcohol	Jet Fuel Kerosene	Diesel Oil	Fuel Oil	Charcoal	Non-Energy
Power plants	-	-	-	-	1.A.1.a Main electricity and heat production	1.A.1.a Main electricity and heat production	-	-
Self-producers	-	-	-	-	1.A.1.a Main	-	-	-

					electricity and heat production			
Transportation	-	-	1A3b - Road transportation	1A3aii - domestic aviation	1A3b - Road transportation	1A3dii - Domestic water borne navigation	-	-
Industry	-	1A2m - Non-specified industry	1A2m - Non-specified industry	-	1A2m - Non-specified industry	1A2m - Non-specified industry	-	-
Residential	1A4b - residential	1A4b - residential	1A4b - residential	1A4b - residential	1A4b - residential	-	1A4b - residential	-
Commercial, services, public sector	-	1A4A - commercial/institutional	1A4A - commercial/institutional	-	1A4A - commercial/institutional	-	1A4a - commercial/institutional	-

Agriculture, fishing, mining	-	-	1A4c Agriculture/Fishing	-	1A4c Agriculture/Fishing	-	-	-
Construction	-	1A2k - construction	1A2k - construction	-	1A2k - construction	-	-	-

Annex V Land use Change Matrices - 2000 to 2020

The following tables demonstrate the breakdown of land use between individual land use categories for each 5 year interval from 2000-2020.

Table 157: Land use Change Matrix between 2000 and 2005

2000-2005	**Area change in ha**						**Total**
	Forestland	**Grassland**	**Cropland**	**Wetland**	**Settlement**	**Other land**	**Area (ha)**
Forestland	174,695	8,047	8,733	6,793	19,478	568	218,313
Grassland	47,850	40,822	30,428	22,554	37,250	1,412	180,315
Cropland	6,885	4,758	16,657	3,040	23,188	1,053	55,581
Wetland	5,075	9,313	2,262	15,502	5,838	11,476	49,465
Settlement	16,586	5,114	15,139	5,311	63,590	7,984	113,724
Other land	355	1,772	470	9,725	6,011	54,111	72,444

Total Area (ha)	251,446	69,826	73,687	62,925	155,354	76,605	689,841

Table 158: Land use Change Matrix between 2005 and 2010

2005-2010	**Area change in ha**						**Total**
	Forestland	**Grassland**	**Cropland**	**Wetland**	**Settlement**	**Other land**	**Area (ha)**
Forestland	210,014	12,259	14,920	8,423	23,650	398	269,664
Grassland	30,242	15,692	19,480	10,124	20,354	7,979	103,871
Cropland	5,230	4,448	16,832	2,244	16,511	547	45,813
Wetland	5,050	31,002	2,201	17,064	4,149	11,787	71,254
Settlement	11,374	4,720	18,796	3,871	59,560	5,424	103,745
Other land	379	667	495	4,841	5,080	43,985	55,447
Total Area (ha)	262,289	68,789	72,723	46,566	129,304	70,121	649,792

Table 159: Land use Change Matrix between 2010 and 2015

2010-2015	**Area change in ha**						**Total**
	Forestland	**Grassland**	**Cropland**	**Wetland**	**Settlement**	**Other land**	**Area (ha)**
Forestland	254,936	6,369	8,558	5,937	21,088	231	297,119

Grassland	71,619	42,578	46,592	30,598	64,678	7,016	263,081
Cropland	2,830	1,227	3,333	1,039	4,948	86	13,463
Wetland	21,927	8,604	1,882	13,051	3,229	4,113	52,805
Settlement	4,391	2,118	7,430	1,271	25,517	2,484	43,212
Other land	373	2,733	744	7,774	7,242	28,451	47,317
Total Area (ha)	356,076	63,629	68,539	59,669	126,702	42,380	716,996

Table 160: Land use Change Matrix between 2015 and 2020

2015-2020	**Area change in ha**						**Total**
	Forestland	**Grassland**	**Cropland**	**Wetland**	**Settlement**	**Other land**	**Area (ha)**
Forestland	243,171	2,424	2,191	14,061	7,288	216	269,351
Grassland	74,795	50,329	7,903	29,760	17,266	10,085	190,138
Cropland	2,506	1,789	2,976	2,569	2,333	33	12,206
Wetland	10,046	11,571	2,445	27,961	824	2,860	55,706
Settlement	5,786	1,516	2,701	749	17,702	1,586	30,040
Other land	372	1,764	65	5,286	2,228	32,929	42,643
Total Area (ha)	336,675	69,393	18,281	80,385	47,641	47,709	600,085