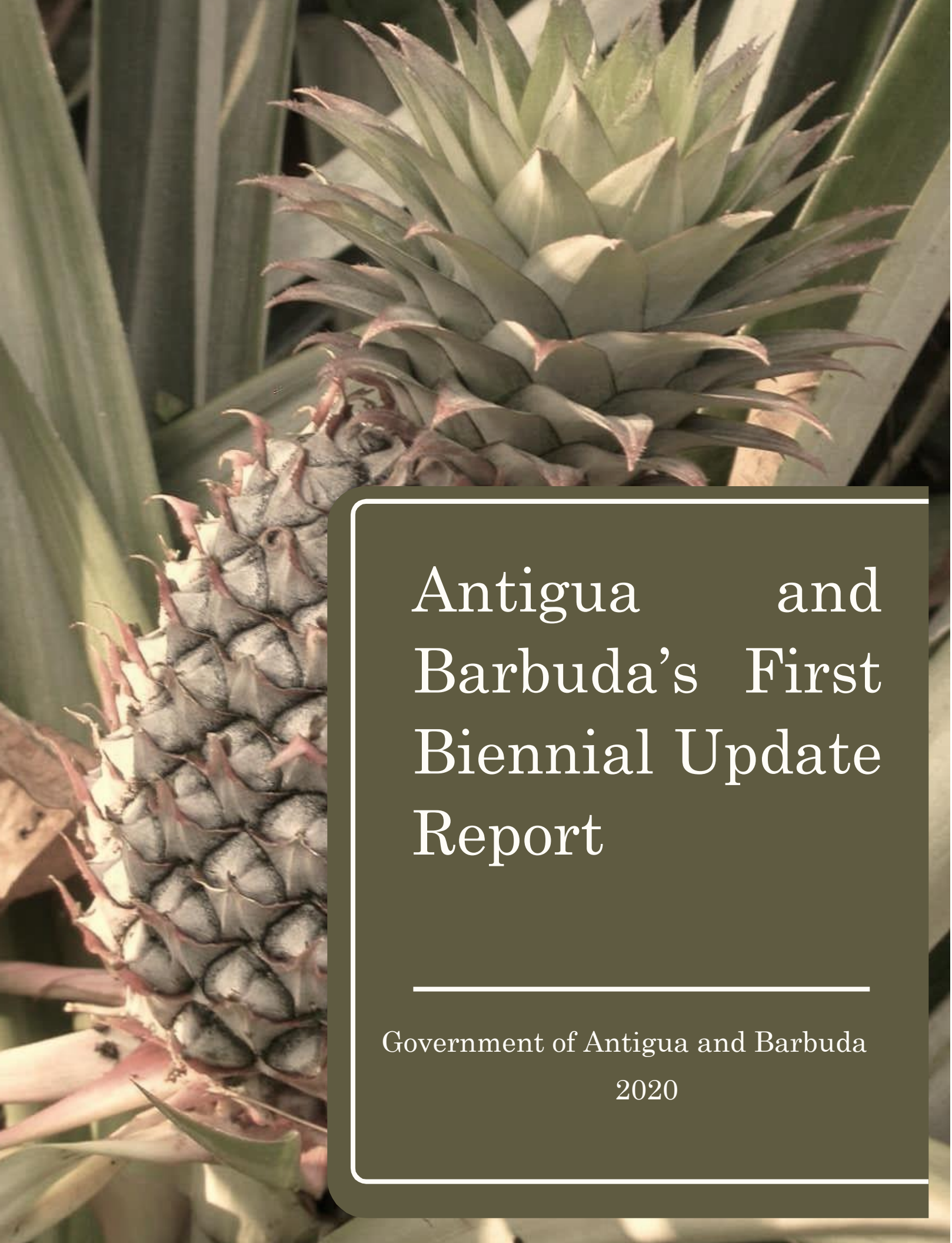

Antigua and Barbuda's First Biennial Update Report

Government of Antigua and Barbuda

2020

Prepared on behalf of

The Government of Antigua & Barbuda

Department of Environment

Ministry of Health, Wellness and the Environment

2020

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EXECUTIVE SUMMARY

Little Ffryes Beach, Antigua

Antigua and Barbuda, like all parties to the UNFCCC (United Nations Framework Convention on Climate Change) and the Paris Agreement, is striving towards sustainable development, where poverty can be a thing of the past. The government has publicly acknowledged that this can only be attained and guided by a sustainable development approach.

As part of its commitment to address climate change matters, the country communicated on October 2015 its Intended Nationally Determined Contributions (INDC's). The INDC's were approved and became Antigua and Barbuda's First Nationally Determined Contributions (NDC). The First NDC communicated Antigua and Barbuda's intention to implement a variety of National and Sector Mitigation policies related to emission reduction and adaptation actions. These mitigation, adaptation and cross-cutting commitments represent a refocusing of the country's efforts to combat climate change away from Antigua and Barbuda's original target, as part of the pledge to the Copenhagen Accord, of a reduction of 25% from 1990 levels by 2020, included in the Third National Communication[1].

The Caribbean region, including Antigua and Barbuda, was responsible for less than 0.35% of global GHG emissions in 2012 (World Bank, 2014), with the small island developing state (SIDS) contributing less than 0.002% (INDC, 2015). Antigua and Barbuda is committed to implement mitigation policies to become a sustainable, low carbon economy that is resilient to the effects of climate change, despite its extreme vulnerability to climate trends (INDC, 2015). Due to a combination of insufficient 1990 baseline data and increasing pressures on Antigua and Barbuda's economy, its mitigation priorities have since been refocussed towards a policies and measures based approach, as indicated by the targets set out in the First NDC. This is therefore a national and sector-based policies and measures approach which contributes to the country achieving its sustainable development objectives and national mitigation and adaptation commitments.

Antigua and Barbuda's first and second GHG inventories were carried out for the years 1990 and 2000 respectively, while the third focused mainly on the year 2006. The present GHG Inventory report was

[1] https://unfccc.int/resource/docs/natc/antnc3.pdf

prepared as a requirement for the Biennial Update Report (BUR). The inventory year for the current report is 2015. Antigua and Barbuda's net emissions were estimated to be 844.28 $GgCO_2e$. This was a decrease of approximately 101 $GgCO_2e$ compared to the previous estimate for the 2006 inventory (compiled in 2015[2]).

The methodology used for this GHG Inventory was the 2006 IPCC Guidelines. For the first time in Antigua & Barbuda's reporting history, the team used the IPCC software. The sectors reflected in this report are (i) Energy, (ii) Industrial Processes and Products Use, (iii) Agriculture, Forestry & other Land Use (AFOLU), and (iv) Waste. However, there were specific instances when the software could not be used due to challenges in the operations. In these cases, the team reverted to using the IPCC excel worksheets. These instances are indicated throughout the methodology.

As reported in the previous inventories, Antigua and Barbuda still imports all fossil fuels required for electricity generation and transport (road, marine, air). The situation in the Industrial Sector remains the same with the sector being very small. The main source of emissions in this sector comes from refrigerants. The AFOLU sector is divided into the subsectors: Agricultural and Forestry & Other Land Use. The main source of emissions within the Agricultural Subsector is due to enteric fermentation and manure management. Previously, the forest cover of the country was limited since most of the forests were cleared during the colonial days to establish sugar plantations. In the last 10 to 15 years, a combination of aerial photography and ground truthing activities allowed for updated data gathering. This has led to significant increases in reporting within this subsector. For this inventory, Google Earth satellite imagery was used for reporting. The Waste Sector continues to see improvement with more efforts being placed on methodologies and quality of data collection especially in the areas of methane emissions from solid waste disposal sites. This has subsequently created an improvement in the quality of data within this report.

A summary of the national GHG emissions are as follows:

- **Carbon Dioxide (CO2): 844.28 Gg,**
- **Methane (CH4): 1.517 Gg,**
- **Nitrous Oxide (N2O): 0.049 Gg,**
- **Non-methane volatile organic compounds (NMVOC): 0.035 Gg,**
- **Hydrofluorocarbons (HFC): 6.051 Gg.**

The overall uncertainty of the inventory is 39.6%.

Continuous efforts are being made to improve the data collection methods in all the sectors of the report. However, there are still many gaps in terms of consistency in data collection and ease of sharing data. Despite these challenges, the majority of the data was collected to provide a GHG Inventory Report that is well representative of the actual situation on the ground.

The current institutional framework for delivering Antigua and Barbuda's mitigation action is coordinated by the Department of Environment (DOE). The DOE coordinates the set-up and delivery of environment related projects and coordinates active engagement from other departments, ministries, the private sector, NGOs and communities. The DOE is also responsible for the monitoring, reporting and verification of climate action. The DOE also coordinates the compilation of the GHG inventory and the development of projects to gather information on and to track climate actions. Antigua and Barbuda recognizes that Domestic MRV (Measurement, Reporting and Verification) is important in communicating and tracking the country's climate actions as well as reporting on the progress made in achieving our NDCs. Antigua and Barbuda has previous experience as it relates to MRV of GHG emissions through the submission of NC (National Communication) reports and will seek to improve upon this under upcoming projects and other initiatives. The information presented

[2] Estimated in the 3rd National Communication: https://unfccc.int/resource/docs/natc/antnc3.pdf

in this BUR describes the arrangements that will serve as the basis of Antigua and Barbuda's MRV system which is currently being designed.

Antigua and Barbuda has been described by many regional reports as one of the most disaster prone countries in the OECS subregion. It is subject to hurricanes, earthquakes, and frequent droughts. Antigua and Barbuda was one of the first countries in the hemisphere therefore to take up technologies like desalination, drip irrigation, as well as Renewable Energy. The economy of Antigua and Barbuda and its financing has always been tested by disaster. The country is very keen therefore to ensure that it uses limited finances effectively. Antigua and Barbuda requires international support from multilateral and bilateral sources and currently receives considerable funding.

The country has received support from the GCF, the GEF and the AF, for capacity building, climate finance and technology transfer to be able to strengthen its current programs, policies and regulations. Since the submission of the TNC (Third National Communication) in 2015, these partnerships have aided in development and implementation of new initiatives, and to fully assess and address the impacts of climate change, as defined in the adaptation and mitigation targets.

However, there are considerable challenges to financing actions related to addressing climate change. Gaps and constraints as well as capacity building needs related to GHG inventory and to the mitigation actions are very evident. There are also additional gaps and constraints related to activities requiring support for implementation of the new and ambitious actions of the country; these include:

- Technology, human resources and financial capacity assessment;
- Support for the development of a Technology Strategy and Road Map that includes repurposing, decommissioning, and disposing of stranded assets;
- Comprehensive assessment of the national costs of adaptation and mitigation;
- Elaboration of a National Adaptation Plan;
- Enhancing MRV processes;
- Development of standardized baselines to assess and monitor the impacts of implementing NDC adaptation and mitigation initiatives and CC program as a whole;
- Support for data collection, storage and management; and
- Support for education, training, public awareness, public participation, public access to information, and international cooperation throughout implementation of the NDC target.

The Government of Antigua and Barbuda Climate Finance Strategy is the Climate Change Transformational Program. This strategy is intended to guide government and national and international stakeholders in the approach to the implementation of the UNFCCC and the Paris Agreement and to bring about transformational change to the country. Antigua and Barbuda envisions transformational change as the catalyst needed to propel successful implementation of mitigation and adaptation measures to climate change.

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ABBREVIATIONS

4NC	Fourth National Communication
ADFD	Abu Dhabi Fund for Development
AF	Adaptation Fund
AFOLU	Agriculture, Forestry and Other Land Use (2006 IPCC Guidelines)
APC	Antigua Power Company
APUA	Antigua & Barbuda Public Utilities Authority
BoP	Bottom of the Pyramid
BUR	Biennial Update Report
CAEP	Climate Action Enhancement Package
CBIT	Capacity Building for Improved Transparency on Climate Actions Project
CC	Climate Change
CCCCC	Caribbean Community Climate Change Centre
CCCD	Monitoring and Assessment of MEA implementation and environmental trends in Antigua and Barbuda" Project funded under the Cross-Cutting Capacity Development focal area of the GEF
CDB	Caribbean Development Bank
CEDA	Caribbean Export Development Agency
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COP 21	21st Conference of the Parties to the UNFCCC
CPEIR	Climate Public Expenditure and Institutional Review
CRIF	Catastrophe Risk Insurance Facility
CSO	Civil Society Organization
CTCN	Climate Technology Centre and Network
DCA	Development Control Authority
DMU	Monitoring, Evaluation and Data Management Unit in the DOE
DOE	Department of Environment
DTU	Technical University of Denmark
EAG	Environmental Awareness Group
EDA	Enhanced Direct Access Project funded by the Green Climate Fund
EE	Energy Efficiency
EIMAS	Environment Information Management and Advisory System
EMS	Environmental Management Systems
EPMA	Environmental Protection and Management Act (2019)

ESMS	Environmental Social Management System
EST	Environmentally Sound Technologies
FAO	Food and Agriculture Organisation
FFI	Fauna and Flora International
FI	Financial Institutions
GCF	Green Climate Fund
GCF NDA	Green Climate Fund-National Designated Authority
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GEF SGP	GEF Small Grants Program
Gg	Gigagram
GHG	Greenhouse Gas
Ha	Hectare
HCFC	Hydrochlorofluorocarbons
HDI	Human Development Index
HFCs	Hydrofluorocarbons
HFO	Heavy Fuel Oil
IADB	Inter-American Development Bank
ICA	International Consultation and Analysis (ICA) process.
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
Kg	Kilogram
LPG	Liquified Petroleum Gas
LULUCF	Land Use, Land-Use Change and Forestry
M&E	Monitoring and Evaluation
MCA	Multi-Criteria Analysis
MEA	Multilateral Environmental Agreement
MFI	Multilateral Financial Institutions
MOA	Ministry of Agriculture
MoU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Waste
MTDS	Medium-Term Development Strategy
MW	Mega Watt
N_2O	Nitrous Oxide

NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategic Action Plan
NC	National Condition
NC's	National Communications
NCCP	National Climate Change Policy
NCSA	National Capacity Self-Assessment
NDC	Nationally Determined Contributions
NEMS	National Environmental Management Strategy
NEP	National Energy Policy
NGO	Non-Governmental Organization
NIMS	National GHG Inventory Management System
NMVOC	Non-methane volatile organic compounds
Non-Annex I	Parties not included in Annex I to the UNFCCC
NOx	Nitrogen Oxides
NPA	National Parks Authority
NPDP	National Physical Development Plan
NREL	U.S. Department of Energy's National Renewable Energy Laboratory
NSO	National Statistics Office
NSWMA	National Solid Waste Management Authority
OAS	Organisation of American States
OECD	Organization for Economic Co-operation and Development
OECS	Organization of Eastern Caribbean States
PFC	Perfluorocarbons
PV	Photovoltaics
QA	Quality Assurance
QC	Quality Control
RE	Renewable Energy
SDD	Sustainable Development Dimensions
SDG	Sustainable Development Goal
SEAP	Sustainable Energy Action Plan
SEF/CDB	Sustainability Energy Facility / Caribbean Development Bank project
SF_6	Sulphur hexafluoride
SIDS	Small Island Developing State
SIRF Fund	Sustainable Island Resource Framework Fund
SIRMZP	Sustainable Island Resource Management Zoning Plan

SLR	Sea Level Rise
SME	Small-medium enterprise
SO_2	Sulphur dioxide
SOEs	State–Owned Enterprises
SPPARE	Sustainable Pathways – Protected Areas and Renewable Energy Project
TAC	Technical Advisory Committee
TNA	Technology Needs Assessment
TNC	Third National Communication
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
WAM	With Additional Measures
WEM	With Existing Measures
WIOC	West Indies Oil Company
WTE	Waste to Energy

FOREWORD

The vulnerability of Small Island Developing States (SIDS) is well-documented. Antigua and Barbuda, as a SIDS, has already begun to experience the intense impacts of climate change through intensified storms, extended periods of drought, and saltwater intrusion. These impacts have required the Government of Antigua and Barbuda to be ambitious and innovative in the planning for climate change.

This Biennial Update Report (BUR) therefore looks critically at the sectors that are directly linked to carbon emissions, and determines actions that will dramatically reduce these emissions through a programmatic approach. Indeed, the approach taken by the Government of Antigua and Barbuda seeks Transformational Change across sectors and integrates sustainable climate finance through the Sustainable Island Resource Framework (SIRF) Fund.

Built into these programmes is a strong emphasis on meaningful engagement with all stakeholders to ensure sustainability in the programmes, and success in their implementation. The results of the BUR also require a cultural shift in data collection and storage, and these considerations have also been built into the projects that will be implemented by the Government of Antigua and Barbuda and its partners.

Undoubtedly, the challenges for real transformational change exist, however Antigua and Barbuda stands ready to meet these head on. Ready to demonstrate strong climate policy and action that makes the slogan "1.5 to stay alive" a reality.

St. John's Hatbour, Antigua

National Circumstances

Shirley's Heights Lookout, Antigua

1 NATIONAL CIRCUMSTANCES

Table 1: Antigua and Barbuda National Features

Antigua and Barbuda at a Glance	
Location	Antigua 17˚10' latitude, 61˚55' longitude, Barbuda latitude 17˚35', and longitude 61˚48 (28 miles north of Antigua) between the Caribbean Sea and the Atlantic Ocean, approximately 250 miles southeast of Puerto Rico.
Geography	Antigua is 280 km² (108 sq. mi) with its highest point—Boggy Peak—standing at 402 meters (1,319 ft.). On the other hand, Barbuda has a relatively flat topography with some low-lying hills rising to just under 40 meters (131 ft.). Barbuda has an area of 141 km² (61 sq. mi.) and houses the Codrington Lagoon, which is separated by a narrow spit of sand.
Climate and Weather	Tropical maritime climate with only slight variations in daily seasonal temperatures. Average monthly temperatures range from 23.9˚C up to 29.6˚C. The lowest temperature ever recorded was 17.0˚C (March 2000) and the highest was 34.1˚C (May 2005). Rainy season - July to December. Dry season - January to June. Average annual rainfall is about 46.75 inches.
Natural Hazards and Risks	Annual hurricane season is from June and November, however August to September usually accounts for 79% of all storms. From 1851 to 2011 Antigua and Barbuda had 93 storm systems with 44 developing into hurricanes. Hurricanes have been known to result in up to 100% loss of GDP. The country is drought prone and rainfall trends are often variable. Severe droughts may occur every 5-10 years. The country has just coped with a three-year drought from 2013 to 2016 during which time the percentage of water generated by desalination had to be increased from 40% to 80% in just a few short years.
Natural Resources	Variety of ecosystems and associated services inclusive of water retention (via its forest and watersheds), shoreline protection (coral reefs, mangrove forest), livelihoods (fisheries), and tourism/eco-tourism (beaches, mangroves, biodiversity, aesthetics) which are instrumental to economic development.
Government	Constitutional monarchy with a British-style parliamentary system of government. Parliamentary system made up of a 17-member appointed Senate (Upper House) and a 17-member elected House of Representatives (Lower House). Full independent status was achieved in November 1981. Member of the Commonwealth, Governor General is the Head of State.
Climate Change Governance	The responsibilities for implementing and complying with the UNFCCC reside with the Department of Environment in the Ministry of Health, Wellness and the Environment. Climate Change policy has been integrated across government agencies by way of policies such as The Sustainable Island Resource Management Zoning Plan (SIRMZP) and its enabling legislation, the National Biodiversity Strategic Action Plan (NBSAP), the National Environmental Management Strategy (NEMS), the Environmental Protection and Management Act (EPMA) 2019, the Sustainable Island Resource Framework Fund (SIRF Fund) and the Medium-Term Development Strategy (MTDS).
Population and Employment	Total population as at 2011 Census was 88,566, however current projections show the population estimate at 96,655. According to the census employment rate is 10.2%, 40,400 were employed while another 3,454 were seeking re-employment. The primary employment sector is tourism— a highly seasonal

	industry— while the agricultural sector has the lowest employment rate. For this reason, the country experiences high rates of seasonal unemployment.
Economy	GDP just under US $1.4 billion per year. Service-based economy with tourism being the main driver of growth, accounting for nearly 60% of the total GDP and 40% of investment. The contribution of the Financial sector to the economy is high relative to the country's size. In 2012, the financial sector accounted for approximately 10.13% of the country's total GDP. However, this figure has been steadily decreasing since, and it is expected to reach 9.15% by 2018.
National Development Priorities	The national MTDS guiding vision is: "A harmonious, prosperous and modern Antigua and Barbuda founded on the principles of sustainability and inclusive growth; where equality of opportunity, peace, and justice prevail for all citizens and residents"[3].The government has publicly acknowledged that this can only be attained and guided by a sustainable development comprised of 4 key principles: Optimal Generation of National Wealth; Enhanced Social Cohesion; Improved Health of the Natural Environment and Sustained Historical and Cultural Assets; and Enhanced Citizen Security.
Climate Change Impacts	30-50% less average annual rainfall by 2090 compared to late 20th century norms. Desalination reliance is already 60% of national water supply, during times of drought, desalination can account for up to 90% of freshwater supply. Sea Level Rise between 1.5 and 3 mm per year, which will increasingly put inland freshwater resources at risk of saline intrusion. One-meter sea level rise (SLR) would impact 10% of major tourism resorts, all seaports, and 2% of major road networks. Floods, in part due to climate variability, affecting the frequency and severity of storms and rainfall extremes. The health sector is exposed to increases in vector borne diseases and the spread of water- borne illnesses. Increase in intensity, if not frequency, of hurricanes posing an increasing threat to Antigua and Barbuda's economy.
Financing Climate Change Actions	The climate change needs for the country to transition to low emission resilient economy will cost at least US $1.4 billion. The cost of mitigation measures to transition to 100% renewable energy is currently being considered by the Government of Antigua and Barbuda and adaptation measures for each building, national infrastructure, water, back-up energy and insurance together represents a difficult task for such a small country. Even with the most ambitious GEF, and GCF replenishment Antigua and Barbuda is only likely to access a small portion of its climate impact needs from sources external to the country.
GHG Emissions Profile	844.28 $GgCO_2e$ in net emissions (2015 inventory). Annual GHG emissions have decreased by 10% between 2006 and 2015. Emissions from Energy and Land Use, Land Use Change and Forestry (LULUCF) are the primary causes of this increase. The largest contribution to GHG emissions comes from fuel combustion in the energy industry (production of electricity) 648.8 Gg. The country importing 100% petroleum requirements.
Mitigation Approach	National and sector-based policies and measures approach which contributes to the country achieving its sustainable development objectives and national mitigation and adaptation commitments.

[3] Antigua and Barbuda Medium Term Development Strategy (2015), Ministry of Finance and Corporate Governance, Government of Antigua and Barbuda.

1.1 GEOGRAPHIC AND TOPOGRAPHIC PROFILE

1.1.1 LOCATION AND LAND AREA

Antigua and Barbuda is a twin island state that lies between the Caribbean Sea and the Atlantic Ocean, approximately 250 miles southeast of Puerto Rico. It has an exclusive economic zone of 110,071 sq. km. The precise coordinates of Antigua are 17˚10' latitude, 61˚55' longitude, while Barbuda is located 28 miles north of Antigua at latitude 17˚35', and longitude 61˚48.

The island of Antigua is made up of 280 km² (108 sq. mi) with its highest point—Boggy Peak—standing at 402 meters (1,319 ft.). On the other hand, Barbuda has a relatively flat topography with some low-lying hills rising to just under 40 meters (131 ft.). Barbuda has an area of 141 km² (61 sq. mi.) and houses the Codrington Lagoon, which is separated by a narrow spit of sand.

1.1.2 TOPOGRAPHIC PROFILE

Antigua has three primary topographic zones: volcanic, central plains and rolling limestone. The first zone is the mountainous southwest portion, which consists of hard indigenous rocks in the uplands and sedimentary material in the associated valleys. This area is associated with the highest forest cover, and this is due in part to higher rainfall and the sandy loamy sediments of a near neutral pH, which is conducive to tree growth. The central plains are principally heavy clay, which is not easily drained and has a near neutral pH. Calcareous clay is found in some regions and the area is known to be difficult to manipulate. The rolling limestone areas that make up the third zone is separated based on their geological content. In the north, the limestone areas are considered productive, and have high clay content with a high base structure and a saturation pH of 8.2. In the east, the limestone areas consist of complex shallow and deep calcareous soils and productivity is limited by the drier climate.

Barbuda, which is dominated by coral limestone rocks, can be separated into three topographic zones. The first one consists of highland limestone areas, which are made up of hard limestone riddled with caverns and sink holes, and the soil is primarily a reddish clay loam. The second zone is the Codrington limestone region, which is composed of sandy and fossiliferous sediments. This region is less crystalline than the highland limestone region as the soil is primarily a brown clay loam. The third zone is the Palmetto Point series that overlies the Highlands and Codrington formations in coastal areas and is composed of beach sands and ridges with shelly horizons.

1.1.3 CLIMATE AND WEATHER

The twin island state is characterized by a relatively arid tropical maritime climate. There is little variation in the daily seasonal temperatures, while average monthly temperatures range from 23.9˚C up to 29.6˚C. The lowest temperature ever recorded was 17.0˚C (March 2000) and the highest was 34.1˚C (May 2005).

Annually, from July to December the country may experience periods of heavy rain, often marked by the passage of tropical systems originating off the coast of West Africa — this is known as the wet season. On the other hand, a period of low precipitation is experienced between the months of January to June — known as the dry season (Figure 3). However, rainfall trends are often variable, and severe droughts may occur every 5-10 years. The average annual rainfall is about 46.75 inches. From 2013 to

2016, the country went through a drought, which was classified as the worst drought in its history. In addition to droughts, the islands are also prone to hurricanes that tend to occur between the months of June and November. From 1851 to 2011 Antigua and Barbuda has had 93 storm systems with 44 developing into hurricanes. The heart of the hurricane season (from August to September) usually accounts for 79% of all storms that affect the island. In September 2017, the country experienced its first ever Category 5 hurricane according to the Saffir-Simpson Hurricane Wind Scale. On September 5, 2017 Hurricane Irma hit Barbuda with winds over 185 mph. The hurricane destroyed more than 90% of the infrastructure in Barbuda leaving the island uninhabitable.

1.2 SOCIO-ECONOMIC PROFILE

1.2.1 POPULATION

A national census is conducted every 10 years by the Statistics Division. The last Population and Housing Census carried out in 2011 provided the population estimate for the nation as 88,566. Current projections show the population estimate at 96, 655. Between the 2001 census and 2011 census there was a 15.6% growth in the population. The split among the population favours the female sex, particularly among the higher age ranges. Concerning the distribution, most of the population is concentrated in the capital.

Approximately 21,643 people live in St John's city, and 29,486 live in rural St. John's. The parish with the second highest number of inhabitants is St. Paul, with 8,116 people living in this area. On the other hand, the parish with the lowest level of population is St. Phillip, while Barbuda has the least number of people in the largest land area. According to the last Population and Housing Census there was an increase in the number of people living in the rural areas of St. John's, between 2001 and 2011. The life expectancy for males is lower (75 years) to that of females (81 years). Education rates have also improved for the young population with some 82% of persons under 15 years of age attending school full-time.

1.2.2 EMPLOYMENT

The 2011 census illustrated that 40,400 individuals had a job while another 3,454 were seeking re-employment. The employment rate is 10.2% with the parish of St. John's having the highest unemployment. The primary employment sector is tourism— a highly seasonal industry— while the agricultural sector has the lowest employment rate. For this reason, the country experiences high rates of seasonal unemployment. The country is presently conducting a national Labour Force Survey which will be able to provide more updated information. This should be available in the upcoming months.

1.2.3 POVERTY

Within the territory of Antigua and Barbuda, indigent persons are defined as individuals whose expenditure per annum is less than EC$2,449 (US$917) but is adjusted to EC$6,318 (US$2,366) per annum as the poverty line. Based on results from the National Country Poverty Assessment Report of 2007, 18% of the population lives below this poverty line with 4% considered indigent. Vulnerable persons are included (i.e. someone at risk of falling into poverty due to a tragedy),and over twenty eight percent (28.3%) of the population is considered to be at risk.

1.2.4 HUMAN DEVELOPMENT

The United Nations Development Programme (UNDP) ranks Antigua and Barbuda 62nd out of 188 countries with a score of 0.786 on its 2015 Human Development Index (HDI). This represents an increase of 1.86% on the 2005 score and is primarily due to the following changes between those years: life expectancy by 4.8 years, average years of schooling by 2.2 years, and expected years of schooling by 0.8 years. Antigua and Barbuda is considered within the category of "High Human Development".

1.3 ENVIRONMENT AND NATURAL RESOURCES

Antigua and Barbuda is recognized for its high biodiversity, which combined with other topographic and geographic features results in a variety of ecosystems and associated services. These natural services are inclusive of water retention (via its forest and watersheds), shoreline protection (coral reefs, mangrove forest), livelihoods (fisheries), and tourism/eco-tourism (beaches, mangroves, biodiversity, aesthetics). The nation places great value in these environmental resources as they are instrumental in its economic and social development. Environmental monitoring is critical to assess climate change and its influences, and it is therefore important to be aware of the potential impacts of this phenomenon on the country's environmental resources.

1.3.1 MARINE AND COASTAL RESOURCES

Owing to its location within the north-eastern archipelago belt of the Caribbean, Antigua and Barbuda is host to a variety of marine ecosystems including: mangrove wetlands, seagrass beds, coral reefs, sandy beaches and rocky-intertidal shores. These ecosystems provide a variety of ecosystem services as described below.

1.3.1.1 CORAL REEFS

The continental shelf of the nation is host to a variety of reef systems. The shelf region is quite narrow in some portions of the island, with depths of >100m found less than one kilometre from the shore, while in other areas it is as much as 5km offshore. Coral reefs are found around the island with an estimated coverage of approximately 44.74 km^2 on the island of Antigua alone. Extensive mapping of the spatial distribution of the reefs on Barbuda or Redonda has not yet been conducted. The islands' reefs systems vary in their development, primarily as a result of water circulation patterns, wave factors, anthropogenic and natural perturbations. The reefs on the windward coast have greater development than those on the leeward coast, primarily a result of the ocean currents, which affect the island. The reef types found around the island vary, and include: barrier reefs, fringing reefs and patch reefs.

Coral reefs are valuable ecosystems. They are essential in the formation and protection of beaches; provide a habitat for a variety of species; and play an important role in economic activities. These ecosystems are highly threatened by both anthropogenic and natural forces. In particular, climate change is predicted to have large scale effects on coral reef ecosystems, including increased frequency and intensity of storms (physical damage to coral reefs), rising ocean temperatures (increased episodes of coral bleaching, and greater spread of diseases), and increased ocean acidity (weakening of the hard structure of reef systems). Additionally, coral reefs also suffer from anthropogenic disturbances, inclusive of illegal marine dumping and pollution (eutrophication, spread of diseases), coastline development and dredging (increased sedimentation, damage to physical structures), and poor management (loss of key species-parrotfish, reef destruction, etc.).

1.3.1.2 SEAGRASS

Seagrass beds are commonly found in the shallow waters of the coasts off of Antigua and Barbuda. The most common types are Turtle Grass (*Thalassia testudinum*), Manatee Grass (*Syringodium filiforme*), variations of the *Halimedia spp* (also a source of sand for beaches) and the invasive Broad Leaf Seagrass (*Halophila stipulacea*). The primary role of seagrass in the marine ecosystem is to

provide a habitat for juvenile marine species, inclusive of juvenile queen conch (*Strombus gigas*) and Caribbean Spiny Lobsters (*Panulirus argus*), which are important for commercial fishing activities. Additionally, they provide food for herbivores, including the endangered Green Sea Turtle (*Chelonia mydas*). Seagrass beds are part of the marine trinity of ecosystems (mangroves, seagrass, coral reefs), which enable the Caribbean marine life to have its high biodiversity.

1.3.1.3 MANGROVE WETLANDS

Antigua and Barbuda is home to extensive mangrove wetland ecosystems, which as of 2010, occupied approximately 10.4% of the country's total land mass. One of the largest mangrove sites is found in Barbuda, and it extends some 352 hectares and is home to the Magnificent Frigate Bird sanctuary. There are four types of mangroves found in the twin island state: *Rhizophora mangle* (red mangrove), *Avicennia germinan*s (black mangrove), *Laguncularia racemosa* (white mangrove) and *Conocarpus erectus* (buttonwood mangrove).

Mangroves play an important role in the marine ecosystem, and they provide habitat for a variety of marine and terrestrial fauna, inclusive of the avian variety, and help to reduce the sediment levels from terrestrial based runoff. Mangroves are also crucial during storms, acting as natural barriers from the impacts of rough waters and storm surge. Studies suggest variations in wetland coverage in Antigua and Barbuda, and in 2010, mangroves covered 3.2% and 23% of Antigua and Barbuda's land mass respectively.

1.3.1.4 BEACHES

An important feature that characterizes the coastal landscape of Antigua and Barbuda is its white, sandy and idyllic beaches. The country proudly boasts 365 beaches which represent one of the biggest tourist attractions thus contributing significantly to the nation's GDP. Beaches also provide habitat for a variety of fauna and flora, inclusive of the native Hawksbill Turtle, which is a national symbol. These beaches are culturally important for the local population who utilize them for aesthetic and leisure reasons. Additionally, they provide a vital ecosystem service by acting as a barrier between the marine and terrestrial environment.

1.3.2 THREATS TO MARINE AND COASTAL ECOSYSTEMS

Mangrove and seagrass ecosystems are threatened by anthropogenic impacts, inclusive of climate change and coastal development. Rising sea levels and increasing ocean temperatures will affect the ability of these ecosystems to remain healthy. The limitation of space or unfavourable growth conditions, along with an increase in storm intensity and frequency will further intensify the physical stressors faced. Coastal developments, inclusive of hotel and marina facilities can alter the coastline resulting in less than optimal conditions for survival. The loss of these ecosystems will, in turn, result in the loss of invaluable ecosystem services, and thus focus has been placed on better understanding and managing these ecosystems. Projects, such as the Sustainable Island Resource Management Mechanism (SIRMM) and the Global Environment Facility (GEF) project Integrating Watershed and

Coastal Areas Management (IWCAM) have both attempted to develop a comprehensive baseline for these ecosystems. Beaches are particularly exposed to the impacts of climate change and other anthropogenic activities. Coastal erosion, primarily due to increased intensity of storms, and sea level rise are two of the factors that particularly threaten these landforms. Furthermore, human activities also severely affect the beach structure, especially activities such as coastal development and sand mining on or near the shoreline.

1.3.3 TERRESTRIAL RESOURCES

1.3.3.1 WATER RESOURCES

Out of the thirteen watersheds that have been identified in Antigua, six, covering over 11,572 hectares of land, are recognized as critical based on their agro-ecological, hydrological and socio-economic values (Body Ponds, Potworks, Fitches Creek, Parham, Bethesda and Christian Valley). These six watersheds account for 41% of the land area in Antigua. They sustain 50% of the forests and 90% of crops, while accounting for 90% of surface, and 80% of groundwater supplies.

Freshwater resources in Antigua are vulnerable to the effects of climate change, inclusive of the predicted effects of increased drought conditions. Another concern is that of saltwater intrusion into the groundwater resources, as a result of sea-level rise and the proximity of these water resources to the marine environment. The water sector has been given priority in respect to adaptation measures, and increased water desalination technologies are currently being utilized in the country.

Four desalination plants supply APUA's (Antigua Public Utilities Authority) water system with two new plants scheduled for commission shortly. Approximately 60% of the public water supply on Antigua is desalinated seawater whereas on Barbuda the water supply is derived from the desalination of brackish water.

As it relates to water storage, the country employs a variety of storage systems, inclusive of reservoirs, ponds and dams, which account for 1.6 billion imperial gallons. Households employ rainwater harvesting systems (e.g. cisterns, tanks, etc.) to deal with the issue of water storage.

The primary source of freshwater in Barbuda has been the shallow aquifers underlying 650 ha of sand in the Palmetto Point Area. However, extensive sand mining in that area has resulted in some desiccation of the water table, resulting in the use of desalination technology to supply water demands. In Barbuda, for example, in 2016 a new Reverse Osmosis plant was installed with a capacity of 100,000 imperial gallons per day.

1.3.3.2 NATURAL VEGETATION AND SOILS

The nation has suffered from trends of forest degradation and loss of floral ecosystem services. This began in the colonial era, where watersheds were denuded of vegetation to facilitate sugar plantations. Over time, sugar plantations were replaced by housing, hotels and other development infrastructure. As such, terrestrial vegetation coverage on Antigua is largely secondary growth, with very few areas of primary growth. The floral community consists of shrublands/ grasslands, lowland tropical forest, montane forest and mangrove forest. Barbuda has retained significant portions of its native forest, which consists primarily of an evergreen bush forest. In total, the islands are home to 54 vegetation communities, 16 of which are rare.

The soil resources of Antigua and Barbuda were described in detail following the soil survey carried out by the Regional Research Centre of the University of the West Indies in the early 1960's and mapped at 1:25,000 scale. This was published in 1966 (Hill 1966). Some additional descriptions were added during the mid-1980's by Ahmad and published by the Organisation of American States (OAS 1990) when a new map at 1:50,000 was provided.

Soil formation has been determined primarily by the parent materials, topography and rainfall regime. Antigua has three main geological regions: the volcanic hills of the south west; the lower central region

of volcanic related deposits; and the limestone region of the north and east. Hill described 33 soils in his survey, but these may be conveniently grouped into five broad groups according to depth and texture. These comprise:

1. Deep alluvial/colluvial soils in the valley systems of the volcanic region. These soils are primarily sandy loams or loams with near neutral pH. Some of the best tree growth is found in these soils
2. Deep kaolinitic clay soils of the Central Plain. These are hard to work, heavy clays with impeded drainage and near neutral pH. Some are saline at various depths below the topsoil. Some calcareous clays are found in parts of this region
3. Generally shallow calcareous clay soils of the limestone areas in the north. These are productive in the deeper phases over the softer marl. Despite the high clay content, they possess good structure and have high base saturation. Soil pH is around 8.2
4. Complex of shallow and deep calcareous soils, mostly in the eastern part of the limestone region. Similar to Group 3 but with greater areas of deeper soils. Drier climate restricts productivity.
5. Shallow soils of the mountainous volcanic region. These are thin to very thin, stony soils formed over andesite and basaltic rocks. They are mostly clay loams and clays of reddish-brown colour with slightly acid pH. Steep slopes, erosion hazard and shallowness preclude use for other than watersheds, and forest cover.

The deeper marl soils and the alluvial soils of the volcanic area are the most productive soils for agriculture and will support production of a range of vegetables and tree crops. Water remains the biggest limitation to agricultural production

In Barbuda, there are three main soil series corresponding to the three geological regions. The Barbuda series is found predominantly over the hard limestone of the Highland region and is composed of a reddish kaolinitic clay loam. The Blackmere series is found at lower elevations over hard limestone and is a brown clay loam. The Codrington series is found on the more recent terraces of hard limestone and is a dark coloured montmorillonitic clay. There are also extensive areas of very young soils developing on stabilized beach sands and dunes, where water holding capacity is very low and drainage is excessive.

1.4 ECONOMY

1.4.1 TOURISM


Ramsar Site: Codrington Lagoon Frigate Bird Sanctuary

Antigua and Barbuda has a service-based economy with tourism being the main driving force of economic growth, accounting for nearly 60% of the total GDP and 40% of investment. Tourism directly provides 5,000 jobs and accounts for 18% of total employment in the nation (World Tourism and Travel Council, 2011). Tourists visiting the twin island state come mainly from the USA, Canada, UK and other Caribbean islands with USA visitors accounting for the largest proportion. As for cruise ship visitors, there has been a slight decrease in the number of passengers. The highest number of passengers recorded was in 2009 where it reached 709,795 passengers per year. However, it has decreased since then reaching 594,729 passengers in 2016. This poses a significant threat to the economic stability of the country, which is extremely dependent on this industry for promoting economic growth. Nonetheless, total visitor expenditure has increased since 2000, following a steady trend in more recent years. For the year 2016, total visitor expenditure was estimated to be US $334.62 million thus accounting for up to 28% of the country's total GDP.

1.4.2 FINANCIAL SERVICES

A common feature of the Caribbean islands, including Antigua and Barbuda, is that they have a high financial sector ratio relative to their size (10 per 100,000 inhabitants, more specifically in the case of insurance). In 2012, the financial sector accounted for approximately 10.13% of the country's total GDP. However, this figure has been steadily decreasing since, and was expected to reach 9.15% by 2018.

The local sector is made up of approximately 60 institutions that include banks, credit unions, insurance companies, pension funds, and any other firm whose operations involve financial intermediation. Furthermore, there are significant offshore financial services, through which Antigua and Barbuda domiciles over 4,200 companies. The country enjoys a relatively stable currency as a member of the Eastern Caribbean Currency Union (ECCU), regulated by the Eastern Caribbean Central Bank. However, there have been challenges and constraints on the economy of the nation and its growth projections.

In 2007, the Catastrophe Risk Insurance Facility (CRIF) was established by Caribbean countries as a result of the disproportionate level of risk that SIDS experience from climate change hazards. Caribbean countries are particularly vulnerable, and evidence shows that they are significantly affected by major weather events and can easily incur losses accounting for up to 100% of their GDP. Hurricane Ivan, for example, cost Grenada 203% of GDP in 2004 and an earthquake in Haiti cost 114% of GDP in 2010.

In the context of climate change, the availability and affordability of insurance is affected. The financial services sector has seen a rise in the costs of private properties and an increase in health insurance rates, all due to the negative impacts of climate change hazards. At a national level, research shows that the financial services sector in Antigua and Barbuda is marginally aware of the risks that come with climate change. Nonetheless, it remains particularly vulnerable given the role of reinsurance, risk assessment methodologies and minimal government and political engagement. The

common response to increased frequency of weather events is to increase the insurance premium levels. Given the country's vulnerability to climate change hazards, an increase in the cost of insurance could result in a major impediment to investments and financial activities in the years to come.

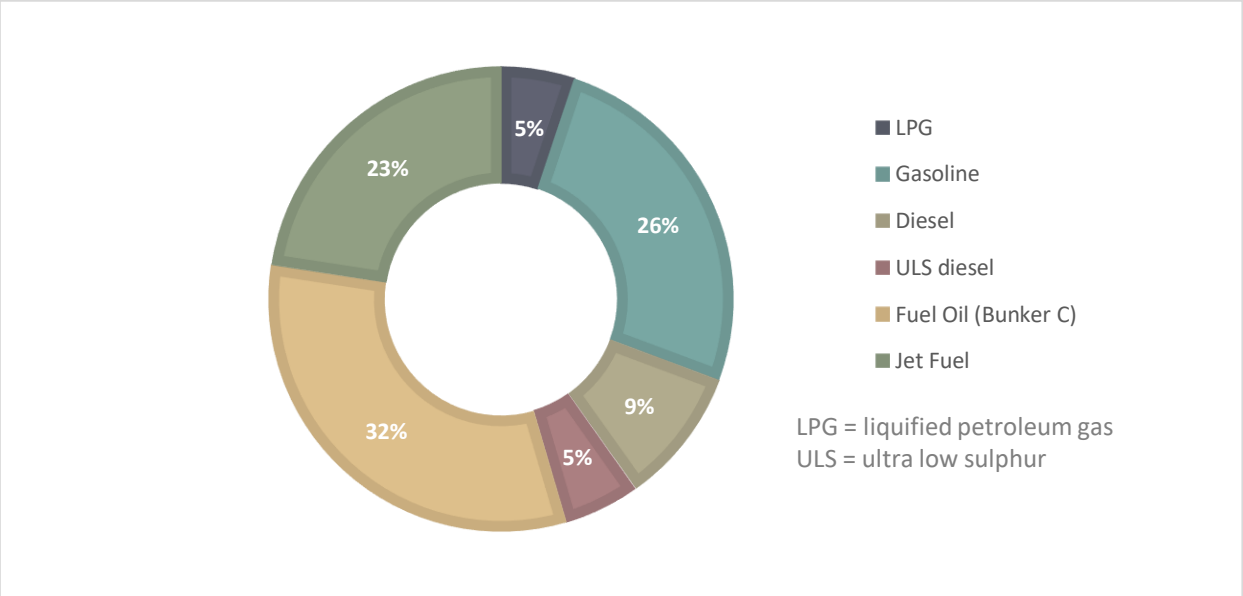
1.5 GHG EMISSIONS TRENDS AND ON-GOING ACTIONS

SIDS like Antigua and Barbuda contribute very little to global GHG emissions. The largest share of emissions is from the Energy Sector, Land Use Change and Waste follow. The country is committed to implementing measures to grow its economy in a low carbon and sustainable manner, in this regard Antigua and Barbuda has already implemented several sector specific actions.

1.5.1 ENERGY SECTOR

With no fossil fuel resources, Antigua and Barbuda imports 100% of its petroleum-based products. These products include Heavy Fuel Oil (HFO), Diesel, Liquified Petroleum Gas (LPG), Jet Fuel and Gasoline— which are used for generating electricity, transportation (vehicular and aviation) and domestic or commercial consumption. The fuel is supplied by the West Indies Oil Company (WIOC) which is privately and government owned. Fuel import averages 4,500 barrels a day, see figure 1 below and in 2015, the estimated value of imported oil was US$160.1 million. The current rate for electricity is USD 0.37/kWh, which resulted from falling oil prices. Previously in 2013, it was USD 0.44/kWh in.

Figure 1: Fossil Fuel Import into Antigua and Barbuda for 2015



Electricity is generated by the Antigua Power Company through generation capacity and energy under a power purchase agreement, as well as by the Wadadli Power Plant. The electricity produced on Antigua is as a result of HFO, whereas Barbuda is powered by a diesel operated plant.

As for renewable energy sources there are few supplied around the island via private entities. However, the government has investigated the use of renewable energy technology and plans to install a 10-MW photovoltaic farm. The V.C. Bird International Airport is currently powered with 3MWp that accounts for 6% of Antigua's estimated 2015 peak demand (IRENA Report). An additional 6 MWp is to be installed at a solar farm in the east of Antigua and on government buildings, while the remaining 1 MWp is set to be used in Barbuda.

Additionally, the feasibility of the use of wind generators to produce renewable energy is being investigated under the Sustainable Pathways – Protected Areas, Renewable Energy (SPPARE) Project. This project will pilot the use of wind generators within the country in the next couple of years.

The use of biodiesel is being explored through the company Themba Biofuels, which collects used cooking oil from hotels, restaurants, bars, and cruise ships and converts it to biodiesel. This waste produces around 218,208 litters of biodiesel per annum and is used in various sectors of the economy: hospitality, construction, transportation, marine, agriculture and waste management. It powers vehicles, heavy equipment, standby generators, furnaces and marine vessels.

1.5.2 WASTE SECTOR

The Ministry of Health, Wellness and the Environment often contributes to the management of waste as it is an imminent health risk. This contribution has been showcased through the implementation of the plastic bag and polystyrene (Styrofoam) bans[4] in 2015 and 2017 respectively, which resulted in a significant reduction in pollution. The mandate for waste management lies with the National Solid Waste Management Authority (NSWMA) with the overall responsibility of managing solid waste generated within the state of Antigua and Barbuda—which includes storage, collection, treatment, and disposal. In the Authority's operational procedures, the methods of disposal are outlined and are dependent on each type of waste collected: household, industrial, commercial, institutional, medical, clean bulk, bulk waste, cruise ship, street sweep, sewage and tyre waste. NSWMA often collaborates with the Department of Environment (DOE), Development Control Authority (DCA), Antigua & Barbuda Public Utilities Authority (APUA), as well as other key stakeholders to assist in an advisory capacity. Based on a recent annual waste receipt communicated to the DOE, bulk waste accounts for the highest proportion of the total waste collected followed by household waste during the period January to February. Other waste types include clean bulk, waste from the industrial and commercial sectors, institutional waste, cruise ship waste, sewage, tyres and street sweep.

However, this is not enough to combat the problems faced. The financial resources of the authority are quite limited thus Antigua and Barbuda is feeling the pressure of increased waste generation on its main facility at Cook's Sanitary Landfill, which is currently not at the highest standard. There is no system in place that facilitates separation among waste types, and it is the hope of the Government of Antigua and Barbuda to build the capacity of the NSWMA through national and international funding to facilitate an improved waste management system.

[4] The External Trade (Shopping Plastic Bags Prohibition) Order, 2017, No. 83 and The External Trade (Expanded Polystyrene) (Prohibition) Order, 2018, No. 44 respectively

1.5.3 TRANSPORTATION SECTOR

Climate Fest: Local electric car dealer shares information about electric vehicles used at the DOE

The transport sector is witnessing significant developments mainly focusing in three rising trends: electrification, shared mobility, and vehicle automation. While being interrelated, these trends have tremendous implications on how people and goods will be moved in the future. Plug-in electric vehicle commercialization started in 2008-9 brought about by the economic downturn and spikes in oil prices in those years, and the consequent policy interest in alternatives to petroleum fuels[5]. The DOE is piloting an Electric School Bus project which is the first step in transforming the island's school bus fleet into fully electric vehicles. An electric vehicle transitioning scoping and technical feasibility study was commissioned and will provide guidance to the upscaling of this project.

Presently, the Transport Board of Antigua and Barbuda's fleet is divided into motorcycles, private vehicles (PV), light duty vehicles (LDV), heavy-duty vehicles (HDV) and buses. Table 2 shows the number of vehicles in each of these categories and specifies fuel type, purpose and weight segment of each of them[6].

Table 2: Road Transport Sector Fleet Composition in the Year 2015

[5] LOGIOS, 2018. Electric Vehicle Transitioning Scoping & Technical Feasibility Study

[6] LOGIOS, 2018. Electric Vehicle Transitioning Scoping & Technical Feasibility Study

Category	Weight	Fuel Type	Operation	Quantity (% of total)
Motorcycles	Light	Gasoline	Private passenger	570 (1%)
Private vehicles	Light	Mostly gasoline	Private passenger	35,350 (72%)
Light-duty vehicles	Light	Gasoline/Diesel	Products and services	8,800 (18%)
Heavy-duty vehicles	Heavy	Mostly diesel	Products and services	2,330 (5%)
Buses	Heavy	Diesel	Public passenger	1,840 (4%)
			Total fleet	**48,900**

1.5.4 FORESTRY AND LAND USE

A Sustainable Island Resource Management Zoning Plan (SIRMZP) was adopted by the Parliament of Antigua and Barbuda for implementation in 2012, and it serves as the National Physical Development Plan (NPDP). Its main goal is to develop a framework that addresses development issues, as well as anthropogenic and natural forces that threaten the country. It also provides a platform to steer national sustainable development projects given the environmental situation of Antigua and Barbuda.

Antigua and Barbuda is highly vulnerable to the impacts of climate change given its geographical location, climate, topography, geology and economic history. The country is rendered more vulnerable to the effects of climate change through its status as a SIDS and the push for revenue generation through development opportunities. In light of this, the SIRMZP was developed and adopted by Parliament in 2012 to inform sustainable development.

The nation has suffered from trends of forest degradation and loss of floral ecosystem services. This began in the colonial era, where watersheds were denuded of vegetation to facilitate sugar plantations. Over time, sugar plantations were replaced by housing, hotels and other development infrastructure. As such, terrestrial vegetation coverage on Antigua is largely secondary growth, with very few areas of primary growth. The floral community consists of shrublands/grasslands, lowland tropical forest, montane forest and mangrove forest. Barbuda has retained significant portions of its native forest, which consist primarily of an evergreen bush forest. In total, the islands are home to 54 vegetation communities, 16 of which are rare (DOE, SIRMM Project Document).

The country experiences development challenges, *inter alia*: unplanned development, roaming livestock, poor farming practices, poor waste management, and poor watershed and associated resource management. Often, these practices lead to poor management of biodiversity resources. Additionally, climate change has forecasted increased instances of drought, which can have devastating effects on water supply, while increased frequency and intensity of storms threaten the ability of the ecosystem and economic facilities to survive in the future.

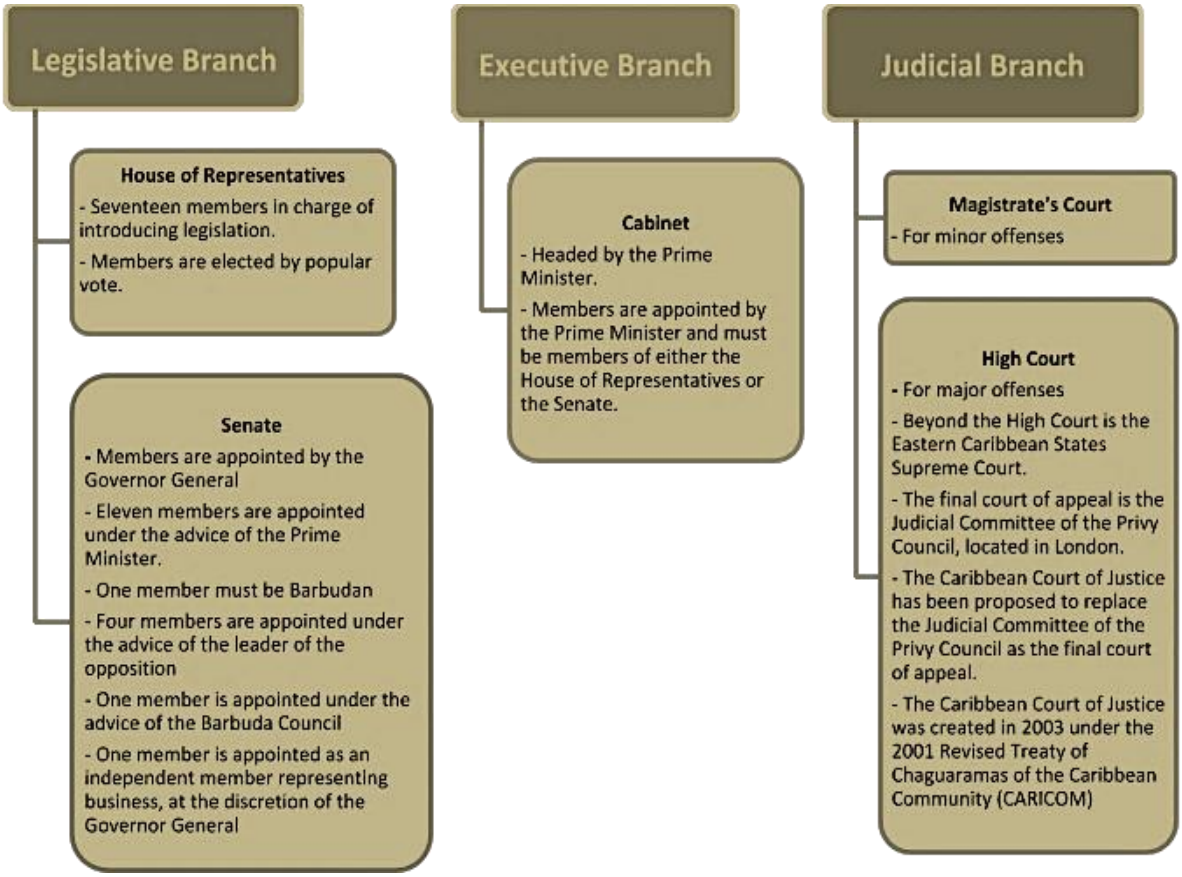
When observing trends in land use for Antigua and Barbuda between the period 1985/95 and 2010, it can be observed that general trends have remained fairly stable, with the exceptions of: recreation and historic areas (decreased), and industrial development (increase). Important to note, an increasing population, from 63,880 in 1980s to 84,816 in 2010, (Statistics Division 2017) has not resulted in any large-scale changes in land available for agriculture. Consequently, there is an increased reliance on food imports to feed the growing populace.

1.6 INSTITUTIONAL FRAMEWORK

1.6.1 GOVERNMENT

Antigua and Barbuda is a constitutional monarchy with a British-style parliamentary system of government. The country has a bicameral parliamentary system made up of a Senate (Upper House) and a House of Representatives (Lower House). The country achieved its full independent status in November 1981. However, the Queen of England, like many Commonwealth Countries, continues to be the Head of State. She is represented by the Governor General, who is a citizen of the country. In the case of Barbuda, the island is governed by the Barbuda Council, which takes its mandate from the Barbuda Local Government Act CAP.44 of the Laws of Antigua and Barbuda. Figure 2 below depicts the structure of Antigua and Barbuda's Government.

Figure 2: Structure of the Government of Antigua and Barbuda



1.6.2 INTERNATIONAL CLIMATE COMMITMENTS

Antigua and Barbuda recognized the need to address the impacts of climate change by ratifying the UNFCCC in 1993. The country is also a Non-Annex 1 Party to the Kyoto Protocol as well as the Montreal Protocol on Substances that Deplete the Ozone Layer which it ratified in 1992. The twin island state is also part of the 150 countries that have ratified the Paris Agreement, thus committing itself to pursue efforts to limit the increase of global temperatures. The Government believes that

effective implementation of these international Climate Agreements are key to protecting its people and its existing and future investments.

As part of its commitment to address climate change matters, the country communicated on October 2015 its Intended Nationally Determined Contributions (INDC's). The INDC's were approved and became Antigua and Barbuda's First Nationally Determined Contributions (NDC). The first NDC communicated Antigua and Barbuda's intention to implement a variety of National and Sector Mitigation policies related to emission reduction and adaptation actions. These mitigation, adaptation and cross-cutting commitments represent a refocusing of the country's efforts to combat climate change away from Antigua and Barbuda's original target, as part of the pledge to the Copenhagen Accord, of a reduction of 25% from 1990 levels by 2020, included in the Third National Communication[7].

Antigua and Barbuda's First NDC[8] Targets are:

- Unconditional targets
    - Enhancing the enabling legal, policy, and institutional environment, for a low carbon emission development pathway to achieve poverty reduction and sustainable development, *and*
    - By 2020, updating the building code to meet projected impacts of climate change.
- Conditional mitigation targets
    - By 2020, establishing efficiency standards for the importation of all vehicles and appliances,
    - By 2020, finalizing the technical studies with the intention to construct and operationalize a waste-to-energy (WTE) plant by 2025,
    - By 2030, achieving an energy matrix with 50 megawatts (MW) of electricity from renewable sources, both on and off grid and in the public and private sectors, *and*
    - By 2030, protecting all remaining wetlands and watershed areas with carbon sequestration potential as carbon sinks.
- Conditional adaptation targets
    - By 2025, increasing seawater desalination capacity by 50% above 2015 levels,
    - By 2030, improving and preparing all buildings for extreme climate events, including drought, flooding, and hurricanes,
    - By 2030, meeting 100% of electricity demand in the water sector and other essential services (including health, food storage, and emergency services) through off-grid renewable sources,
    - By 2030, protecting all waterways to reduce the risks of flooding and health impacts
    - By 2030, making available an affordable insurance scheme for farmers, fishers, *and* home and business owners to cope with losses resulting from climate variability.

Given that Antigua and Barbuda is a SIDS, additional funding will be required to meet the conditional mitigation and adaptation targets.

[7] https://unfccc.int/resource/docs/natc/antnc3.pdf

[8] Prior to the 21st COP, these commitments were referred to as Intended Nationally Determined Contributions (INDCs) and post COP, as NDCs. " First NDC" is used throughout the BUR document for simplicity.

1.6.3 CLIMATE CHANGE GOVERNANCE ARRANGEMENTS

With the increase in globalization and changes in technology, countries are required to continuously review and update their legal framework, which is needed to ensure effective international competition, reporting and compliance with the requirements of MEA's. Prior to 2015, the environmental legislative framework was made up of forty pieces of legislation that governed various areas of sustainable development. The institutional arrangements were also fragmented, and they were designed in such a way that agencies that were major resource users were given power and the ability to regulate themselves. However, this legislative framework did not include criteria to assess resource exploitation based on sustainable, environmental or social protection terms. As a result, this represented an additional burden on the country's adaptive capacity to climate change.

The Government of Antigua and Barbuda decided to include a provision within the present EPMA 2019 which allows for the establishment of an appropriate coordinating mechanism for all the multilateral environmental agreements the country has ratified (inclusive of the climate change ones). However, this mechanism is yet to become fully operational.

This action is aligned with the EPMA 2019 which states in Part XI, Section 90 that:

> *The Minister (with responsibility for the environment) shall ensure that Antigua and Barbuda–*
>
> > *… (d) establishes appropriate mechanisms to facilitate the exchange of information relating to negotiating and implementation of, and compliance with multilateral environmental agreements.*

The creation of this mechanism is intended to facilitate a more flexible and robust system that would allow the integration of new climate change related policies into national plans and programmes and more importantly into the national budgetary process. The government also established an Energy Desk responsible for addressing matters within this sector, which is the greatest contributor to greenhouse gas emissions.

The responsibilities for implementing and complying with the UNFCCC reside with the Department of Environment (DOE). Located within the Ministry of Health, Wellness and Environment, this institution uses a functional approach, allowing it to be flexible in the implementation of its projects and programmes. The DOE is currently transitioning from a culture of serving as a Division to that of a Department. The transition process includes the development of policies and operational manuals, participation in training, and the passage of regulations to give effect to policies. The process has seen some unanticipated delays, but the DOE is steadfast in its approach to fulfil the goal.

Policy and legislative mandates are integrated into various policy documents, such as: the SIRMZP and its enabling legislation, the National Biodiversity Strategic Action Plan (NBSAP), the National Environmental Management Strategy (NEMS), the EPMA 2019, the Sustainable Island Resource Framework Fund (SIRF Fund) and the Medium-Term Development Strategy. The Government of Antigua and Barbuda has committed to effectively managing climate change and other environmental issues through the establishment of the NDCs. This is in keeping with the UNFCCC Paris Agreement. The country is now working towards meeting the various adaptation, mitigation and unconditional targets outlined in the First NDCs.

With the typical challenges of small countries to access funding, the Government of Antigua and Barbuda sought to design the SIRF Fund that will leverage resources from the GEF, AF, GCF and local resources. The DOE is the Focal Point for each of the funding agencies as well as the UNFCCC itself as well as an accredited entity to the AF. The DOE's mandate is enshrined within the EPMA 2019. The DOE is also joint NDA for the GCF and is accredited to the GCF as a direct access entity. The coordination between the climate funds has allowed Antigua and Barbuda to pool and maximize the impact of the funds available to the country. This has enabled the centralization of the resources

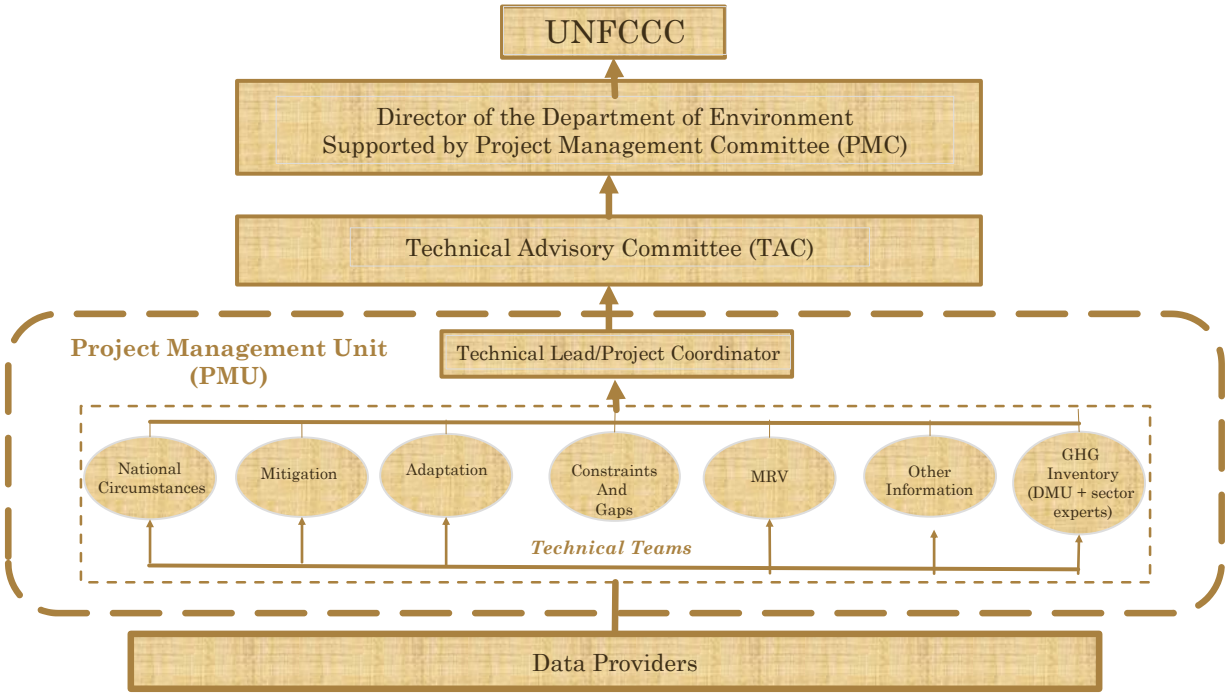
and relevant risks which are compensated by the DOE, who is mandated by law to utilize a coordinated approach to the full implementation of the UNFCCC.

1.7 ARRANGEMENTS FOR THE PRODUCTION OF NC'S AND BUR'S ON A CONTINUOUS BASIS

Antigua & Barbuda has prepared and submitted three national communications to the United Nations Framework Convention on Climate Change, i.e. the First National Communication (2001), the Second National Communication (2009) and the Third National Communication (2015). In all three cases, the financial support for the preparation of the reports was provided by the Global Environment Facility (GEF). In the first instance, the Office of the Prime Minister was responsible for the coordination of that report with the Environment Division spearheading the development of the two latter reports. Presently, the Biennial Update Report (BUR) is being coordinated by the Department of Environment (DOE) in the Ministry of Health, Wellness & the Environment and it is foreseen that future reports will be coordinated by the DOE.

The DOE is putting in place the institutional arrangements for regular preparation of national communications and biennial update reports. The structure is depicted in Figure 3 below.

Figure 3: Organizational arrangements for preparation of NC's and BUR's



The DOE will assume the role of national coordinating entity and the Director will identify a Technical Lead/Project Coordinator to oversee the overall preparation of the reports. The Director will also coordinate the selection of the necessary technical teams to prepare the individual chapters. A Technical Lead will be appointed for each chapter of the report, to include the drafting of the National Circumstances, Mitigation, Adaptation, Constraints & Gaps, Monitoring, Reporting & Verification and Other Information. The Greenhouse Gas Inventory will be led by the Monitoring, Evaluation & Data Management Unit (DMU) of the DOE. The Data Manager will assemble the technical team from within the DMU to oversee the GHG inventory and identify relevant sector experts to support data collection and analysis. A draft National Inventory Management System (NIMS) is being delivered

with the BUR, however, this has not been completed. This will be finalized with the Fourth National Communication.

The DOE is supported by several technical teams that are responsible for providing high-level technical guidance, policy input and support. Additionally, these teams play a role in facilitating communication, technical cooperation and coordination among stakeholder agencies and other project partners. The Technical Lead/Project Coordinator for the reports will be selected from the Project Management Unit (PMU), a Unit that consists of the officers directly involved with the day-to-day operation of the projects and programs. The Technical Advisory Committee (TAC) comprises representatives of government and non-governmental organizations (NGOs) and facilitates a link between national priorities and international obligations. The TAC's main role and responsibility is to share knowledge, test and verify findings, conduct risk analysis, and support with education. All technical documents prepared are first reviewed by this team of technicians before being finalized. Lastly, the Project Management Committee (PMC) is a cabinet appointed committee that is established to primarily provide financial, policy and administrative oversight. The function of the PMC is to focus mainly on final decisions on procurement, institutional arrangements and financial management of the project.

Generally, the flow of information will be from the data providers to the technical national working groups led by their respective Technical Leads. Draft reports will be submitted by the Technical Lead/Project Coordinator to the TAC who will review and, upon finalizing the report, submit to the Director of the DOE and the PMC. The DOE then submits to the UNFCCC on behalf of Antigua and Barbuda.

1.8 NATIONAL DEVELOPMENT PRIORITIES

The Government of Antigua and Barbuda is determined to facilitate a nation that is harmonious, prosperous, modern and guided by the principles of sustainability and inclusive growth where equality of opportunity, peace, and justice will prevail for all citizens and residents. Efforts to achieve this will be guided by a strong development planning and implementation framework that will complement the free market mechanism. This means that a sustainable development framework will be used to develop and implement actions towards reaching its vision.

The sustainable development approach that the nation will follow is essentially a systematic one in which the public-sector machinery is treated as a single system that works towards a singular goal. Under this framework, targets will be set for achievement of goals over the long-term planning period (2015 to 2030), as well as over the medium-term planning period (2016 to 2020). These goals and their associated targets are to be synergized, where applicable, based on national circumstances, with the Sustainable Development Goals (SDGs) and their associated targets, which have been agreed to by the international community.

Antigua and Barbuda's agenda for socio-economic development, has been cultivated by the Ministry of Finance and Corporate Governance, which is under the directive of Prime Minister Hon. Gaston Browne. This agenda has since been manifested into a strategic plan for medium term development and, so named the "Medium-Term Development Strategy (MTDS)".

1.8.1 MEDIUM TERM DEVELOPMENT STRATEGY

The MTDS' ultimate goal is to improve the quality of life for all Antiguan's and Barbudan's and their posterity. The overarching goal will be attained based on the following four Sustainable Development Dimensions (SDDs):

1. Optimal Generation of National Wealth;
2. Enhanced Social Cohesion;
3. Improved Health of the Natural Environment and Sustained Historical and Cultural Assets; and
4. Enhanced Citizen Security.

Seven flagship priorities have been identified as having the potential to transform Antigua and Barbuda over the medium-term in support of the overarching goal and the SDD:

1. Adequate Infrastructure;
2. Strong Tourism Industry as an Economic Anchor;
3. Transform Barbuda into a Green, Low Density, High-End Tourism Destination;
4. Better Utilization of our Marine Space;
5. Export of Non-Tourism Services;
6. Reducing the Cost of Energy and Improving Energy Security; and
7. Better Access to Adequate Housing.

The MTDS was completed in 2015 and represents a set of strategies and actions to be undertaken by Antigua and Barbuda over the medium-term (2016 to 2020) with the intention to set guidelines and targets in moving the country towards its long-term goals of embodying sustainability. The Ministry of Finance will also be tasked with: monitoring the achievement of the Ultimate Goal, the Sustainable Development Dimensions, and the Underlying Necessary Conditions, as well as examining system-

wide constraints relating to the effectiveness of development planning, strategy implementation, budgeting, the adequacy of fiscal resources, and human resource capacity limitations[9]. Monitoring of other key strategic actions will be undertaken by line ministries, other public-sector bodies and State–Owned Enterprises (SOEs). The MTDS also allows for reporting on the Sustainable Development Goals outlined in "The 2030 Agenda on Sustainable Development".

[9] Antigua and Barbuda Medium Term Development Strategy (2015), Ministry of Finance and Corporate Governance, Government of Antigua and Barbuda.

1.9 CLIMATE FINANCE STRATEGY – THE TRANSFORMATIONAL CHANGE PROGRAM

Antigua and Barbuda, like all parties to the UNFCCC and the Paris Agreement, is striving towards sustainable development, where poverty can be a thing of the past. The government has publicly acknowledged that this can only be attained and guided by a sustainable development approach. The Government has designed a Climate Change Transformational Program which will act as a catalyst for leveraging financing and promoting behavioural change required for the country to meet its mitigation commitments and adaptation needs. Changes to the current systems of governance and economic management are needed to allow Antigua and Barbuda to adapt to the impacts of climate change. This will allow the economy and the people to withstand a category 5 hurricane, one meter of sea level rise, and a drought lasting over three years, while the core economy remains functioning at a capacity similar to that if climate change was not occurring.

1.9.1 CHALLENGES IN ADDRESSING CLIMATE IMPACTS AND ACTIONS

The Gross Domestic Product (GDP) of Antigua and Barbuda is just under 1.4 Billion United States Dollars per year. Since Antigua and Barbuda has limited financial, physical and human resources, meeting its environmental targets will particularly depend on international support from organizations such as the GCF, the GEF, the Adaptation Fund (AF), along with multilateral and bilateral agreements. Achieving these targets will cost the country a significant amount of money.

As reported in Antigua and Barbuda's first NDC, only the cost of implementing the adaptation targets would reach up to US$20 million per year for the next ten years. It is estimated that the climate change needs for the country to transition to a low emission resilient economy will cost at least 1.4 Billion United States Dollars[10]. The cost of mitigation measures to transition to 100% renewable energy is currently being considered by the Government of Antigua and Barbuda and adaptation measures for each building, national infrastructure, water, back-up energy and insurance together represents a difficult task for such a small country.

Climate change, however, is one of the major threats to the country's ability to meet its developmental goals. This is further complicated by the country's status. As a middle-income country Antigua and Barbuda does not qualify for concessional financing. This type of financing is based on GDP and not on the ability of the country to cope with an environmental disaster caused by others. Antigua and Barbuda considers this system particularly unfair; it represents an abandonment of the polluter pays principle.

Antigua and Barbuda is ranked 152nd in the world for access to finance compared to other countries[11]. The country has just coped with a three-year drought during which time the percentage of water generated by desalination had to be increased from 40% to 80% in just a few short years and Barbuda was completely decimated by Category 5 Hurricane Irma in September 2017. This has placed a strain on the country since access to capital and credit is challenging. It is difficult for the country to maintain its economic growth if it were to face another hurricane or other natural disaster. The likelihood of these disasters has increased due to climate change caused by GHG emissions polluting our shared atmosphere, a problem to which the country has contributed very little.

Even with the most ambitious GEF, and GCF replenishment Antigua and Barbuda is only likely to access a small portion of its climate impact financing needs from sources external to the country. The largest source of financing available to the country for its climate change program therefore are,

[10] Information provided by the National Climate Change Focal Point.
[11] http://www.doingbusiness.org/data/exploreeconomies/antigua-and-barbuda

savings from phasing out fossil fuel completely (80M USD of June 2019) ensuring that local Financial Institutions (FI) green their portfolios to reduce climate impact risks via measures such as land use planning policy and legislation and enforcing building standards and purchasing insurance.

With each impact of climate change there is a major impact of the ability of the country i.e. Government, homeowners, and businesses to continue making payments to the banks and other financial institutions after a major event. The Government is designing this Climate Change Transformational Program to allow for rapid recovery from these events.

1.9.2 TRANSFORMATIONAL CHANGE – CATALYST FOR SOLUTIONS

The Government of Antigua and Barbuda Climate Finance Strategy is the Climate Change Transformational Program. This strategy is intended to guide government, national and international stakeholders in the approach to the implementation of the UNFCCC and the Paris Agreement and to bring about transformational change to the country. Antigua and Barbuda envisions transformational change as the catalyst needed to propel successful implementation of mitigation and adaptation measures to climate change. A programmatic approach is being pursued to achieve transformational impact to a low carbon and resilient economy. This transition is being designed to reduce risks to the country as the transition takes place. The transformational change program was developed using the recently developed policies and programs such as the Medium-Term Development Strategy (MTDS), the First NDC, the EPMA 2019, the draft Paris Regulations for Antigua and Barbuda, the GEF Small Grants Country Program Strategy, the soon to be adopted National Environmental Management Strategy, and the Climate Change Policy and Implementation Plan.

The Transformational Program is designed to address the gaps in environmental governance, policy development and implementation, project and program development execution, as well as other issues such as just transition of the workforce, gender, and monitoring and evaluation of impacts.

1.9.2.1 STRATEGIC APPROACHES AND KEY OUTCOMES

The government is therefore seeking to bring about transformative change in the areas of adaptation and mitigation to ensure that it is within its overall developmental aspirations and that climate change will not be a limiting factor. To this end, the country has developed a list of climate projects and has submitted these to the national government, the GCF and other donors for funding. These projects, along with those already under implementation, are expected to transform the key sectors and stakeholders to ensure that the climate change is not a deterrent to development. The list of projects is provided in Chapter 5 on Constraints and Gaps.

1.9.2.2 CHARACTERISTICS AND PRINCIPLES OF THE TRANSFORMATIONAL PROGRAM

The program will be designed and implemented based on the following principles:

- Procurement policy that deters the development of local monopolies and includes social investors;
- Special emphasis on private sector and community organizations such as churches, schools, clinics and other public and community buildings that are needed during droughts and hurricanes;
- Focus on government buildings and procurement using Environmental Management Systems Standards as a holistic approach to the design of projects as agents of change;
- Ensure a just transition of the workforce to support the new economy; and
- Develop and implement a sustainable procurement policy that respects GHG emissions, plastics and sustainable consumption.

The Climate Change Transformational Program and projects are guided by the country's draft Paris Agreement Regulations which uses a systematic approach of sustainable consumption and the Environmental Management Systems Approach to mainstream climate into national policies and work

programs of government agencies and business models of the private sector. Other guiding policies are listed within the entirety of this BUR.

1.9.3 CLIMATE CHANGE TRANSFORMATION PRIORITIES

Antigua and Barbuda's spatial development is guided by a National Physical Development Plan (NPDP). This physical development plan is a requirement under the Physical Planning Act of 2003 and is updated periodically. In 2012, the Cabinet of Antigua and Barbuda approved the Sustainable Island Resource Management and Zoning Plan (SIRMZP) to serve as the updated NPDP, which presents a forward-looking strategic, national spatial development framework that addresses current development issues, and provides a platform for feasible private and public-sector development initiatives, reflecting local cultural values and aspirations over the next twenty years.

Antigua and Barbuda intends to complement the SIRMZP strategy through the adaptation targets that have already been presented in the first NDC. These targets are incremental efforts to the national physical development plan as the targets elevate ambition beyond development, to build resilience through adaptation interventions in preparation for projected climate impacts.

The Climate Change Transformational Program will initially give priority to projects that build resilience in the Building, Infrastructure, Energy (off –grid back-up energy), Micro - Finance and Health sectors. Priority mitigation projects and programs will be in the area of grid resilience and stability, transportation, and waste to energy. The projects will be implemented alongside the development portfolio of the Ministry of Finance. This general approach will allow for coordination of financing including co-financing, improve social and gender inclusion into projects and generate measurable results.

1.9.3.1 DROUGHT AND WATER

Drought is a major concern for the country. Historically, the water sector in Antigua and Barbuda has been vulnerable to shortages as a result of droughts every 5 to 10 years. This is coupled with contamination from saltwater intrusion that threatens groundwater supplies. Some wells have already been capped as a result of saltwater intrusion.

Climate impacts will exacerbate freshwater scarcity. Antigua and Barbuda is in a zone expected to receive 30-50% less average annual rainfall by 2090 compared to late 20th century norms. In the Caribbean, sea level rise has been observed at between 1.5 and 3 mm per year, which will increasingly put inland freshwater resources at risk of saline intrusion.

Adaptation in the water sector is of national priority. Desalination reliance has already grown to account for 60% of national water supply, and this is the most viable option for enhancing freshwater resources. During times of drought, desalination can account for up to 90% of freshwater supply. Antigua and Barbuda has set the goal of **increasing seawater desalination capacity by 50% above 2015 levels by 2025.** This means approximately 5.4 million to over 8 million US gallons per day (GPD) to counteract freshwater scarcity in Antigua and Barbuda.

Given that desalination is the primary adaptation solution to Antigua and Barbuda's freshwater challenges, and that its ability to meet demand is contingent on a stable and uninterrupted energy supply, implementing resilience in energy systems for water resources is a critical adaptation measure. Off-grid renewable energy resources can enhance resilience in the water sector. **By 2030, 100% of electricity demand in the water sector and other essential services (including health, food storage and emergency services) will be met through off-grid renewable sources** to enhance resilience to drought and hurricanes.

The need for adaptation in the water sector is not limited to freshwater supply. In recent years, the impact of floods in Antigua and Barbuda has become particularly acute, in part due to climate variability affecting the frequency and severity of storms and rainfall extremes. Development that has

increased impervious surface cover and constricted drainage also contributes to this vulnerability. The health sector is exposed to climate impacts through vector borne diseases and the spread of water-borne illnesses, where trends suggest increases in Antigua and Barbuda. **By 2030, all waterways will be protected to reduce the risks of flooding and health impacts.**

1.9.3.2 BUILDING AND INFRASTRUCTURE

Climate models projecting hurricane trends have generally determined that there will be an increase in intensity, if not frequency, of hurricanes in the Atlantic and the Caribbean. As such, hurricanes will pose an increasing threat to Antigua and Barbuda's economy. Between the years 1995 and 2010, six major hurricanes impacted Antigua and Barbuda: Hurricane Luis in 1995, Hurricane Georges in 1998, Hurricanes Jose and Lenny in 1999, Hurricane Omar in 2008, and Hurricane Earl in 2010. This resulted in economic losses and damages on the twin island state totalling US $335 million. Physical infrastructure in Antigua and Barbuda must be adapted to the dynamic threats of water scarcity, heavy rainfall events, and more intense storms and hurricanes. **By 2030, all buildings will be improved and prepared for extreme climate events, including drought, flooding and hurricanes.**

Physical adaptation measures will not always be enough to prevent significant loss and damage to the infrastructure and economy of Antigua and Barbuda. As a coastal economy, one-meter sea level rise (SLR) would impact 10% of major tourism resorts, all seaports, and 2% of major road networks in Antigua and Barbuda. The fisheries sector sustains significant losses during hurricanes, and will be negatively impacted by ocean acidification, SLR, and increasing sea surface temperatures. The recent annual influx of Sargassum seaweed to Antigua and Barbuda's windward shores, which may be a result of climatic factors, is an unanticipated slow onset event with significant economic repercussions in tourism and fisheries. The agricultural sector is also particularly vulnerable to climate impacts. A drought in 2010 resulted in an overall loss of crops by 15%, with some crops sustaining losses up to 50%, while later that year excessive rain incurred losses to the crop sector totalling US $1 million. A loss and damage mechanism is integral to building resilience to climate change in Antigua and Barbuda. **By 2030, an affordable insurance scheme will be available for farmers, fishers, and residential and business owners to cope with losses resulting from climate variability.**

1.9.3.3 ELECTRICITY

Without any known fossil fuel resources, Antigua and Barbuda relies almost exclusively on imported fossil fuels for energy: heavy fuel oil in electricity generation, gasoline and diesel for transport, and liquefied petroleum gas (LPG) for cooking. This has resulted in relatively high emissions and extremely high fuel costs. In 2006, Antigua and Barbuda's national emissions totalled 945.5 Gg CO, of which 92% were derived from fuel combustion in the energy sector. In addition, the cost of fossil fuel imports, valued at US $165.4 million in 2013, or equivalent to 13.7% of the country's GDP, is a financial burden on the country's economy. The cost of electricity has risen to over US $0.40 per kWh, and consumers in Antigua and Barbuda pay among the highest electricity prices in the world. High electricity rates inhibit adaptation strategies, such as energy intensive seawater desalination, the provision of essential services, small businesses, low- and middle-income households and economic growth.

However, in recent years, Antigua and Barbuda has made important strides in its sustainable energy policy. A National Energy Policy (NEP) was approved in November 2011 (and it is currently under review) serving as the main policy for renewable energy (RE) and energy efficiency (EE) development. This strategic plan proposes to exploit local energy resources and reduce fossil fuel dependence. The NEP sets out the national approach to achieving its vision:

"By 2030 Antigua and Barbuda will meet the needs of the present generation while safeguarding the environment and enabling future generations to meet their own energy needs. All citizens and residents will have access to affordable, efficient, socially responsible and reliable forms of energy".

In March 2013, Antigua and Barbuda released a Sustainable Energy Action Plan (SEAP), to foster energy conservation and efficiency, diversification of energy sources, sustainable energy consumption and generation as well as the utilization of renewable energy sources. Parliament enacted the Renewable Energy Act of 2015, to establish a legal, economic and institutional basis to promote the use of renewable energy resources. To this end, Antigua and Barbuda will, by **2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off-grid in the public and private sectors.**

Domestic and industrial waste is a growing environmental concern in Antigua and Barbuda. Technological assistance could reverse this trend and create new opportunities. A preliminary review of annual waste streams to the sanitary landfill suggests that some 80,000 tonnes annually of feedstock could be available for conversion to energy if an appropriate facility were available, mitigating CO, NO and CH emissions. Antigua and Barbuda's goal is **by 2020 to finalize technical studies with the intention to construct and operationalize a waste to energy (WTE) plant by 2025.**

In 2006, land use change and forestry contributed 7% of national emissions. Land use change can be mitigated through removal of GHG emissions by carbon sinks. The EPMA 2019 establishes the legal backing such that: *Where the area is protected as a carbon sink it shall follow the principles developed by the UNFCCC.* **By 2030, all remaining wetlands and watershed areas with carbon sequestration potential will be protected as carbon sinks.**

1.9.3.4 TRANSPORTATION

In 2014, the transport sector consumed over one quarter of the country's fossil fuel imports, 20% of which were gasoline and 11% diesel. The NEP addresses this emissions sector by *inter alia* recommending the use of vehicles with higher fuel efficiency and lower emissions, and support for hybrid, flex-fuel for electric vehicles as national targets. Antigua and Barbuda aims to **establish efficiency standards for the importation of all vehicles and appliances by 2020.**

1.9.3.5 FINANCE - PARTICULARLY MICROFINANCE

Satisfying the potential demand for clean energy solutions at the Bottom of the Pyramid (BoP) represents an enormous market opportunity for the private sector that can offer solutions that are cost-effective, result in tangible savings at the household level (for instance, compared to diesel generated electricity or kerosene lighting) and reduce GHG emissions. While poor households enjoy savings over the lifetime of the product or service, they often cannot afford the higher upfront investment costs of clean energy solutions which can be 3 to 8 times higher than conventional solutions. Scaling up in this sector of the local market is therefore more than demand but access to financing and financial services and products that are sensitive to the fluctuations and volatility of household income at the BoP, and can be adjusted so that paybacks are equivalent or less than savings compared to the 'dirty energy' solutions.

The scale up of the funds will therefore increase scope of beneficiaries to include the Bottom of the Pyramid, small-medium enterprise (SME), and larger international investors, reduce spending on imported fossil fuel, and ensure investments into assets are safe and resilient.

1.9.4 BARRIERS TO SCALING UP - MICROBUSINESSES

While micro and small entrepreneurs face significant barriers in accessing finance for business in general, this is even more true in the case of climate-related businesses which come with comparatively higher cost technology and include significant innovation and transitional risks. These barriers can often result in: risk averse behaviour of local financial institutions that are not familiar with the new climate related technologies (such as solar home systems) and business models (such as public private partnership arrangements for mini grids); the high transaction costs involved in reaching a large

number of customers for relatively small payments; lack of traditional collaterals among BoP clients; and policy and legislative obstacles, such as burdensome financial reporting requirements for very small loans.

Microfinance is by no means a panacea for climate financing at the BoP. There are at least two significant limitations that need to be addressed when considering scaling up microfinance for climate change: the need for larger loan sizes and longer maturities for critical climate investments; and the need to use these larger amounts to leverage the 'greening' local banking portfolios (**i.e. Implementation of Paris Agreement 2.1c.).** The funds provided from donors may not be significant and all require policies and measures to scale up. However, with the full portfolio of projects under implementation at the DOE these will have a significant impact and will get the attention of the private sector.

1.9.4.1 GREENING THE PORTFOLIO OF LOCAL FINANCIAL INSTITUTIONS (FIS) (PARIS AGREEMENT ARTICLE 2.1C)

Microfinancing, like other sources of financing, is contributing to climate change and environmental degradation. The 'greening' of financial flows to be in compliance with Article 2.1C can be achieved in the following ways:

1. Adjust the existing policies and programs to reduce its carbon footprint, for instance by linking up with national financial policies and other financial programs to bring down the cost of green alternatives, and identify perverse incentives for brown technologies or even banning technologies altogether (see plastic bag ban in Antigua and Barbuda). Phasing out high-carbon lending for technologies such as charcoal or kerosene, where alternative technologies are one of the approaches currently under consideration.
2. Offer other payment conditions that make low-carbon options affordable by increasing the maturity period and adjusting repayment to seasonal income streams. Many BoP households in Antigua and Barbuda work within the seasonal hotel sector. Many of these are also part-time farmers and fishers to diversify their incomes when the hotels may be closed for the season. These sectors are vulnerable to layoffs after a storm event and can be without an income for over 6 months.
3. Pilot other innovative green products or income generating activities – for instance, the GCF funded EDA project sought to pilot funding schemes for climate friendly technologies in the building sector. Furthering the 'Eco-Micro' Program of the Multilateral Investment Fund of the Inter-American Development Bank (IADB) is a good example of a program working on the greening of International FIs. Co- financed by IADB and the Nordic Development Fund, the program uses a competitive process to select about four MFIs each year with innovative ideas for green finance products and for reducing the climate vulnerability of their portfolio, and then supports scaling up these activities via technical assistance.

Some countries are taking concrete steps to help scale up micro finance for climate action and overcome the barriers mentioned above. National governments will often consider policies and programs that subsidize to compensate for higher upfront costs of nationally and internationally agreed technologies that are appropriate for mitigation and adaptation (e.g. Norway's approach for electric vehicles). Antigua and Barbuda rarely uses subsidies as a financial policy[12] but can consider tax breaks. The government's priority therefore is the removal of perverse incentives favouring fossil fuel solutions which is cheaper that funding direct subsidies.

1.9.4.2 RISK IDENTIFICATION AND MITIGATION

[12] This is mainly due to the lack of financing as well as the political risk and the resulting ability to phase out subsidies

A second important focus of national enabling policies is financial and transitional risk reduction. Risk should be discussed openly, and management responses should be developed to address them. Guarantee facilities and other steps can sometimes help to reduce risk to a manageable level. But the development of bureaucratic systems to reduce risks in the Multilateral Financial Institutions (MFI's) including the GCF's and other fund's business processes may inadvertently introduce inefficiencies, high costs and barriers to accessibility[13]. As a result, local experts in the local micro- financing community, in Antigua and Barbuda as well as the other pilot countries, are not keen to engage with the GCF and other MFIs since these entities are perceived as risk averse.

To mitigate against these the Government of Antigua and Barbuda established the SIRF Fund established under Part XII of the EPMA 2019. The purpose of the SIRF Fund is to provide financing to implement the EPMA 2019 in a coordinated, systematic and cost-effective manner. This Fund will allow the Government to absorb the risks as well as the bureaucracy. Also, the Fund can develop practical Monitoring, Reporting and Verification mechanisms to capture financial flows using nationally appropriate indicators. The SIRF Fund is mandated to provide access to funding to the public sector, the private sector, and to non-governmental and community organizations in Antigua and Barbuda, and decision-making is managed by a General Board. Representatives from the private sector and non-governmental organizations are appointed to the SIRF Fund General Board as observers, to provide transparency and accountability in the management of the SIRF Fund. The SIRF Fund held its first meeting on 10th October 2019[14].

Many of Antigua and Barbuda's climate change projects are designed with a microfinancing component. Caution is however needed when scaling up financial pilots such as those currently under the SIRF Fund, and the GCF EDA to the FIs using external funding. Any effort to scale up climate financing via FI through external concessional funding will have to carefully balance the legitimate need of FIs for grant or concessional funding with the risk of creating donor dependency or over-expansion of micro finance supply in an already saturated market. The micro finance sector, like its much bigger counterpart, has its share of crisis triggered by factors of declining economic growth and internal structural problems linked to excessive commercialization to prevent over-indebtedness of borrowers. Hence, any schemes designed by the government to scale up climate change-related micro finance will have to ensure a robust delivery system, capable of maintaining high portfolio quality while increasing the volume of funding and the number of borrowers.

1.9.5 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION OF THE CLIMATE CHANGE TRANSFORMATIONAL PROGRAM

The focal point for UNFCCC, the DOE, and the Ministry of Finance (co-GCF NDA,) with partnership assistance from several accredited entities and national and regional executive entities and agencies like CTCN, have developed Antigua and Barbuda's Climate Change Transformational Program. The Government has also agreed to partner with several international technical agencies to provide assistance to the program. This approach is also reflected in the GCF (Green Climate Fund) Country Program implementation arrangements. It is expected that the GCF Country program can achieve transformational change in a predictable and consistent manner suitable to the capacity for change of the country and its people and Government.

The Climate Change Transformational Program will be implemented by achieving economic and social co-benefits by including, where possible, complimentary microfinancing programs integral to project/program design and implementation. These microfinancing programs will target the NGO's

[13] See GCF Funds Evaluation for a full explanation of this concept.
[14] Information provided by DMU in the DOE

and the Private Sector in a strategic approach that allows them to be implemented alongside the Government.

1.9.6 DELIVERY AND EFFECTIVENESS OF FINANCIAL RESOURCES

Factors impacting effectiveness and delivery of resources are related to the amount of funding provided, project cycle length, cost of project development and predictability of resources. The main aim of the design of the Climate Finance Strategy of Antigua and Barbuda is to maximize effectiveness to allow for rapid recovery from major climatic events as well as to reduce the time spent in a transformational process. The recovery process will be designed for government, private sector and individuals.

To do this the government will be working to:

- Finalize the operationalization of the SIRF Fund to provide funding at scale and with shortened project cycle time;
- Design projects and programs that will have the highest impacts even though they may be high risk and;
- Design projects and programs to be gender responsive and provide functional involvement of all stakeholders.

To support an impactful program, the government will be seeking to use these projects and programs to leverage national resources for programs such as insurance and revolving funds. The details of these national funding schemes are yet to be decided and implemented.

1.9.7 PROGRAM-TO ACHIEVE TRANSFORMATIONAL IMPACTS

To meet the objectives of the Climate Change Transformational Program the country will need to leverage significant financing. The following opportunities and approaches, which form the basis of a work program have been identified:

- Access to readiness grants from the GCF for the period 2016 - 2020
- Access to project preparation grants and technical assistance for the development of the GCF portfolio of projects;
- Access funding from the GCF for National Adaptation Planning;
- Access to USD $120 Million in project funding via agencies such as UNEP, CCCCC, OECS the CDB and other relevant international Accredited Entity;
- Conduct detailed assessments of gender, social impacts and develop methodology to distinguish development and climate for several sectors;
- Access funding from the GEF, GCF, the Adaptation Fund and bilateral sources;
- Capacity building for executing agencies, financial mechanisms of the SIRF Fund, NGOs, community groups and the private sector.
- Mainstream new policies and procedures such as the Building Code, sustainable procurement and the implementation of the Paris Agreement Regulations; and
- Participate in programs that will capture lessons learned and project impacts.

The measures outlined above represent a work program of actions to address climate change capacity and gaps. At this point Antigua and Barbuda envisions that this work program will span the period 2019-2021. The success will be highly dependent on the cooperation of partners to meet objectives of the Climate Change Transformational Program.

The work program and the accompanying readiness actions will have four main outputs:

1. Strengthen institutional and fiduciary capacity to enable entities to access the GCF;
2. Enhance coordination amongst stakeholders and institutions of regional and national entities to manage and deliver climate finance;
3. Develop a system for identifying, prioritizing, and developing climate change programs/projects;
4. Leverage national private sector financial resources to scale up climate change solutions through microfinancing options and using environmental management systems to address climate at all levels of consumption.

Domestic MRV

St. John's Cathedral, Antigua

2 DOMESTIC MRV

Article 13 of the Paris Agreement states that there must be "the establishment of an enhanced transparency framework with the objective to build mutual trust and confidence and promote the effective implementation of actions." Further to the obligations under the Paris Agreement the Government is implementing the transparency provisions as its obligations to its stakeholders. The data transparency program for Antigua and Barbuda places the country on a path towards establishing strengthened monitoring, reporting, and verification (MRV) systems to assess the impact of climate change actions, track the implementation of the First NDC goals and meet the needs of all stakeholders.

2.1 CURRENT STATUS OF DOMESTIC MRV

Unfortunately, as a SIDS, Antigua and Barbuda is challenged in providing data due to limited human, technical, and infrastructural resources dedicated to the process of data collection and management. These challenges result from: dispersed and not well-documented existing data and information, unsecured infrastructure and data management system, lack of technical capacity and awareness, and limited financial resources. Antigua and Barbuda's vulnerability as a SIDS also extends to the collection and management of data. Government agencies in Antigua and Barbuda have lost years' worth of data and information as a result of hurricanes that destroyed buildings and caused water damage to equipment and paper records. Although technology is improving, cloud storage and back-up systems are impractical as a result of slow internet speeds island wide, which heightens data security concerns where data and information may only be secured on physical infrastructure. Power surges, frequent power cuts, and excessive humidity are just some of the ongoing practical challenges to establishing a robust and transparent information system in Antigua and Barbuda.

Antigua and Barbuda recognize that Domestic MRV is important in communicating and tracking the country's climate actions as well as reporting on the progress made in achieving our NDCs. Antigua and Barbuda has previous experience as it relates to MRV of GHG emissions through the submission of NC reports and will seek to improve upon this under upcoming projects and other initiatives. The information presented in this BUR describes the arrangements that will serve as the basis of Antigua and Barbuda's MRV system which is currently being designed.

International support, particularly through the Global Environment Facility, has allowed Antigua and Barbuda to advance a framework for integrated environmental information systems and, thereby, its capacity to transparently report on MEAs, including its progress towards implementing its Nationally Determined Contributions under the Paris Agreement. Previous and ongoing projects, such as the NAP, CCCD and the CBIT, have been supporting Antigua & Barbuda in advancing technically towards establishing the integrated environmental information system as well as on general capacity for reporting.

Antigua and Barbuda is aligning national regulatory systems with the objectives and provisions of the Paris Agreement. Support from the GCF will be used to operationalize the pollution section of the Environment Registry, a domestic MRV system, which will promote tracking of NDCs and enhancement of GHG inventories and other important climate indicators related to adaptation, social indicators, gender and women.

2.2 INSTITUTIONAL AND LEGAL ARRANGEMENTS FOR MRV

In Antigua and Barbuda, the DOE is responsible for implementing climate change planning and management, monitoring all climate change issues within a national context and reporting to the UNFCCC. These arrangements have been described previously in Chapter 1.6. Within the DOE, there is a Monitoring, Evaluation and Data Management Unit (DMU) with the overall mandate of overseeing the monitoring and evaluation of environmental projects, coordinating environmental data

collection, as well as managing the environmental databases. This mandate is sanctioned under Part X section 87 of the EPMA 2019 which also defines the institutional arrangements for the MRV system. The EPMA establishes the Environment Registry as the mechanism for monitoring, compliance, reporting and notification under MEAs, to include the UNFCCC. The DMU will take a pivotal role in ensuring that the DOE fulfils its domestic MRV requirements as well as in the production of National Communications (NC's) and Biennial Update Reports (BUR's) on a continuous basis.

2.3 PROGRESS TOWARDS ESTABLISHMENT OF A DOMESTIC MRV SYSTEM

The DOE has recognized that maintaining an inventory of relevant environmental and climate information is essential to informing the environmental and climate management processes in the country. This also supports reporting to the MEA's with specific emphasis on the UNFCCC. For this reason, monitoring and evaluation (M&E) is an essential part of implementing the EPMA, 2019. The primary reasons for effective M&E are transparency, accountability, learning and improvement which is directly supported by the data management systems being created by the DOE.

One such system is the Environment Registry that is to be established under Part X, section 87 of the EPMA 2019. This calls for the provision of this environmental data management system, which

"The DOE shall, in collaboration with such appropriate authorities, establish and operate a Registry to be known as the Environment Registry for the purpose of:

> *(a) administering the information on the environment;*
>
> *(b) providing assistance to the Department in the monitoring, compliance, reporting and notification requirements under multilateral environmental agreements to which Antigua and Barbuda is a party" (EPMA, 2019: Part X section 87(1) (a-b)).*

In this respect, the GEF recently approved a project entitled "Capacity Building for Improved Transparency on Climate Actions through an Environment Registry in Antigua and Barbuda (CBIT)". The overall objective of this project is to promote mainstreaming MRV into domestic systems and strengthen institutional capacity to enable routine, concurrent and participatory monitoring processes that enhance transparency under the Paris Agreement. The CBIT Project will develop regulations, procedures and guidelines for monitoring, reporting and verifying climate change data. The project will:

- Design a legal structure for climate data collection and sharing based on MoUs and other formal agreements
- Develop QA/QC standards for the data that will be collected by the various stakeholders
- Develop and formalize methodologies and guidelines for data collection, management and sharing

The main output of this project would be the development of the Environment Registry as outlined in Part X of the EPMA 2019 and will also serve as the MRV Registry. Through a participatory process, procedures and guidelines for operationalizing MRV with climate change data will be developed. Within this overall MRV framework, the Environment Registry will be designated to serve as an information repository. Based on the targets put forward in Antigua and Barbuda's First NDC, the project will also seek to develop country-specific indicators for tracking and transparency throughout implementation.

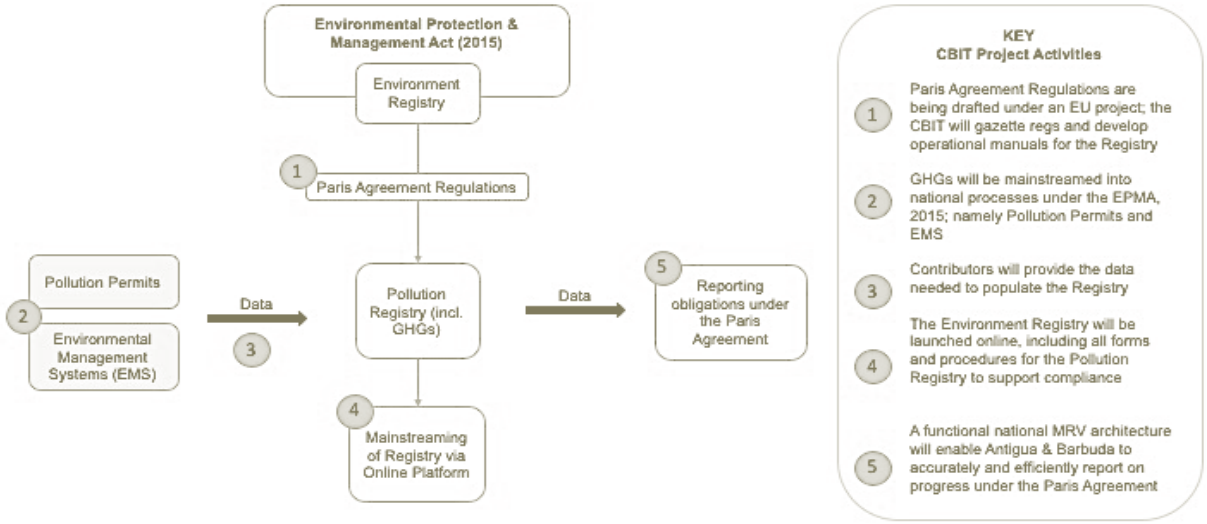
The Registry will also be accessible to the public through an online platform which further promotes accountability and transparency. The design of this online platform will be made user-friendly to accommodate the input from public sector stakeholders, non-government organizations (NGOs), private sector and civil society organizations (CSOs) via consultations.

Additionally, the UNEP-DTU Partnership formulated a report under the UNEP-GEF INDC Support project whereby recommendations on Institutional Arrangements for an MRV System were made. The MRV system which will be developed in Antigua and Barbuda seeks to measure mitigation and adaptation actions, support received, as well as GHG emissions by sector. By taking into account these variables, it will enhance reporting measures and track progress towards a low-emission country. UNEP DTU facilitated the delivery of a short analytical report which will make some recommendations/suggestions regarding the development of an MRV system (institutional focus) based on the arrangements that are already in place in the country. The recommendations made by UNEP-DTU will be taken into consideration when establishing the domestic MRV system.

Antigua and Barbuda is also currently undertaking a National Adaptation Plan (NAP) project which is aiming to revise, approve and gazette the draft Paris Agreement Regulations (2017) that will directly support MRV. The draft regulations were developed to recognize and address the need for an effective and progressive response to the urgent threat of climate change based on the best available scientific knowledge.

It is foreseen that a fully functional and operational MRV system will be developed by the DOE based on the framework presented below in Figure 4.

Figure 4:Antigua and Barbuda's Framework for Tracking and Reporting; and Integrating, Obligations under the Paris Agreement into national Institutional Arrangement.



The EPMA 2019 also aligns national law with the objectives of the UNFCCC – to reduce greenhouse gas emissions and to adapt to the impacts of climate change – by controlling pollution. Under the EPMA, "pollution" includes GHGs. Pollution is recorded in an Environment Registry, which the public has access to per the EPMA 2019. The registry also promotes compliance with adaptation as it is required to contain information on "guidelines and codes of practice in environmental matters." This includes, for example, the Building Code, which is being updated to mainstream adaptation measures in buildings.

In addition to the capacity gaps identified in the Third National Communication, non-state actors face capacity challenges and this will inhibit their ability to contribute to the Pollution Registry. To satisfy the provisions of the EPMA and to benefit from shared responsibility with non-state actors, Antigua and Barbuda will need to actively integrate non-state actors into the MRV system. This is likely to

motivate these actors' engagement in transparency-related and general climate change-related process – a gap also identified in the Third National Communications. Cross-sectoral collaboration will support mainstreaming of climate change into national processes and form a basis for progress tracking and improvement of transparency over time.

2.4 COMPONENTS OF THE PROPOSED DOMESTIC MRV SYSTEM

Antigua and Barbuda's Domestic MRV system will be used to identify the progress that a country is making towards achieving a sustainable environment. The components of Antigua and Barbuda's MRV include the methods used to track specific activities and impacts; transparently communicate selected information to national stakeholders and/or the international community; and measures to ensure that selected reported information is accurate and complete[15]. Antigua and Barbuda aims to develop a domestic MRV system that focuses on three main areas:

- **MRV of GHG Emissions**: Estimation of national and sectoral emissions
- **MRV of Mitigation Actions**: Impacts of mitigation policies and actions
- **MRV of Support**: Financial flows, technology transfers, capacity building and their transfers

2.4.1 MEASUREMENT GHG EMISSIONS AND MITIGATION IMPACTS

Measurement, as it relates to the MRV system, will be analysed in terms of the GHG emissions, mitigation actions and climate finance/support. Measurement in the context of the UNFCCC MRV system refers to measuring efforts to address climate change and the impacts of these efforts. This section addresses the measurement of GHG emissions and Mitigation Impacts.

2.4.1.1 MEASURING GHG EMISSIONS

The DOE is currently the agency developing the national GHG inventory, along with the assistance of other ministries or agencies. Sector experts are contracted to collect data on the respective sectors (energy, industry, agriculture, waste, forestry and other land use) and calculate emissions based on the 2006 IPCC Guidelines.

The inventory is not produced on a continuous basis, however there are plans to develop a system to ensure data is collected yearly thus making it easier to formulate at the time of reporting. To aid in receiving data continuously the enforcement of existing legal instruments needs to be enforced. Additionally, regulations that clearly state the roles and responsibilities of the DOE in terms of monitoring and reporting of climate change data and information need to be put in place. The ongoing NAP project is seeking to enact the Paris Agreement regulations which will address these concerns and ensure that data from agencies emitting pollutants into the environment will be collected and stored within the MRV data system.

The DOE will work along with partner agencies that also collect GHG data, such as the National Statistics Office (NSO). The NSO has a mandate to collect, compile, analyse and publish official statistics; and to carry out such censuses and surveys in relation to the subjects listed in the First Schedule of the EPMA 2019 (i.e. demographic and social statistics, economic statistics, environment and multi-domain statistics, and methodology of data collection, processing, dissemination and analysis) and to develop an integrated statistical system[16].

The current Biennial Update Report will be delivering the first version of a National GHG Inventory Management System (NIMS) that will identify the stakeholders that will contribute to the GHG

[15] Knowledge Product Elements and Options for National MRV Systems

[16] National Bureau of Statistics Act, 2013

Inventory as well as the relevant data and methodologies. Unfortunately, at the time of submission the NIMS was still under development. The soon to be implemented CBIT project will seek to update and finalize the NIMS, building upon it with the aim of institutionalization.

2.4.1.2 MEASURING MITIGATION IMPACTS

Through this BUR project, the DOE created a climate action database containing a list of mitigation initiatives that contribute to the achievement of the national NDC targets. The template has been developed and has the capability to record relevant information on the mitigation actions with the option of tracking progress and outcomes achieved under these targets. This resource will be used in the CBIT project, where one of the outputs is to establish a fully functioning NDC plan with country-specific indicators.

Antigua and Barbuda's NDC targets are currently undergoing revision for submission in March 2020. To support this venture, Antigua and Barbuda has received technical assistance through the NDC Partnership's Climate Action Enhancement Package (CAEP). The country is seeking to get support under CAEP's two main objectives: enhancing NDCs by raising ambition (Objective 1) and fast-tracking implementation by providing in-country technical expertise and capacity building (Objective 2).

In developing this area of the MRV system, the DOE will ensure that several features are included, such as:

- Developing a baseline: determine the difference between the emissions projection scenario with and without the Nationally Appropriate Mitigation Actions (NAMAs)
- Evaluating co-benefits: indicators to track progress (achievement of mitigation goals/ SDGs)
- Establishing data management system: identify and record measurable data
- Defining responsibilities: identify relevant sectoral organizations/stakeholders

2.4.2 REPORTING GHG EMISSIONS AND MITIGATION IMPACTS

As mentioned earlier, the DOE is the official agency responsible for reporting to the UNFCCC. The objective of the reporting element is to report results and activities on actions taken to implement the UNFCCC and facilitate discussions on the progress made in implementation.

Under the CBIT project, outcome 2 will ensure that the Environment Registry becomes the official national source for NDC reporting. A critical element to this goal is the raising of awareness across a diverse set of sectors, thus training will be provided to government agencies, private sector, and civil society. Data will also be presented in a concise non-technical format to ensure that all individuals from all sectors within the society can interpret the data. Another aspect of outcome 2 is conducting an evaluation, learning and scaling up of the transparency initiative. This will enable reflection on progress and dissemination of lessons learned to other capacity-constrained SIDS and within the OECS.

2.4.2.1 REPORTING GHG EMISSIONS

GHG emissions are reported following existing guidelines and timelines provided by the UNFCCC in the form of a National Inventory Report e.g. NCs & BURs. Within that report, greenhouse gas emissions, and removals, are calculated based on the 2006 IPCC guidelines by sector. National GHG Inventory teams are also responsible in developing a manual describing existing procedures and arrangements made to streamline the reporting process.

According to the EPMA 2019 Part VII, Environmental Management & Monitoring, owners of commercial and industrial facilities shall submit an environment management plan, including reporting. The CBIT project will develop the data based to receive the information and the NAP project

is developing the regulations that will outline the information to be provided. Through the CBIT and the NAP project a template or list of data that should be monitored would be provided along with guidelines for reporting.

2.4.2.2 REPORTING MITIGATION ACTIONS

Mitigation actions are classified in three different ways: type of action, scope, and source of funding. The majority of Antigua and Barbuda's actions are projects or programmes across all sectors with many falling under the energy sector. Through the BUR, the project team was able to develop a registry of relevant projects and status of implementation as shown in Section 4 on *Mitigation Actions & their Effects*.

Through implementation of the CCCD[17] and CBIT projects, there will be an improvement in data collection measures and thus reporting requirements for environmental data. The CBIT project will develop guidelines for reporting information to ensure transparent, consistent, comparable and complete reporting including reporting frequency, reporting requirements and formats. The CCCD project will contribute by identifying relevant indicators to monitor within the UNFCCC reporting process.

Institutions involved in implementing mitigation measures should be tasked with reporting on these actions on a periodic basis. However, the DOE coordinates the majority of the reporting as the national focal point for climate action. The DOE will operationalize the Climate Action database, or other relevant instrument, that will be used as the primary tool to report on mitigation actions.

2.4.3 VERIFICATION OF GHG AND MITIGATION IMPACT DATA

As with the other areas of the MRV system, the DOE will also oversee the verification process. It is essential that all data, methodologies & reports are subjected to some level of verification. At the international level, NCs and BURs are verified through the International Consultation and Analysis (ICA) process. However, on a domestic level majority of Antigua and Barbuda's reports, data collection, management and review related to climate change are verified through the Technical Advisory Committee (TAC).

The TAC is an inter-agency, multi stakeholder advisory committee made up of representatives from key sectors/ministries covered by the inventory, as well as NGOs and CSOs. The committee meets on a monthly basis to conduct verification measures, risk management and technical guidance on environmental projects.

The GHG Inventory is first verified through the DMU. After finalizing the inventory, it is presented to the TAC for technical oversight and input. A validation workshop is also held with stakeholders who provide data necessary for calculating emissions to ensure validation of the results. A similar method to the verification of GHG Emissions is used when validating mitigation actions and impacts across sectors.

2.4.4 MRV OF FINANCE

Under the MRV framework, measurement of climate support refers to forms of finance, capacity building and technology transfer received. Monitoring of these variables can also inform donors or national public and private finance institutions. Currently, the DOE maintains an internal database of the ongoing and proposed environmental projects with relevant information to include funding amount. The country does receive significant investment from donors such as the Green Climate Fund

[17] UNDP implemented – "Monitoring and Assessment of MEA implementation and environmental trends in Antigua and Barbuda" Project funded under the Cross Cutting Capacity Development focal area of the GEF

(GCF), the Adaptation Fund, and the Global Environment Facility (GEF). However, there is no national database or platform which supplies information related to climate support funding. Once a system is developed to monitor climate finance/support it will include information on forms of finance (grants etc.), purpose of support (mitigation/adaptation), results and impacts of support. Reporting is done to the UNFCCC as part of NCs, BURs and any future reporting requirements for post-2020 contributions, as well as to donor agencies. It is likely that this will be paired with the climate action database, or other relevant tool, used to monitor NDC implementation.

National Inventory of Greenhouse Gases for Antigua and Barbuda

Inventory Year 2015

3 NATIONAL INVENTORY OF GREENHOUSE GASES FOR ANTIGUA AND BARBUDA

3.1 SUMMARY OF GHG INVENTORY

Antigua & Barbuda is a non-Annex 1 party to the United Nations Framework Convention on Climate Change (UNFCCC) and has submitted three previous GHG Inventories. These were submitted within the Initial, Second and Third National Circumstances with corresponding inventory years: 1990, 2000 and 2006, respectively. This report presents the GHG inventory for inventory year 2015 as part of the requirements of the First BUR.

As reported in the previous inventories, Antigua and Barbuda still imports all its fossil fuels required for electricity generation and transport (road, marine, air). The situation in the Industrial Sector remains the same with the sector being very small. The main source of emissions in this sector comes from refrigerants. The AFOLU sector is divided into the subsectors: Agricultural and Forestry & Other Land Use. The main source of emissions within the Agricultural Subsector are due to enteric fermentation and manure management. Previously, the forest cover of the country was limited since most of the forests were cleared during the colonial days to establish sugar plantations. In the last 10 to 15 years, a combination of aerial photography and ground truthing activities allowed for updated data gathering. This has led to significant increases in reporting within this subsector. For this inventory, Google Earth satellite imagery was used for reporting. The Waste Sector continues to see improvement with more effort being placed on methodologies and quality of data collection, especially in the areas of methane emissions from solid waste disposal sites. This has subsequently created an improvement in the quality of data within this report.

A summary of the national GHG emissions (Table 3) are as follows:

- **Carbon Dioxide (CO2): 844.28 Gg,**
- **Methane (CH4): 1.517 Gg,**
- **Nitrous Oxide (N2O): 0.049 Gg,**
- **Non-methane volatile organic compounds (NMVOC): 0.035 Gg,**
- **Hydrofluorocarbons (HFC): 6.051 Gg.**

The overall uncertainty of the inventory is 39.6%.

Continuous efforts are being made to improve the data collection methods in all the sectors in the report. However, there are still many gaps in terms of consistency in data collection and also ease of sharing data. Despite these challenges, the majority of the data was collected to provide a GHG Inventory Report that is well representative of the situation on the ground.

Table 3: Summary of Antigua and Barbuda GHG Emissions and Removals (Gg) for 2015

Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)					Emissions (Gg)			
	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
Total National Emissions and Removals	844.27627	1.51745	0.04863	6.05119	0	0	0	0	0	0	0.03539	0
1 - Energy	648.7595793	0.02579	0.00512	0	0	0	0	0	0	0	0	0
1.A - Fuel Combustion Activities	648.7595793	0.02579	0.00512	0	0	0	0	0	0	0	0	0
1.A.1 - Energy Industries	648.7595793	0.02579	0.00512						0	0	0	0
1.A.2 - Manufacturing Industries and Construction	0	0	0						0	0	0	0
1.A.3 - Transport	0	0	0						0	0	0	0
1.A.4 - Other Sectors	0	0	0						0	0	0	0
1.A.5 - Non-Specified	0	0	0						0	0	0	0
1.B - Fugitive emissions from fuels	0	0	0	0	0	0	0	0	0	0	0	0
1.B.1 - Solid Fuels	0	0	0						0	0	0	0
1.B.2 - Oil and Natural Gas	0	0	0						0	0	0	0
1.B.3 - Other emissions from Energy Production	0	0	0						0	0	0	0
1.C - Carbon dioxide Transport and Storage	0	0	0	0	0	0	0	0	0	0	0	0
1.C.1 - Transport of CO2	0								0	0	0	0
1.C.2 - Injection and Storage	0								0	0	0	0
1.C.3 - Other	0								0	0	0	0
2 - Industrial Processes and Product Use	3.143924176	0	0.00202	6.05119	0	0	0	0	0	0	0.03539	0
2.A - Mineral Industry	1.409771976	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	0								0	0	0	0
2.A.2 - Lime production	0								0	0	0	0
2.A.3 - Glass Production	0								0	0	0	0
2.A.4 - Other Process Uses of Carbonates	1.409771976								0	0	0	0
2.A.5 - Other (please specify)	0	0	0						0	0	0	0
2.B - Chemical Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.B.1 - Ammonia Production	0								0	0	0	0
2.B.2 - Nitric Acid Production			0						0	0	0	0

2.B.3 - Adipic Acid Production			0						0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			0						0	0	0	0
2.B.5 - Carbide Production	0	0							0	0	0	0
2.B.6 - Titanium Dioxide Production	0								0	0	0	0
2.B.7 - Soda Ash Production	0								0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	0	0							0	0	0	0
2.B.9 - Fluorochemical Production				0	0	0	0	0	0	0	0	0
2.B.10 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.C - Metal Industry	1.2347192	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	0	0							0	0	0	0
2.C.2 - Ferroalloys Production	0	0							0	0	0	0
2.C.3 - Aluminium production	0				0			0	0	0	0	0
2.C.4 - Magnesium production	0					0		0	0	0	0	0
2.C.5 - Lead Production	0								0	0	0	0
2.C.6 - Zinc Production	1.2347192								0	0	0	0
2.C.7 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0.499433	0	0	0	0	0	0	0	0	0	0	0
2.D.1 - Lubricant Use	0.492334333								0	0	0	0
2.D.2 - Paraffin Wax Use	0.007098667								0	0	0	0
2.D.3 - Solvent Use									0	0	0	0
2.D.4 - Other (please specify)	0	0	0						0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor				0	0	0	0	0	0	0	0	0
2.E.2 - TFT Flat Panel Display					0	0	0	0	0	0	0	0
2.E.3 - Photovoltaics					0			0	0	0	0	0
2.E.4 - Heat Transfer Fluid					0			0	0	0	0	0
2.E.5 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	6.05119	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning				2.69719				0	0	0	0	0
2.F.2 - Foam Blowing Agents				0				0	0	0	0	0
2.F.3 - Fire Protection				0	0			0	0	0	0	0
2.F.4 - Aerosols				3.354				0	0	0	0	0
2.F.5 - Solvents				0	0			0	0	0	0	0

2.F.6 - Other Applications (please specify)				0	0			0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0.00202	0	0	0	0	0	0	0	0	0
2.G.1 - Electrical Equipment					0	0		0	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses					0	0		0	0	0	0	0
2.G.3 - N2O from Product Uses			0.00202						0	0	0	0
2.G.4 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.H - Other	0	0	0	0	0	0	0	0	0	0	0.03539	0
2.H.1 - Pulp and Paper Industry	0	0							0	0	0	0
2.H.2 - Food and Beverages Industry	0	0							0	0	0.03539	0
2.H.3 - Other (please specify)	0	0	0						0	0	0	0
3 - Agriculture, Forestry, and Other Land Use	191.5398703	0.62928	0	0	0	0	0	0	0	0	0	0
3.A - Livestock	0	0.62928	0	0	0	0	0	0	0	0	0	0
3.A.1 - Enteric Fermentation		0.596							0	0	0	0
3.A.2 - Manure Management		0.03328	0						0	0	0	0
3.B - Land	191.5398703	0	0	0	0	0	0	0	0	0	0	0
3.B.1 - Forest land	-59.84328775								0	0	0	0
3.B.2 - Cropland	43.76822525								0	0	0	0
3.B.3 - Grassland	206.3978708								0	0	0	0
3.B.4 - Wetlands	0		0						0	0	0	0
3.B.5 - Settlements	1.217062								0	0	0	0
3.B.6 - Other Land	0								0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	0	0	0	0	0	0	0	0	0	0	0	0
3.C.1 - Emissions from biomass burning		0	0						0	0	0	0
3.C.2 - Liming	0								0	0	0	0
3.C.3 - Urea application	0								0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils			0						0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils			0						0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management			0						0	0	0	0
3.C.7 - Rice cultivations		0							0	0	0	0
3.C.8 - Other (please specify)		0	0						0	0	0	0
3.D - Other	0	0	0	0	0	0	0	0	0	0	0	0
3.D.1 - Harvested Wood Products	0								0	0	0	0
3.D.2 - Other (please specify)	0	0	0						0	0	0	0

4 - Waste	0.83289624	0.86238	0.04149	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal	0	0	0	0	0	0	0	0	0	0	0	0
4.B - Biological Treatment of Solid Waste	0	0.35408	0.02125	0	0	0	0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	0.83289624	0.08968	0.00172	0	0	0	0	0	0	0	0	0
4.D - Wastewater Treatment and Discharge	0	0.41861	0.01853	0	0	0	0	0	0	0	0	0
4.E - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	0	0	0	0	0	0	0	0	0	0	0	0
5.B - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0

3.2 INTRODUCTION

As party to the UNFCCC, Non-Annex 1 countries have been required to prepare regular Greenhouse Gas (GHG) Inventories. For Antigua & Barbuda, the first and second GHG inventories were carried out for the years 1990 and 2000 respectively, while the third focused mainly on the year 2006. The present GHG Inventory report was prepared as a requirement for the Biennial Update Report (BUR). The inventory year for the current report is 2015.

The methodology used for this GHG Inventory was the 2006 IPCC Guidelines. For the first time in Antigua & Barbuda's reporting history, the team used the IPCC software. The sectors reflected in this report are (i) Energy, (ii) Industrial Processes and Products Use, (iii) Agriculture, Forestry & other Land Use, and (iv) Waste. However, there were specific instances when the software could not be used due to challenges in the operations. In these cases, the team reverted to using the IPCC excel worksheets. These instances are indicated throughout the methodology.

This chapter of Antigua and Barbuda's First BUR presents each sector separately, with a brief description of the sector, along with the methodology clearly describing the methods of data collection and the related quantities of specific GHG emissions. The gases reported on were: CO2, CH4, N2O, NMVOC and HFCs.

Chapter 3.8 includes the Key Category Analysis. The purpose of the Key Category Analysis is to identify those areas that contribute greatly to the total GHG emissions. IPCC guidelines suggest that it is good practice to conduct Key Category Analysis so as to focus resources on those areas that produce most GHG emissions.

Uncertainties were then considered within each sector. Mainly qualitative uncertainty analysis was carried out on activity data and quantitative uncertainty analysis on default emission factors used.

Recommendations were made for each sector to improve the quality of data collection for future GHG inventories. Finally, the policies that have been put in place to reduce GHG emissions were also noted.

3.3 ENERGY SECTOR

3.3.1 DESCRIPTION OF THE SECTOR

Antigua and Barbuda is a twin island state that imports 100% of its petroleum products required. The West Indies Oil Company Ltd. (WIOC) is the sole and only supplier of fuel importation into the country. Since the previous report, WIOC has restructured its ownership. It is now owned by three stakeholders, i.e. the government of Antigua and Barbuda as a majority shareholder of 51% interest and two other private entities holding 24% and 25% respectively.

Most of the fuel consumed by the country is primarily used for generating electricity and transportation (vehicular and aviation) of which the percentage allocated for domestic and commercial consumption has increased drastically due to the amount of motor vehicular and air traffic in and to the country.

For the Energy Sector, GHG emissions are estimated using both the Reference Approach (based on importation data) and Sectoral approach (consumption/sales). The Energy Sector activities in the nation of Antigua and Barbuda are exclusively due to combustion of fuel.

As there are no refinery processes active in Antigua and Barbuda, fugitive emissions from primary and secondary fossil fuel production are null and void.

3.3.2 METHODOLOGY

The DOE provided an official letter to the designated members associated with this sector stating the purpose of data collection. Information was then gathered from the respective parties through interpersonal meetings and in some cases verbal conversation.

This task of gathering this information proved a bit challenging due to the deficiency of documenting data for energy related activities. Country-specific energy sector activity data were provided by the following agencies and businesses:

- WIOC provided information on the quantities of gasoline, diesel, Ultra low Sulphur Diesel (ULSD), fuel oil, jet fuel and Liquified Petroleum Gas (LPG). This information was tabulated under the heading “Fuel Imports and Sales” see the Appendix which has been submitted as a separate document
- Statistics Division (Government of Antigua and Barbuda) also provided import data for lubricants and other petroleum related products. (This information was not utilized in calculation)
- WIOC also provided additional data on all the marinas and service stations, and fuel transferred to the airport facility. This information was used to compare against the data previously given for fuel imports and sales.
- Data on wood and charcoal consumption were unobtainable due to unavailability of accurate information.

Default values for emission and conversion factors from Revised 2006 IPCC Workbook were utilized.

3.3.3 CO_2 EMISSIONS

The carbon dioxide emissions by the reference and sectoral approach may be seen in Table 4 below.

Table 4: CO2 Emissions in Antigua and Barbuda for the Energy Sector (2015 - Inventory Year)

Greenhouse Gas Energy Sector in Gg (Sectoral Approach)
Gg Carbon Dioxide (CO_2)
648.75958
Greenhouse Gas Energy Sector in Gg (Reference Approach)
Gg Carbon Dioxide (CO_2)
726.26

3.3.4 NON-CO_2 EMISSIONS

The non-CO2 emissions from the Energy Sector may be seen in Table 5.

Table 5: Non-CO2 Emissions in Antigua and Barbuda from the Energy Sector - Inventory Year 2015

	Sectoral Approach	
Energy Sector	Gg Methane (CH_4)	Gg Nitrous Oxide (N_2O)
Total	0.02579	0.00507

3.4 INDUSTRIAL SECTOR

3.4.1 DESCRIPTION OF SECTOR

Antigua and Barbuda, with limited resources and relatively no naturally occurring minerals and few processing industries, is heavily dependent on the mass importation of finished goods and products. Mining activity is virtually non-existent, however several quarries on Antigua produce construction aggregates in this growing sector. Historically, given the hot Caribbean climate and minimal rainfall, the refrigeration and air conditioning business has been the greatest GHG contributor in this sector. However, a shift has been noted towards the mineral industry as being the greatest contributor for the inventory year of 2015, with overall emissions of 1.40977 Gg CO_2. Emissions were particularly prevalent in the construction aggregates section of this sub-sector. It must be noted that recorded data is still very limited or not forthcoming in certain sections of the Industrial Processes and Product Use sector by way of sale activity and consumption by providers. The IPCC Inventory Software was used to calculate GHG emissions across the sector and the Tier 1 methodology approach was used in all instances.

3.4.2 METHODOLOGY

Data for the determination of emissions in this sector was provided by:

- The National Statistics Division;
- The Ministry of Trade, Commerce and Industry - Ozone Depleting Substances (ODS) Unit;
- The Ministry of Health, Wellness and the Environment – Department of Environment; and
- Stakeholders across various sub-sectors of the Industrial Processes and Product Use sector to include owners, managers, supervisors and subject matter experts.

3.4.3 EMISSIONS

The emissions are detailed in Table 6 and summarised in Table 7.

Table 6: Detailed Emissions from the Industrial Sector - Inventory Year 2015

Categories	(Gg)		(Gg)	
	CO2	N2O	HFCs	NMVOCs
2.A-Mineral Industry	1.409771	0	0	0
2.B-Chemical Industry	0	0	0	0
2.C-Metal Industry	1.234719	0	0	0
2.D-Non-Energy Products from Fuels and Solvent Use (6)	0.499433	0	0	0
2.E-Electronics Industry	0	0	0	0
2.F-Product Uses as Substitutes for Ozone Depleting Substances	0	0	6.05119	0
2.G-Other Product Manufacture and Use	0	0.0020	0	0
2.H-Other	0	0	0	0.03539[18]

[18] Although estimated activity data for this sector was acquired, it is noted that the software did not provide the options for this sector. Therefore, NMVOC emissions were calculated using the Revised 1996 IPCC guidelines for this sector.

Table 7: Summary Emissions in Antigua and Barbuda from the Industrial Sector - Inventory Year 2015

Type of Emission Gas	Quantity of Emission Gas (Gg)
CO_2	3.14393
HFC's	6.051189
N_2O	0.00202
NMVOC's	0.03539[19]

[19] Although estimated activity data for this sector was acquired, it is noted that the software did not provide the options for this sector. Therefore, NMVOC emissions were calculated using the Revised 1996 IPCC guidelines for this sector.

3.5 AGRICULTURE SECTOR

3.5.1 DESCRIPTION OF SECTOR

For centuries, the Agricultural Sector for Antigua and Barbuda consisted exclusively of sugar cane cultivation. By 1981 when Antigua and Barbuda became an independent twin island nation sugar cultivation was abandoned and tourism became the main industry. In its wake, cotton harvesting, and animal husbandry were explored as a means of diversifying the agricultural sector. Today the agricultural sector consists mainly of livestock production as well as fruit and vegetable production.

Of the plethora of greenhouse gases that are measured, the main focus is methane, direct and indirect nitrous oxide, and carbon dioxide. As it relates to livestock, methane is the predominant greenhouse gas that is emitted. Ruminants, especially cattle, given their size, have high methane emissions due to their high enteric fermentation rates. Carbon dioxide emissions from livestock were considered negligible, and therefore were not considered in the data inventory and analyses.

Livestock manure provides emissions for two greenhouse gasses, i.e. methane, and direct and indirect nitrous oxide. Methane emissions from livestock manure are small and depend on the type of livestock as well as the manure management system that is employed. The manure management system that is used is still traditional. For large ruminants and livestock, manure is left in the open field to decompose. However, in the case of poultry and swine (pigs), the animals are confined and intensely reared and this leads to a different manure management system. Here, housing quarters are regularly cleaned and flushed, and the liquid and solid manure are gathered and placed into deep pits and left open to dry. This primitive form of manure management is widespread, and farmers reuse the manure as a form of mulching and composting. The quantity of manure is far less compared to large ruminants. In some cases, quicklime (calcium oxide and calcium hydroxide) is sprinkled over the manure to accelerate the decomposition process and eliminate odor.

Carbon dioxide, methane, direct and indirect nitrous oxide emissions are also generated from agricultural soils. However, soils in Antigua and Barbuda are not limed therefore carbon dioxide emissions are at best negligible. In recent years the increase in importation and use of natural and artificial fertilizers, which have high concentrations in urea, have led to meaningful and measurable sources of carbon dioxide emissions. Unfortunately, there was insufficient data available from managed soils to assess the emission for direct and indirect nitrous oxide. Finally, methane emission from rice production was nil since rice is not cultivated in Antigua and Barbuda.

3.5.2 METHODOLOGY

Specific methodologies may be found in the Appendix. Default and emission factors were taken from the 2006 IPCC Guidelines. The data used to determine GHG emissions came from the following sources:

- The Veterinary and Livestock Division – Ministry of Agriculture. They provided information on livestock population as well as manure management system.
- The Plant Protection Unit – Ministry of Agriculture. Information on managed soils, and types of fertilizers was provided.
- The Agricultural Extension Division - Ministry of Agriculture.
- Pesticide and Toxic Chemical Control Board. Provided information on types and quantity of fertilizers uses.
- The National Statistics Division. Provided data on livestock population and fertilizer imports.

- The Food and Agriculture Organisation (FAO) provided data on livestock population

The data gathering process consisted of formal request in writing to the various Departments.

The data was then analysed using a Tier 1 system using the IPCC Guidelines and including specific default and emissions factors.

3.5.3 EMISSIONS

The carbon dioxide, methane, direct and indirect nitrous oxide emissions from the agricultural sector may be found in Table 8. The summarized emissions may be found in Table 9.

Table 8: Detailed emissions in Antigua and Barbuda from Agricultural Sector - Inventory Year 2015

Area within Sector	Type of Emission Gas	Quantity of Emission Gas (Gg)
Enteric Fermentation	CH4	0.589
Manure Management	CH4	0.031
Manure Management	Direct N_2O	0.0*

Table 9: Summary Emissions in Antigua and Barbuda from the Agricultural Sector - Inventory Year 2015

Type of Emission Gas	Quantity of Emission Gas (Gg)
CH4	0.620
Direct N_2O	0.0*

Note* It should be mentioned that a technical glitch with the IPCC Software, beyond the solution of the experts, caused the data for the calculation of Nitrous Oxide to be rejected and thus no emission was determined for the Agriculture Sector.

3.6 FORESTRY AND OTHER LAND-USE SECTOR

3.6.1 DESCRIPTION OF SECTOR

During the early colonial settlement, in Antigua and Barbuda most of the original forest was cleared to establish sugar plantations. In 1990, the reporting year for the Initial National Communications, it was reported that there was 13.45 kilo hectares (kha) of forest cover. This consisted of moist tropical forest (2.2 kha), dry tropical forest (10.75 kha), and mangroves (0.50 kha). It was also reported that there was 0.01 kha of open savannah and 12,000 non-forest trees. In 2003, the Forestry Division, Ministry of Agriculture was able to provide some data for Antigua but not Barbuda. This data indicated that Antigua has a forest cover of 5.60kha consisting of 0.52 kha of cactus scrub, 1.09 kha of deciduous seasonal forests, 0.57kha of evergreen seasonal forests, 0.044 kha of littoral woodland, 0.44 kha of mangroves, 1.52 kha of semi evergreen, 1.09 kha of thorn and 0.33 kha of citronella.

In the Third National Communications (TNC), the data used came from 2004 and 2010. In 2009, the 2004 aerial photo imagery of Antigua and Barbuda was digitized into EIMAS (Environment Information Management and Advisory System) which is a GIS platform. EIMAS was later updated using the 2010 aerial photo imagery of Antigua and Barbuda taken by the Survey Department.

The 2010 EIMAS data indicated that Antigua has a forest cover of 8.7 kha. Data derived from expert judgment from the Forestry Division shows that of this approximately 20% is tropical moist deciduous forest, 15% tropical forest dry scrub land and the remainder 65% is tropical dry forest.

3.6.2 METHODOLOGY

Antigua & Barbuda's First Biennial Update Report (BUR) utilized 2015 as the inventory year. The data was gathered using the Collect Earth application.

Collect Earth is a free and open source software for land monitoring developed by FAO. Built on Google desktop and cloud computing technologies, Collect Earth facilitates access to multiple freely available archives of satellite imagery, including archives with very high spatial resolution imagery (Google Earth, Bing Map) and those with very high temporal resolution imagery (e.g. Google Earth Engine, Google Earth Engine Code Editor).

By altering the inputs of Collect Earth, i.e. the data collection form, sampling design and plot size, users can easily configure Collect Earth to address specific land monitoring purposes, such as landscape restoration, reporting for REDD+, national forest inventories, disaster assessments and humanitarian work, livestock and rangeland management, etc. with a multi-temporal and multi-scale approach.

Antigua & Barbuda's sample was designed to capture an entire coverage by a mesh of plots of 25 hectares. Within these plots, the analyst would collect data on Land Use for 2003 and 2015 on the whole plot, followed by more specific data on the half a hectare subplot in the centre. The sampling design was produced through a Google Earth Engine script (LINK TO GEE SCRIPT) where the EPSG code used was EPSG:2001 (Antigua 1943 / British West Indies Grid), the sampling design set as systematic and the distance between plots set to 500 meters. This analysis was only conducted for mainland Antigua and, unfortunately Barbuda was excluded.

Specific methodology may be found in the Appendix which has been submitted as a separate document.

3.6.3 EMISSIONS

The carbon dioxide emissions and removals within the forestry sector may be found in Table 10 below.

Table 10: Detailed Emissions for Forestry and Land Use CO2 Emissions and Removals

Inventory Year: 2015	
Categories	(Gg)
	Net CO2 emissions / removals
3 - Agriculture, Forestry, and Other Land Use	191.5398703
3.B - Land	191.5398703
3.B.1 - Forest land	-59.84328775
3.B.1.a - Forest land Remaining Forest land	-52.5398148
3.B.1.b - Land Converted to Forest land	-7.303472953
3.B.1.b.i - Cropland converted to Forest Land	-1.21723646
3.B.1.b.ii - Grassland converted to Forest Land	-5.815757567
3.B.1.b.iii - Wetlands converted to Forest Land	-0.270478927
3.B.1.b.iv - Settlements converted to Forest Land	0
3.B.1.b.v - Other Land converted to Forest Land	0
3.B.2 - Cropland	43.76822525
3.B.2.a - Cropland Remaining Cropland	36.33066325[20]
3.B.2.b - Land Converted to Cropland	7.437562
3.B.2.b.i - Forest Land converted to Cropland	7.437562
3.B.2.b.ii - Grassland converted to Cropland	0
3.B.2.b.iii - Wetlands converted to Cropland	0
3.B.2.b.iv - Settlements converted to Cropland	0
3.B.2.b.v - Other Land converted to Cropland	0
3.B.3 - Grassland	206.3978708
3.B.3.a - Grassland Remaining Grassland	206.3017876[21]
3.B.3.b - Land Converted to Grassland	0.096083167
3.B.3.b.i - Forest Land converted to Grassland	0.032032
3.B.3.b.ii - Cropland converted to Grassland	0.064051167
3.B.3.b.iii - Wetlands converted to Grassland	0
3.B.3.b.iv - Settlements converted to Grassland	0
3.B.3.b.v - Other Land converted to Grassland	0
3.B.4 - Wetlands	0
3.B.4.a - Wetlands Remaining Wetlands	0
3.B.4.a.i - Peatlands remaining peatlands	0
3.B.4.a.ii - Flooded land remaining flooded land	

[20] There were some challenges calculating the values for this worksheet in the software, therefore the IPCC 2006 excel worksheets were used instead

[21] There were some challenges calculating the values for this worksheet in the software, therefore the IPCC 2006 excel worksheets were used instead

3.B.4.b - Land Converted to Wetlands	0
3.B.4.b.i - Land converted for peat extraction	
3.B.4.b.ii - Land converted to flooded land	0
3.B.4.b.iii - Land converted to other wetlands	
3.B.5 - Settlements	1.217062
3.B.5.a - Settlements Remaining Settlements	0
3.B.5.b - Land Converted to Settlements	1.217062
3.B.5.b.i - Forest Land converted to Settlements	0.384332667
3.B.5.b.ii - Cropland converted to Settlements	0
3.B.5.b.iii - Grassland converted to Settlements	0.832729333
3.B.5.b.iv - Wetlands converted to Settlements	0
3.B.5.b.v - Other Land converted to Settlements	0
3.B.6 - Other Land	0
3.B.6.a - Other land Remaining Other land	
3.B.6.b - Land Converted to Other land	0
3.B.6.b.i - Forest Land converted to Other Land	0
3.B.6.b.ii - Cropland converted to Other Land	0
3.B.6.b.iii - Grassland converted to Other Land	0
3.B.6.b.iv - Wetlands converted to Other Land	0
3.B.6.b.v - Settlements converted to Other Land	0
3.C - Aggregate sources and non-CO2 emissions sources on land (2)	0
3.D - Other	0

3.7 WASTE SECTOR

3.7.1 DESCRIPTION OF SECTOR

The National Solid Waste Management Authority (NSWMA) is mandated to manage all solid waste disposed in Antigua and Barbuda. Solid waste is divided into the following categories: biodegradable organic material, other organic material, paper, plastics, metals, glass, hazardous, green waste/agricultural, and construction/demolition.

The island has no centralized sewage system, nor does it have a centralized sewage treatment facility and so the NSWMA is also responsible for handling sewage that is collected from septic tanks across the island and delivered to the landfill facility where it is discharged onto the landfill.

Industrial wastewater, edible oils, fats and petroleum-based oils and lubricants are in large part managed through a network of private stakeholders. These include privately owned wastewater treatment facilities (hotels and resorts) and oil rendering and biofuel conversion facilities. Wastewater from some commercial facilities is discharged into the natural environment due primarily to the lack of treatment options.

A small portion of the solid waste generated on the island, including some plastics, metals and paper, are recycled via a network of small recyclers, most notably the Rotary Club of Antigua (Antigua Barbuda Waste Recycling Corporation - ABWREC), which established a facility in the Powells area that sorts, bails and exports plastic, metal and paper packaging materials.

3.7.2 METHODOLOGY

The 2006 IPCC guidelines for national greenhouse gas inventories was used in conjunction with the IPCC inventory software to collect, prepare and analyse national waste generation, composition and management data. The primary methods used for data collection included physical records, published reports, published statistical records, laboratory analysis and written observations, which in all cases were provided by stakeholders including the NSWMA, Department of Environment, Antigua & Barbuda Fire Department, United Nations Statistics Division as well as various private sector entities including the Antigua Distillery, ABWREC.

3.7.3 EMISSIONS

The emissions are detailed in Table 11 and summarised in Table 12

Table 11: Detailed Emissions in Antigua and Barbuda from the Waste Sector - Inventory Year 2015

Area within Sector	Type of Emission Gas	Quantity of Emission Gas (Gg)
Biological Treatment of Solid Waste	CH_4	0.3541
Biological Treatment of Solid Waste	N_2O	0.0212
Open Burning of Waste	CO_2	0.8329
Open Burning of Waste	CH_4	0.0897
Open Burning of Waste	N_2O	0.0017

Table 12: Summary Emissions in Antigua and Barbuda from the Waste Sector - Inventory Year 2015

Type of Emission Gas	Quantity of Emission Gas (Gg)
CO_2	0.8329
N_2O	0.0415
CH_4	0.8624

3.8 KEY CATEGORY ANALYSIS

Volume 1 Chapter 4 of the 2006 IPCC Guidelines states that "it is good practice to identify key categories by performing a quantitative analysis of the relationships between level and the trend of each category's emissions and removals and total national emissions and removals". The Key Category Analysis emphasizes those areas in the GHG Inventory that contribute most significantly to the GHG emissions. Presented below is the Key Category Analysis that was performed for the last GHG inventory of 2006 (Table 13) and also the similar analysis on the present GHG inventory 2015 (Table 14).

Approach 1 was used in the Key Category Analysis since it was the most suitable to the current national conditions. As estimates are available only for a single year and not several consecutive years the "Level Assessment" was carried out as seen in Table 13 for the 2006 GHG Inventory and in Table 14 for the 2015 GHG Inventory.

Table 13: Approach 1 Level Assessment for GHG Inventory for 2006 (previous inventory) in Key Category Analysis – The Key Categories are in bold *italics*

IPCC Category Code	IPCC Category	Green-house Gas	Latest Year Estimate	Absolute Value of Latest Year Estimate	Level Assessment F = E/SUM(E)	Cumulative Total of Column F
1A Fuel Comb 4 of 4	***Fuel Combustion Activities***	***CO2***	***875.78***	***875.78***	***0.44***	***0.44***
1A Ref App. 3 of 3	***Fuel Combustion Activities***	***CO2***	***856.80***	***856.80***	***0.43***	***0.87***
2F	***Product Uses as Substitutes for Ozone Depleting Substances - Aerosols***	***HFC***	***114.03***	***114.03***	***0.06***	***0.92***
3B2a	***Cropland Remaining Cropland: Annual change in carbon stocks in biomass***	***CO2***	***72.11***	***72.11***	***0.04***	***0.96***
3B1a	***Forest Land Remaining Forest Land: Annual increase in carbon stocks in biomass (includes above-ground and below-ground biomass)***	***CO2***	***-39.36***	***39.36***	***0.02***	***0.98***
3B3a	Grassland Remaining Grassland: Annual change in carbon stocks in mineral soils	CO2	34.25	34.25	0.02	1.00
3C6	Manure Management	N2O	5.75	5.75	0.00	1.00
3B5b	Land Converted to Settlements: Annual change in carbon stocks in biomass	CO2	1.50	1.50	0.00	1.00
4C	Open Burning of Waste	CO2	1.18	1.18	0.00	1.00
2D1	Non-Energy Products from Fuels and Solvent Use	CO2	0.55	0.55	0.00	1.00
3B5b	Land Converted to Settlements: Annual change in carbon stocks in dead wood/litter	CO2	-0.52	0.52	0.00	1.00
3A1	Enteric Fermentation	CH4	0.51	0.51	0.00	1.00

3B1b	Land Converted to Forest Land: Annual change in carbon stocks in dead organic matter due to land conversion	CO2	-0.21	0.21	0.00	1.00
3C3	Urea fertilization	CO2	0.17	0.17	0.00	1.00
3B2a	Cropland Remaining Cropland: Annual change in carbon stocks in mineral soils	CO2	0.16	0.16	0.00	1.00
3B6b	Land Converted to Other Land: Annual change in carbon stocks in biomass	CO2	0.08	0.08	0.00	1.00
4B	Waste - Biological Treatment of Solid Waste	CH4	0.07	0.07	0.00	1.00
4B	Waste - Biological Treatment of Solid Waste	N2O	0.05	0.05	0.00	1.00
Fuel Comb 4 of 4	Fuel Combustion Activities	CH4	0.04	0.04	0.00	1.00
2-13s1	Industrial -Alcoholic Beverages	NMVOC	0.03	0.03	0.00	1.00
3A2	Manure Management	CH4	0.03	0.03	0.00	1.00
3A21	Manure Management	N2O	0.02	0.02	0.00	1.00
2A2	Mineral Industry -Lime Production	CO2	0.01	0.01	0.00	1.00
Fuel Comb 4 of 4	Fuel Combustion Activities	N2O	0.01	0.01	0.00	1.00
2D2	Non-Energy Products from Fuels and Solvent Use - Paraffin Wax Use	CO2	0.01	0.01	0.00	1.00
2-13s2	Industrial - Bread Prodn	NMVOC	0.00	0.00	0.00	1.00
2G	Other Product Manufacture and Use - N2O from Product Uses	N20	0.00	0.00	0.00	1.00
2A4	Mineral Industry -Other Process Uses of Carbonates	CO2	0.00	0.00	0.00	1.00
4C2	Open Burning of Waste	N2O	0.00	0.00	0.00	1.00
4C1	Open Burning of Waste	CH4	0.00	0.00	0.00	1.00
Total				2003.23	1	

**Key categories* are those that, when summed together in descending order of magnitude, add up to 95 percent of the total in Column G (2006 IPCC Guidelines pg 4.15, Vol. 4, Chap 4)

Table 14: Approach 1 Level Assessment for GHG Inventory for 2015 in Key Category Analysis – The Key Categories are in red*

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	648.7595793	648.7595793	0.667711623	**0.667711623**
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	206.3017876	206.3017876	0.212328428	**0.88004005**
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-52.5398148	52.5398148	0.054074647	**0.934114697**
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	36.33066325	36.33066325	0.037391981	**0.971506678**
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	7.437562	7.437562	0.007654834	**0.979161512**
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	-7.303472953	7.303472953	0.007516827	**0.986678339**
2.F.4	Aerosols	HFCs, PFCs	3.354	3.354	0.00345198	**0.990130319**
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	2.697188973	2.697188973	0.002775981	**0.9929063**
2.A.4	Other Process Uses of Carbonates	CARBON DIOXIDE (CO2)	1.409771976	1.409771976	0.001450955	**0.994357255**
2.C.6	Zinc Production	CARBON DIOXIDE (CO2)	1.2347192	1.2347192	0.001270789	**0.995628044**
3.B.5.b	Land Converted to Settlements	CARBON DIOXIDE (CO2)	1.217062	1.217062	0.001252616	**0.99688066**
4.C	Incineration and Open Burning of Waste	CARBON DIOXIDE (CO2)	0.83289624	0.83289624	0.000857227	**0.997737887**
3.A.1	Enteric Fermentation	METHANE (CH4)	0.596	0.596	0.000613411	**0.998351298**
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	0.499433	0.499433	0.000514023	**0.998865321**
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	0.419	0.419	0.00043124	**0.999296561**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
4.B	Biological Treatment of Solid Waste	METHANE (CH4)	0.354	0.354	0.000364341	**0.999660902**
2.H	Other	NMVOC	0.03539	0.03539	3.64238E-05	**0.999697326**
3.A.2	Manure Management	METHANE (CH4)	0.033	0.033	3.3964E-05	**0.99973129**
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	0.026	0.026	2.67595E-05	**0.999758049**
4.B	Biological Treatment of Solid Waste	NITROUS OXIDE (N2O)	0.021	0.021	2.16135E-05	**0.999779663**
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	0.019	0.019	1.9555E-05	**0.999799218**
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	0.096083167	0.096083167	9.889E-05	**0.999898108**
4.C	Incineration and Open Burning of Waste	METHANE (CH4)	0.09	0.09	9.26291E-05	**0.999990737**
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	0.005	0.005	5.14606E-06	**0.999995883**
2.G	Other Product Manufacture and Use	NITROUS OXIDE (N2O)	0.002	0.002	2.05843E-06	**0.999997942**
4.C	Incineration and Open Burning of Waste	NITROUS OXIDE (N2O)	0.002	0.002	2.05843E-06	**1**
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.1	Energy Industries - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.1	Energy Industries - Gaseous Fuels	METHANE (CH4)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.1	Energy Industries - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.1	Energy Industries - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.1	Energy Industries - Other Fossil Fuels	METHANE (CH4)	0	0	0	**1**
1.A.1	Energy Industries - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.1	Energy Industries - Peat	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.1	Energy Industries - Peat	METHANE (CH4)	0	0	0	**1**
1.A.1	Energy Industries - Peat	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.1	Energy Industries - Biomass	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.1	Energy Industries - Biomass	METHANE (CH4)	0	0	0	**1**
1.A.1	Energy Industries - Biomass	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and	NITROUS OXIDE (N2O)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
	Construction - Other Fossil Fuels					
1.A.2	Manufacturing Industries and Construction - Peat	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Peat	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Peat	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Biomass	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Biomass	METHANE (CH4)	0	0	0	**1**
1.A.2	Manufacturing Industries and Construction - Biomass	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.a	Civil Aviation	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.a	Civil Aviation	METHANE (CH4)	0	0	0	**1**
1.A.3.a	Civil Aviation	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.b	Road Transportation	METHANE (CH4)	0	0	0	**1**
1.A.3.b	Road Transportation	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.c	Railways	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.c	Railways	METHANE (CH4)	0	0	0	**1**
1.A.3.c	Railways	NITROUS OXIDE (N2O)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.3.d	Water-borne Navigation - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Liquid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Gaseous Fuels	METHANE (CH4)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	METHANE (CH4)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Peat	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Peat	METHANE (CH4)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Peat	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Biomass	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Biomass	METHANE (CH4)	0	0	0	**1**
1.A.3.d	Water-borne Navigation - Biomass	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.3.e	Other Transportation	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.3.e	Other Transportation	METHANE (CH4)	0	0	0	**1**
1.A.3.e	Other Transportation	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.4	Other Sectors - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Gaseous Fuels	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.4	Other Sectors - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Other Fossil Fuels	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.4	Other Sectors - Peat	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Peat	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Peat	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.4	Other Sectors - Biomass	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.4	Other Sectors - Biomass	METHANE (CH4)	0	0	0	**1**
1.A.4	Other Sectors - Biomass	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.5	Non-Specified - Liquid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.5	Non-Specified - Gaseous Fuels	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.5	Non-Specified - Other Fossil Fuels	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Peat	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.5	Non-Specified - Peat	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Peat	NITROUS OXIDE (N2O)	0	0	0	**1**
1.A.5	Non-Specified - Biomass	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.A.5	Non-Specified - Biomass	METHANE (CH4)	0	0	0	**1**
1.A.5	Non-Specified - Biomass	NITROUS OXIDE (N2O)	0	0	0	**1**
1.B.1	Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.B.1	Solid Fuels	METHANE (CH4)	0	0	0	**1**
1.B.1	Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	**1**
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
1.B.2.a	Oil	METHANE (CH4)	0	0	0	**1**
1.B.2.a	Oil	NITROUS OXIDE (N2O)	0	0	0	**1**
1.B.2.b	Natural Gas	CARBON DIOXIDE (CO2)	0	0	0	**1**
1.B.2.b	Natural Gas	METHANE (CH4)	0	0	0	**1**
1.B.2.b	Natural Gas	NITROUS OXIDE (N2O)	0	0	0	**1**
1.C	Carbon dioxide Transport and Storage	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.A.1	Cement production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.A.2	Lime production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.A.3	Glass Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.1	Ammonia Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.2	Nitric Acid Production	NITROUS OXIDE (N2O)	0	0	0	**1**
2.B.3	Adipic Acid Production	NITROUS OXIDE (N2O)	0	0	0	**1**
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NITROUS OXIDE (N2O)	0	0	0	**1**
2.B.5	Carbide Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.5	Carbide Production	METHANE (CH4)	0	0	0	**1**
2.B.6	Titanium Dioxide Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.7	Soda Ash Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.8	Petrochemical and Carbon Black Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.B.8	Petrochemical and Carbon Black Production	METHANE (CH4)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
2.B.9	Fluorochemical Production	SF6, PFCs, HFCs and other halogenated gases	0	0	0	**1**
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.C.1	Iron and Steel Production	METHANE (CH4)	0	0	0	**1**
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.C.2	Ferroalloys Production	METHANE (CH4)	0	0	0	**1**
2.C.3	Aluminium production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.C.3	Aluminium production	PFCs (PFCs)	0	0	0	**1**
2.C.4	Magnesium production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.C.4	Magnesium production	Sulphur Hexafluoride (SF6)	0	0	0	**1**
2.C.5	Lead Production	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.E	Electronics Industry	SF6, PFCs, HFCs and other halogenated gases	0	0	0	**1**
2.F.2	Foam Blowing Agents	HFCs (HFCs)	0	0	0	**1**
2.F.3	Fire Protection	HFCs, PFCs	0	0	0	**1**
2.F.5	Solvents	HFCs, PFCs	0	0	0	**1**
2.F.6	Other Applications (please specify)	HFCs, PFCs	0	0	0	**1**
2.G	Other Product Manufacture and Use	SF6, PFCs	0	0	0	**1**
2.H	Other	CARBON DIOXIDE (CO2)	0	0	0	**1**
2.H	Other	METHANE (CH4)	0	0	0	**1**
3.A.2	Manure Management	NITROUS OXIDE (N2O)	0	0	0	**1**
3.B.4.a.i	Peatlands remaining peatlands	CARBON DIOXIDE (CO2)	0	0	0	**1**

A IPCC Category code	B IPCC Category	C Greenhouse gas	D 2015 Ex,t (Gg CO2 Eq)	E |Ex,t| (Gg CO2 Eq)	F Lx,t	CALCULATED Cumulative Total of Column F
3.B.4.a.i	Peatlands remaining peatlands	NITROUS OXIDE (N2O)	0	0	0	**1**
3.B.4.b	Land Converted to Wetlands	NITROUS OXIDE (N2O)	0	0	0	**1**
3.B.4.b	Land Converted to Wetlands	CARBON DIOXIDE (CO2)	0	0	0	**1**
3.B.5.a	Settlements Remaining Settlements	CARBON DIOXIDE (CO2)	0	0	0	**1**
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	0	0	0	**1**
3.C.1	Emissions from biomass burning	METHANE (CH4)	0	0	0	**1**
3.C.1	Emissions from biomass burning	NITROUS OXIDE (N2O)	0	0	0	**1**
3.C.2	Liming	CARBON DIOXIDE (CO2)	0	0	0	**1**
3.C.3	Urea application	CARBON DIOXIDE (CO2)	0	0	0	**1**
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	0	0	0	**1**
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	0	0	0	**1**
3.C.6	Indirect N2O Emissions from manure management	NITROUS OXIDE (N2O)	0	0	0	**1**
3.C.7	Rice cultivations	METHANE (CH4)	0	0	0	**1**
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	0	0	0	**1**
4.A	Solid Waste Disposal	METHANE (CH4)	0	0	0	**1**
			851.9298489	971.6164244		

Note: The software did not provide accurate results for the "Cumulative Total of Column F", therefore a manual calculation was employed. This is presented above in Table 14. Additionally, the results obtained from the calculations using the IPCC excel worksheets were manually inserted into the table above.

Good Key Category Analysis is usually performed on a time series of data. It was expected that this could have been done for the period of 2006 – 2015 to address data gaps from the previous GHG Inventory. However, this was not the case as for the 2007 – 2015 period very few sectors had good quality data available.

3.9 UNCERTAINTIES

In the present GHG Inventory, the uncertainties were mainly from two areas; the emission factors and the activity data itself. The country does not have the resources presently to develop its own national emission factors, hence, its heavy reliance on the default emission factors provided by the 2006 IPCC Guidelines. With regards to the activity data, uncertainties came mainly from when the data was not available due to the data custodians not having the resources to collect and manage the data. The specific sector related uncertainties in activity data is discussed below under each sector.

Uncertainty analysis is essential as it can serve as a means to direct meagre national resources in reducing the degree of uncertainty in future GHG inventories and also can guide future decisions in methodology. The Approach 1 method of Uncertainty Analysis was used to estimate uncertainties. 2006 IPCC Guidelines suggest that in inventories where the Tier 1 methodology is predominant Approach 1 is the most suitable fit when estimating uncertainties.

3.9.1 ENERGY

Areas of uncertainty within the Energy Sector are as follows:

- Reference Approach: Import data of all types of fuels is provided by one agency (West Indies Oil Company - WIOC). There is no way to verify this data as the National Statistics Division has no up to date information on fuel import data.
- Sectoral Approach
    - WIOC provided most of the information used in this assessment.
    - WIOC also provided data on gas stations, marinas and airport fuel consumption for data for the specified period of 2015. The data does not include all commercial sites, hence uncertainty in calculating emissions.
- Regarding the use of charcoal, this posed the most difficult to collect information. The charcoal producers could not give an average estimate of their monthly production. The producers do not keep records of these activities.
- The Tier 1 Method was used since Antigua and Barbuda does not have country specific emission factors.

3.9.2 INDUSTRIAL SECTOR

Areas of uncertainty in the Industrial Processes and Product Use sector include the following:

- The mining of construction aggregates has proven to be one of the key contributors to CO_2 emissions. However, it can be deduced that actual emission volumes are more elevated than those reported as some major stakeholders in this sub-sector did not choose to participate in the data collection process.

- Data collected for HFC emissions were obtained from activity data provided by the Ministry of Trade, Industry and Commerce as per a recently conducted survey by this governmental body. It is noted that the data for the 2015 inventory year (6.05118 Gg) was significantly less than the 2006 inventory year (114.03369 Gg). This potentially introduces a level of uncertainty due to the vast difference in volumes.
- In reference to calculating emissions of NMVOCs (Non-methane volatile organic compound) in the Food and Beverage sector, results were unobtainable via 2006 IPCC guidelines. The IPCC Software provides the relevant space for data entry and hence the option to calculate NMVOCs was notably absent. As discussed previously in the methodology for this sector, estimated activity data for this sector was acquired, and subsequently the Revised 2006 IPPC guidelines were used. No data was ascertained from bakeries on bread production which would similarly increase the levels of NMVOCs produced.

3.9.3 AGRICULTURE SECTOR

Areas of Uncertainty within the Agricultural Sector are listed below:

- The data used for the livestock population were based upon those provided by the Food and Agricultural Organization (FAO). This was obtained in October 2018 from its website: www.fao.org/faostat/en/#data/QA. There was no basis for correlating this information with the actual figures from the Ministry of Agriculture and the Livestock and Veterinary Division. These estimated figures introduced some uncertainties as the method of collection and estimation was unknown.
- Information on the specific emission factors for animal species within Antigua and Barbuda was not available. Due to the lack of information the IPCC default emission factors and typical animal mass were used to estimate the enteric fermentation.
- The absence of a developed manure management system in Antigua and Barbuda led to a "best guess" approach and this could affect the calculation of nitrous oxide and methane from manure management.
- In calculating the direct N_2O emissions from manure management, default nitrogen excretion rate values were used for swine that assumed that 90% of the swine population is market swine and 10% is breeding swine. However, in general 50% of the swine population is market swine and the remaining 50% is breeding swine. It is possible that this will affect the accuracy of the N_2O emissions calculated.
- Although the soils in Antigua and Barbuda are not limed, the increased use of some urea-based fertilizers will account for some greenhouse gas emission. The absence of this data and measurement will affect the total output and final calculation of the emission for Antigua and Barbuda.
- As part of the calculation of methane and direct N_2O emissions from poultry, the excretion rate factor for boilers was used. However, the range of poultry in Antigua and Barbuda includes ducks, pullets, hens and chickens reared for egg production. This could affect the final calculation given that each sub-category carries different excretion rates.

3.9.4 FORESTRY AND OTHER LAND USE SECTOR

Areas of Uncertainty within the Forestry and Other Land Use Sector are listed below:

- The analysis of land use change between 2003 and 2015 was conducted using the software Collect Earth and this was only applied to mainland Antigua. Additionally, there were four technicians who divided the work, which could have influenced the resulting data.

- Similarly, with the case of the TNC, expert judgment of the Forestry staff was used to determine acreage of forests' sub-categories which led to the calculation of increase in carbon stocks. More accurate data can be obtained if additional resources are invested into developing the capacity of the Forestry Unit in using the Collect Earth, or other appropriate land use analysis tools
- Another gap that was identified in the TNC was the absence of numbers of acres burned per year. The emissions from biomass burning in forest could not be determined since this information is not available. The Fire department still only keeps data on number of fires and not the types of fires. This lack of data would reduce the accuracy of calculated GHG emissions due to fires.

3.9.5 WASTE SECTOR

- In the absence of waste characterization data and national emissions factors, defaults values were taken from the IPCC guidelines/model and used to calculate emissions from solid waste disposal.
- In calculating emissions from composting, assumptions were made about the proportion of waste that is green landscaping material.
- In calculating emissions from open burning of waste, the default value of 2% of total municipal solid waste was taken from the 2006 IPCC guidelines.
- The author made 'best guess' estimates of the degree of utilization of septic tanks versus latrines in regional and urban buildings

3.9.6 QUANTIFIED UNCERTAINTY

Uncertainty is defined by the 2006 IPCC Guidelines as:

> *…lack of knowledge of the true value of a variable that can be described as a probability density function (PDF) characterising the range and likelihood of possible values. Uncertainty depends on the analyst's state of knowledge, which in turn depends on the quality and quantity of applicable data as well as knowledge of underlying processes and inference methods, (pg 3.8, Section 3.1.3, Vol 1, 2006 IPCC Guidelines)*

Approach 1 was used in quantifying uncertainty and may be seen in Table 15 below. Approach 1 requires use of base year emissions. In some cases, different methodologies were used from one GHG Inventory to the next. Therefore, it is difficult to compare subsequent inventories to each other.

Table 15 indicates that the Percentage Uncertainty in the total inventory is 39.6%. It must be noted that not all of the uncertainties clearly laid out previously can be quantified, therefore, the value of 39.6% is not an absolute value but it is the best statistical way of quantifying uncertainties for the present GHG Inventory.

Table 15: Approach 1 Uncertainty Calculation -Base year for assessment of uncertainty in trend: 2015, Year T: 2015

A	B	C	E	F	CALCULATED	
2006 IPCC Categories	**Gas**	**Base Year emissions or removals (Gg CO2 equivalent)**	**Activity Data Uncertainty (%)**	**Emission Factor Uncertainty (%)**	Combined Uncertainty (%)	Contribution to Variance by Category in Year T
1.A - Fuel Combustion Activities						
1.A.1.a.i - Electricity Generation - Liquid Fuels	CO2	0	0	0	0	0
1.A.1.a.i - Electricity Generation - Liquid Fuels	CH4	0	0	0	0	0
1.A.1.a.i - Electricity Generation - Liquid Fuels	N2O	0	0	0	0	0
1.A.1.b - Petroleum Refining - Liquid Fuels	CO2	648.7595793	50	4	50.15974482	1459.054363
1.A.1.b - Petroleum Refining - Liquid Fuels	CH4	0.02579285	50	100	111.8033989	1.14578E-05
1.A.1.b - Petroleum Refining - Liquid Fuels	N2O	0.005116565	50	100	111.8033989	4.50879E-07
1.A.3.b.vi - Urea-based catalysts	CO2	0	0	0	0	0
1.B.1 - Fugitive Emissions from Fuels - Solid Fuels					0	0
1.B.1.a.i.1 - Mining	CO2	0	0	0	0	0
1.B.1.a.i.1 - Mining	CH4	0	0	0	0	0
1.B.1.a.i.2 - Post-mining seam gas emissions	CO2	0	0	0	0	0
1.B.1.a.i.2 - Post-mining seam gas emissions	CH4	0	0	0	0	0
1.B.1.a.i.3 - Abandoned underground mines	CH4	0	0	0	0	0
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CH4	0	0	0	0	0
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CO2	0	0	0	0	0

1.B.1.a.ii.1 - Mining	CO2	0	0	0	0	0
1.B.1.a.ii.1 - Mining	CH4	0	0	0	0	0
1.B.1.a.ii.2 - Post-mining seam gas emissions	CO2	0	0	0	0	0
1.B.1.a.ii.2 - Post-mining seam gas emissions	CH4	0	0	0	0	0
1.B.2 - Fugitive Emissions from Fuels - Oil and Natural Gas					0	0
1.C - CO2 Transport Injection and Storage					0	0
1.C.1.a - Pipelines	CO2	0	0	0	0	0
1.C.1.b - Ships	CO2	0	0	0	0	0
1.C.1.c - Other (please specify)	CO2	0	0	0	0	0
1.C.2.a - Injection	CO2	0	0	0	0	0
1.C.2.b - Storage	CO2	0	0	0	0	0
1.C.3 - Other	CO2	0	0	0	0	0
2.A - Mineral Industry					0	0
2.A.1 - Cement production	CO2	0	0	0	0	0
2.A.2 - Lime production	CO2	0	0	0	0	0
2.A.3 - Glass Production	CO2	0	0	0	0	0
2.A.4.a - Ceramics	CO2	0.000323549	0	0	0	0
2.A.4.b - Other Uses of Soda Ash	CO2	0	0	0	0	0
2.A.4.c - Non-Metallurgical Magnesia Production	CO2	0	0	0	0	0
2.A.4.d - Other (please specify)	CO2	1.409448427	3	3	4.242640687	4.92679E-05
2.B - Chemical Industry					0	0
2.B.1 - Ammonia Production	CO2	0	0	0	0	0
2.B.2 - Nitric Acid Production	N2O	0	0	0	0	0
2.B.3 - Adipic Acid Production	N2O	0	0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0	0	0	0	0

2.B.5 - Carbide Production	CO2	0	0	0	0	0
2.B.5 - Carbide Production	CH4	0	0	0	0	0
2.B.6 - Titanium Dioxide Production	CO2	0	0	0	0	0
2.B.7 - Soda Ash Production	CO2	0	0	0	0	0
2.B.8.a - Methanol	CO2	0	0	0	0	0
2.B.8.a - Methanol	CH4	0	0	0	0	0
2.B.8.b - Ethylene	CO2	0	0	0	0	0
2.B.8.b - Ethylene	CH4	0	0	0	0	0
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CO2	0	0	0	0	0
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CH4	0	0	0	0	0
2.B.8.d - Ethylene Oxide	CO2	0	0	0	0	0
2.B.8.d - Ethylene Oxide	CH4	0	0	0	0	0
2.B.8.e - Acrylonitrile	CO2	0	0	0	0	0
2.B.8.e - Acrylonitrile	CH4	0	0	0	0	0
2.B.8.f - Carbon Black	CO2	0	0	0	0	0
2.B.8.f - Carbon Black	CH4	0	0	0	0	0
2.B.9.a - By-product emissions	CHF3	0	0	0	0	0
2.B.9.a - By-product emissions	CH2F2	0	0	0	0	0
2.B.9.a - By-product emissions	CH3F	0	0	0	0	0
2.B.9.a - By-product emissions	CF3CHFCHFCF2CF3	0	0	0	0	0
2.B.9.a - By-product emissions	CHF2CF3	0	0	0	0	0
2.B.9.a - By-product emissions	CHF2CHF2	0	0	0	0	0
2.B.9.a - By-product emissions	CH2FCF3	0	0	0	0	0
2.B.9.a - By-product emissions	CH3CHF2	0	0	0	0	0
2.B.9.a - By-product emissions	CHF2CH2F	0	0	0	0	0
2.B.9.a - By-product emissions	CF3CH3	0	0	0	0	0
2.B.9.a - By-product emissions	CF3CHFCF3	0	0	0	0	0

2.B.9.a - By-product emissions	CF3CH2CF3	0	0	0	0	0
2.B.9.a - By-product emissions	CH2FCF2CHF2	0	0	0	0	0
2.B.9.a - By-product emissions	CF4	0	0	0	0	0
2.B.9.a - By-product emissions	C2F6	0	0	0	0	0
2.B.9.a - By-product emissions	C3F8	0	0	0	0	0
2.B.9.a - By-product emissions	C4F10	0	0	0	0	0
2.B.9.a - By-product emissions	c-C4F8	0	0	0	0	0
2.B.9.a - By-product emissions	C5F12	0	0	0	0	0
2.B.9.a - By-product emissions	C6F14	0	0	0	0	0
2.B.9.a - By-product emissions	SF6	0	0	0	0	0
2.B.9.a - By-product emissions	CHCl3	0	0	0	0	0
2.B.9.a - By-product emissions	CH2Cl2	0	0	0	0	0
2.B.9.a - By-product emissions	CF3 I	0	0	0	0	0
2.C - Metal Industry					0	0
2.C.1 - Iron and Steel Production	CO2	0	0	0	0	0
2.C.1 - Iron and Steel Production	CH4	0	0	0	0	0
2.C.2 - Ferroalloys Production	CO2	0	0	0	0	0
2.C.2 - Ferroalloys Production	CH4	0	0	0	0	0
2.C.3 - Aluminium production	CO2	0	0	0	0	0
2.C.3 - Aluminium production	CF4	0	0	0	0	0
2.C.3 - Aluminium production	C2F6	0	0	0	0	0
2.C.4 - Magnesium production	CO2	0	0	0	0	0
2.C.4 - Magnesium production	SF6	0	0	0	0	0
2.C.5 - Lead Production	CO2	0	0	0	0	0
2.C.6 - Zinc Production	CO2	1.2347192	10	50	50.99019514	0.005461388
2.D - Non-Energy Products from Fuels and Solvent Use						
2.D.1 - Lubricant Use	CO2	0.492334333	20	50	53.85164807	0.000968527
2.D.2 - Paraffin Wax Use	CO2	0.007098667	20	100	101.9803903	7.22071E-07

2.E - Electronics Industry					0	0
2.E.1 - Integrated Circuit or Semiconductor	C2F6	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor	CF4	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor	CHF3	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor	C3F8	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor	SF6	0	0	0	0	0
2.E.2 - TFT Flat Panel Display	CF4	0	0	0	0	0
2.E.2 - TFT Flat Panel Display	SF6	0	0	0	0	0
2.E.3 - Photovoltaics	CF4	0	0	0	0	0
2.E.3 - Photovoltaics	C2F6	0	0	0	0	0
2.E.4 - Heat Transfer Fluid	C6F14	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances					0	0
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2FCF3	2.697188973	0	0	0	0
2.F.4 - Aerosols	CH2FCF3	3.354	0	0	0	0
2.F.4 - Aerosols	CH3CHF2	0	0	0	0	0
2.F.4 - Aerosols	CF3CHFCF3	0	0	0	0	0
2.F.4 - Aerosols	CF3CHFCHFCF2CF3	0	0	0	0	0
2.F.5 - Solvents	CF3CHFCHFCF2CF3	0	0	0	0	0
2.F.5 - Solvents	C6F14	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CHF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CH2F2	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CH3F	0	0	0	0	0

2.F.6 - Other Applications (please specify)	CF3CHFCHFCF2CF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CHF2CF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CHF2CHF2	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CH2FCF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CH3CHF2	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CHF2CH2F	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CF3CH3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CF3CHFCF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CF3CH2CF3	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CH2FCF2CHF2	0	0	0	0	0
2.F.6 - Other Applications (please specify)	CF4	0	0	0	0	0
2.F.6 - Other Applications (please specify)	C2F6	0	0	0	0	0
2.F.6 - Other Applications (please specify)	C3F8	0	0	0	0	0
2.F.6 - Other Applications (please specify)	C4F10	0	0	0	0	0
2.F.6 - Other Applications (please specify)	c-C4F8	0	0	0	0	0
2.F.6 - Other Applications (please specify)	C5F12	0	0	0	0	0
2.F.6 - Other Applications (please specify)	C6F14	0	0	0	0	0
2.G - Electrical Equipment					0	0

2.G.1.a - Manufacture of Electrical Equipment	SF6	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	CF4	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	C2F6	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	C3F8	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	C4F10	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	c-C4F8	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	C5F12	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment	C6F14	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	SF6	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	CF4	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	C2F6	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	C3F8	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	C4F10	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	c-C4F8	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	C5F12	0	0	0	0	0
2.G.1.b - Use of Electrical Equipment	C6F14	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	SF6	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	CF4	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	C2F6	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	C3F8	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	C4F10	0	0	0	0	0

2.G.1.c - Disposal of Electrical Equipment	c-C4F8	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	C5F12	0	0	0	0	0
2.G.1.c - Disposal of Electrical Equipment	C6F14	0	0	0	0	0
2.G.2.a - Military Applications	SF6	0	0	0	0	0
2.G.2.a - Military Applications	CF4	0	0	0	0	0
2.G.2.a - Military Applications	C2F6	0	0	0	0	0
2.G.2.a - Military Applications	C3F8	0	0	0	0	0
2.G.2.a - Military Applications	C4F10	0	0	0	0	0
2.G.2.a - Military Applications	c-C4F8	0	0	0	0	0
2.G.2.a - Military Applications	C5F12	0	0	0	0	0
2.G.2.a - Military Applications	C6F14	0	0	0	0	0
2.G.2.b - Accelerators	SF6	0	0	0	0	0
2.G.2.b - Accelerators	CF4	0	0	0	0	0
2.G.2.b - Accelerators	C2F6	0	0	0	0	0
2.G.2.b - Accelerators	C3F8	0	0	0	0	0
2.G.2.b - Accelerators	C4F10	0	0	0	0	0
2.G.2.b - Accelerators	c-C4F8	0	0	0	0	0
2.G.2.b - Accelerators	C5F12	0	0	0	0	0
2.G.2.b - Accelerators	C6F14	0	0	0	0	0
2.G.2.c - Other (please specify)	SF6	0	0	0	0	0
2.G.2.c - Other (please specify)	CF4	0	0	0	0	0
2.G.2.c - Other (please specify)	C2F6	0	0	0	0	0
2.G.2.c - Other (please specify)	C3F8	0	0	0	0	0
2.G.2.c - Other (please specify)	C4F10	0	0	0	0	0
2.G.2.c - Other (please specify)	c-C4F8	0	0	0	0	0
2.G.2.c - Other (please specify)	C5F12	0	0	0	0	0
2.G.2.c - Other (please specify)	C6F14	0	0	0	0	0

2.G.3.a - Medical Applications	N2O	0.002021	0	0	0	0
2.G.3.b - Propellant for pressure and aerosol products	N2O	0	0	0	0	0
2.G.3.c - Other (Please specify)	N2O	0	0	0	0	0
2.H - Other					0	0
2.H.2 - Food and Beverages Industry	CO2	0	0	0	0	0
2.H.2 - Food and Beverages Industry	CH4	0.03539	0	0	0	0
3.A - Livestock		0			0	0
3.A.1.a.i - Dairy Cows	CH4		0	0	0	0
3.A.1.a.ii - Other Cattle	CH4	0.36	0	0	0	0
3.A.1.b - Buffalo	CH4	0	0	0	0	0
3.A.1.c - Sheep	CH4	0	0	0	0	0
3.A.1.d - Goats	CH4	0.07	0	0	0	0
3.A.1.e - Camels	CH4	0.135	0	0	0	0
3.A.1.f - Horses	CH4	0	0	0	0	0
3.A.1.g - Mules and Asses	CH4	0.009	0	0	0	0
3.A.1.h - Swine	CH4	0.017	0	0	0	0
3.A.1.j - Other (please specify)	CH4	0	0	0	0	0
3.A.2.a.i - Dairy cows	N2O	0	0	0	0	0
3.A.2.a.ii - Other cattle	N2O	0	0	0	0	0
3.A.2.b - Buffalo	N2O	0	0	0	0	0
3.A.2.c - Sheep	N2O	0	0	0	0	0
3.A.2.d - Goats	N2O	0	0	0	0	0
3.A.2.e - Camels	N2O	0	0	0	0	0
3.A.2.f - Horses	N2O	0	0	0	0	0
3.A.2.g - Mules and Asses	N2O	0	0	0	0	0
3.A.2.h - Swine	N2O	0	0	0	0	0
3.A.2.i - Poultry	N2O	0	0	0	0	0
3.A.2.j - Other (please specify)	N2O	0	0	0	0	0

3.A.2.a.i - Dairy cows	CH4	0.01	0	0	0	0
3.A.2.a.ii - Other cattle	CH4	0	0	0	0	0
3.A.2.b - Buffalo	CH4	0	0	0	0	0
3.A.2.c - Sheep	CH4	0.0028	0	0	0	0
3.A.2.d - Goats	CH4	0.00594	0	0	0	0
3.A.2.e - Camels	CH4	0	0	0	0	0
3.A.2.f - Horses	CH4	0.001095	0	0	0	0
3.A.2.g - Mules and Asses	CH4	0.00204	0	0	0	0
3.A.2.h - Swine	CH4	0.01	0	0	0	0
3.A.2.i - Poultry	CH4	0.0014	0	0	0	0
3.A.2.j - Other (please specify)	CH4	0	0	0	0	0
3.B - Land					0	0
3.B.1.a - Forest land Remaining Forest land	CO2	-52.5398148	8	40	40.79215611	6.328833452
3.B.1.b.i - Cropland converted to Forest Land	CO2	-1.21723646	8	40	40.79215611	0.003397007
3.B.1.b.ii - Grassland converted to Forest Land	CO2	-5.815757567	8	40	40.79215611	0.077545961
3.B.1.b.iii - Wetlands converted to Forest Land	CO2	-0.270478927	8	40	40.79215611	0.000167731
3.B.1.b.iv - Settlements converted to Forest Land	CO2	0	0	0	0	0
3.B.1.b.v - Other Land converted to Forest Land	CO2	0	0	0	0	0
3.B.2.a - Cropland Remaining Cropland	CO2	36.33066325	8	50	50.6359556	4.662919775
3.B.2.b.i - Forest Land converted to Cropland	CO2	7.437562	8	75	75.42545989	0.433601126
3.B.2.b.ii - Grassland converted to Cropland	CO2	0	0	0	0	0
3.B.2.b.iii - Wetlands converted to Cropland	CO2	0	0	0	0	0
3.B.2.b.iv - Settlements converted to Cropland	CO2	0	0	0	0	0

3.B.2.b.v - Other Land converted to Cropland	CO2	0	0	0	0	0
3.B.3.a - Grassland Remaining Grassland	CO2	206.3017876	8	40	40.79215611	97.57814868
3.B.3.b.i - Forest Land converted to Grassland	CO2	0.032032	8	90	90.35485598	1.15416E-05
3.B.3.b.ii - Cropland converted to Grassland	CO2	0.064051167	8	90	90.35485598	4.61477E-05
3.B.3.b.iii - Wetlands converted to Grassland	CO2	0	0	0	0	0
3.B.3.b.iv - Settlements converted to Grassland	CO2	0	0	0	0	0
3.B.3.b.v - Other Land converted to Grassland	CO2	0	0	0	0	0
3.B.4.a.i - Peatlands remaining peatlands	CO2	0	0	0	0	0
3.B.4.a.i - Peatlands remaining peatlands	N2O	0	0	0	0	0
3.B.4.b.i - Land converted for peat extraction	N2O	0	0	0	0	0
3.B.4.b.ii - Land converted to flooded land	CO2	0	0	0	0	0
3.B.5.a - Settlements Remaining Settlements	CO2	0	0	0	0	0
3.B.5.b.i - Forest Land converted to Settlements	CO2	0.384332667	8	90	90.35485598	0.00166154
3.B.5.b.ii - Cropland converted to Settlements	CO2	0	0	0	0	0
3.B.5.b.iii - Grassland converted to Settlements	CO2	0.832729333	8	90	90.35485598	0.007800169
3.B.5.b.iv - Wetlands converted to Settlements	CO2	0	0	0	0	0
3.B.5.b.v - Other Land converted to Settlements	CO2	0	0	0	0	0
3.B.6.b.i - Forest Land converted to Other Land	CO2	0	0	0	0	0

3.B.6.b.ii - Cropland converted to Other Land	CO2	0	0	0	0	0
3.B.6.b.iii - Grassland converted to Other Land	CO2	0	0	0	0	0
3.B.6.b.iv - Wetlands converted to Other Land	CO2	0	0	0	0	0
3.B.6.b.v - Settlements converted to Other Land	CO2	0	0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land					0	0
3.C.1.a - Biomass burning in forest lands	CH4	0	0	0	0	0
3.C.1.a - Biomass burning in forest lands	N2O	0	0	0	0	0
3.C.1.b - Biomass burning in croplands	CH4	0	0	0	0	0
3.C.1.b - Biomass burning in croplands	N2O	0	0	0	0	0
3.C.1.c - Biomass burning in grasslands	CH4	0	0	0	0	0
3.C.1.c - Biomass burning in grasslands	N2O	0	0	0	0	0
3.C.1.d - Biomass burning in all other land	CH4	0	0	0	0	0
3.C.1.d - Biomass burning in all other land	N2O	0	0	0	0	0
3.C.2 - Liming	CO2	0	0	0	0	0
3.C.3 - Urea application	CO2	0	0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils	N2O	0	0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils	N2O	0	0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management	N2O	0	0	0	0	0
3.C.7 - Rice cultivations	CH4	0	0	0	0	0
3.D - Other					0	0
3.D.1 - Harvested Wood Products	CO2	0	0	0	0	0

4.A - Solid Waste Disposal					0	0
4.A - Solid Waste Disposal	CH4	0	0	0	0	0
4.B - Biological Treatment of Solid Waste					0	0
4.B - Biological Treatment of Solid Waste	CH4	0.354083584	0	0	0	0
4.B - Biological Treatment of Solid Waste	N2O	0.021245015	0	0	0	0
4.C - Incineration and Open Burning of Waste					0	0
4.C.1 - Waste Incineration	CO2	0	0	0	0	0
4.C.1 - Waste Incineration	CH4	0	0	0	0	0
4.C.1 - Waste Incineration	N2O	0	0	0	0	0
4.C.2 - Open Burning of Waste	CO2	0.83289624	0	0	0	0
4.C.2 - Open Burning of Waste	CH4	0.08968104	0	0	0	0
4.C.2 - Open Burning of Waste	N2O	0.001717737	0	0	0	0
4.D - Wastewater Treatment and Discharge					0	0
4.D.1 - Domestic Wastewater Treatment and Discharge	CH4	0.409039597	0	0	0	0
4.D.1 - Domestic Wastewater Treatment and Discharge	N2O	0.01853172	0	0	0	0
4.D.2 - Industrial Wastewater Treatment and Discharge	CH4	0.0095744	0	0	0	0
4.E - Other (please specify)						
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3						
5.B - Other (please specify)						
Total						
		851.9289274			sum	1568.154988
					FINAL	39.59993672

Note: The reporting team observed a discrepancy when calculating the Uncertainties using the IPCC Software. It was noted that the values obtained by the software for the variables: "G" – Combined Uncertainty % and "H" - Contribution to Variance by Category in Year T were not accurate. The team subsequently conducted a manual calculation of the two variables using the 2006 IPCC Guidelines equations, i.e.

$$G = \sqrt{E^2 + F^2}$$

And

$$H = \frac{(G \bullet D)^2}{(\sum D)^2}$$

The calculated values are presented in the table above resulting in an Uncertainty of 39.6%.

Note: In all cases presented the uncertainties were known for each of the emission factors and activity data separately, hence there is no correlation between them. Therefore, Sensitivity A was not used.

3.10 RECOMMENDATIONS

In an effort to improve the quality of data collected for future inventories, a list of recommendations is provided below by sector. The goal is to also decrease the levels of uncertainties, which could become a reality if the recommendations are implemented. Finally, it would be to the benefit of the country to implement a system for the continuous collection of GHG-related data, thereby making trend analysis possible in the future.

3.10.1 ENERGY SECTOR

Due to the significant lack of good data from the end users it is recommended that the following data be collected annually within the sector by the National Statistics Division:

- Annual consumption of fuel according to fuel type by gas stations, marinas and airports
- Annual consumption of fuel by the National Power Company (APUA and APC). This would improve record keeping by end users of petroleum products.
- Agencies such as the Bureau of Standards should be targeted to verify accuracy of measuring instruments being used to determine consumption of fuel, lubricants and charcoal.
- It is recommended that indigenous energy resources should be developed, which in this case would be primarily from wind and photovoltaic systems (PV) to reduce the use of fossil fuels and GHG emissions.
- The National Statistics Division should retain information from the entities that contribute to the consumption of energy such as charcoal and fuel distribution of refined products. This information should be collected monthly.
- Antigua and Barbuda should in fact seek to utilize more renewable energy such as wind and photovoltaic systems (solar energy) to further reduce carbon footprint.

3.10.2 INDUSTRIAL SECTOR

The Government of Antigua and Barbuda should consider mandating stakeholders to participate in ventures of this nature to ensure collection of data in order to obtain a more complete study. A further detailed study of the refrigerants sub-sector must occur to address the discrepancies noticed with 2015 inventory year vs 2006 inventory year. It is recommended that the disconnect for NMVOC emissions in the existing guidelines for the food and beverage sub-sector be addressed for future inventory activities of this nature.

3.10.3 AGRICULTURAL SECTOR

- The Ministry of Agriculture should ensure that more frequent livestock population censuses are carried out. There is one scheduled with the Food and Agricultural Organization (FAO) for the year 2020. This will seek to obtain information on animal species, population and more specifically the population of breeders in each species.
- Additionally, it is suggested that the Ministry of Agriculture develops protocols for regular data collection and adequate data storage systems to enable more efficient management of this sector, as well as to facilitate a more proficient analysis of the GHG emissions.
- Ministry of Agriculture could collaborate with the Department of Environment to develop a data management and collections protocol.

- Antigua and Barbuda should collaborate with the UNFCCC and other international and regional agencies to develop national emission factors.
- The legislative framework is established to have farmers be responsible to register and report data on their livestock, if this is not already in place, with the necessary penalties for not reporting the same. Meanwhile, there is also a need to capture and archive the data for stray animals.
- There were inconsistencies in the data gathering process in that the data at the sources, for example, the Ministry of Agriculture did not always correspond with that at the Statistical Department. There is therefore a need to strengthen the data sharing platform so that there is a central repository where data can be easily accessed.
- The establishment of a quality control methodology to be instituted at the data source and a secondary mechanism for quality control and quality assurance at the level of the central repository. This ensures that data necessary for a multitude of projects as well as data for reporting to international agencies are as accurate as possible and stored in the necessary format for reporting.
- With regards to the situation in Barbuda, getting accurate numbers of deer and wild pigs may prove difficult without the necessary capacity. However, advice may be obtained from agencies such as WSPA (World Society for Protection of Animals) among others, who may have extensive experience in accurately estimating wild livestock populations.

3.10.4 FORESTRY AND OTHER LAND USE SECTOR

- The analysis of land use change between 2003 and 2015 was conducted using the software Collect Earth and this was only applied to mainland Antigua. Additionally, there were four technicians who divided the work, which could have influenced the resulting data. A recommendation would be to use one or two trained experts working together to conduct this analysis, which could allow for the resulting data to be more consistent. Additionally, this exercise should be extended to mainland Barbuda.
- Similarly, with the case of the TNC, expert judgment of the Forestry staff was used to determine acreage of forests' sub-categories which led to the calculation of increase in carbon stocks. More accurate data can be obtained if additional resources are invested into developing the capacity of the Forestry Unit in using the Collect Earth, or other appropriate land use analysis tools
- Another gap that was identified in the TNC was the absence of numbers of acres burned per year. The emissions from biomass burning in forest could not be determined since this information is not available. The Fire department still only keeps data on number of fires. This lack of data would reduce the accuracy of calculated GHG emissions due to fires. It is recommended that resources are allocated to the Fire Department to assist them in collecting this data.
- The lack of nationally generated emission factors would also influence the accuracy of the calculations. In all cases, the default factors had to be used and this may not result in accurate calculations of emissions. It is recommended that options be explored where possible for the development of national, or even regional, emission factors.
- It is noted that this data has other uses, such as in determining the national Land Degradation values needed for reporting to the United Nations Convention to Combat Desertification.

3.10.5 WASTE SECTOR

- The next GHG Inventory will be conducted under the Fourth National Communications. It is recommended that a tier 2 approach be adopted for the assessment of solid waste disposal given the availability of data in a waste characterization study that was conducted in 2019.
- Similarly, tier 2 assessments should be performed for biological treatment of waste via composting given the availability of empirical data on proportions of landscaping waste for the next inventory report.
- It is recommended that the National Fire Service be engaged and encouraged to implement a system of monitoring and recording instances of open burning of waste in the country. It is believed that a suitably designed managed system could capture information about the quantities and composition of waste materials that are disposed of this way.
- A detailed assessment of the numbers of septic tanks versus latrines in the various communities across the country would facilitate a more accurate estimate of emissions from wastewater treatment and discharge.
- It is recommended to capture data relating to illegal dumping sites. This can be done through estimates and/or conducting rapid assessments of these sites.
- It is recommended to partner with the Royal Police Force of Antigua and Barbuda under the ongoing CariSecure Project that is being implemented. This project is providing the Police Force with necessary training to create and maintain databases.

3.11 POLICIES

In its Third National Communication, Antigua and Barbuda identified a quantified economy wide emissions reduction limit to reduce its GHG emissions by 25% by 2020 compared to a 1990 baseline, a commitment under the Copenhagen Accord. Due to a combination of insufficient 1990 baseline data and increasing pressures on Antigua and Barbuda's economy, its mitigation priorities have since been refocused towards a 'policies and measures'-based approach, as indicated by the targets set out in the Nationally Determined Contributions (NDC).

The Conditional Mitigation targets presented in the NDCs that would have a direct impact on the GHG emissions are:

- **By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off-grid in the public and private sectors**
- **By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks**

The existing policies in Antigua and Barbuda that contribute to the reduction of GHG emissions and/or improving GHG removal potential are:

- Environmental Protection and Management Act, 2019
- Renewable Energy Act, 2015
- National Energy Policy, 2011
- Interconnection Policy, 2011
- Regional Energy Efficient Building Code, 2018

3.12 SUMMARY

A summary of the national GHG emissions (Table 2) for 2015 are as follows:

- **Carbon Dioxide (CO2): 844.28 Gg,**
- **Methane (CH4): 1.517 Gg,**
- **Nitrous Oxide (N2O): 0.049 Gg,**
- **Non-methane volatile organic compounds (NMVOC): 0.035 Gg,**
- **Hydrofluorocarbons (HFC): 6.051 Gg.**

The overall uncertainty of the inventory is 39.6%. It is important to note that there are efforts in place to significantly reduce GHG emissions by 2020. This can be seen in the previous section of policies that are now in place to assist with this target. Additionally, data from this Inventory may be used to provide evidence of the present-day situation so that solutions can be encouraged to reduce emissions and point the way forward towards Renewable Energy Sources and Energy Efficiency.

3.13 APPENDICES

The Appendices are provided as a separate document. The contents of the Appendices are as follows:

A. Energy Sector

Detailed Methodology

Worksheets

Raw Data

B. Industrial Sector

Detailed Methodology

Worksheets

Raw Data

C. Agricultural Sector

Detailed Methodology

Worksheets

Raw Data

D. Forestry and Other Land Use Sector

Detailed Methodology

Worksheets

Raw Data

E. Waste Sector

Detailed Methodology

Worksheets

Raw Data

Mitigation Actions

Historic windmills used on sugar plantations

4 MITIGATION ACTIONS

4.1.1 TRENDS AND PROJECTIONS OF GHG EMISSIONS AND REMOVALS

The Caribbean region, including Antigua and Barbuda, was responsible for less than 0.35% of global GHG emissions in 2012 (World Bank, 2014), with the small island developing state (SIDS) contributing less than 0.002% (INDC, 2015). However, Antigua and Barbuda is committed to implementing mitigation policies to become a sustainable, low carbon economy that is resilient to the effects of climate change, despite its extreme vulnerability to climate trends (INDC, 2015). Antigua and Barbuda's Third National Communication identified a quantified economy-wide emissions reduction limit to reduce its GHG emissions by 25% by 2020 compared to a 1990 baseline, a commitment under the Copenhagen Accord. Due to a combination of insufficient 1990 baseline data and increasing pressures on Antigua and Barbuda's economy our mitigation priorities have since been refocused towards a policies and measures based approach, as indicated by the targets set out in the INDC. For the latest calculation of emissions and removals (January 2019) for the 2015 inventory year, Antigua and Barbuda's net emissions were estimated to be 844.28 $GgCO_2e$. This was a decrease of approximately 101 $GgCO_2e$ compared to the previous estimate for the 2006 inventory (compiled in 2015[22]).

A comparison of the separate inventory estimates suggests that Antigua and Barbuda's annual GHG emissions ($GgCO_2e$) have decreased by 10% between 2006 and 2015. However, the emissions for the present GHG inventory is similar to the 2006 one, in that the major emissions came from the Energy and Land Use, Land-Use Change and Forestry (LULUCF) sectors. The biggest change in emissions from the LULUCF sector comes from an increase in emissions from sub-sector 3.B.3.a – annual change in carbon stocks in mineral soils (grassland remaining grassland) (increase of 501 % from the 2006 inventory year). However, there was an issue with the calculation of this subsector, and it was not possible to use the IPCC software, instead IPCC 2006 Excel worksheets were used, this may have contributed to the discrepancy. In addition to this, there have been significant changes to the data collection methodology. Aerial photography and ground truthing were employed for the 2006 inventory, however this was improved upon with the use of the FAO land monitoring software Collect Earth and a Google Earth Engine script for the 2015 inventory. As a result, it becomes difficult to compare the two datasets. Another trend in the data is the apparent decrease of F-Gases between the 2006 and 2015 inventories. This is also the result of a change in HFC emission estimation methodology between the 2006 and the 2015 inventories. Estimations for the 2006 inventory relied on refrigerant data from the National Statistics Division, whereas the 2015 inventory relies on data provided by the Ozone Office focal point in the Ministry of Trade.

The largest contribution to Antigua and Barbuda's GHG emissions comes from fuel combustion in the energy industry (production of electricity). CO_2 emissions from fuel combustion activities alone were calculated to be 648.8 Gg (approximately 76% of total emissions following the sectoral approach), a decrease of just under 4% since 2006. This represents stability in energy consumption and its contribution to emissions. It must be noted that there were no major changes to the methodology and increasing GDP in the electricity generation sector and population of the country during this period[23].

These highlighted a stable trend of emissions towards 2030 for a business as usual scenario (BAU), for parts of the energy sector only. It is worth noting that the inventory figures are not complete national total estimates and it is difficult to present a consistent picture between the projections analyses and GHG inventory data used for the Third National Communication (2015) reported to the UNFCCC and the latest GHG inventory produced for this BUR report. Notwithstanding, the projections scenario for

[22] Estimated in the 3rd National Communication: https://unfccc.int/resource/docs/natc/antnc3.pdf
[23] Statistics Division, Ministry of Finance and Corporate Governance, 05/03/2019

the INDC estimated a GHG emissions increase of approximately 80% between 2015 and 2030. Further analyses were performed for a range of different scenarios. These analyses highlight that the implementation of mitigation strategies could limit GHG emissions increases to approximately 8% between 2015 and 2030 for the energy sector. A description of the assumptions made in generating these scenarios are provided in the section on Projections. These projections should be interpreted as indicative and highlight the need for further analyses of projected emissions. However, they do emphasize the importance of climate action and policy implementation in mitigating GHG emissions for Antigua and Barbuda. It must be noted as well that the Department of Environment is about to start the development of the Fourth National Communication (4NC) to the UNFCCC. The GHG Inventory team has taken a decision to recalculate the emissions as far back as 2005 to present date for the 4NC. Once completed that would provide a better picture as to the state of emissions in the country.

4.1.2 CLIMATE ACTIONS

Students install solar panels at their school

Antigua and Barbuda has communicated its intention to implement a variety of national and sector mitigation policies. An overview of the number of climate actions by sector category and status of implementation is found in Table 16. These mitigation actions are expected to contribute to the country achieving its sustainable development objectives and national mitigation and adaptation commitments highlighted by in Antigua and Barbuda's First NDC.

Table 16: Number of Actions and Status of Implementation by Sector

Sector	Number of actions by status of implementation			
	Idea	Planning	Under Implementation	Completed
Energy supply	0	3	6	0
Fuel combustion	0	2	3	0

LULUCF	0	1	4	0
Agriculture	1	1	2	0
Waste	1	0	0	1

The majority of Antigua and Barbuda's mitigation actions are focused on energy supply or adaptation projects with energy supply elements, most of which are under implementation. Fuel combustion/ efficiency and LULUCF sectors have five ongoing or planned projects respectively. There are two ongoing projects in the Agriculture sector but currently no projects under implementation for the Waste sector, however there are several in idea or planning phase. Table 17 provides a summary list of actions. Full details of the actions can be found in Mitigation Annex A.

Table 17: Summary of climate actions by sector

ID	Name	Status	Linked indicator IDs
Energy Supply			
2	GISS: Grid-Interactive Solar PV Systems for Schools and Clinics	Under Implementation	I2; I19;
4	Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project	Under implementation	I2; I17; I18;
6	SPPARE component 3: Renewable Energy in Support of Protected Areas System	Under Implementation	I2; I17; I18;
10	10 MW Solar Project	Under Implementation	I14
11	Green Barbuda Project	Planning	I15
18	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda	Planning	I10; I11; I12; I13;
19	Resilience to hurricanes in the building sector in Antigua and Barbuda (GCF Build)	Under GCF Review	I34
20	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed	Under Implementation	I23; I24; I25; I26; I27; I28; I29; I30;
22	Community led renewable energy initiatives	Under Implementation	-
Fuel Combustion			
1	Electric Bus Pilot Project	Under implementation	I20
3	Energy for Sustainable Development in the Caribbean (ESD Project)	Under Implementation	I22
12	Street lighting project	Under Implementation	I16
13	Energy audit of public buildings	Planning	-

15	GEF7 Antigua and Barbuda Sustainable Low-emission Island Mobility project	Late Development Stage	I1
LULUCF			
5	SPPARE component 2: Improve Management Effectiveness of Sustainable Pilot Protected Area – Boggy Peak National Park	Under implementation	I3
7	SPPARE component 4: Enhance Forest Management	Planning	I4; I5;
14	Integrated Water, Land and Ecosystem Management (IWEco)	Under Implementation	-
16	Redonda restoration programme and offshore restoration programme	Under Implementation	I21
21	The Path to 2020	Under Implementation	I31; I32; I33;
Waste			
8	Testing a Prototype Caribbean Regional Fund for Wastewater Management (GEF CReW)	Completed	-
9	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda	Planning	I6; I7; I8; I9;
Agriculture			
17	SOILCARE - Caribbean Soil Management for Restored Watersheds and Sustainable food systems Project	Idea	-
23	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy	Planning	I35; I36; I37
24	Use of protected culture technologies for the production of high value vegetable crops to build resilience against impacts of climate change in the Agricultural Sector	Under Implementation	I38; I39
25	Agricultural Technology Cooperation Project between China and Antigua and Barbuda	Under Implementation	I38; I40

4.1.3 ACTION INDICATORS

Tracking the impact of the listed actions will be an important process for monitoring progress towards NDCs, national strategies and SDGs. Quantitative information on the impacts and progress of these actions is measured using a set of linked indicators. Table 18 provides a summary list of indicators developed. A full list of these indicators is available in Mitigation Annex B: Indicator Registry. The indicators can be categorised into three types:

1) GHG impact;

2) Progress; and

3) Wider impacts

Table 18: Summary of climate action indicators

Indicator ID	Indicator Name	Units	Linked Action IDs
Energy Supply			
I2	GHG emissions mitigated from the energy sector	tCO_2 mitigated	2, 4, 6;
I10	GHG emissions from electricity generation attributed to desalination	tCO_2eq emitted from desalination plants	18;
I11	Installed off-grid renewable energy capacity	MW of renewable energy installed.	18;
I12	Increased access to water for general population during/after climate-induced water stress events	Percentage of people with access to water during climate-stressed events	18;
I13	Increased resilience of water system to climate shocks/stressors	Cubic meters of water being stored in storage tanks and reservoirs	18;
I15	Installed capacity of renewable energy projects in Barbuda	Kw of solar energy capacity installed	11;
I17	Installed solar energy output	kWh per year	4;
I18	CO_2 emissions avoided	tCO_2	4;
I19	Renewable energy systems installed on schools	Number of schools	2;
I23	Homes equipped with water storage facilities	% of homes equipped with 2 weeks' worth of water stored on-site with filtration and pump equipment	20;
I24	Homes installed with hurricane shutters and rainwater harvesting	% of homes benefitting from the installation of hurricane shutters and rainwater harvesting	20;
I25	Number of people requiring shelters during droughts	% reduction in the number of people requiring shelters during natural disasters	20;
I26	Vulnerable homes with back up renewable energy systems	% of vulnerable homes with back-up RE (for essential services including pumping water)	20;
I27	Shelters with back up renewable energy systems	% of shelters	20;
I28	Mosquito larvae in local water bodies	% reduction in mosquito larvae abundance	20;

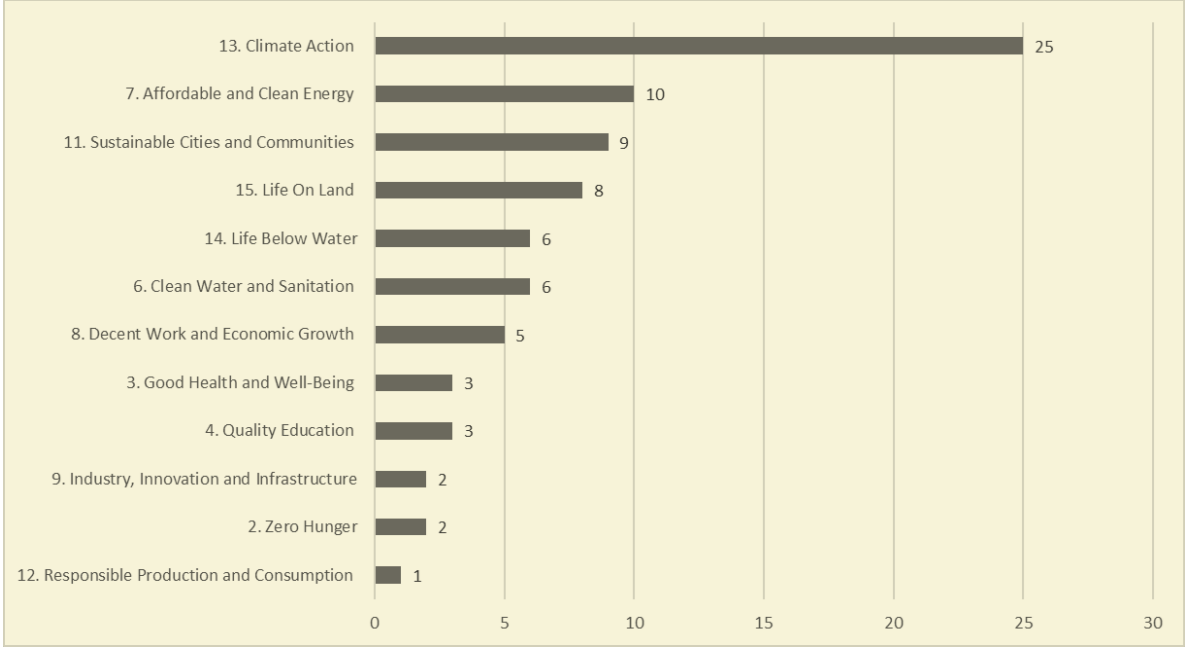
I29	Exposure to public awareness materials	% of families and businesses exposed to the project's public awareness material	20;
I30	Community groups trained	Number of community groups trained in the management and maintenance of adaptation interventions	20;
Fuel Combustion			
I16	Sodium street lighting replaced by LED lighting	% of sodium bulb streetlighting with LEDs.	12;
I20	Electric charging stations installed	Number of electric charging stations installed	1;
I22	CO_2 emissions mitigated due to energy efficiency improvements	kt CO_2	3;
LULUCF			
I3	Securement of land as new protected area	Hectares	5;
I4	Annual CO_2 savings from land restoration and avoided land degradation	tCO_2 sequestered per year	7;
I31	Management effectiveness and financial sustainability scores	% increase in management effectiveness and financial sustainability scores	21;
I32	Expansion of protected areas in support of species conservation	Increase in hectares of protected areas	21;
I33	Useful and sustainable species	Increase in the number of species over baseline	21;
Waste			
I6	GHG emissions mitigated from waste	tCO_2eq emissions avoided	9;
I7	Creation of new jobs in the circular economy	Number of new jobs created	9;
I8	Reduction in landfill fires	Landfill fire hours per year	9;
I9	Reduction in discharge of nutrient rich landfill leachate and vinasse into waterways.	Concentration of landfill leachate and vinasse in waterways	9;
Agriculture			
I35	Upgrading observation and monitoring infrastructure	Number of meteorological stations upgraded	23;
I36	Allocation of grant packages to farmer groups	% of farmer groups	23;
I37	Adoption of soil and water conservation practises	Number of farmers	23;

I38	N2O emissions avoided through targeted fertilizer application	t CO2eq	24; 25
I39	Construction of greenhouses	Number of greenhouses	24
I40	Construction of greenhouses	Number of greenhouses	25

4.1.4 WIDER IMPACTS AND CO-BENEFITS

As a small island developing state (SIDS) suffering from systemic vulnerabilities and structural challenges caused by its limited size and high exposure to natural disasters, Antigua and Barbuda is vulnerable to a number of shocks outside its control. Antigua and Barbuda is therefore aiming to promote synergies between initiatives to mitigate climate change and promote other co-benefits for both islands. In addition to helping fulfil sustainable development goal 13 (Climate Action), 11 other SDGs are targeted by the 23 various outlined climate actions proposed or implemented. Affordable and Clean Energy (SDG 7), Life on Land (SDG 15), Clean Water and Sanitation (SDG 6), Decent Work and Economic Growth (SDG 8) and Life Below Water (SDG 14) were recognised as the most likely to be fulfilled following the successful implementation of the various mitigation policies see Figure 5 below.

Figure 5: Number of climate actions which contribute to the fulfilment of the Sustainable Development Goals



In addition to SDGs, the mitigation climate actions had wider impacts including fulfilling a number of Necessary Conditions (NC), which are more broadly linked to four Sustainable Development Dimensions (SDDs):

1. Optimal Generation of National Wealth;
2. Enhanced Social Cohesion;
3. Improved Health of the Natural Environment and Sustained Historical and Cultural Assets; and
4. Enhanced Citizen Security

By following these four SDDs and their corresponding NCs, Antigua and Barbuda hopes to move the country towards its long-term goals, through the undertaking of various strategies and actions over the Medium-Term (2016-2020). This is all part of the Medium-Term Development Strategy (MTDS)[24]. The Necessary Conditions which are likely to be fulfilled by adopting the previously outlined climate actions, to the greatest extent, include 'Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications) (NC 1.6)', 'Technological Adaptation and Innovation (Including Green Technology) (NC 1.4.5)' and 'Disaster Risk Management and Climate Change Resilience (NC 3.1.3)'. All 23 climate action policies have a wide range of additional environmental and socio-economic co-benefits, with three fulfilling a total of 8 SDGs and NCs. These included 'Green Barbuda Project', 'Circular Economy' and 'Resilience to hurricanes, floods and droughts in the building sector'.

Devastation in Barbuda following Category 5+++ Hurricane Irma in 2017

4.1.5 CONSTRAINTS AND GAPS

The work on the Third National Communication provided several recommendations on how best to address constraints and gaps. The report also highlighted how to enhance and facilitate the implementation of identified mitigation actions. Overarching identified constraints for the implementation of several mitigation scenarios include:

[24] http://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

- Financial;
- Technical Capacity;
- Institutional Capacity; and
- MRV Data Collection.

4.1.5.1 FINANCIAL

As a SIDS, the country has a relatively limited annual tax revenue, and therefore must rely on international support to fund its mitigation policies. However, this international capital funding might not be sufficiently accessible to Antigua and Barbuda due to its middle-income status. Some international funding also might be targeted to the whole Caribbean region, which minimises national impact as these regional projects may not directly align with national priorities[25].

4.1.5.2 TECHNICAL CAPACITY

Due to Antigua and Barbuda being a SIDS, it is limited by its human, technical and infrastructural resources, which means that access to innovative and modern technologies, technical knowledge and personnel are sometimes lacking[26]. Limited knowledge and awareness of skills and technologies can lead to limitations in what climate actions and technologies a country can implement. Technical capacity barriers to successful implementation were identified in section 4.10

4.1.5.3 INSTITUTIONAL CAPACITY

By passing the EPMA in 2015, Antigua and Barbuda created an enabling legal environment for progressive climate action. The EPMA 2019 represents an update of the 2015 Act and further advanced the framework of Climate Action. However, a need has been identified to put in place suitable institutional arrangements to encourage technological adaptation and innovation[27].This need resonates with several climate actions, specifically those that address behavioural change in well-established communities such as farmers and land-owners. A lack of a well-defined and proven institutional framework can present a barrier to the successful implementation of climate actions. Institutional capacity barriers to successful implementation were identified in section 4.10

4.1.5.4 MRV DATA COLLECTION

Data collection and data management systems surrounding climate actions can be challenging due to the lack of financial, human and technical capacity outlined above. Whilst different agencies do have a mandate to prioritise the collection of data in order to report to Permanent Secretaries and Ministers, there is a shortfall on meeting the regular data collection schedules and sharing of data. As a result, data is often collected on project-by-project basis to meet specific reporting requirements. This, combined with a shortage of trained staff, brain drain, a lack of resources and inadequate coordination between agencies has led to dispersed and inadequately documented existing data and information, lack of integrity and security in data management systems, lack of awareness of the availability and importance of data and information, and an increased risk of climate change impacts potentially destroying technology recording data. The Third National Communication highlighted that one of the main gaps related to effective MRV and national inventory reporting, was lack of data availability. None of the climate actions had sufficient data available to be able to calculate GHG impacts, however the indicators drafted for this report should facilitate a more detailed approach to data collection. There are two GEF funded projects ongoing and planned that will look to address these challenges: 'Monitoring and Assessment of Multilateral Environmental Agreements (MEA) Implementation and Environmental Trends in Antigua and Barbuda'; and 'Capacity Building for Access and Transparency on Climate Actions through an Environment Registry in Antigua & Barbuda' (CBIT).

[25] https://unfccc.int/resource/docs/natc/antnc3.pdf

[26] https://www.thegef.org/sites/default/files/project_documents/CBIT_Antigua_and_Barbuda_PIF_07March18.pdf

[27] http://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

4.2 INTRODUCTION

This chapter presents an overview of the planned, ongoing and completed projects and programmes that mitigate the release of GHGs and reduce contributions towards climate change. However, as a SIDS, Antigua and Barbuda's narrative surrounding climate change is predominantly focused on adapting to the risks and vulnerabilities posed by the damaging effects of climate change. As such, projects that fall under the umbrella term 'climate change action' are largely cross-cutting activities that address both mitigation and adaptation needs. Some actions may be focused on climate change mitigation, such as the installation of renewable energy systems, and have smaller adaptation components. Others are focused on building climate resilience, a high priority for the country given the high risk of hazardous climate events. These have also been included where there is some component of climate change mitigation, for example the installation of off-grid renewable energy systems. Given the cross-cutting nature of many of these actions it has also been important to develop a reporting structure that facilitates reporting on both mitigation and adaptation aspects.

As an overview of climate change mitigation and cross-cutting actions across Antigua and Barbuda, this chapter covers:

- The challenges that drive mitigation action including key sectors for GHG emissions, trends in emissions and emissions projections;
- The targets and objectives that the actions outlined are designed to help achieve;
- An overview of planned, ongoing and completed climate actions, split by sector, including summaries of key actions, stakeholders, wider benefits and indicators;
- A summary of the key supporters providing investment for climate action across the country and a description of the ongoing initiatives to streamline and generate further investment for action;
- An analysis of wider impacts, links between climate actions, Sustainable Development Goals and National Strategies;
- A brief report on the financial, technical and institutional constraints and gaps limiting climate action implementation;
- A description of the key institutions and stakeholders responsible for climate action data; and
- A description of the methods, data sources and assumptions used to produce this chapter.

4.3 GREENHOUSE GAS TRENDS AND PROJECTIONS

4.3.1 CHALLENGES

In the last 30 years, global greenhouse gas (GHG) emissions have increased by an estimated[28] average of 1.6% annually, with carbon dioxide (CO_2) emissions from fossil fuels increasing by approximately 1.9% per year[29]. It is currently projected that global emissions will continue to increase, requiring urgent action by countries across the world. The Caribbean region, including Antigua and Barbuda, was responsible for less than 0.35% of global GHG emissions in 2012 (World Bank, 2014), with Antigua and Barbuda contributing 0.002% (INDC, 2015). However, Antigua and Barbuda is committed to

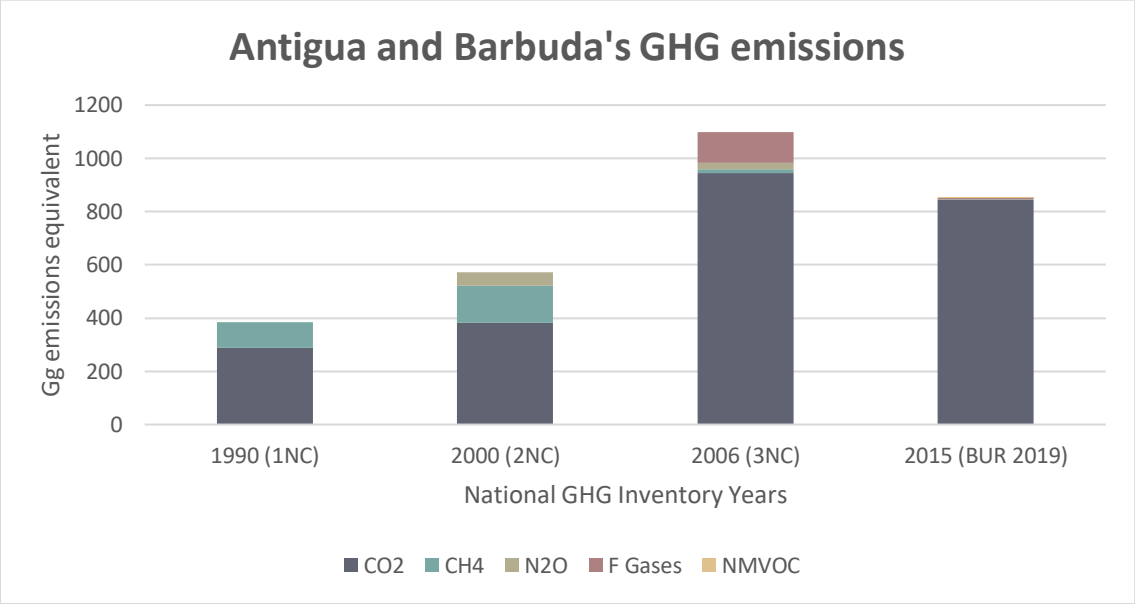
[28] Note that because the GHG inventory is compiled differently for different historical years this trend is difficult to quantify. It is recommended that future GHG estimates be compiled for a consistent timeseries so that trends can be properly evaluated.

[29] https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_mitigation.pdf

implementing mitigation policies to become a sustainable, low carbon economy that is resilient to the effects of climate change, despite its extreme vulnerability to climate trends (INDC, 2015).

Antigua and Barbuda's National 2015 GHG Inventory (see GHG inventory chapter) quantified the GHG emissions sources and sinks across various socio-economic sectors in Antigua and Barbuda. For the latest calculation of emissions and removals for the 2015 inventory year, Antigua and Barbuda's net emissions were estimated to be 844.28 $GgCO_2e$. This was a decrease of approximately 101 $GgCO_2e$ compared to the previous estimate for the 2006 inventory (compiled in 2015[30]). The compiled inventory estimates extracted from the first, second and third National Communications are presented in Figure 6. Whilst the data suggests an increasing trend in emissions between 1990 and 2006, it appears that between 2006 and 2015 there were somewhat stable emissions of CO_2. However, it is difficult to compare emission estimates as a result of discrepancies in the calculation methodologies.

Figure 6: Total aggregate GHG emissions and removals by year and gas



A comparison of the separate inventory estimates suggests that Antigua and Barbuda's annual GHG emissions ($GgCO_2e$) have decreased by 10 % between 2006 and 2015, with Figure 6 illustrating that emissions from Energy and LULUCF are the primary causes of emissions. The biggest change in emissions from the LULUCF sector comes from an increase in emissions from subsector 3.B.3.a – annual change in carbon stocks in mineral soils (grassland remaining grassland) (increase of 501 % from the 2006 inventory year). However, there was an issue with the calculation of this subsector, and it was not possible to use the IPCC software, instead IPCC 2006 Excel worksheets were used, this may have contributed to the discrepancy. In addition to this, there have been significant changes to the data collection methodology. Aerial photography and ground truthing were employed for the 2006 inventory, however this was improved upon with the use of the FAO land monitoring software Collect Earth and a Google Earth Engine script for the 2015 inventory. As a result, it becomes difficult to compare the two datasets. Another trend in the data is the apparent decrease of F-Gases between the 2006 and 2015 inventories. This is also the result of a change in HFC emission estimation methodology between the 2006 and the 2015 inventories. Estimations for the 2006 inventory relied on refrigerant data from the Statistics Division, whereas the 2015 inventory relies on data provided by the Ozone Office focal point in the Ministry of Trade.

From the 2015 GHG inventory we can deduce the following. The largest contribution to Antigua and Barbuda's GHG emissions comes from fuel combustion in the energy industry (production of

[30] Estimated in the 3rd National Communication: https://unfccc.int/resource/docs/natc/antnc3.pdf

electricity) (Figure 7), with the country importing 100% of its petroleum requirements from the West Indies Oil Company (WIOC) (GHG Inventory chapter). CO_2 emissions from fuel combustion activities alone were calculated to be 648.8 Gg (approximately 76% of total emissions following the sectoral approach), a decrease of just under 4% since 2006. This represents stability in energy consumption and its contribution to emissions. It must be noted that there were no major changes to the methodology and increasing GDP in the electricity generation sector and population of the country during this period[31].

Figure 7: GHG Emissions and removals by year and sector

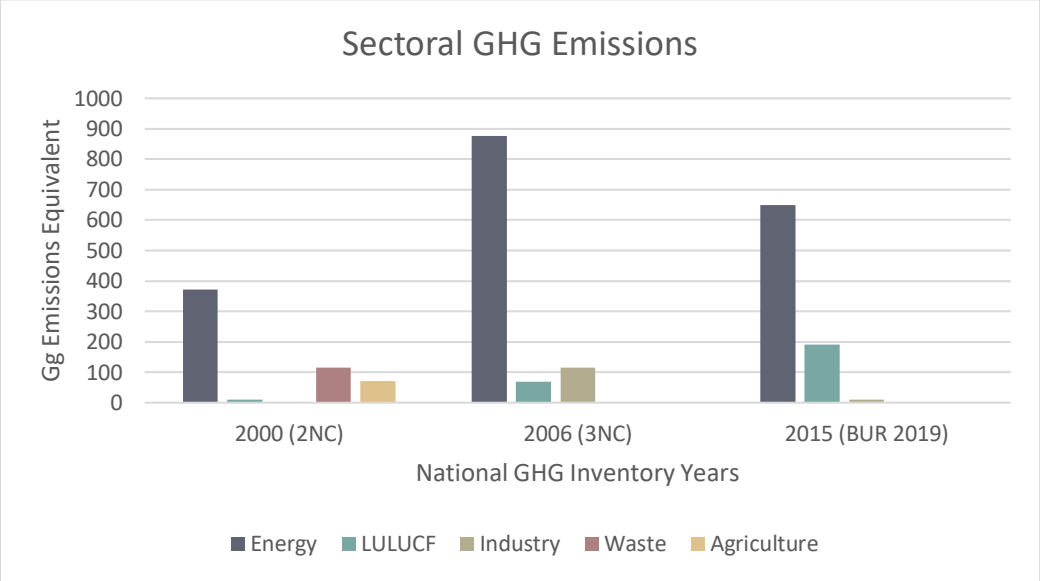
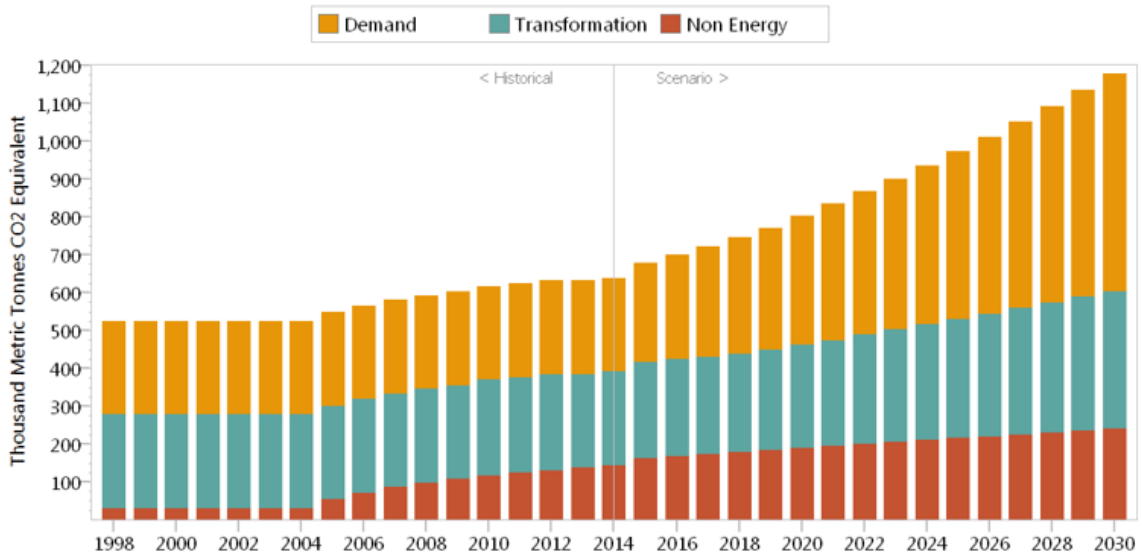


Figure 8 below shows the trends and projections in net GHG emissions from 1998 – 2030 compiled for the 2015 INDC analysis of a selection of climate mitigation actions. This analysis was conducted by the Clean Energy Solutions Centre (CESC). It is worth noting that the inventory figures are not complete national total estimates and it is difficult to present a consistent picture between the projections analyses and GHG inventory data used for the Third National Communication (2015) reported to the UNFCCC and the latest GHG inventory produced for this BUR report. Notwithstanding, this scenario estimated a GHG emissions increase of approximately 80 % between 2015 and 2030. Further analyses were performed for a range of different scenarios, demonstrated in Figure 9. These analyses highlight that the implementation of mitigation strategies could limit GHG emissions increases to approximately 8% between 2015 and 2030 for the energy sector. A description of the assumptions made in generating these scenarios is provided in the section 4.1 on Projections. These projections should be interpreted as indicative and highlight the need for further analyses of projected emissions. However, they do emphasize the importance of climate action and policy implementation in mitigating GHG emissions for Antigua and Barbuda.

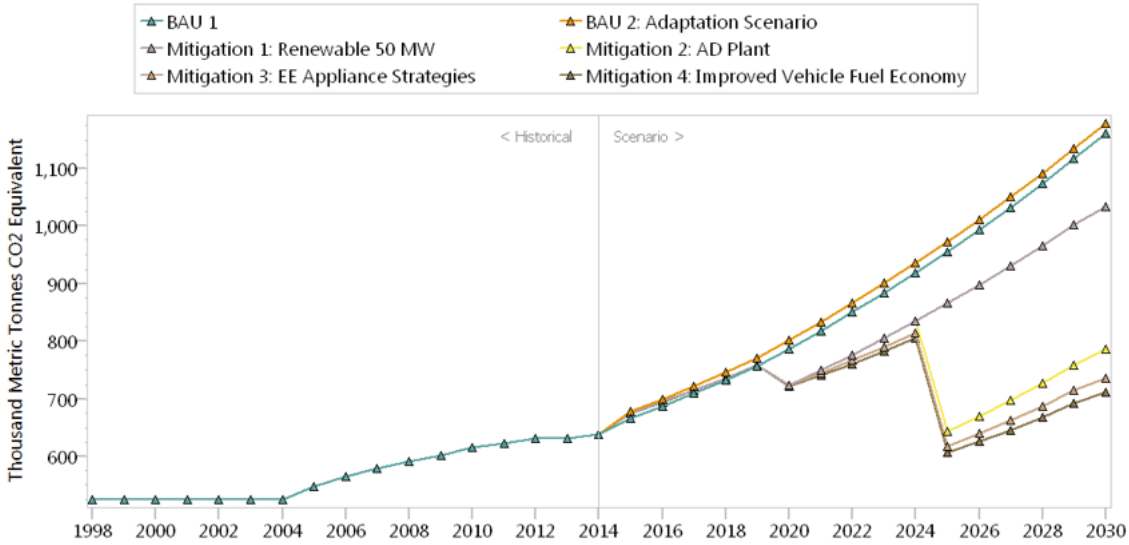
[31] Statistics Division, Ministry of Finance and Corporate Governance, 05/03/2019

Figure 8: CESC emissions projections to 2030 by sector



Note: Emissions totals for historic years do not match inventory data used for the Third National Communication (2015) reported to the UNFCCC and the latest GHG inventory produced for this BUR report, projections should be viewed as indicative of an increasing trend.

Figure 9: CESC emissions projections to 2030 by projection scenario



Note: Emissions totals for historic years do not match inventory data used for the Third National Communication (2015) reported to the UNFCCC and the latest GHG inventory produced for this BUR report, projections should be viewed as indicative of an increasing trend. Full information on the assumptions and methodologies behind the scenarios can be found in section 9.2 Projections.

Regardless of changes in methodology outlined above, the latest inventory data provides an indication of where mitigation efforts in Antigua and Barbuda should be focused. The Key Category Analysis performed on the 2015 inventory found the Energy and LULUCF sectors to be the two main

contributors to the country's GHG emissions. As a result, it is important for Antigua and Barbuda to implement appropriate climate actions with targets and objectives aimed at addressing these two key sectors.

4.3.1.1 ENERGY SECTOR

GHG emissions from the Energy Sector accounted for 76% of total emissions in the 2015 inventory, with CO_2 emissions from fuel combustion activities decreasing by 4% from the 2006 inventory. This stability in electricity production and consumption is partly due to similarities in methodology used between inventories. As a SIDS, electricity costs on the island remain higher than the average within the Caribbean region, as 100% of fuel is imported. It is therefore important for the country to introduce climate actions which specifically address this overreliance on expensive and imported fuel for the energy sector. Increases in green technology and reliance on renewable energy is therefore a major priority for the country.

4.3.1.2 LULUCF SECTOR

GHG emissions from the LULUCF Sector accounted for 22% of total emissions in the 2015 inventory. Technological advances have allowed the use of aerial photography and ground truthing activities, which aid in providing more accurate GHG emission estimates. Soil cultivation in croplands, settlements and grasslands were identified as key categories during Key Category Analysis. Antigua and Barbuda is therefore aiming to implement climate actions which specifically address CO_2 emissions from land use and land use change, by increasing the potential for carbon sinks across the island through the establishment of national parks and restoration of degraded land.

4.4 TARGETS AND OBJECTIVES

In its Third National Communication, Antigua and Barbuda identified a quantified economy wide emissions reduction limit to reduce its GHG emissions by 25% by 2020 compared to a 1990 baseline, a commitment under the Copenhagen Accord. Due to a combination of insufficient 1990 baseline data and increasing pressures on Antigua and Barbuda's economy its mitigation priorities have since been refocused towards a policies and measures based approach, as indicated by the targets set out in the Intended Nationally Determined Contribution (INDC). They include both adaptation and mitigation targets. Many of them are linked, including actions to improve new buildings and building stock energy efficiency and resilience, and generation of renewables to improve resilience as well as reduce emissions. Some adaptation targets may also increase GHG emissions (such as increased water desalination). The items below provide an update on the list presented in the First NDC:

4.4.1 CONDITIONAL ADAPTATION TARGETS

- By 2030, all buildings are improved and prepared for extreme climate events, including drought, flooding and hurricanes
- By 2030, 100% of electricity demand in the water sector and other essential services (including health, food storage and emergency services) will be met through off-grid renewable sources
- By 2030, all waterways are protected to reduce the risks of flooding and health impacts
- By 2030, an affordable insurance scheme is available for farmers, fishers, and residential and business owners to cope with losses resulting from climate variability
- By 2050, increase seawater desalination capacity by 50% above 2015 levels

4.4.2 CONDITIONAL MITIGATION TARGETS

- By 2020, establish efficiency standards for the importation of all vehicles and appliances
- By 2020, finalise the technical studies with the intention to construct and operationalise a waste to energy (WTE) plant by 2025
- By 2030, achieve an energy matrix with 50 MV of electricity from renewable sources both on and off-grid in the public and private sectors
- By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks

4.4.3 UNCONDITIONAL TARGETS

- Enhance the established enabling legal, policy and institutional environment for a low carbon emission development pathway to achieve poverty reduction and sustainable development
- By 2020, update the building code to meet projected impacts of climate change

The conditional targets rely on Antigua and Barbuda receiving additional international support. This support is required for capacity building, technology transfer and financial resources. Implementing the adaptation targets could cost approximately US $200 million, whilst implementing the mitigation targets will approximately cost US $220 million. Various stakeholder groups and funding agencies are expected to provide this international support, including the Global Environment Facility (GEF), the Green Climate Fund (GCF), the Adaptation Fund and other multilateral agencies and bilateral agreements (INDC, 2015).

Meeting these targets also involves the national development of an enabling legal, policy and institutional environment. This includes the coordination and enactment of the Renewable Energy Act of 2015[32] and the Environmental Protection and Management Act (EPMA) of 2019[33] as well as the achievement of the targets set out in the National Energy Policy (NEP)[34] through the implementation of the Sustainable Energy Action Plan[35]. Five key goals are outlined in the NEP:

- Energy Cost Reduction: Reduction of the overall energy intensity of the economy by 10% below a 2010 baseline, by 2021.
- Diversification of Energy Sources: 15% renewable energy in the electricity supply by 2030.
- Electricity Reliability Improvement: Regulatory reform designed to protect consumer interest and improve the quality of electricity supply.
- Environmental Protection: Laws and regulations which ensure that environmental considerations are an integral part of the energy permit process and in the planning and execution of energy related projects.
- Stimulate new Economic Opportunities: Incentives and market mechanisms to create an enabling environment for private investment in renewable energy and energy efficiency measures, including support for education and training.

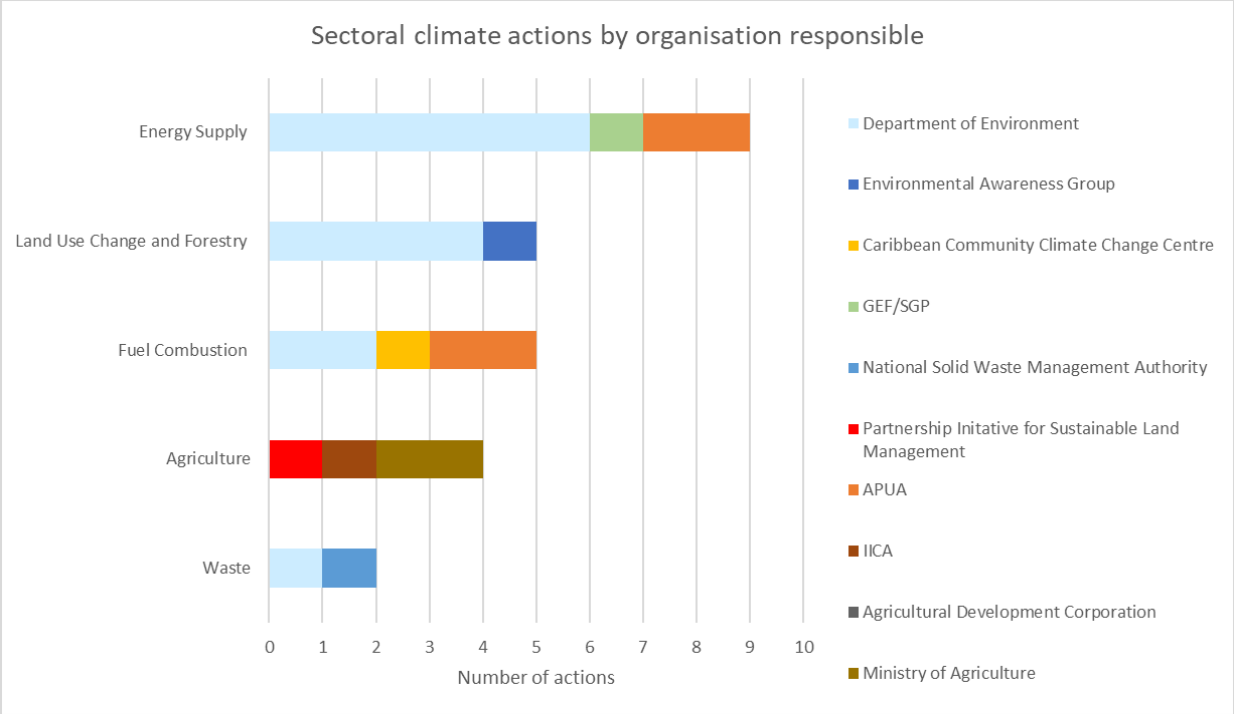
More broadly, these targets interact with the country's national strategic objectives through the Medium-Term Development Strategy[36], which outlines the core programme of action across Antigua and Barbuda. These national strategies have been referenced and linked directly to planned and ongoing climate change actions to highlight the wider impacts of climate action.

[32] http://extwprlegs1.fao.org/docs/pdf/ant145972.pdf
[33] http://www.ilo.org/dyn/natlex/docs/ELECTRONIC/102699/124270/F-977987007/ATG102699.pdf
[34] https://www.ctc-n.org/files/resources/antiguabarbuda_national_energy_policy.pdf
[35] http://www.oas.org/en/sedi/dsd/Energy/Doc/EAP_AntiguaBarbuda_web.pdf
[36] http://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

4.5 CLIMATE ACTIONS

Antigua and Barbuda has adopted (or planned to adopt) a variety of national and sector mitigation policies. These mitigation actions are expected to contribute to the country achieving its sustainable development objectives and national mitigation and adaptation commitments highlighted by the First NDC. Figure 9 summarises the actions by sector and responsible institution. Most actions are coordinated by the Department of Environment, the national focal point for climate action.

Figure 10: Climate actions by sector and responsible institution



There are several large-scale initiatives in the country that are working towards a more sustainable future. One of the main ongoing programmes is the Sustainable Pathways, Protected Areas and Renewable Energy (SPPARE) project. This initiative, executed by the Department of Environment in partnership with a host of different organisations, looks to establish a revenue stream from renewable energy systems to fund Protected Areas through the Sustainable Island Resource Framework Fund (SIRF Fund). This is in addition to the improved management of protected areas, the installation of 7MW of renewable energy and the restoration of watershed forests with a view to reducing forest fires. For the purpose of this chapter this programme has been separated into three distinct actions to better track the impacts.

Another major initiative in the country is the development of the circular economy approach to reducing emissions in the waste sector. This is in response to the fact that Antigua and Barbuda is one of the largest per capita generators of waste in the world. It also addressed a target set out in Antigua and Barbuda's NDC to construct and operationalise a waste to energy (WTE) plant by 2025, which has been deprioritised in favour of the circular economy approach in response to preliminary feasibility studies.

In the LULUCF sector, The Path to 2020 programme has been established in response to the passing of the EPMA. It in turn aims to improve management of landscapes and seascapes to enhance protection and sustainable use of globally significant biodiversity in protected areas and surrounding communities.

4.5.1 CLIMATE ACTIONS BY SECTOR

Climate change actions outlined in this chapter are presented by sector and sub-sector. The majority of Antigua and Barbuda's mitigation actions are focused on energy supply or adaptation projects with energy supply elements, most of which are under implementation. Fuel combustion/ efficiency and LULUCF sectors have five ongoing or planned projects respectively. There are two ongoing projects in the Agriculture sector but currently no projects under implementation for the Waste sector, however there are several in idea or planning phase. Table 19 provides a summary of actions by status of implementation before each sector is explored in more detail below. Key indicators have also been developed for the actions, and these can be used to track GHG impacts, project progress and wider impacts. Full details of the actions and indicators can be found in Mitigation Annex A and Annex B respectively.

Table 19: Number of climate actions by status of implementation and sector category

Sector	Number of actions by status of implementation			
	Idea	Planning	Under Implementation	Completed
Energy Supply	0	3	6	0
Fuel Combustion	0	2	3	0
LULUCF	0	1	4	0
Agriculture	1	1	2	0
Waste	1	0	0	1

4.5.1.1 ENERGY SUPPLY

Antigua and Barbuda has set ambitious targets for renewable energy production. These have been communicated in the INDC and they focus on both mitigation and adaptation:

- By 2030, achieve an energy matrix with 50 MV of electricity from renewable sources both on and off-grid in the public and private sectors.
- By 2030, 100% of electricity demand in the water sector and other essential services (including health, food storage and emergency services) will be met through off-grid renewable sources.

As a result, there are multiple ongoing programmes orientated towards the installation of traditional renewable energy plants as well as innovative grid-interactive renewable energy systems designed to improve resilience during extreme weather events. The 10 MW Solar Project, currently under implementation and co-ordinated by the Ministry of Public Utilities, Civil Aviation, Transportation and Energy, offers the largest installation of renewable energy capacity from an individual project. Work under this project has built a 3 MW solar farm at the VC Bird International Airport, a 4 MW solar farm in Bethesda and 1.3 MW of solar panels distributed across government owned buildings. A final 1.7 MW solar farm is planned at the Sir Vivian Richards Stadium.

While the majority of renewable energy projects across the islands are also focussed on solar installations, a major component of the SPPARE project is the installation of 33 wind turbines, in part to power a reverse osmosis plant. Using a concessionary loan from the Abu Dhabi Fund for Development (ADFD), as well as GEF funding and bilateral funding from the Italian Government, an expected 4 MW of wind power (15 turbines) will be installed with a view to installing a further 18 turbines pending additional funding. This will bring the total capacity to around 7 MW. Additional support from ADFD and Green Tech Solar will also result in the installation of 542 kW of solar energy capacity across hospitals, clinics and schools. SPPARE is one of three ongoing renewable energy projects looking to mitigate at least 100,000 tonnes of CO_2 equivalent. The other two projects contributing towards this specific target are: GISS: Grid-Interactive Solar PV Systems for Schools and

Clinics, funded through grants made available by the Italian government; and the Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project, a regional project aimed at promoting the increased use of renewable energy and reduced energy use through energy efficiency measures.

There is a strong focus across multiple projects on installing solar energy systems as a climate resilient measure. For example, to build backup energy systems for critical services such as healthcare, fire services and the police (GCF Build project) and to power carbon neutral power for water pumping and generation (Sustainable Integrated Water Resources Management project). A key supporter of these actions is the GCF which made grants available to fund these programmes, see section 5.1 Key Supporters of Climate Action for more details.

It is also worth noting that members of civil society and the local community have been actively involved in procuring solar energy systems across the country. To date, ten community groups have accessed green finance primarily from a GEF Small Grants Program (SGP) fund and with support from the Organisation of American States (OAS) and the DOE.

Key indicators related to these actions include direct GHG emissions mitigated from renewable energy projects such as SPPARE component 3, GISS and the SEF/CDB projects. Other key progress indicators for this sector include the tracking of installed capacity of renewable energy projects in Antigua and Barbuda for the 10 MW Solar and Green Barbuda projects respectively. The wider impacts of climate resilience projects with off-grid renewable components such as the Sustainable Integrated Water Resources Management project can be tracked using key indicators measuring the volume of water stored in storage tanks and reservoirs and the increasing percentage of people with access to water during climate-stressed events. See Mitigation Annex B for a full list of indicators. Table 20 below provides a summary list of mitigation and cross-cutting actions related to energy supply.

Table 20: Climate actions related to energy supply

ID	Name	Scenario	Status	Timeframe	Budget USD ($)	Lead Institution	Linked indicator IDs
2	GISS: Grid-Interactive Solar PV Systems for Schools and Clinics	WEM	Under Implementation	2017-TBD	825,000	DOE	I2; I19;

4	Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project	WEM	Under Implementation	2017-TBD	1,095,890	DOE	I2; I17; I18;
6	SPPARE component 3: Renewable Energy in Support of Protected Areas System	WEM	Under Implementation	2015-2020	15,000,000	DOE	I2
10	10 MW Solar Project	WEM	Under Implementation	2015-Ongoing	Unknown	APUA	I14
11	Green Barbuda Project	WEM	Planning	2019-TBD	5,200,000	APUA	I15
18	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda	WAM	Planning	TBD	65,000,000	DOE	I10; I11; I12; I13;
19	Resilience to hurricanes, floods and droughts in the building sector in Antigua and Barbuda (GCF Build)	WEM	Planning	2018/19-2023/24	45,000,000	DOE	I34
20	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed	WEM	Under Implementation	2017-2021	10,000,000	DOE	I23; I24; I25; I26; I27; I28; I29; I30;
22	Community led renewable energy initiatives	WEM	Under Implementation	2012-Ongoing	116,000	GEF; SGP	-

4.5.1.2 FUEL COMBUSTION

Climate actions related to fuel combustion in Antigua and Barbuda can be categorised further into actions focussed on energy efficiency in transport, buildings and civil infrastructure (e.g. street lighting). There are two key actions being led by DOE focussed on reducing GHG emissions from the transport sector: a flagship pilot project, supported by the Italian Government, to purchase an electric school bus and install electric charging stations; and a GEF funded project promoting the widespread use of low carbon electric vehicles, still in the planning phase. Both projects are expected to reduce GHG emissions through the promotion and adoption of electric vehicle technology for mass transit purposes. They also contribute towards SDG 11, Sustainable Cities and Communities as well as national strategies NC 1.4.5. Technological Adaptation and Innovation and NC 1.6 Adequate Infrastructure.

Energy efficiency in buildings and civil infrastructure is being improved through ongoing and planned projects to promote reduced energy use including the regional Energy for Sustainable Development in the Caribbean project whose objective is to reduce short term and long-term fossil fuel based electrical energy use in buildings by 20% and 50% respectively. Antigua Public Utilities Authority (APUA) is also responsible for two projects to reduce energy usage in public buildings and street lighting through an energy audit of three facilities and by replacing sodium bulbs with energy efficient LED bulbs across the country. These measures should also contribute to lowering government energy expenditure, hence the average consumer cost per month, as the cost of public buildings is shouldered by taxpayers.

Key action indicators for this sector include the GHG emissions mitigated from the transport sector due to the adoption of low carbon technologies resulting from the Sustainable Low-emission Island Mobility project. Key progress trackers include monitoring the percentage of sodium bulb street lighting replaced with LEDs, for the street lighting project, and the number of electric charging stations installed for the Electric Bus Pilot Project. See Mitigation Annex B for a full list of indicators. Table 19 below provides a summary list of mitigation and cross-cutting actions related to fuel combustion.

Table 21: Climate actions related to fuel combustion

ID	Name	Scenario	Status	Timeframe	Budget USD ($)	Lead Institution	Linked indicators
1	Electric Bus Pilot Project	WEM	Under implementation	2017-TBD	625,000	DOE	I20
3	Energy for Sustainable Development in the Caribbean (ESD Project)	WEM	Under Implementation	2013-2017	1,292,500	CCCCC	I22
12	Street lighting project	WEM	Under Implementation	2017-2019	Unknown	APUA	I16
13	Energy audit of public buildings	WAM	Planning	2019-TBD	Unknown	APUA	-
15	GEF7 Antigua and Barbuda Sustainable Low-emission Island Mobility project	WEM	Planning	2019-2023	12,980,000	DOE	I1

4.5.1.3 LULUCF

Climate action in the LULUCF sector is focussed on the establishment and development of protected areas, restoration of areas of special biological interest and protection of wetlands and watersheds leading to significant carbon sequestration. Components two and four of the SPPARE project have a large role through the demarcation, establishment and management of the Boggy Peak National Park (BPNP). Through these activities, including the development of supporting financial mechanisms, it is expected that 1,719 ha of land will be protected from further development. Work is ongoing to quantify the carbon sequestration value of this land. Forest management techniques such as the development of a wildfire prevention strategy, afforestation and sustainable husbandry practises are expected to lead to an increase of 43,216 tCO_2 sequestered by 2020.

Similarly, the Path to 2020 project looks to expand protected areas nationwide to support species conservation, as well strengthening regulatory mechanisms. Efforts are also ongoing, through the Redonda Restoration Programme, to restore offshore ecosystems which have been degraded by invasive alien species, through the physical removal of wildlife and introduction of biosecurity procedures. This has had success in improving the vegetation coverage on Redonda island, increasing the amount of CO_2 sequestered. All actions covered by this sector are broadly expected to improve the biodiversity and genetic resources on the island and so are contributing towards SDGs 14 and 15 – Life Below Water and Life on Land. Similarly, they are contributing broadly towards National Strategy NC 3.1.1 Ecosystems Management.

Key action indicators for this sector include the CO_2 sequestration impacts of land restoration and avoided land degradation, for example for SPPARE component 4. Progress of these actions can also be measured by tracking the hectares of land secured for a protected area. For example, SPPARE component 2 includes tracking the hectares of vegetated land restored; while for the Redonda Restoration Programme monitoring the increase in the number of species found in a given area is imperative; w hich will lead to better conservation efforts under the Path to 2020 project. See

Mitigation Annex B for a full list of indicators. Table 22 below provides a summary list of mitigation and cross-cutting actions related to LULUCF.

Table 22: Climate actions related to Land Use, Land Use Change and Forestry

ID	Name	Scenario	Status	Timeframe	Budget USD ($)	Lead Institution	Linked indicators
5	SPPARE component 2: Improve Management Effectiveness of Sustainable Pilot Protected Area – Boggy Peak National Park	WEM	Under implementation	2015-2019	1,816,667	DOE	I3
7	SPPARE component 4: Enhance Forest Management	WEM	Planning	2015-2020	1,186,606	DOE	I4; I5;
14	Integrated Water, Land and Ecosystem Management (IWEco)	WEM	Under Implementation	2017-2022	3,812,323	DOE	-
16	Redonda restoration programme and offshore restoration programme	WEM	Under Implementation	2016-Ongoing	Unknown	EAG	I21
21	The Path to 2020	WEM	Under Implementation	2018-2022	8,229,153	DOE	I31; I32; I33;

4.5.1.4 WASTE

Antigua and Barbuda's NDC contains one target specific to the waste sector:

- By 2020, finalize the technical studies with the intention to construct and operationalize a waste to energy (WTE) plant by 2025.

However, since the drafting of these targets, there has been a shift in momentum within the country away from the construction of a WTE plant towards a circular economy-based approach. This is in part due to ongoing feasibility studies that indicate there is not sufficient waste generation in the country to sustain such a plant economically. There is also a growing movement to view waste as a resource, and whilst the circular economy approach has highlighted the potential for significant GHG emissions reductions, through various waste management techniques including treating organic solid waste in landfill via anaerobic digestion and increased reuse, recycling and upcycling of solid waste, it is also expected to deliver wider social and environmental benefits too. These include an estimated 500 new jobs in the circular economy and reduced landfill leachate and fires.

The other action in this sector focuses on the improved management of wastewater and reducing energy consumption at wastewater treatment plants. Table 23 below provides a summary list of mitigation and cross-cutting actions related to waste.

Table 23: Climate actions related to waste

ID	Name	Scenario	Status	Timeframe	Budget USD ($)	Lead Institution	Linked indicators
8	Testing a Prototype Caribbean Regional Fund for Wastewater Managemen	WEM	Completed	2013-2017	65,000	DOE	-

	t (GEF CReW)						
9	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda	WAM	Planning	TBD	28,650,000	NSWMA	I6; I7; I8; I9;

Key indicators for waste sector actions and the circular economy approach include GHG emissions mitigated through improved waste management practises, as well as the wider social and environmental benefits such as tracking the number of new jobs created, the reduction of nutrient rich landfill leachate discharge and reduced number of hours for which landfill fires have been recorded. See Annex B for a full list of indicators.

4.5.1.5 AGRICULTURE

Antigua and Barbuda has four key cross-cutting climate change actions in the Agriculture sector; 'SOILCARE - Caribbean Soil Management for Restored Watersheds and Sustainable food systems Project' is a regional programme focussed on improving agricultural and soil management practises in Caribbean SIDS. The main outputs for Antigua and Barbuda include benefitting from the lessons learned from the implementation of sustainable land management approaches across agriculture and watershed restoration in Caribbean countries, as well as delivering a soils information database with updated soil information for the country that will inform land degradation calculations and future GHG inventories. The lessons learned from these approaches will be used to inform national projects that will be developed in the future. It is expected that through those projects, carbon sinks will increase, mitigating GHG emissions. The development of climate resilient farming communities in Antigua and Barbuda is also in focus. A Food and Nutrition Security Strategy is aiming to implement cost-effective adaptation measures in the community via interventions at the institutional, farm- and environment level to simultaneously build natural, institutional and social adaptive capacity. The primary objective of this project is to increase resilience in the agriculture sector, however improved efficiency of resource use and reduced loss of soil organic matter will contribute towards mitigation of GHG emissions. A summary of Climate Actions is presented in Table 24 below. The two remaining actions (actions 24 and 25) are focused on the development of capacity regarding greenhouse technology and knowledge sharing initiatives. These actions are expected to contribute towards SDGs 2, 4, 11, 13, 14 and 15, - Zero Hunger, Quality Education, Sustainable Cities and Communities, Climate action, Life Below Water and Life on Land. The following National Strategies are also addressed NC 1.2, NC 1.7, NC 3.1.1, NC 3.1.2 and NC 3.1.3 – Penetrating Export Markets, Adequate Skills and Capacity to Support Sustainable Development, Ecosystems Management, Water Resource Management and Disaster Risk Management and Climate Change Resilience. Linked indicators for these actions track improvements to agricultural infrastructure, such as meteorological stations and the installation of greenhouses, training delivered to farmers, and the reduction of emissions from agriculture through the implementation of SLM approaches, for example the targeted application of fertilizer and the impact on N_2O emissions. See Mitigation Annex B for a full list of indicators.

Table 24: Climate actions related to Agriculture

ID	Name	Scenario	Status	Timeframe	Budget USD ($)	Lead Institution	Linked indicators
17	SOILCARE - Caribbean Soil Management for Restored Watersheds and Sustainable food systems Project	WEM	Idea	2019-2022	500,000	PISLM	-
23	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy	WEM	Planning	TBD	11,494,625	IICA	I35; I36; I37
24	Use of protected culture technologies for the production of high value vegetable crops to build resilience against	WEM	Under Implementation	TBD	814,000	Ministry of Agriculture	I38; I39

	impacts of climate change in the Agricultural Sector						
25	Agricultural Technology Cooperation Project between China and Antigua and Barbuda	WEM	Under Implementation	2018-2021	Unknown	Ministry of Agriculture	I38; I40

4.5.2 ACTION INDICATORS

Tracking the impact of the listed actions will be an important process for monitoring progress towards NDCs, national strategies and SDGs. Quantitative information on the impacts and progress of these actions is measured using a set of linked indicators. These indicators have been listed in Mitigation Annex B: Indicator Registry. The structure of these indicators is defined by a simple framework which applies for three distinct types of indicators:

1) GHG impact;

2) Progress; and

3) Wider impacts.

Key experts can provide data and methodologies on the baseline, ex-anti(before) and ex-post(after) analyses of GHG emissions mitigation. These estimations can be updated as new information and calculation methods become available. In this way, a time series of emissions can be built up from a series of ex-post analyses, which contribute towards the achievement of the ex-anti target. GHG emission mitigation targets may apply to an individual action or group of actions, for example I2: GHG emissions mitigated from the energy sector, which tracks GHG emissions mitigated through climate actions 2 (GISS), 4 (SEF/CDB), and 6 (SPPARE component 3).

Stakeholders responsible for an action and project coordinators can also use this format to quantitatively track the progress of mitigation actions. By defining the units of the indicator, baseline, ex-anti and ex-post analyses can be reported for action evolution. For example, I14: Installed capacity of renewable energy projects in Antigua, and installation of solar energy systems tracked through reporting on the installed capacity (in MW) of the project against a target capacity. This quantification relies on the availability of a broad range of datasets and effective referencing of estimates to increase confidence in their legitimacy.

Similarly, the impacts of a mitigation action beyond that of its primary objective can be tracked quantitatively. By selecting an appropriate unit of quantification, for example the number of jobs generated by the solar energy system installation, it is possible to estimate a baseline value, a target ex-anti value aligned with national strategic areas, and ex-post analyses that track the progress towards achievement of the target.

Successful implementation of these action indicators relies heavily on the availability and transparency of various data sources. If employed comprehensively, the indicators can provide the data necessary to produce simple visualisations of the narrative surrounding mitigation action in Antigua and Barbuda. This enables effective communication with decision makers and stakeholders across civil and public spheres alike. Table 25 provides a summary of indicators developed, organised by sector.

Table 25: Summary of climate action indicators

Indicator ID	Indicator Name	Units	Linked Action IDs
Energy Supply			

I2	GHG emissions mitigated from the energy sector	tCO_2 mitigated	2, 4, 6;
I10	GHG emissions from electricity generation attributed to desalination	tCO_2eq emitted from desalination plants	18;
I11	Installed off-grid renewable energy capacity	MW of renewable energy installed.	18;
I12	Increased access to water for general population during/after climate-induced water stress events	Percentage of people with access to water during climate-stressed events	18;
I13	Increased resilience of water system to climate shocks/stressors	Cubic meters of water being stored in storage tanks and reservoirs	18;
I15	Installed capacity of renewable energy projects in Barbuda	Kw of solar energy capacity installed	11;
I17	Installed solar energy output	kWh per year	4;
I18	CO_2 emissions avoided	tCO_2	4;
I19	Renewable energy systems installed on schools	Number of schools	2;
I23	Homes equipped with water storage facilities	% of homes equipped with 2 weeks' worth of water stored on-site with filtration and pump equipment	20;
I24	Homes installed with hurricane shutters and rainwater harvesting	% of homes benefitting from the installation of hurricane shutters and rainwater harvesting	20;
I25	Number of people requiring shelters during droughts	% reduction in the number of people requiring shelters during natural disasters	20;
I26	Vulnerable homes with back up renewable energy systems	% of vulnerable homes with back-up RE (for essential services including pumping water)	20;
I27	Shelters with back up renewable energy systems	% of shelters	20;
I28	Mosquito larvae in local water bodies	% reduction in mosquito larvae abundance	20;

I29	Exposure to public awareness materials	% of families and businesses exposed to the project's public awareness material	20;
I30	Community groups trained	Number of community groups trained in the management and maintenance of adaptation interventions	20;
Fuel Combustion			
I16	Sodium street lighting replaced by LED lighting	% of sodium bulb streetlighting with LEDs.	12;
I20	Electric charging stations installed	Number of electric charging stations installed	1;
I22	CO_2 emissions mitigated due to energy efficiency improvements	kt CO_2	3;
LULUCF			
I3	Securement of land as new protected area	Hectares	5;
I4	Annual CO_2 savings from land restoration and avoided land degradation	tCO_2 sequestered per year	7;
I31	Management effectiveness and financial sustainability scores	% increase in management effectiveness and financial sustainability scores	21;
I32	Expansion of protected areas in support of species conservation	Increase in hectares of protected areas	21;
I33	Useful and sustainable species	Increase in the number of species over baseline	21;
Waste			
I6	GHG emissions mitigated from waste	tCO_2eq emissions avoided	9;
I7	Creation of new jobs in the circular economy	Number of new jobs created	9;
I8	Reduction in landfill fires	Landfill fire hours per year	9;
I9	Reduction in discharge of nutrient rich landfill leachate and vinasse into waterways.	Concentration of landfill leachate and vinasse in waterways	9;
Agriculture			

I35	Upgrading observation and monitoring infrastructure	Number of meteorological stations upgraded	23;
I36	Allocation of grant packages to farmer groups	% of farmer groups	23;
I37	Adoption of soil and water conservation practises	Number of farmers	23;
I38	N_2O emissions avoided through targeted fertilizer application	t CO2eq	24; 25
I39	Construction of greenhouses	Number of greenhouses	24
I40	Construction of greenhouses	Number of greenhouses	25

4.6 SUPPORT RECEIVED FOR MITIGATION

4.6.1 KEY SUPPORTERS OF CLIMATE ACTION

Antigua and Barbuda has been able to mobilise a significant amount of investment for the climate actions listed in this Chapter. Table 26 below lists the active funders and support of climate action in the country.

Table 26: Active funders and support of climate action in Antigua and Barbuda

Name of funder	Acronym	Type of fund	Public/Private/Philanthropic	Region of activity
Abu Dhabi Fund for Development	ADFD	Bilateral	Public	Worldwide
Antigua Public Utilities Authority	APUA	National	Public	Antigua and Barbuda
Caribbean Agricultural Research and Development Institute	CARDI	Donation	Public	Caribbean
Caribbean Development Bank	CDB	Loan	Private	Caribbean
Environmental Awareness Group	EAG	Donation	Public	Antigua and Barbuda
European Development Fund	EDF	Donation	Public	Africa, Caribbean and Pacific countries
European Investment Bank	EIB	Loan	Private	Worldwide
Global Environment Agency	GEF	Donation	Public	Worldwide
Government of Antigua and Barbuda	GoAB	National	Public	Antigua and Barbuda
Italian Government	Italian Government	Bilateral	Public	Selected countries
Green Climate Fund	GCF	Donation	Public	Worldwide
Ministry of Finance	MoF	National	Public	Antigua and Barbuda
National Parks Authority	National Parks Authority	National	Public	Antigua and Barbuda
National Renewable Energy Laboratory	NREL	Donation	Public	Worldwide
New Zealand Government	New Zealand Government	Bilateral	Public	Selected countries
The Adaptation Fund	AF	Donation	Public	Worldwide
United Nations Environment Program	UNEP	Donation	Public	Worldwide
United States Agency for International Development	USAID	Donation	Public	Worldwide

Information on climate action funding is not currently held in a single database. Therefore, information has been derived on a project by project basis and so is not available for every action. However, the available information indicates that a total of US$ 34,544,093 has been committed for

the listed actions. An additional US$ 11,531,525 has been disbursed, however project documents highlight that US$ 150,644,625 is still needed for the outlined actions.

The key players for climate action investment are:

4.6.1.1 GCF

US$ 97 million identified as needed for the implementation of the circular economy approach. GCF Build and Sustainable Integrated Water Resources Management to Build Resilience in the Water Sector projects

4.6.1.2 MINISTRY OF FINANCE

US$ 6 million disbursed in co-financing for SPPARE and US$ 23 million identified as needed in co-financing for the Sustainable Integrated Water Resources Management to Build Resilience in the Water Sector project.

4.6.1.3 CDB

US$ 6 million committed for the Sustainable Energy for the Eastern Caribbean: Street lighting project and US$ 8.5 million identified as needed for the development of the circular economy approach.

4.6.1.4 GEF

Approximately US$ 7.3 million committed to the SEF/CDB, Path to 2020 and Sustainable Low-emission Island Mobility projects. Approximately US$ 3.8 million disbursed across the ESD, SPPARE and GEF CReW projects and approximately US$ 500,000 identified as needed for the SOILCARE project.

Table 27 below provides a summary of the investment, split by funding organisation. Full information on climate action funding is available with the full list of actions in Mitigation Annex A.

Table 27: Summary of the investments, split by funding organization

Funders and Supporters	Committed (US Dollar)	Disbursed (US Dollar)	Needed/Requested (US Dollar)	Total (US Dollar)
GCF			97,000,000	97,000,000
Ministry of Finance		6,000,000	23,000,000	29,000,000
CDB	6,000,000		8,500,000	14,500,000
GEF	7,362,093	3,851,525	500,000	11,713,618
EDF; CDB; EIB			7,950,000	7,950,000
Developers, financing institutions, technology suppliers	6,000,000			6,000,000
GoAB	2,885,000		1,850,000	4,735,000
Department of Environment	4,650,000			4,650,000
ADFD	3,000,000			3,000,000
Italian Government	2,075,000			2,075,000
APUA (Water Levy)		1,300,000		1,300,000
AF	997,000			997,000
USAID	744,000			744,000
New Zealand Government	500,000			500,000
CARDI	450,000			450,000

Department of Environment; APUA		350,000		350,000
GoAB; CDB			350,000	350,000
UNEP	250,000	30,000		280,000
Municipalities/City Council Administrations	150,000			150,000
National Parks Authority	100,000			100,000
Ministry of Agriculture	70,000			70,000
UNEP Country Office	50,000			50,000
EAG	50,000			50,000
NREL	25,000			25,000
Unidentified			114,94,625	114,94,625
Total	**35,358,093**	**11,531,525**	**150,644,625**	**197,534,243**

4.6.2 INITIATIVES TO GENERATE REVENUE FOR MITIGATION ACTION

Antigua and Barbuda is a highly indebted state, with national debt ranging from 87% - 130% of its GDP[37]. The country's small population also limits opportunities to generate national revenue for climate action through tax streams. This makes national climate financing unaffordable and as a SIDS, costs associated with responding to and preparing for climate change are increasing with an estimated US$ 420 million required before 2030 to meet the NDC targets on adaptation and mitigation. As identified above, information on climate funding received has not previously been stored in a co-ordinated database. In order to streamline and attract further green finance from international and domestic sources, the Government of Antigua and Barbuda has established the Sustainable Island Resource Framework (SIRF) Fund. Designed to catalyse funding, the SIRF Fund has been legislated through the EPMA (2019) and will act as the primary channel for climate finance in a coordinated, systematic and cost-effective manner. The fund's priorities include:

- Streamlining finance streams;
- Establishing a predictable, consistent funding stream to reduce long-term vulnerability;
- Providing funding to improve resilience in the water sector including the provision of renewable energy;
- Diversifying the electricity mix to include renewable energy sources to mitigate volatile fossil fuel prices and to reduce GHG emissions;
- Supporting not-for-profit organisations; and
- Supporting vulnerable groups.

The three main vehicles for funding are:

1. International and Regional funding agencies:
    - Green Climate Fund (GCF)
    - Adaptation Fund
    - Global Environment Facility (GEF)

[37] https://environment.gov.ag/assets/uploads/attachments/64e97-sirf_businessconceptnote_v3.pdf

- Caribbean Biodiversity Fund
- Bilateral and other sources

2. Public Private Partnerships:
    - Catalysis of environmental business initiatives and ecosystem services
3. National funding sources, for example:
    - Visitor fees
    - Water levies

One key mechanism through which the SIRF will continue to fund adaptation and mitigation action is in the process of being established through the SPPARE project. Component 1 of this project seeks to channel revenue generated by renewable energy through the SIRF fund to increase revenue for the Boggy Peak National Park (BPNP) protected area system by approximately US$2 million per year.

4.7 WIDER IMPACTS AND LINKS TO SDG'S AND NATIONAL STRATEGY

4.7.1 SUSTAINABLE DEVELOPMENT GOALS

As a small island developing state (SIDS) suffering from systemic vulnerabilities and structural challenges caused by its limited size and high exposure to natural disasters, Antigua and Barbuda is vulnerable to numerous shocks outside its control. Extreme weather events, such as hurricanes, continue to impact mangrove ecosystems which are essential for maintaining healthy beach and reef systems, in addition to leading to volatile foreign trade, and economic downturns in key economic sectors such as tourism. Saltwater intrusion continues to be a prevalent environmental issue in Antigua and Barbuda. With these vulnerabilities in mind, Antigua and Barbuda aims to promote synergies between its initiative to mitigate climate change and the threat of rising sea levels, and additionally promote the 17 UN Sustainable Development Goals.

Antigua and Barbuda aims to reduce emissions of GHGs in ways which also decrease dependency on imported fossil fuels, while also enabling national social and economic co-benefits such as improved air quality, work opportunities, sustainable communities and healthy aquatic and land ecosystems. The various climate actions proposed and/or implemented in Antigua and Barbuda, will not only help to mitigate the country's GHG emissions, but also contribute to a wide variety of wider impacts which will benefit the island's natural resources and residents. 12 of the 17 sustainable development goals are targeted by the 23 previously outlined climate actions, as seen in Figure 11.

Figure 11 Number of climate actions which contribute to the fulfilment of Sustainable Development Goals

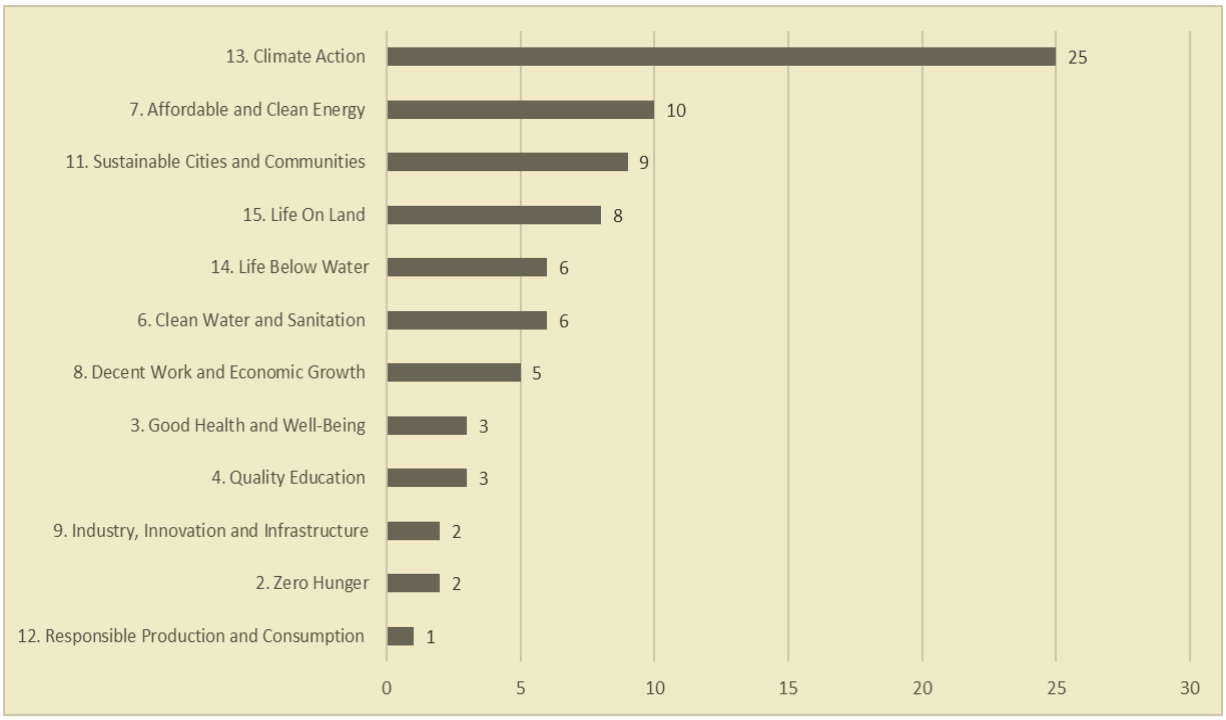


Figure 11 above shows that beyond Goal 13: Climate Action, the mitigation actions were linked most strongly to the SDGs detailed below.

4.7.1.1 GOAL 7: AFFORDABLE AND CLEAN ENERGY

Antigua and Barbuda rely solely on imports for fossil fuels which have volatile prices and a large environmental footprint. Antigua and Barbuda's utility rates are approximately US $0.40k/Wh[38], which is above the Caribbean regional average of US $0.33/kWh [39]. Antigua and Barbuda spends 13.7% of total GDP on importing fossil fuels[40], with electricity representing 4% alone. The increased demand for energy from economic growth in combination with price volatility of global oil prices, indicates why many climate actions are focusing on increasing clean energy and renewable energy generation.

4.7.1.2 GOAL 15: LIFE ON LAND

Antigua and Barbuda's economic and social development is heavily dependent upon its environmental resources and inter-related ecological functions. Tourists continue to be drawn to the country due to its significant natural resources such as reefs, beaches, evergreen forests, grasslands and shrublands, as well as for the islands' heritage and historic infrastructure. With the tourism industry accounting for over half the country's GDP, the country remains extremely reliant on these environmental resources and therefore strives to protect them. Antigua and Barbuda is therefore focusing on increasing forest management and expanding national parks in the country through various climate actions.

4.7.1.3 GOAL 6: CLEAN WATER AND SANITATION

Saltwater intrusion is a significant issue in Antigua and Barbuda, further exacerbated by natural disasters such as hurricanes, and rising sea levels. Antigua's 86 watersheds are at risk of saltwater intrusion, which is extremely costly due to the expensive nature of desalinated water. With desalinated water prioritised for domestic and tourism sectors, there is continual stress on freshwater supply, particularly in the agricultural sector. Drought worsens this issue, with more than 60-95% of the water supply generated from the desalination process. It is therefore important to combat this saltwater intrusion issue in Antigua and Barbuda, by adopting climate actions which help to increase availability of clean water and sanitation.

4.7.1.4 GOAL 8: DECENT WORK AND ECONOMIC GROWTH

Unemployment and poverty remain prevalent in Antigua and Barbuda, with 18.4% of the population in 2015 living below the poverty line (US$2366 per annum[41]) and an unemployment rate of 11%[42] (in 2014). Many of the proposed and implemented climate actions require labour, which provides work opportunities for the island's residents and contributes to the reduction of poverty. An increased work force on the island helps to further contribute to economic growth.

4.7.1.5 GOAL 14: LIFE BELOW WATER

Coral reefs are essential to Antigua and Barbuda as they contribute to the formation and protection of beaches, which are key to attracting tourists to the islands. Coral reef coverage can reach as high as 26 km^2. Mangrove and seagrass ecosystems, in addition to watershed and salt pond ecosystems, are also essential. In addition to the tourism sector, food security on the island is heavily reliant on the protection of these marine and freshwater ecosystems. Therefore, it is desirable for Antigua and Barbuda to adopt climate actions which help to protect life below water.

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[38] Samuel, H. A., 2014. *Antigua and Barbuda Renewables Readiness Assessment (RRA) Background Paper, Working Draft for discussion at RRA Experts and Stakeholders Workshop. IRENA, p. 6*

[39] https://www.nrel.gov/docs/fy15osti/64115.pdf

[40] http://www.sustainablesids.org/wp-content/uploads/2016/11/INDC-2015-Antigua-Barbuda.pdf

[41] https://unfccc.int/resource/docs/natc/antnc3.pdf

[42] https://theodora.com/wfbcurrent/antigua_and_barbuda/antigua_and_barbuda_economy.html

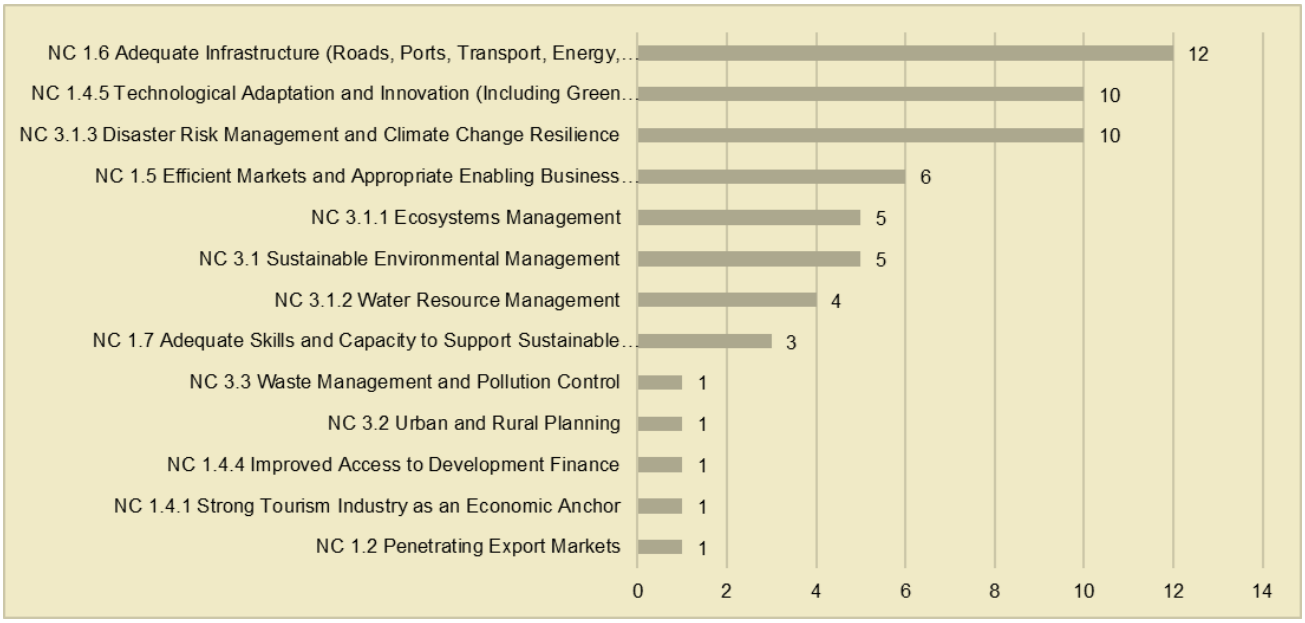
4.8 NATIONAL STRATEGY

In addition to achieving progress towards various SDGs, the climate actions have wider impacts including fulfilling a number of Necessary Conditions (NC), a set of strategic areas that are in place to support the achievement of four Sustainable Development Dimensions (SDDs):

1. Optimal Generation of National Wealth;
2. Enhanced Social Cohesion;
3. Improved Health of the Natural Environment and Sustained Historical and Cultural Assets; and
4. Enhanced Citizen Security

By following these four SDDs and their corresponding NCs, Antigua and Barbuda hopes to move the country towards its long-term goals, through undertaking various strategies and actions over the Medium-Term (2016-2020). This is all part of the Medium-Term Development Strategy (MTDS)[43]. Figure 13 outlines the number of climate actions which should contribute towards fulfilling various Necessary Conditions:

Figure 13: Number of climate actions which contribute to the fulfilment of Number of climate actions which contribute to Necessary Conditions



The Necessary Conditions which are likely to be contributed to, by adopting the previously outlined climate actions include:

4.8.1 NC 1.6: ADEQUATE INFRASTRUCTURE

Good transportation infrastructure is essential for the development of the tourism industry which is vital to Antigua and Barbuda's economy. Additional maintenance and enhancements are required in order to increase the country's competitiveness in the tourism industry, in addition to increasing

43 http://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

domestic living standards. As a water-scarce country susceptible to saltwater intrusion, new technologies and infrastructure needs to be adopted to increase the country's fresh water supply. Adequate infrastructure to produce efficient energy is also required to help reduce energy costs, enhance energy security, and reduce undesirable environmental impacts. Climate actions which help to meet this necessary condition include the 'Electric School Bus Pilot Project' (Action 1) and the '10 MW Solar project' (Action 10).

4.8.2 NC 1.4.5: TECHNOLOGICAL ADAPTATION AND INNOVATION (INCLUDING GREEN TECHNOLOGY)

Technical adaptation and innovation are required to keep the country in a competitive position; helping to build capacity and introduce new scientific technologies like Green Technology. Adopting green technology in the energy sector can help to reduce GHG emissions, in addition to reducing reliance on fossil fuel imports. Several climate actions will help to reach this necessary condition such as 'SPPARE component 3: Renewable Energy in Support of Protected Areas System' (Action 6) and the 'Circular Economy Approach' (Action 9).

4.8.3 NC 3.1.3: DISASTER RISK MANAGEMENT AND CLIMATE CHANGE RESILIENCE

Antigua and Barbuda remains extremely vulnerable to climate trends and corresponding natural disasters such as droughts, rising sea levels and hurricanes. Climate change resilience in the water sector is essential due to the high risk of saltwater intrusion, with specific climate actions targeting this environmental issue (Action 18). Several climate actions also address resilience in the country's buildings and infrastructure, such as 'Resilience to hurricanes, floods and droughts in the building sector' (Action 19). Building resilience in the agriculture sector is also a priority, with climate actions focussed on the implementation of sustainable land management practices (Action 23).

4.9 KEY ACTIONS

Several climate actions were identified as key actions, as they had a wide range of environmental and socio-economic co-benefits. The three climate actions listed below addressed a total of 8 SDGs and NCs each.

4.9.1 GREEN BARBUDA PROJECT

The Green Barbuda Project (Action 11) aims to install a modular hybrid power plant that will consist of 720kW of solar capacity, 860kW of battery storage and 660kW of diesel engine capacity. The climate action related to SDG 7, 8, 15 and 13, in addition to NC 1.4.5, 1.5, 1.6, 3.1.3. The project requires innovative green technology and improvements in infrastructure within the energy sector, which in turn provides employment opportunities. The project aims to reduce reliance on imported fossil fuels for energy, which will aid in reducing vulnerability of the energy supply chain to natural disasters.

4.9.2 CIRCULAR ECONOMY

The Circular Economy Approach (Action 9) to reducing emissions in the waste sector of Antigua and Barbuda related to SDG 6, 8, 9, 12 and 13, in addition to NC 1.4.5, 1.6 and 3.3. The circular economy approach aims to repurpose waste as a valuable resource, which in turn will help to reduce emissions

from the waste sector. In addition to other environmental impacts such as eliminating the discharge of nutrient rich landfill leachate, the action has the capacity to provide work opportunities, increase responsible consumption, and increase the country's infrastructure. The circular economy approach is innovative and introduces further adoption of green technology in the country.

4.9.3 RESILIENCE TO HURRICANES, FLOODS AND DROUGHTS IN THE BUILDING SECTOR

The Increased Climate-Resilience in the Building Sector Project (Action 19) seeks to implement climate-resilient technologies and interventions in public and community buildings, through innovative technology and improvements in public infrastructure. Increasing climate-resilience in the building sector relates to SDG 3, 6, 7, 9, 11 and 13, in addition to NC 3.1.3 and 1.6. Well-being of the general public will increase, as buildings become updated and the potential risk and damage to public buildings as a result of natural disasters will be reduced.

4.10 CONSTRAINTS AND GAPS RELATED TO MITIGATION ACTIONS

The National Capacity Self-Assessment (NCSA)[44] for Antigua and Barbuda, conducted with support from GEF-3, identified the following barriers:

- Lack of integrated policy frameworks for sustainable development;
- Limited human resource capability;
- Inadequate funding;
- Limited public awareness and support; and
- Emphasis on vertical communications and information flows[45] .

This section highlights four overarching constraints and gaps that have emerged and potentially compromise the adoption of some climate actions in the country. Overcoming these obstacles will aid Antigua and Barbuda's progress towards meeting their GHG emissions reductions targets.

4.10.1 FINANCIAL

Despite Antigua and Barbuda making great strides with protecting its natural resources and social programs, this has required significant investment. The government of Antigua and Barbuda has a relatively limited annual tax revenue of US$570 million[46] due to its small population[47], meaning it must rely on international support to fund its mitigation and adaptation policies. The country had previously entered an IMF program to restructure its finances[48], however as of February 2019, Antigua and Barbuda has paid off its obligations to the IMF[49]. Notwithstanding, the country's financial and economic barriers limit the distribution of renewable energy technologies across Antigua and Barbuda, particularly in more rural and impoverished areas. There is additional concern that any potential

[44] https://www.thegef.org/sites/default/files/ncsa-documents/419.pdf
[45] https://www.thegef.org/sites/default/files/project_documents/CBIT_Antigua_and_Barbuda_PIF_07March18.pdf
[46] Government of Antigua and Barbuda (GoAB). 2014. 2014 Budget Statement. Ministry of Finance, the Economy, Public Administration, and Public Broadcasting and Information
[47] 90 000 in July 2014. Information available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ac.html [accessed 14.03.2017].
[48] https://unfccc.int/resource/docs/natc/antnc3.pdf
[49] https://www.imf.org/external/np/fin/tad/exfin2.aspx?memberKey1=25&date1key=2099-12-31

international capital funding is limited due to the country's middle-income status, which makes it increasingly ineligible for donor funding[50].

The lack of financial resources has been identified as a barrier to successfully implementing the following mitigation actions in the country:

- Electric School Bus Pilot Project (Action 1)
- GISS: Grid-Interactive Solar PV Systems for Schools and Clinics (Action 2)
- SPPARE Component 2: Improve Management Effectiveness of Sustainable Pilot Protected Area (Action 5)
- SPPARE Component 3: Renewable Energy in Support of Protected Areas System (Action 6)
- SPPARE Component 4: Enhance Forest Management (Action 7)
- Circular Economy Approach (Action 9)
- Redonda restoration programme and offshore restoration programme (Action 16)
- Soil Management for Integrated Landscape Restoration and Sustainable Food Systems: Phase 1 (SOILCARE Phase 1) Resilience to hurricanes, floods and droughts in the building sector (Action 17)
- Integrated approach to physical adaptation and community resilience in northwest McKinnon's watershed (Action 20)
- The Path to 2020 (Action 21)
- Community Led Renewable Energy Initiatives (Action 22)
- Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy (Action 23)

While there have been international support initiatives and programmes put in place to help finance some of these climate actions, many of these are geared towards regional bodies and multiple countries. Some international support is provided to the Caribbean region as a whole, such as CCCCC, OECS and CDB. This minimises national impact as these regional projects are inflexible to country specific cultural norms and variables, as stringent methodologies and approaches must be followed[51]. Economies of scale is a financial barrier which also exists in the small island state, with international organisations less likely to fund mitigation projects which are on such a small scale as the cost per unit of output is too high and the number of people impacted deemed too few. This barrier is prevalent in climate action 1 for example, as the size of the Antiguan market is deemed by certain actors as prohibitive to large scale deployment of electric vehicle technology. This project was also restricted by a small budget which limited the procurement of a larger fleet. This would have allayed concerns that a pilot project reliant on only two vehicles may prove difficult to establish clear beneficial trends.

4.10.2 TECHNICAL CAPACITY

Due to Antigua and Barbuda being a SIDS, it is limited by its human, technical and infrastructural resources meaning access to innovative and new technologies, technical knowledge and trained personnel are sometimes lacking[52]. Climate actions focusing on technical innovation and climate-resilience, particularly within the building sector, are limited by the country's technical capacity and prohibitive economies of scale. Training in required sectors is not always available due to a perceived lack of demand for the development of economically viable vocations. The limited knowledge and

[50] Sulzbach et al 2012 Antigua and Barbuda Health Systems
[51] https://unfccc.int/resource/docs/natc/antnc3.pdf
[52] https://www.thegef.org/sites/default/files/project_documents/CBIT_Antigua_and_Barbuda_PIF_07March18.pdf

awareness of skills and technologies can lead to limitations in what climate actions and technologies Antigua and Barbuda can implement independently.

The lack of relevant knowledge or skill, has been identified as a constraint to the following actions being successfully adopted:

- Energy audit of public buildings (Action 13): APUA lacks the additional personnel to collect the required data for the audit and lacks a financial incentive to address this. One potential solution is to develop a mechanism that facilitates the collection of this data and ensures regular reporting to the relevant agencies.
- Redonda Restoration Programme and offshore restoration programme (Action 16): A lack of biosecurity protocols and capacity storage is a potential barrier to the removal of invasive alien species from Redonda island.
- Resilience to hurricanes, floods and droughts in the building sector in Antigua and Barbuda (Action 19): Increasing climate-resilience in Antigua and Barbuda's building sector requires extensive technical capacity for the design, implementation and maintenance of adaptation interventions, which might not be available in the country.
- Integrated approach to physical adaptation and community resilience in the country's northwest McKinnon watershed (Action 20): There are few institutions and donors that are technically capable of piloting a revolving loan funding mechanism, which is a significant potential barrier to successfully increasing the ability of the McKinnon's watershed to withstand extreme rainfall.
- The Path to 2020 initiatives (Action 21): A lack of knowledge surrounding balancing conservation efforts and land-use is a potential constraint to the successful management of landscapes and seascapes.
- Other cross-cutting skills that have been identified in the country as lacking include coastal engineering, reef restoration and rehabilitation, and the measurement of carbon sequestration. These skills are lacking the required vocational training, which is not readily available due to a perceived lack of economically viable demand.

4.10.3 INSTITUTIONAL CAPACITY

By passing the EPMA in 2015 and its subsequent 2019 amendment, Antigua and Barbuda created an enabling legal environment for progressive climate action. However, a need has been identified to put in place suitable institutional arrangements to encourage technological adaptation and innovation [53] .This need resonates with several climate actions, specifically those that address behavioural change in well-established communities such as farmers and landowners. A lack of a well-defined and proven institutional framework can present a barrier to the successful implementation of climate actions.

The following actions have been identified where a lack of buy-in or institutional arrangements pose a potential constraint on the success of implementation:

- Soil Management for Integrated Landscape Restoration and Sustainable Food Systems: Phase 1 (SOILCARE Phase 1) (Action 17): Getting commitment from the other Caribbean countries to implement the regional scope.
- An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed (Action 20): Insufficient historical demonstration to policy makers of the benefits of cost-effective adaptation interventions focused on

[53] http://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

ecosystems; Limited number of institutions and donors that are willing and technically capable of piloting a revolving loan funding mechanism.

- The Path to 2020 – Antigua and Barbuda (Action 21): Identified risks for project implementation include a reluctance to address institutional fragmentation, conflicting interests between conservation and land use and an unwillingness of communities and farmers to participate in the scheme.

4.10.4 MRV DATA COLLECTION

The development and maintenance of data collection and data management systems concerned with climate actions can be challenging due to the lack of financial, human and technical capacity outlined above. Whilst different agencies do have a mandate to prioritise the collection of data in order to report to Permanent Secretaries and Ministers, there is a shortfall on meeting the regular data collection schedules and sharing of data. As a result, data is often collected on project-by-project basis to meet specific reporting requirements. This, combined with a shortage of trained staff, brain drain, a lack of resources and inadequate coordination between agencies has led to dispersed and inadequately documented existing data and information, lack of integrity and security in data management systems, lack of awareness of the availability and importance of data and information, and an increased risk of climate change impacts potentially destroying technology recording data.

The Third National Communication highlighted that one of the main gaps related to effective MRV and national inventory reporting, was lack of data availability. For this report, there is insufficient data on any of the climate actions to be able to estimate GHG impacts, however the indicators drafted should facilitate a more detailed approach to data collection.

There are two key projects that will look to address the challenges of MRV and data collection in the country. The GEF funded 'Monitoring and Assessment of Multilateral Environmental Agreements (MEA) Implementation and Environmental Trends in Antigua and Barbuda' (2018 – 2022), which directly aligns with the Cross-Cutting Capacity Development (CCCD) GEF focal area, and seeks to build capacity for newly passed environmental legislation. It will focus on improving collection, monitoring and reporting processes for environmental data and support the development of a Natural Resource Inventory which will provide researchers, policymakers, and environmentalists with information concerning the natural resources of Antigua and Barbuda. Also, in preparation is the GEF funded 'Capacity Building for Access and Transparency on Climate Actions through an Environment Registry in Antigua & Barbuda' (CBIT) project. The CBIT project, which is projected to start in 2020, is a three-year programme designed to institutionalise MRV data collection practises through:

- The development of a legal framework and data handling methodologies;
- The construction of an 'Environment Registry' – a user friendly online data management portal;
- Further analysis of the mitigation and adaptation impacts of actions;
- Update and further development of GHG projections;
- An assessment of data security measures;
- The development of the NDC implementation plan and indicators; and
- The delivery of a training programme to key stakeholders and Data Management Unit.

4.10.5 INSTITUTIONAL FRAMEWORK FOR ACTION IMPLEMENTATION AND TRACKING

The current institutional framework for delivering Antigua and Barbuda's mitigation action is coordinated by the Department of Environment (DOE). The DOE coordinates the set-up and delivery of environment related projects and coordinates active engagement from other departments, ministries, the private sector, NGOs and communities. The DOE is also responsible for the monitoring, reporting and verification of climate action. The DOE also coordinates the compilation of the GHG inventory and the development of projects to gather information on and to track climate actions. Table 29 highlights the different organisations involved with the various mitigation policies, and the specific role they play.

Table 28: The different organisations involved with the implementation of the mitigation policies in Antigua and Barbuda

Organisation	Acronym	Responsibilities
Government organisations		
Antigua and Barbuda Meteorological Services	Met Office	The National Meteorological Centre responsible for climatological data collection and tracking, also serves as the national IPCC focal point and collects data on climate risks and vulnerabilities.
Ministry of Agriculture	MOA	Government body responsible for management of agricultural affairs including data collection activities and priority setting.
Department of Environment	DOE	The overarching National Government Agency responsible for Environmental Management in Antigua and Barbuda. National Focal Point to the UNFCCC.
Energy Desk		Part of the Ministry of Public Utilities, Civil Aviation and Energy, the Energy Desk is responsible for collecting data on energy usage and energy sector projects.
Fisheries Division		Responsible for maintaining data on national fish stocks and the fishing fleet.
Forestry Unit		A government agency responsible for the conservation and management of the nation's terrestrial biological diversity. Actively involved in data collection activities on the country's forest stocks and land use.
Statutory bodies		
Agriculture Development Corporation	ADC	Manages agricultural processes and projects under the guidance of the Ministry of Agriculture.
Antigua Public Utilities Authority	APUA	Provider of electricity, water, internet and mobile services to Antigua and Barbuda which includes the Ministry of Public Utilities, Civil Aviation, Transportation and Energy
Development Control Authority	DCA	A statutory corporation governed by the Antigua and Barbuda Physical Planning Act of 2003, it is mandated to implement physical and land use planning and development functions in Antigua and Barbuda.
National Parks Authority	NPA	Non-profit organisation dedicated to the management of Antiguan National Parks, helping to decide the most appropriate direction for management of specific areas with regards to ecological, historical etc.
National Solid Waste Management Authority	NSWMA	Managing solid waste effectively through the use of cutting-edge technology to maintain clean and healthy environment

Transport Board		Part of the Ministry of Public Utilities, Civil Aviation and Energy, the Transport Board is responsible for collecting data on private vehicle registration and public transport services.
Regional organisations		
Caribbean Community Climate Change Centre	CCCCC	Helps to coordinate the Caribbean region's response to climate change, providing information on climate change issues and the region's response to managing and adapting to climate change
Caribbean Development Bank	CDB	A financial institution that helps Caribbean nations finance social and economic programs in its member countries
Caribbean Export Development Agency	CEDA	Agency which works to enhance the competitiveness of regional small and medium sized enterprises (SMEs), to promote stronger trade and investment opportunities among CARIFORUM, French Caribbean Outermost Regions (FCORs) and EU Overseas Countries and Territories (OCTs)
Organisation of Eastern Caribbean States	OECS	Organisation dedicated to economic harmonisation and integration, protection of human and legal rights, and encouragement of good governance between countries in Eastern Caribbean
Partnership Initiative for Sustainable Land Management	PISLM	Coordinated by the Government of Trinidad and Tobago through the Caribbean Network for Integrated Rural Development (CNIRD) in collaboration with Caribbean SIDS, UNEP, FAO, GM/UNCCD, UNCCD Secretariat and the Caribbean Community Secretariat. PISLM serves as a mechanism to facilitate exchange of experiences and good land management practices between participating countries.
Regional Collaboration Centre	RCC	A partnership between UNFCCC and the Windward Islands Research and Education Foundation (WINDREF), based in Grenada, designed to support clean development mechanism (CDM) projects in the region.
International organisations		
Abu Dhabi Fund for Development	ADFD	A foreign aid agency with a fund with provides concessionary loans to fund economic and social development projects
Fauna and Flora International	FFI	Organisation helping to protect Antigua and Barbuda's endemic and threatened species, and conserve ecosystems worldwide
Food and Agriculture Organisation	FAO	UN organisation aiming to reduce world hunger primarily hoping to expand agricultural sector in Antigua and Barbuda; increase nutrition of population; management of hunger and poverty programmes; social protection systems and pro-poor employment and income-generation opportunities
United Nations Environment Programme	UNEP	An agency of the United Nations, coordinates the organization's environmental activities and assists developing countries in implementing environmentally sound policies and practices
NGOs		
Environmental Awareness Group	EAG	A national, voluntary, not-for-profit, non-governmental organisation aiming to inform and empower Antigua and Barbuda to sustainably use and manage its natural resources
Private organisations		
VERGNET		A French wind turbine manufacturer which designs small to midsize turbines for operation in tropical countries, in addition to producing and installing water pumps

4.11 METHODS, DATA SOURCES AND ASSUMPTIONS

4.11.1 GHG INVENTORY

The Greenhouse Gas Trends and Projections was compiled using GHG inventory data for the years 1990, 2000, 2006 and 2015. The GHG emission data was gathered from the 1st National Communication, 2nd National Communication, 3rd National Communication and the Inventory Chapter from this BUR, respectively. Further details of the GHG inventory methodology for the 2015 estimates is contained in Chapter 3 of the BUR.

4.11.2 PROJECTIONS

The data on projections presented in this chapter has been adapted from an original analysis carried out by the Clean Energy Solutions Centre (CESC) in 2015 for the November 30th update of the INDC. The analyses were carried out using the Long-range Energy Alternatives Planning System (LEAP) modelling tool, and six scenarios were modelled in total. The included measures for the six scenarios are outlined in Table 30 below.

Table 29: Various scenarios and the measures included under the CESC emissions projections

Scenario	Included Measures
BAU 1 Scenario	Use of existing policies and generation and demand based on GDP growth.
BAU 2 - Adaptation Scenario	Increased desalination and air conditioning in government buildings with existing generation resources.
Mitigation Scenario 1	Ramping up to 50 MW of total renewable electricity generation
Mitigation Scenario 2	Operation of AD facility with 93,000 tonnes/yr capacity (80,000 tonnes of MSW (including sewage), plus 13,000 tonnes of distillery waste).
Mitigation Scenario 3	Enactment of Appliance energy efficiency measures.
Mitigation Scenario 4	Enactment of transport pollution control and vehicle fuel efficiency standards.

In addition to these included measures, each scenario also relies on a series of assumptions. These are outlined below:

4.11.2.1 BAU 1 SCENARIO

Energy demand growth:

- Regression analysis, total MWH electricity sales against growth in GDP/capita between 2000 and 2014, show energy sales will reach 289,786 MWH in 2025 and 336,192 MWH by 2030
- Residential, Commercial, Government and Industrial energy use was based on historical percentages of energy use in those sectors.

Energy supply:

- Assumed installed capacity: 116 MW diesel and 3.9 MW of renewables (3.85 MW solar + 0.05 MW Wind)
- Technical and commercial losses: both technical and non-technical losses are estimated at 27%

Transport sector:

- Historical data extracted from Antigua and Barbuda Mitigation Assessment Report
- Gasoline vehicle growth: 5.8% (based on gasoline consumption growth between 2000 and 2009)
- Diesel vehicle growth: 4.2% (based on gasoline consumption growth between 2000 and 2009)
- Gasoline and diesel vehicle fuel economy: assumed 10% less than US fuel economy for all vehicle categories.

4.11.2.2 BAU 2 ADAPTATION SCENARIO

Energy demand growth:

- Assumptions are the same as for BAU 1 Scenario in addition to a 50% growth (about 16,900 MWH) in desalination plant energy use by 2030

4.11.2.3 MITIGATION SCENARIO 1

Unless otherwise stated, same as BAU 1 Scenario

Energy supply:

- Growth in installed RE projects to 50 MW by 2030
- Decommissioning of 28 MW Black Pine Plant in 2019
- Technical and commercial losses: Large On-Grid RE Project - 20%, Small On-Grid RE Project – 5%, Off-Grid RE Project – 5%, HFO Project – 27%

4.11.2.4 MITIGATION SCENARIO 2

Unless otherwise stated, same as BAU 1 Scenario

Anaerobic Digestion:

- 80,000 tonnes/yr sorted municipal solid waste
- Waste growth linked to overall growth expectations and includes sewage numbers in MSW (15,000 tonnes of sewage sludge in 2015). Growth linked to GDP growth of 3.3% (13-year historical). 13,000 tonnes/yr organic waste assumed from distillery.
- Facilities brought online in 2025

4.11.2.5 MITIGATION SCENARIO 3

Unless otherwise stated, same as BAU 1 Scenario

Appliance Standards for Energy Efficiency:

- Assumes adoption of standards outlined in section 2.6 of UNEP Energy for Sustainable Development in Caribbean Buildings, by 2020

- Assumes 15-16% decrease in residential, commercial and government energy use by 2030.

4.11.2.6 MITIGATION SCENARIO 4

Unless otherwise stated, same as BAU 1 Scenario

Transport sector:

- Improved fuel economy for new cars (starting in 2021)
- Addition of 20 Prius' per year from 2016 to 2020 (100 total) for government fleet
- Replacement or emissions control on 50% of the older vehicles (total number from 2020) starting in 2021 to 2030 (5% per year)

4.11.3 CLIMATE ACTIONS

Public notice example for consultations done by the DOE

The data on climate actions presented in this chapter was collected through consultation with stakeholders during the week beginning 7th January 2019 which involved one-to-one meetings and a wider stakeholder workshop. Relevant stakeholders responsible for climate actions were asked to provide as much information as possible on planned, ongoing and completed climate actions in their sector. The full set of information provided by stakeholders can be found in Mitigation Annex A. Project documents were referenced where actions had been identified but information was lacking. Most of the information on project finance, for example, was derived from project documents. Indicators have been developed where information is available from project documents on broader GHG emission mitigation targets, on specific project objectives or wider impacts. In many cases it has not been possible to quantify these indicators due to a lack of data, but the listed indicators should provide a good basis for future reporting.

Finance, technology and capacity-building needs and support received

5 CONSTRAINTS AND GAPS

Antigua and Barbuda has been described by many regional reports as one of the most disaster prone countries in the OECS subregion. It is subject to hurricanes, earthquakes, and frequent droughts. Antigua and Barbuda was one of the first countries in the hemisphere therefore to take up technology like desalination, drip irrigation as well as Renewable Energy. The economy of Antigua and Barbuda and its financing has always been tested by disaster. The country is very keen therefore to ensure that it uses limited finances effectively. Antigua and Barbuda requires international support from multilateral and bilateral sources and currently receives considerable funding. The country has received support from the GCF, the GEF and the AF, for capacity building, climate finance and technology transfer to be able to strengthen its current programs, policies and regulations. Since the submission of the TNC in 2015, these partnerships have aided in development and implementation of new initiatives, and to fully assess and address the impacts of climate change, as defined in the adaptation and mitigation targets.

However as outlined in Section 1.8 there are considerable challenges to Financing Actions related to addressing Climate Change. Gaps and Constraints as well as capacity building needs related to GHG inventory and to the mitigation actions are extensively reported on in the Sections 3 and 4 respectively. Additional gaps and constraints are related to activities requiring support for implementation of the new and ambitious actions of the country include:

- Technology, human resources and financial capacity assessment;
- Support for the development of a Technology Strategy and Road Map that includes repurposing, decommissioning, and disposing of stranded assets;
- Comprehensive assessment of the national costs of adaptation and mitigation;
- Elaboration of a National Adaptation Plan;
- Enhancing Measurement, Reporting and Verification (MRV) processes;
- Development of standardized baselines to assess and monitor the impacts of implementing NDC adaptation and mitigation initiatives and CC program as a whole;
- Support for data collection, storage and management; and
- Support for education, training, public awareness, public participation, public access to information, and international cooperation throughout implementation of the NDC target

5.1 PROGRESS TOWARDS ADDRESSING GAPS AND CONSTRAINTS

Antigua and Barbuda has been making efforts to address previously identified Gaps and Constraints Table 31 below presents a summary of gaps previously outlined in the TNC and the progress made towards addressing those as well as new Gaps related to the production of this First BUR.

Table 30: Summary of Gaps Identified in the TNC and new Gaps in the BUR

Gaps identified in TNC	State of Gaps	Progress made as of 2019	BUR 2019 Gaps	Next Steps
Data collection	GHG emissions are not part of the national data collection systems thus making it difficult to have accurate data.	The Government passed the EPMA in 2015 and an amended revised version was passed in 2019. This provides the mandate for the DOE to collect this data. The DMU has increased in staffing since the submission of the TNC and has 4 technicians assigned to supporting the preparation of future GHG inventory reports	The institutional arrangements are in place and systematic data collection is being collected. However, it is difficult to get reliable data from the various agencies (see recommendations section of GHG chapter). The DOE has started to form partnerships with universities to provide interns to conduct research within the DOE.	Continue the path of data collection until this becomes the culture of the various government agencies. Implement a functional MRV system coordinated by the DOE. Continued use of local educational institutions to collect the data as part of receiving credits. Secondary and tertiary institutions will be targeted.
Inadequate infrastructure	Gaps included policy, technical capacity, infrastructure transition particularly energy and adaptation. The TNC focused on renewable energy in the electricity and the transportation sector.	The Government has passed the renewable energy Act 2015 and the EPMA (2015 revised 2019). The EPMA identifies GHG as a pollutant and is therefore subjected to pollution reduction.	During this period the Government implemented a resilient road policy. The implementation of this in 2 roads caused a significant amount of delays and uncertainty. The country is therefore seeking a more organized way to build resilient infrastructure.	The country is redeveloping its building code for infrastructure in the building, roads and RE sectors. Several GCF projects are in development to address these sectors. The country is applying to the GCF for funding for the just transitioning of the workforce as a component of each of these projects.
Financial Services Sector	Gaps identified in policy and information on the impact of climate change on the insurance and banking sectors. The results of increases in Insurance rates as well as loan default rates due to hurricanes and droughts. Stranded assets in the housing sector.	There has been greater awareness of the need to address the issue in the finance sectors and more work has been done in this area. Further, several projects have been developed and approved to address loan default rates for homeowners.	These gaps still exist but much more work is being done in this area. The country has established a National Environment Fund, called the SIRF Fund to provide a mechanism to allow for the country to work with vulnerable people to allow them to still have access to the Financial sector of Antigua and Barbuda and the region.	Antigua and Barbuda is developing a project for submission to the GCF to study and provide resilience in the finance sector. Further partnerships are being developed with the UNFCCC Secretariat for financial needs assessment as well as the identification of climate finance spending in Antigua and Barbuda.

Private and Public Sector Engagement	Information on climate change making it to the private sector as well as other government agencies.	There is evidence of increasing climate change awareness in the government sector, but this is still considered a major gap. Since the TNC the Government has initiated its first NAP (National Adaptation Plan), submitted its First NDC, and is in the process of revising it and preparing a second NDC with support under the Climate Action Enhancement Package (CAEP). The country has a Climate Change country program submitted to the GCF and has established a Fund to incorporate the private sector.	This area still represents a major gap. The country's strategy to reduce this gap is via policy initiatives such as requiring all companies to develop an Environment Management Systems report and for the Government to develop a Sustainable Procurement Policy.	The development of the Sustainable Procurement policy for the OECS region and to build the capacity of the government and the private sector to prepare and implement their EMS plans. To raise local and international financing to implement the provisions of the EMS.
Transportation Sector	Lack of environmental and economic data for this sector leading to a limited awareness of the impact of this sector on climate change.	The Government has implemented a pilot electric school bus project that will add 2 e-buses to the Government fleet. Some work has been done in this area, however there is still more work to be done.	The environmental and economic data gaps for this sector have improved and the country has developed a Technical and Financial feasibility study for the transition of the transportation sector to electric vehicles.	The Government will be considering first transitioning its fleet of vehicles with a loan from the GCF. This will be done in collaboration with the local oil company as well as the car dealers and importers. A GEF7 electric mobility project had also been developed and implementation is expected to start in late 2020. There are gaps in clear policy and legislation, and this is expected to be addressed under the Fourth National Communication about to start in Antigua and Barbuda.

5.2 MONITORING FRAMEWORK AND EVALUATION

Antigua and Barbuda does not have a culture of tracking impact of national actions. This is a major gap and a constraint to project implementation and building consensus and confidence in climate action. To assist in this regard, the OECS Commission initiated a process to assist the country. The OECS Commission has a monitoring and evaluation unit with specialized expertise that has experience monitoring projects financed by EU DEVCO, USAID, and other international donors. The OECS Commission M&E Unit will perform independent monitoring and evaluation services for the DOE, pending capacity building efforts. The M&E arrangements will be designed to build capacity at the national level and eventually have a culture change to track impact of national actions

5.3 ADDITIONAL ACTIONS REQUIRED TO MEET GAPS AND CONSTRAINTS

Antigua and Barbuda has taken progressive actions towards overcoming the various gaps and constraints. Further actions are required that will lead to:

- Strengthened institutional and fiduciary capacity to enable national entities to access local and international funds;
- Enhanced coordination among stakeholders and institutions at regional and national entities to manage and deliver climate action;
- Supported strengthening of climate change regulations, policies, plans and budgeting especially for Adaptation (NAPS);
- Increased stakeholder access to information and knowledge products on climate change (EIMAS, Environment Registry and website);
- Development of a system for identifying, prioritizing, and developing climate change programs/projects;
- Monitoring and evaluation (MRV) templates and guidance developed;
- Leveraging of private sector resources to scale up climate change solutions through market, Microfinancing and output-based and inclusive value chain business model;
- Facilitating private sector resource mobilization and engagement on climate change activities;
- Strengthening the technical and financial capacity of public, private and CSO stakeholders in inclusive business development and marketing of climate change solutions.

5.4 TECHNOLOGY TRANSFER NEEDS

Antigua and Barbuda participated in Phase III of the Technology Needs Assessment (TNA) project. The project originated within the *Strategic Programme on Technology Transfer* approved by the GEF in 2005. The national aim of the TNA process was to allow for a stakeholder process to assess and raise awareness of the technologies present in Antigua and Barbuda that are often disregarded. The purpose of the TNA is also to analyse technology priorities for climate change adaptation and mitigation, determine a portfolio of Environmentally Sound Technologies (ESTs), along with context-specific programs/projects that would facilitate transfer of and access to selected ESTs, and progress towards implementation of Article 4.5 of the UNFCCC.

Antigua and Barbuda's first national communication on climate change in 2001 outlined the national inventory of GHG, climate change vulnerability and adaptation profile and target sectors for GHG mitigation. The second national communication that followed in 2009 used regional climate change projections to detail impacts on climate-dependent and climate-sensitive economic sectors for which adaptation and mitigation programs needed to be developed. Building on these and the overall national development agenda, Antigua and Barbuda communicated the INDC's to the UNFCCC in 2015 these were later approved and submitted as the country's first NDC. Chapter 1.9.3 of this BUR document highlights *building, water, energy and transportation* as the nation's priority sectors for climate change adaptation and mitigation and outlines the role that the Finance sector can have in promoting new growth in business related to these sectors. However, since the country previously addressed the energy sector in the TNC and will be addressed in the 4NC – building, water and transport sectors were chosen for the TNA project.

This initial step was aimed at prioritising adaptations and mitigation technologies for Antigua and Barbuda. The resulting TNA Report provides the outcome of a participatory process where relevant stakeholders identified and assessed climate-smart technologies that would aid in achieving targets outlined in the INDCs, increasing overall resilience to the negative impacts of climate change and supporting the national development agenda.

Project activities are organized from within DOE – the TNA Coordinating Agency – where the Coordinator acts as the core of the national TNA team, maintaining and managing communication between the TNA Steering Committee, – the Technical Advisory Committee (TAC) – national consultants and sectoral working groups. To facilitate a fully participatory process, stakeholder consultations, which encouraged candid feedback from all participants, were organized at strategic points in the prioritization process to garner input from a representative group from across the local society. Also essential to the TNA process is ensuring that gender considerations were streamlined throughout all TNA activities. To this end gender equity was mainstreamed by considering how climate change impacts affected women and female-led households, ensuring gender balance in stakeholder selection and identifying technology options that would benefit both males and females equally.

The following list of seven (7) technologies were shortlisted after a screening workshop and approval by the TAC:

- Rainwater Harvesting
- Stormwater Reclamation and Reuse *for controlled groundwater recharge and watershed rehabilitation.*
- Wastewater Reuse for Irrigation
- Climate-proofing Assets *(Resilient infrastructure)*
- Solar Pumping Systems
- Atmospheric Water Generators

- Water Savers

Rainwater harvesting technology

In reference to adaptation in the building sector, it was specified that by 2030 buildings must be prepared to withstand extreme climatic events. Therefore, the ESTs chosen sought to directly address this policy and target. Simultaneously, it was important that the selection of the building sector technologies would directly contribute to the goals set out in Antigua and Barbuda's INDCs.

The transport sector focused primarily on mitigation efforts. The INDCs emphasised the establishment of efficiency standards for vehicles by 2020, in an attempt to reduce CO_2 emissions. Therefore, the chosen technologies aimed to meet this goal both directly and indirectly based on the level of projects adopted for technology implementation.

Technology fact sheets were prepared for each of the abovementioned technologies and shared with sectoral working groups to help facilitate discussions and the Multi-Criteria Analysis (MCA) process which was used to prioritize the technology options that would be taken into the next step of the TNA. The final lists by sector that will be carried forward into the *Barrier Analysis* step are:

5.4.1.1 WATER SECTOR:

1. Solar Pumping Systems
2. Rainwater Harvesting
3. Water Savers
4. Climate-proofing Assets

5. Stormwater Reclamation and Reuse

5.4.1.2 BUILDING SECTOR:

1. Passive House Designs / Site Selection
2. Best Roof Pitch Angle
3. Impact / Energy Efficient Windows & Doors
4. Construction of Energy Efficient Building Infrastructure
5. High Efficiency Lighting System

5.4.1.3 TRANSPORT SECTOR:

1. Improvement of Road Infrastructure
2. Hybrid and Electric Vehicles
3. Alternate Fuel & Biofuels
4. Integrated Public Transport
5. Efficiency in Transport Sector

Antigua and Barbuda continues to evaluate technologies via pilot projects and programs to demonstrate their technical and financial feasibility in the country. Technologies are evaluated and recommendations developed for uptake within the private sector. This approach using project "incubators" is fully supported, particularly by the education sector that has ready access to individuals eager to test and verify new technologies. The draft TNA is being considered for adoption at the Cabinet of Antigua and Barbuda.

5.5 SUPPORT RECEIVED

Antigua and Barbuda has been able to mobilise a significant amount of investment for the climate actions listed in Chapter 4 on Mitigation Actions. Table 26 in that chapter provides a list of active funders and support of climate action in Antigua and Barbuda. Information on climate action funding is not currently held in a single database. Therefore, information has been derived on a project by project basis and so is not available for every action. However, the available information indicates that a total of US$ 34,544,093 has been committed for the listed actions. An additional US$ 11,531,525 has been disbursed, however project documents highlight that US$ 150,644,625 is still needed for the outlined actions. Key players for Climate Action investments are: GCF, Ministry of Finance, CDB and the GEF. Table 27 in Chapter 4 provides a summary of the investment, split by funding organisation.

Table 31: List of Climate Change Project under implementing in Antigua and Barbuda

DONOR AGENCY	TITLE OF PROGRAMME / PROJECT	SHORT DESCRIPTION OF PROGRAMME / PROJECT	START DATE	END DATE	STATUS	BUDGET & CURRENCY ($USD M)	FINANCING Instrument	IMPLEMENTING AGENCY
Adaptation Fund	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed	The project will implement concrete adaptation interventions in Antigua's northwest watershed. The project goal is to reduce vulnerability of the community, by increasing the ability of the watershed to handle extreme rainfall, while increasing the resilience of the built environment simultaneously to cope with the multiple stressors of climate change. It will do this by: 1) restoring 3 km of waterways, 2) providing concessional loans to households and small businesses for adaptation, and 3) engaging community groups through grants and contracts to continue project interventions. This integrated approach will ensure that the community as a whole will be able to withstand projected climate change impacts while the ecosystems can accommodate increased rainfall.	June 2017	2021	Implementation	10	Grant	Department of Environment

DONOR AGENCY	TITLE OF PROGRAMME / PROJECT	SHORT DESCRIPTION OF PROGRAMME / PROJECT	START DATE	END DATE	STATUS	BUDGET & CURRENCY ($USD M)	FINANCING Instrument	IMPLEMENTING AGENCY
Special Climate Change Fund	Building climate-resilience through innovative financing mechanisms for Ecosystem-based Adaptation (SCCF)	This project will build resilience of ecosystems and vulnerable communities who depend on them for their livelihoods through innovative financing of EbA measures. Such innovative mechanisms which the project could develop or support are the proposed Sustainable Island Resource Fund (SIRF), a planned levy on water, microfinance for small scale investors in ecosystem oriented enterprises, reinvesting or using carbon credits, and capacity building with private sector small and medium enterprises e.g. in the tourism sector. These financing mechanisms will catalyse resilient livelihood activities that are dependent on healthy ecosystems (including in and around protected areas) and the services they provide to small-scale agriculture production, and fisheries and tourism-related activities	December 2016	2020	Implementation	11.3	Grant + Co-financing	UNEP
Italian Government (bilateral)	Construction of Wind Turbine Bases	Objectives are two-fold: 1. Preparatory work for final wind turbine designs and costing, and 2. Construct 16 wind turbine bases. This financing will be a concessional loan.	2018	2020	Project Preparation Phase	3	Grant	Department of Environment
CTCN	CTCN Technical Assistance for Buildings assessment	Feasibility assessment of buildings to inform the GCF BUILD project	2018	2019	Complete	0.07	Co-Financing	Department of Environment

DONOR AGENCY	TITLE OF PROGRAMME / PROJECT	SHORT DESCRIPTION OF PROGRAMME / PROJECT	START DATE	END DATE	STATUS	BUDGET & CURRENCY ($USD M)	FINANCING Instrument	IMPLEMENTING AGENCY
Italian Government (bilateral)	Electric School Bus Pilot	This pilot project will install two electric charging stations and purchase one electric school bus to collect data. Technical and financial feasibility studies will be conducted and a Small/Medium size GCF project will be developed and submitted for funding.	April 2017	2018	Implementation	0.625	Grant	Department of Environment
Global Environment Facility	Energy for Sustainable Development in Caribbean Buildings (ESD)	The Energy for Sustainable Development in the Caribbean (ESD) is aimed at reducing the growth of energy demand in five Caribbean countries through increasing the efficiency of energy use in buildings, increased use of energy conservation and promoting the increased use of renewable energy resources.(project status is uncertain). Total project budget was US$4,859,000. Allocation shown is for Antigua and Barbuda	2012	2017	Implementation	0.989	Grant + Co-financing	UNEP
Italian Government (bilateral)	Grid-Interactive Solar Systems for Schools and Clinics	Solar PV installation with battery back-up for schools and clinics			Implementation	0.825	Grant + Co-financing	Department of Environment
Green Climate Fund	GCF Enhanced Direct Access (EDA)	Enhanced Direct Access (EDA) project by Antigua and Barbuda with Dominica and Grenada, and in partnership with the OECS Commission. The project will demonstrate enhanced access to climate financing in the public, private and non-governmental sectors.	2018	2022	Implementation	38.5	Grant +Co-financing	Department of Environment

DONOR AGENCY	TITLE OF PROGRAMME / PROJECT	SHORT DESCRIPTION OF PROGRAMME / PROJECT	START DATE	END DATE	STATUS	BUDGET & CURRENCY ($USD M)	FINANCING Instrument	IMPLEMENTING AGENCY
Green Climate Fund	GCF Readiness - National Adaptation Plan (NAP)	Green Climate Fund (GCF) is allocating Readiness for NAP development. A&B will submit a USD 3 million project to develop sectoral adaptation/climate resilient plans	August 2017	2020	Implementation	4.2	Grant + Co-financing	Department of Environment
Green Climate Fund	Green Climate Fund (GCF) Readiness project for Direct Access to climate financing	The objective is to enhance Antigua and Barbuda's capacity, country ownership and climate finance access to the Green Climate Fund. In particular, it aims to develop the capacity of the NDA through operational enhancement, knowledge management and public awareness, and to support coordination and capacity building across stakeholders through existing national coordinating mechanisms (Readiness Area 1). It will also assist to develop a strategic country programme that includes an investment framework and the identification of priorities that will build on existing policies and plans and the Fund's results management framework. The support will also help to develop a pipeline of projects identified during consultations and the country programme priorities (Readiness Area 2).	April 2017	April 2018	Closed	0.696	Grant + Co-financing	Department of Environment

DONOR AGENCY	TITLE OF PROGRAMME / PROJECT	SHORT DESCRIPTION OF PROGRAMME / PROJECT	START DATE	END DATE	STATUS	BUDGET & CURRENCY ($USD M)	FINANCING Instrument	IMPLEMENTING AGENCY
Global Environment Facility	Sustainable Energy Facility (SEF)	Reduce the dependency on fossil fuels by promoting the implementation of Energy Efficiency (EE) measures and Renewable Energy (RE) pilot demonstration projects and solutions, including through promotion of Smart Grid solutions, as a way to reduce energy consumption and costs. Budget total for Antigua & Barbuda is US$3,013,669; portion managed by the Department of Environment is shown here.	2013	2019	Implementation	2.32	Grant + Co-financing	Caribbean Development Bank
Global Environment Facility	Technology Needs Assessments - Phase III (TNA Phase III)	Provide participating countries (23 countries) targeted financial and technical support to prepare new or updated and improved TNAs, including Technology Action Plans (TAPs), for prioritized technologies that reduce greenhouse gas emissions, support adaptation to climate change, and are consistent with Nationally Determined Contributions and national sustainable development objectives	2018 (in preparation phase)	2021	Implementation	0.295	Grant + Co-financing	UNEP
Abu Dhabi Fund for Development	Transformation of the Water and Government Sectors using Renewable Energy (IRENA ADFD)	Concessional loan for Antigua and Barbuda to invest in renewable (solar and wind) energy, which will establish the national financial mechanism, the Sustainable Island Resource Framework Fund (SIRF Fund) as an independent power produced and will secure some additional revenue for national environmental management.	2016	2019	Implementation	17.2	Loan + Co-financing	IRENA

Other Information

6 OTHER INFOMATION

6.1 MEANINGFUL STAKEHOLDER INVOLVEMENT

Many Caribbean countries in the Latin America and Caribbean (LAC) region have signed on to multilateral environmental agreements (MEAs) but still struggle with mainstreaming them into national policy, management and legislative frameworks. This is also the case for Antigua and Barbuda. Notwithstanding this, the country is determined to embark on an ambitious GCF program towards transformational change and addressing climate change. This program is coordinated with the other MEAs and their respective objectives e.g. protecting critical and threatened biodiversity, and effective management of substances and chemicals components. To successfully accomplish this the environmental governance system, need to be reviewed towards meaningful participation of all. In particular, there is a need for more attention to the full and effective application of **Principle 10 of the Rio Declaration** which guarantees that everybody, including individuals in vulnerable situations, have access to timely and reliable information, can participate meaningful in the decisions that affect their lives and have access to justice in environmental matters. Many MEA agreements including the Climate Change Convention and the Paris Agreement do not contain compliance mechanism but include robust Principle 10 provisions (Article 13 of the Paris Agreement on transparency) as an accountability mechanism. MEAs can only be effectively implemented if spaces are created for informed, robust, timely and effective participation of local communities, youth and those most likely affected by failures to implement the polluter pays principle.

6.1.1 STAKEHOLDER ANALYSIS FOR CLIMATE ACTION IN ANTIGUA AND BARBUDA

To better understand the range of stakeholders in Antigua and Barbuda it is important to understand the impacts of climate change in the country. The Intergovernmental Panel on Climate Change (2014) as well as the latest report on 1.5 degrees, predicts that greenhouse gas emissions will continue to reach record levels over the coming century. Global temperatures will rise, precipitation will increase, and extreme climate variability will occur. This will lead to increasing frequencies of drought, flooding, extreme temperatures and storms, most of which will appear gradually (Stewart et al. 2015). To address the impacts of even the lowest projected climate change predictions, it is likely that both short and long-term adaptation measures will be necessary. This means there will be an increasing need for governments, planners and investors to include adaptation and mitigation in planning.

6.1.2 FUTURE WORK IN STAKEHOLDER BASELINE ANALYSIS

The Department of the Environment has a considerable amount of experience in the involvement of stakeholders. Many of the stakeholders already involved within climate change programs and projects are well known and information on these are published in all the DOE project, policy and other documents. There is a need however for the DOE to conduct detailed stakeholder assessments to broaden the list of stakeholders. The gaps to be addressed include:

- To determine capacity building needs of executing agencies in both the public and the NGOs sectors;

- To assess the most appropriate partnership with the private sector that can meet the needs of the program;
- Conduct detailed gender-based assessment of the communities that will be impacted by the projects and programs
- Based on the above, prepare risk assessment reports to carefully identify and efficiently approach the management of risk among stakeholders.

The result of these studies will assist the DOE in in carefully tracking the impact and risk of the implementation of this transformation program.

6.2 RECENT IMPACTS FROM NATURAL DISASTERS

Antigua and Barbuda is already facing several climate and weather related impacts.

- Climate change impacts on infrastructure such as roads, beaches, office buildings; power distribution lines, homes, drains etc.
- Disasters such as floods, rainstorms and strong winds are becoming more frequent than ever before. Over the years, provision of infrastructure facilities such as roads, bridges, and housing in Antigua and Barbuda have been taken into consideration, however the impacts of climate change are occurring much too fast for the country to keep up. The new building codes hope to address this, but the additional cost to construction will impact every aspect of the economy and disenfranchise the poorest.
- The ultimate effect is that in times of intense climatic impacts such as flooding, infrastructure facilities are not able to withstand the shocks.
- In recent times, floods have had consequences beyond local coping and government capacities. This obviously calls for improved infrastructure facilities to withstand the impacts of climate change.
- Coastal erosion aided by rising sea levels will destroy a substantial portion of the west, north and south coast of Antigua and Barbuda, carrying along millions of dollars of national and foreign investments in infrastructure. This will also result in reduction of tourism the main earner for the economy.
- Heavy downpours will affect the road network resulting in enormous annual cost of road repairs that prevents meaningful expansion of road infrastructure needed to increase accessibility.

Climate-proof infrastructure in homes and businesses costs more than conventional designs. With Limited access to capital this has resulted in a reduction in the quantum of public and private infrastructural investments. Infrastructure falls within the 'hard' adaptation measures which are high cost interventions but necessary for social and economic growth and protection.

In a country like Antigua and Barbuda where access to financing is severely restricted at the government, private sector and the individual levels, this does not allow much room for transformation adaptation action.

6.3 OPPORTUNITIES FROM MITIGATION AND ADAPTATION IN ANTIGUA AND BARBUDA TO MEET SOCIAL AND WELLBEING OBJECTIVES

The impacts listed above cut across many aspects of life in Antigua and Barbuda. In response, the country has identified mitigation and adaptation activities in the National Climate Change Policy (NCCP) and the First NDC that aim to both reduce emissions and increase climate resilience.

Antigua and Barbuda recognizes that the human impact of climate change falls, for the most part, on the poor, and very often on women and children, the elderly and the physically challenged. As such, social protection and social safety nets to smooth out inequities and build a more cohesive society are vital for climate resilience and national development. Climate-change-linked opportunities such as low-carbon economic growth could generate significant development benefits.

Programs like the SIRF Fund to meet the needs of the vulnerable and grants for the NGOs and community levels is the main approach to achieve transformation in the NGO and private sectors.

6.3.1 POLICIES THAT IMPACT THE WELLBEING AND ACTIONS OF STAKEHOLDERS

Policies that impact on national response to climate for effective mainstreaming in the government and private finance and consistent efforts to reduce vulnerability in natural and social systems include:

- National Energy Policy and Strategy;
- Renewable Energy Act;
- National Water Policy;
- Sanitation Policy;
- Food and Nutrition Policy; and
- Poverty Studies for Antigua and Barbuda

carefully tracking the impact and risk of implementing this transformational program.

6.4 ENVIRONMENTAL AND SOCIAL SAFEGUARDS

Environmental and Social safeguards are considered by the country as a critical risk mitigation measure as well as an effort to improve the quality of design of projects and programs. For Antigua and Barbuda these "safeguards" are considered key to impacts and essential as implementation partners. The consideration of safeguards is mainstreamed into the normal processes of the Government. To meet the requirement of the Funding agencies however the Government has developed stand-alone gender, and other policies. These are available on the DOE's website.

The Government is still working on improving the appropriate indicators of ESS impacts and mitigation success since the current indicators are not considered appropriate. The development of meaningful indicators will be an activity using funding from GCF readiness as well as resources from the 4NC.

6.5 JUST TRANSITION OF THE WORKFORCE

Following the COP 21, many nations have realized the need for assistance in achieving goals established in Paris and outlined in their NDC's. Antigua and Barbuda requested such support from the UNFCCC Climate Technology Centre and Network (CTCN) for developing a workforce strategy to mobilize local labour to implement projects in fulfilment of the country's First NDC. The CTCN selected the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) to partner with the DOE on this endeavour, the key outcomes of which were a stakeholder workshop and a workforce strategy.

Building on the information collected during a stakeholder workshop, the workforce strategy identifies short-, medium-, and long-term actions for Antigua and Barbuda to enhance local capacity to implement priority energy sector projects that can help the country to meet its NDC. The workforce strategy includes the purpose and objectives, a budget for programme development and implementation, and key stakeholders and their roles in implementation. The document also describes the expected workforce breakdown, the baseline skills profile of the islands of Antigua and Barbuda, and anticipated areas of skills shortages. The strategy defines the objectives of the workforce and training activities, as well as actions needed to achieve these objectives. The document then goes on to note potential partner organizations, including regional and international finance and development institutions.

6.5.1 THE WORKFORCE DEVELOPMENT PLAN

For Antigua and Barbuda to achieve its First NDC commitments, a sufficient and appropriately trained workforce must be in place. This workforce will include a variety of personnel who will be needed to contribute different skills to support the high-quality development, construction, and operation of best-fit technologies at reasonable labour rates. Antigua and Barbuda has a strong commitment towards training and developing an appropriate workforce. Training and development is also key to empowering employees with the knowledge and skills required to meet the health, safety and environment standards specified in employment, in permitting regulations, and encountered when developing clean energy projects. This strategy is designed with the local context in mind, focusing on Antigua and Barbuda's climate and development priorities, while utilizing existing on-island as well as regional institutions. This strategy has been prepared to address particular social opportunities and issues, including:

- Encouraging economic development with increased private sector participation and entrepreneurship in developing new energy projects;
- Increasing labour-force participation and local skills capacity, including maximizing employment opportunities for local residents and under-represented groups;
- Establishing apprenticeships, scholarships, vocational training, and other programs;
- Supporting readiness work programs and pre-trade training concepts; and
- Identifying necessary enabling activities to promote successful initiatives.

6.5.2 SCOPE OF THE WORKFORCE STRATEGY

Antigua and Barbuda's First NDC priority sectors are:

1. Energy, including islanded renewable energy, storage, energy efficiency and audits, and WTE;
2. Buildings and Construction, including climate resilient buildings and infrastructure;

3. Transportation, including setting and enforcing new standards for vehicles; and
4. Finance and Fund Management, including the national SIRF Fund

Per guidance from the DOE, and given the emphasis of this strategy on private sector and NGO engagement, the workforce strategy focuses on the energy and buildings sectors with actions in the transportation and finance sectors pertaining more specifically to internal government capacity. Within the energy sector, this strategy centres around opportunities to develop and operate solar photovoltaics (PV), WTE, and wind energy generation projects, as well as improve the resiliency and energy efficiency of buildings via retrofits and new construction.

The workforce strategy involves all workforce and training activities, including those of primary contractors. The actions and activities outlined extend across the construction, operation, and decommissioning phases of clean energy projects. This can also include conducting price assessments, developing viable projects, and maintaining systems. Initial recommendations from Antigua and Barbuda indicates capacity development would target small and medium enterprises (SMEs) and would focus on in-person, learning-by-doing trainings leading to internationally recognized certifications. The trainings would be designed for working professionals with a minimum of a primary education. Given the extensive capacity building requirements, the workforce strategy includes specific activities to facilitate the successful recruitment and retention of an appropriate workforce by optimizing direct and indirect employment opportunities, while managing challenges around the availability of, and competition for, local labour.

Most of the categories of labour could be provided by small and medium enterprises. Labour for engineering, design, construction, inspection, operation and maintenance, distribution and retail services can all be provided by SMEs. Some of the services not likely to be provided by SMEs include financing, insurance, and manufacturing. In the analysis of job creation, statistics from Hawaii were considered as a model rather than mainland United States. Hawaii has much more work performed by SMEs than the mainland, and the jobs are more in these service sectors whereas the mainland workforce also includes manufacturing and other aspects not provided by SMEs.

6.6 A&B PROJECT PIPELINE – PROGRAMMATIC APPROACH

Antigua and Barbuda plans to approach the GCF via a programmatic approach. The program will include projects that are strategically linked to coordinate with the country's overall developmental agenda (see Table 33 below). This maximizes the availability of co-financing and therefore program impacts. Together this will provide a systematic and impactful approach to the full implementation of the NDC and the climate elements of the government's developmental programs. The program is designed to have the following characteristics:

- The projects pipeline will be executed over a 6-10 year period;
- The projects will be implemented by a variety of external partners including the OECS Commission;
- Some projects will also be implemented by the DOE as a direct access entity;
- The projects will require executing agencies in Government agencies as well as NGO's to undergo capacity building programs;
- Co-financing will be maximized to have project support from the government as well as the Board of the GCF;

The program will have to be able to distinguish between development and climate.

Table 32: Country projects/programmes pipeline

Project Title	**Description**	**Accredited Entity**		**Submission timeframe**
Demonstrating Enhanced Direct Access in the public, private, and civil society sectors of Antigua and Barbuda, Dominica, and Grenada in the Eastern Caribbean (EDA)	The project will be implemented in three (3) countries within the Eastern Caribbean – Antigua and Barbuda, Dominica and Grenada. The overall goal of the project is to contribute to the achievement of the provisions enshrined in Article 24 of the Eastern Caribbean's Revised Treaty of Basseterre governing environmental sustainability, namely addressing the causes and impacts of climate change, by piloting an integrated and collaborative approach to increasing adaptive capacity of vulnerable communities. The objectives of the project are three-fold: (i) to demonstrate the benefits of enhanced direct access in the public, private and non-governmental sectors for supporting concrete action at the local level in selected Member States of the Eastern Caribbean, (ii) to achieve open, transparent and multi-stakeholder decision-making systems that allocate climate finance to vulnerable communities, and (iii) to increase the adaptive capacity of ecosystems and built infrastructure in vulnerable communities to the projected impacts of climate change.	Department of Environment, Antigua and Barbuda (pending accreditation)		Re-submission in October 2017 (B.18)
Fund level strategic impacts		**Total financing:** **23M**		**Status**
6, 7 with co-benefits for 1 and 3		GCF: 20 M	Other: SCCF, Adaptation Fund	First draft submitted to the GCF in August 2016; Readiness support to develop the EDA project document was secured; the Department of

				Environment has applied for Accreditation (fast-track).

Action	Lead	Timeline
Submission of revised funding proposal	National Implementing Entity (pending)	October 2017 (B.18)

Project Title	Description	Accredited Entity		Submission timeframe
Resilience to Hurricanes in the Building Sector (GCF Build)	Physical infrastructure in Antigua and Barbuda must be adapted to the dynamic threats of more intense storms and hurricanes. The project will implement the NDC target: *By 2030, all buildings will be improved and prepared for extreme climate events, including drought, flooding and hurricanes.* The project will build the resilience of key Government and community buildings to climate change to support services in health, education and emergency response (police, fire stations, etc.).	Department of Environment		Submitted November 2019
Fund level strategic impacts:		**Total financing:**		**Status**
6, 7 with cobenefits for 1 and 3		GCF: $26.08 M	Other: Government of Antigua and Barbuda $13.09M	Full funding proposal package submitted to the GCF Secretariat November 2019. Currently undergoing the Secretariat review process. Full project proposal anticipated for B.26

Action	Lead	Timeline
Submit Concept Note to GCF	UN Environment	June 2017
Full funding proposal	Department of Environment	November 2019

Project Title	Description	Accredited Entity	Submission timeframe
A blueprint for adapting road infrastructure to projected climate	As a small island developing state (SIDS), Antigua and Barbuda is extremely vulnerable to the impacts of extreme climate events, such as hurricanes, floods and droughts. These events are already having severe	Department of Environment	2021

extremes in Antigua and Barbuda (GCF Roads)	impacts on the country's built environment, particularly critical road and utilities infrastructure, and these impacts are expected to become increasingly severe under future climate change conditions. To address this problem, the proposed GCF Roads project will build on the existing Road Infrastructure Rehabilitation and Reconstruction Programme (RIRRP) to increase the climate resilience of critical road infrastructure and utilities in Antigua and Barbuda. This will be achieved by climate-proofing four primary roads and their associated infrastructure as well as adapting target utilities to withstand the impacts of extreme climate events including Category 4 and 5 hurricanes, as well as climate-induced floods and droughts. A suite of complementary transformative solutions will be implemented under the proposed project to mitigate the risk of the target infrastructure to such events. This will include a combination of engineering and ecosystem-based adaptation (EbA) interventions. The sustainability of this approach will be supported by strengthening the capacity of the Ministry of Public Works (MoW), Development Control Authority (DCA) and Antigua Public Utilities Authority (APUA) to operate, monitor and maintain climate-proofing measures implemented on primary road and utilities infrastructure. The proposed project will be executed by Antigua and Barbuda's Ministry of Finance (MoF) in coordination with the Department of Environment (DoE).			
Fund level strategic impacts:		**Total financing:**		**Status**
		GCF: 27 M	Other: 15M Government of A&B	Concept Note and PPF application have been developed
Action	**Lead**	**Timeline**		
Project Preparation Facility	Department of Environment	2020		

Project Title	Description	Accredited Entity		Submission timeframe
SIRF Fund Revolving for Adaptation	This project will build upon Adaptation Fund and GEF-approved projects that established the Adaptation Revolving Fund for Antigua and Barbuda's Sustainable Island Resource Framework Fund (SIRF Fund). The national Fund targets adaptation activities in the building sector and funds are provided to traditionally high-risk groups that are unable to access credit. Communities in Antigua and Barbuda use a "box hand" as local microfinancing for persons who cannot get financing through traditional sources. The project will support low-income home and building owners, single-headed home (including female-headed homes), farmers and fishers.	Selection in process		2018
Fund level strategic impacts:		**Total financing:**		**Status**
6, 7 with cobenefits for 1 and 3		GCF: 10 M	Other: Government of Antigua and Barbuda 13M	The Revolving Fund is being piloted with funding from the GEF and the Adaptation Fund as well as the proposed GCF Enhance Direct Access program.

Action	Lead	Timeline
Finalization of feasibility studies; **Technical Feasibility Studies for Project focus.**	National Implementing Entity (pending)	**2017**

Project Title	Description	Accredited Entity		Submission timeframe
Renewable Energy Programme	A series of projects designed to help the country transition to 100% renewable energy in bother the electricity and transport sectors. These projects will target the following: - Transitioning of the government vehicle fleet to electric mobility - Creating an enabling environment for electrification of public vehicles - Increasing renewable energy penetration for both the public and private sectors Increasing renewable energy penetration in the back-up energy sector for both businesses and homeowners	Department of Environment		2021
Fund level strategic impacts:		**Total financing:**		**Status**
		GCF: 80 M	Other: Bilateral support; Government of Antigua and Barbuda	Concept notes and PPF applications are being developed for submission to the GCF in late 2020

Action	Lead	Timeline
Financial, technical and environmental and social feasibility studies	National Implementing Entity with partner agencies	2017
Concept note and PPF	Department of Environment	2020

Project Title	Description	Accredited Entity	Submission timeframe
Reducing Emissions in the Transportation Sector	Reduction of GHG emissions from the transportation sector by urban planning, emissions standards in vehicles, and converting mass transit vehicles from fossil fuel to electric, using renewable energy sources. The project will establish an incentives framework for the private sector to transition to electric vehicles.	Selection in process	2018
Fund level strategic impacts:	The reimbursable grant component will be programmed as a revolving fund with the DOE operated SIRF Fund for the purchase of electric vehicles for public sector transportation. Grants will be programmed for the establishment of the	**Total financing:**	**Status**

1, 2 with co-benefits for 5, 7	infrastructure in public places and to prepare the policy and legal framework for the transition to sustainable transportation including public transportation for schools, health, and Government.	GCF: 40 M	Other: Bilateral support; Government of Antigua and Barbuda	Antigua and Barbuda has received USD 625,000 through bilateral support to conduct financial, technical and EIA studies

Action	**Lead**	**Timeline**
Financial, technical and environmental and social feasibility studies	National Implementing Entity with partner agencies	2017
Concept and full proposal	AE to be identified	2018

Table 33: Country Project Preparation pipeline

Project Title	**Description**	**Accredited Entity**		**Submission timeframe**
Designing a Climate Secure Future for Water in Antigua and Barbuda	Antigua and Barbuda is applying for funding to conduct the baseline studies for the water sector transformation programme. Antigua and Barbuda will augment the PPF request with support from the Government and other bilateral and multilateral sources.	National Implementing Entity (pending)		July 2017
Fund level strategic impacts		**Total financing:**		**Status**
6, 7 with co-benefits for 1 and 3		GCF: 800,000	Other: Gov't of A&B	*PPF application under development*

Action	**Lead**	**Timeline**
Application for PPF	NIE (pending)	July 2017

7 MITIGATION ANNEX

7.1 MITIGATION ANNEX A: FULL LIST OF ACTIONS

This annex contains the full list of information on Antigua and Barbuda's climate change actions. These actions have been linked to support information (climate finance), SDGs, NDC targets, National Strategies and broader wider impacts. Related challenges and vulnerabilities that the actions address have also been outlined as well as links between the actions and the action indicators (listed in the Indicator Registry, Mitigation Annex B).

Action ID	1				
Title	Electric School Bus Pilot Project				
Objective	1. Pilot electric vehicles in the public sector as a means of collecting data on transportation to assist with transitioning Antigua and Barbuda to clean technology, and sharing the results within the Caribbean region 2. Build the capacity of the Transport Authority to manage and maintain clean technology vehicles 3. Develop local capacity through training in operations and maintenance of electric vehicle systems and hands-on educational opportunities for young people and the private sector 4. Scoping for a carbon tax and/or verified GHG emission reduction credits as a sustainable financing approach				
Description	This pilot project will install two electric charging stations and purchase two electric school bus to collect data. Technical and financial feasibility studies will be conducted and a Small/Medium size GCF project will be developed and submitted for funding.				
Action Type	Mitigation	**Adaptation Priority**	N/A	**Mitigation Priority**	Low
Status of implementation	Under implementation	**Start date**	Apr 2017	**Full implementation date**	TBD
Sector category	1.1.2.1. Transport	**Institution responsible**	Department of Environment	**Lead stakeholder**	Brian Payne
Activities covered	CO_2, NO_x, Petrol, Diesel	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	625,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	https://www.environment.gov.ag/projects-reports#/Electric-Bus-Pilot-Project
Constraints	Inability to achieve economies of scale			**Constraint type**	Financial

Related SDGs	13. Climate Action; 11. Sustainable Cities and Communities
Related NDC target	By 2020, establish efficiency standards for the importation of all vehicles and appliances.
Related national strategies	NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications); NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology)
Wider impacts	Improvements to air quality
Related challenges	GHG emissions from the transport sector; Dependency on imported fuels
Related Indicators	Electric charging stations installed

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
Italian Government	Committed	Grant	Bilateral cooperation	Department of Environment	625,000	USD	-	https://www.environment.gov.ag/projects-reports#/Electric-Bus-Pilot-Project

Action ID	**2**				
Title	GISS: Grid-Interactive Solar PV Systems for Schools and Clinics				
Objective	1. Assist the selected schools in completion of their Environmental Management Systems reports as a collaborative effort between students and staff; 2. Identify GHG emissions being generated by the schools for both electricity and transportation and determined GHG reduction measures; 3. Identify adaptation measures needed for each of the schools; 4. Implement the installation of grid-interactive Solar PV systems with battery backup on sixteen (16) facilities (i.e. schools and clinics); 5. Develop educational programs for the implementation of the environmental management systems designed pursuant to the requirements under the EPMA; and share lessons learned, best practices and identify opportunities for scaling up interventions.				
Description	The goal of this project is to assist schools to become fully operational following major climactic events such as hurricanes and droughts. This is being done through the provision of clean technology solutions, in the form of grid-interactive solar PV systems. Schools apply for the grants, made available through the funding provided by the Ministry of Environment, Land and Sea of Italy.				
Action Type	Cross-cutting	**Adaptation Priority**	High	**Mitigation Priority**	Medium
Status of implementation	Under implementation	**Start date**	Sep 2017	**Full implementation date**	TBD
Sector category	1.1.1. Energy supply 2.6.5. Public infrastructure	**Institution responsible**	Department of Environment	**Lead stakeholder**	Shema Roberts
Activities covered	CO_2, Waste	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	825,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	https://www.environment.gov.ag/projects-reports#/Grid09586Interactive-Solar-PV-Systems-for-Schools-and-Clinics
Constraints	Project Disbursements being available on time			**Constraint type**	Financial
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; 3. Good Health and Well-Being; 4. Quality Education				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.; By 2030, 100% of electricity demand in the water sector and other essential services will be met through off-grid renewable sources.				
Related national strategies	NC 3.1.3 Disaster Risk Management and Climate Change Resilience; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)				
Wider impacts	Reduced reliance on imported fossil fuels; Improvements to air quality				

Related challenges	Dependency on imported fuels; vulnerability of critical facilities to natural hazards
Related Indicators	Installation of renewable energy systems; GHG emissions mitigated from the energy sector

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
Government of Italy	Committed	Grant	Bilateral cooperation	Department of Environment	825,000	USD	-	https://www.environment.gov.ag/projects-reports#/Grid09586Interactive-Solar-PV-Systems-for-Schools-and-Clinics

Action ID	3				
Title	Energy for Sustainable Development in the Caribbean (ESD Project)				
Objective	Goal: A reduction in the GHG emissions through activities that promotes sustainable development and sustainable energy use in the buildings sector through the use of energy efficient measures and renewable energy technology. The national project will include the demonstration of sustainable energy use and promotion of the benefits and best practises in the reduction of GHG emissions and sustainability. Objective: To reduce fossil fuel based electrical energy use in buildings by 20% and plan for 50% reduction longer term.				
Description	The Energy for Sustainable Development in the Caribbean (ESD) is aimed at reducing the growth of energy demand in five Caribbean countries through increasing the efficiency of energy use in buildings, increased use of energy conservation and promoting the increased use of renewable energy resources. Total project budget was US$4,859,000. Allocation shown is for Antigua and Barbuda				
Action Type	Mitigation	**Adaptation Priority**	N/A	**Mitigation Priority**	High
Status of implementation	Under implementation	**Start date**	Feb 2013	**Full implementation date**	2017
Sector category	1.1.1. Energy supply; 1.1.2. Energy Combustion	**Institution responsible**	Caribbean Community Climate Change Centre (CCCCC)	**Lead stakeholder**	Joan Sampson
Activities covered	CO_2, N_2O	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	1,292,500 US Dollars	**Geographical area included**	Antigua Grammar School, The Office of the Prime Minister, the Bolans Clinic and the Department of Environment.	**Methodologies and assumptions**	Project Identification Form (PIF)
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; 11. Sustainable Cities and Communities				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.; By 2020, update the Building Code to meet projected impacts of climate change.				
Related national strategies	NC 3.1.3 Disaster Risk Management and Climate Change Resilience; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications); NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology)				
Wider impacts	Reduced reliance on imported fossil fuels				

Related challenges	Dependency on imported fuels
Related Indicators	CO_2 emissions mitigated due to energy efficiency improvements

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Disbursed	Grant	Multilateral cooperation	Department of Environment	1,292,500	USD	2013	https://www.thegef.org/project/energy-sustainable-development-caribbean-buildings

Action ID	4				
Title	Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project				
Objective	The objective of the Sustainable Energy Facility (SEF) for the Eastern Caribbean is to contribute to the diversification of the energy matrix in Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines ("the Eastern Caribbean Countries" or "ECC") in an effort to reduce the cost of power generation and electricity tariffs by promoting the implementation of Energy Efficiency (EE) and Renewable Energy (RE) technologies to reduce the region's dependency on liquid fossil fuels. The document below is the Draft Environmental, Social and Gender Assessment Management Plan for Consultation and review.				
Description	Reduce the dependency on fossil fuels by promoting the implementation of Energy Efficiency (EE) measures and Renewable Energy (RE) pilot demonstration projects and solutions, including through promotion of Smart Grid solutions, as a way to reduce energy consumption and costs.				
Action Type	Mitigation	**Adaptation Priority**	N/A	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	2017	**Full implementation date**	TBD
Sector category	1.1.1. Energy supply	**Institution responsible**	Department of Environment	**Lead stakeholder**	Joan Sampson
Activities covered	CO_2, N_2O	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	1,095,890 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	https://www.environment.gov.ag/projects-reports#/Sustainability-Energy-Facility-Program
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; 3. Good Health and Well-Being; 4. Quality Education				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.				
Related national strategies	NC 3.1.3 Disaster Risk Management and Climate Change Resilience; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)				
Wider impacts	Reduced reliance on imported fossil fuels				
Related challenges	Dependency on imported fuels				
Related Indicators	GHG emissions mitigated from the energy sector; Installed solar energy output; CO_2 emissions avoided				

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Committed	Grant	Multilateral cooperation	Department of Environment	1,095,890	USD	-	https://www.environment.gov.ag/projects-reports#/Sustainability-Energy-Facility-Program

Action ID	**5**				
Title	SPPARE component 2: Improve Management Effectiveness of Sustainable Pilot Protected Area – Boggy Peak National Park.				
Objective	To establish 1,039 ha of land as national park, contributing towards mitigation targets, and to improve management effectiveness of this new protected area.				
Description	Component 2 of the SPPARE project relates to the legal demarcation of the Boggy Peak National Park, the establishment of sustainable funding streams and the construction of an Eco-Interpretation Centre at Boggy Peak National Park, fitted with renewable energy generation systems. This component contains the following outputs: Output 2.1 Legal Declaration of Boggy Peak Output 2.2 Financial Agreements in Place for Boggy Peak Output 2.3 Infrastructure to Support Park Visitation and Sustainable Financing				
Action Type	Cross-cutting	**Adaptation Priority**	High	**Mitigation Priority**	High
Status of implementation	Under implementation	**Start date**	May 2015	**Full implementation date**	Mar 2019
Sector category	1.3.2 Land use Change and Forestry	**Institution responsible**	Department of Environment	**Lead stakeholder**	Genevieve Renaud-Byrne
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Regulatory
Estimated Action Costs	1,816,667 US Dollars	**Geographical area included**	Boggy Peak National Park	**Methodologies and assumptions**	UNEP GEF PIR document
Constraints	Original budget not feasible for planned construction of Eco-Interpretation Centre with RE System			**Constraint type**	Financial
Related SDGs	13. Climate Action; 15. Life On Land;				
Related NDC target	By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks.				
Related national strategies	NC 1.4.1 Strong Tourism Industry as an Economic Anchor; NC 3.1.1 Ecosystems Management;				
Wider impacts	Improved ecosystem health; Improved awareness of biodiversity issues for the general public and tourists.				

Related challenges	Emissions from land use, land use change and forestry
Related Indicators	Securement of land as new protected area

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
No data available								

Action ID	**6**				
Title	SPPARE component 3: Renewable Energy in Support of Protected Areas System				
Objective	To procure and install wind turbines with a target of generating 7MW from 33 turbines. This will ultimately contribute to mitigating 100,000 tonnes of CO_2 equivalent emissions from entering the atmosphere, through the increase in renewable energy capacity, with a further aim to increase offset to 1,000,000 CO_2 equivalent.				
Description	Component 3 of the SPPARE project will focus on the installation of renewable energy technology that will support the pilot protected area established in component 2. This project aims to install wind turbines in protected areas, in part to power a reverse osmosis plant. Preparatory work will require the final wind turbine designs and costing, and then constructing the 16 bases. This component contains the following outputs: Output 3.1 Additional Funds for RE are Secured Output 3.2 Sites Prepared for RE Installation Output 3.3 Equipment is Procured and Installed				
Action Type	Cross-cutting	**Adaptation Priority**	High	**Mitigation Priority**	High
Status of implementation	Under implementation	**Start date**	2015	**Full implementation date**	2020
Sector category	1.1.1. Energy Supply	**Institution responsible**	Department of Environment	**Lead stakeholder**	Genevieve Renaud-Byrne
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	15,000,000 US Dollars	**Geographical area included**	Boggy Peak National Park	**Methodologies and assumptions**	UNEP GEF PIR document
Constraints	Lack of funding to install the full 4MW			**Constraint type**	Financial
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; 6. Clean Water and Sanitation; 8. Decent Work and Economic Growth				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.; By 2030, 100% of electricity demand in the water sector and other essential services will be met through off-grid renewable sources.				
Related national strategies	NC 1.5 Efficient Markets and Appropriate Enabling Business Environment; NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)				
Wider impacts	Reduced reliance on imported fossil fuels				
Related challenges	Dependency on imported fuels; emissions from the energy sector; A secure supply of clean water				
Related Indicators	GHG emissions mitigated from the energy sector				

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Disbursed	Grant	Multilateral cooperation	Department of Environment	1,260,752	USD	2015-2018	SPPARE Project document
Ministry of Finance	Disbursed	Cash	Co-financing	Department of Environment	6,000,000	USD	2015-2018	SPPARE Project document

Action ID	7				
Title	SPPARE component 4: Enhance Forest Management				
Objective	To develop a national wildfire prevention strategy to protect the forest ecosystems, and reduce nationwide fires by 20%. Additionally, to plant 20,000 trees, in order to restore degraded land and increase CO_2 sequestration. Overall aim is to successfully rehabilitate the watershed.				
Description	Component 4 of the SPPARE project will focus on forest management, hoping to educate the public surrounding issues like bush fires, and create a national wildfire prevention strategy. The project aims to assess current forest conditions and conduct baseline assessments, whilst planting additional trees. This component contains the following outputs: Output 4.1 Develop a national wildfire prevention strategy to protect the forest ecosystems Output 4.2 Restoration efforts and avoided degradation lead to CO_2 savings Output 4.3 Demonstration of Sustainable Husbandry Practises				
Action Type	Cross-cutting	**Adaptation Priority**	Medium	**Mitigation Priority**	Medium
Status of implementation	Planning	**Start date**	2015	**Full implementation date**	2020
Sector category	1.3.2 Land use Change and Forestry	**Institution responsible**	Department of Environment	**Lead stakeholder**	Genevieve Renaud-Byrne
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Information, Project
Estimated Action Costs	1,186,606 US Dollars	**Geographical area included**	Bendalls Valley, Wallings and Blubber Valley, Obama National Park	**Methodologies and assumptions**	UNEP GEF PIR document
Constraints	Lack of funding to complete measurements on current forest ecosystem			**Constraint type**	Financial
Related SDGs	13. Climate Action; 14. Life on Land				
Related NDC target	By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks.				
Related national strategies	NC 3.1.1 Ecosystems Management; NC 3.1.3 Disaster Risk Management and Climate Change Resilience				
Wider impacts	Reduction in the number of wildfires; reduction in the abundance of pests;				
Related challenges	Degradation, loss of biodiversity; public awareness of fire management and % of fires nationwide; increase health of watershed and vegetation cover				

Related Indicators	Annual CO_2 savings from land restoration and avoided land degradation; Trees planted							
Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Disbursed	Grant	Multilateral cooperation	Department of Environment	586,606	USD	2016-2018	SPPARE Project document
APUA (Water Levy)	Disbursed	Cash	Co-financing	Department of Environment	1,300,000	USD	2016-2018	SPPARE Project document

Action ID	8				
Title	Testing a Prototype Caribbean Regional Fund for Wastewater Management (GEF CReW)				
Objective	The aim of the project is to pilot revolving financing mechanisms and their wastewater management reforms that can be subsequently established as feasible instruments to provide sustainable financing for the implementation of environmentally sound and cost-effective wastewater management measures				
Description	Component 1 – Investment and innovative financing for wastewater management: The component was expected to finance (i) the capitalization of four individual Pilot Financing Mechanisms (PFMs) (ii) Project Development Support to provide technical assistance; and (iii) strengthening the technical capacity of executing agencies at the pilot level. This component was executed by IDB Component 2 – Reforms for wastewater management: This policy, institutional and legislative reform component finances actions for improved wastewater management that are consistent with the UNEP/GPA Strategic Action Plan Guidelines on Municipal Wastewater Management. These included: i) Capacity Building relating to Policy and Institutional Strengthening; ii) Legislative reforms; and iii) Awareness raising. This component is executed by the UNEP's Caribbean Regional Coordinating Unit (CAR/RCU). Component 3 – Communications, Outreach and Information Exchange: This component finances activities related to the dissemination of information related to the CReW to counterpart agencies, implementing partners, related programs (e.g., in integrated water resources management), and relevant stakeholders from the WCR, including the private sector. This component is executed by the UNEP CAR/RCU.				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Completed	**Start date**	2013	**Full implementation date**	2017
Sector category	1.4.2. Wastewater	**Institution responsible**	Department of Environment	**Lead stakeholder**	Itajah Simmons
Activities covered	Wastewater management, CO_2, CH_4, N_2O	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Fiscal
Estimated Action Costs	65,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	Crew - Technical Report revised 6 Jun 2017_v2.pdf
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	6. Clean Water and Sanitation; 8. Decent Work and Economic Growth; 13. Climate Action				
Related NDC target	By 2030, all waterways are protected to reduce the risks of flooding and health impacts.				
Related national strategies	NC 3.1.2 Water Resource Management; NC 1.4.4 Improved Access to Development Finance				

Wider impacts	Fewer human health impacts as a result of marine pollution and poor sanitation.							
Related challenges	GHG emissions from wastewater treatment plants; Ineffective and inefficient sewage disposal systems and methods; marine pollution, lack of treatment facilities							
Related Indicators	Unknown							
Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Disbursed	Grant	Multilateral cooperation	Department of Environment	65,000	USD	2015 - 2016	GEF CReW Project progress report

Action ID	**9**				
Title	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda				
Objective	Antigua & Barbuda is amongst the largest per capita generators of waste in the world and is reliant on a single, ageing landfill that has exceeded its design capacity and requires urgent attention. The objective of this programme is to initiate a transition to the circular economy by working with waste industry stakeholders to repurpose waste as a valuable resource and as a result, drive emissions out of the sector. The programme has been developed in conjunction with the Department of Environment (NDA) and the National Solid Waste Management Authority (EE) and will be overseen by the Ministry of Finance; collectively these agencies will be responsible for managing environmental and social risks.				
Description	The proposed waste management programme has been designed to significantly alter the greenhouse gas emissions profile of the waste sector. The following activities are proposed: - Establish Investment Accelerator - Establish Revolving Loan Fund (working capital & expansion finance) - Develop Public Awareness, Outreach & Training Programs - Develop Stakeholder Management Plan - Conduct Studies & Prepare Project Document - Review of Legal and Regulatory Environment for Waste Management and Waste to Energy - Construct Waste Management Complex These activities are expected to produce the following outputs: - Increased Levels of Entrepreneurial activity in reuse, recovery and recycling - Mainstreaming of circular economy principles and practises - Operational Waste Management Facility - Recommended Legislative & Regulatory Changes to Underpin Shift to Circular Economy These outputs are expected to have the following outcomes: - Thriving Private Sector Circular Economy Business Ecosystem Working in Conjunction with NSWMA - Circular Economy Principles & Practices Fully Integrated into Waste Management Value Chains - Enabling Environment for Circular Economy Waste Management These outcomes are expected to have the following impacts: - 75% Reduction in Emissions from Waste Sector - Improved Working Conditions and Incomes for 500 Low to Middle Income Families				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown

Status of implementation	Planning	**Start date**	TBD	**Full implementation date**	TBD
Sector category	1.4. Waste	**Institution responsible**	National Solid Waste Management Authority	**Lead stakeholder**	Emanuel Dubois
Activities covered	CO_2, CH_4, Anaerobic digestion	**Mitigation scenario**	With additional measures	**Type of policy instrument**	Other
Estimated Action Costs	28,650,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	GCF Concept Note
Constraints	Need for funding from GCF due to limited ability to attract foreign investment, in addition to significant co-financing from the public and private sector			**Constraint type**	Financial
Related SDGs	13. Climate Action; 12. Responsible Production and Consumption; 9. Industry, Innovation and Infrastructure; 8 Decent Work and Economic Growth; 6. Clean Water and Sanitation				
Related NDC target	By 2020, finalize the technical studies with the intention to construct and operationalize a waste to energy (WTE) plant by 2025.; By 2030, all waterways are protected to reduce the risks of flooding and health impacts.				
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications); NC 3.3 Waste Management and Pollution Control				
Wider impacts	The circular economy approach is expected to deliver on the following wider impacts: - Redeployment of 18 fulltime waste pickers operating at the landfill, providing them with improved income and working conditions. - Creation of an estimated 500 new jobs				
Related challenges	GHG emissions from the waste sector; Pollution of waterways from waste; landfill fires				
Related Indicators	GHG emissions mitigated from waste; Creation of new jobs in the circular economy; Reduction in landfill fires; Reduction in discharge of nutrient rich landfill leachate and vinasse into waterways				

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GCF	Needed	Grant	Multilateral cooperation	Department of Environment	10,000,000	USD	-	GCF Concept Note

EDF; CDB; EIB	Needed	Grant	Co-financing	Department of Environment	7,950,000	USD	-	GCF Concept Note
Private; CDB	Needed	Equity; loan	Co-financing	Department of Environment	8,500,000	USD	-	GCF Concept Note
GoAB	Needed	Grant	Co-financing	Department of Environment	1,850,000	USD	-	GCF Concept Note
GoAB; CDB	Needed	Grant	Co-financing	Department of Environment	350,000	USD	-	GCF Concept Note

Action ID	**10**				
Title	10 MW Solar project				
Objective	To provide Antigua and Barbuda with 10 MW of renewable energy distributed across 4 distinct locales.				
Description	The project consists of 3 MW solar farm at the VC Bird Int'l Airport, 4 MW solar farm in Bethesda, 1.3 MW distributed on government owne Stadium (pending). Funded by renewable energy fund (primarily from the government, part of renewable energy act).				
Action Type	Mitigation	**Adaptation Pri**	N/A	**Mitigation Priority**	Unknown
Status of implementat	Under implementation	**Start date**	2015	**Full implementation**	TBD
Sector category	1.1.1. Energy supply	**Institution res**	Ministry of pub energy	**Lead stakeholder**	Mali Barnes
Activities covered	CO_2, Oil, Diesel	**Mitigation scer**	With existing m	**Type of policy instru**	Project
Estimated Action Cost	Unknown	**Geographical a**	VC Bird Int'l Ai buildings, Sir Vi	**Methodologies and as**	Unknown
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; Decent Work and Economic Growth; 15. Life on Land;				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.				
Related national strat	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.5 Efficient Markets and Appropriate Enabling Business (Roads, Ports, Transport, Energy, Water, and Telecommunications)				
Wider impacts	Reduced reliance on imported fossil fuels				
Related challenges	GHG emissions from the energy sector; reliance on imported fuels.				
Related Indicators	Installed capacity of renewable energy projects in Antigua				

Action finance

Name of funder	Status	Type of instrun	Type of fundin	Recipient	Amount	Currency	Year	Data Source
No data available								

Action ID	11				
Title	Green Barbuda Project				
Objective	To install a modular hybrid power plant that will consist of 720 kW of solar capacity, 860 kW battery storage, and 660 kW diesel engine capacity.				
Description	Construction of solar and diesel hybrid power plant on the island of Barbuda in response to hurricane damage inflicted in 2017.				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Planning	**Start date**	2019	**Full implementation date**	TBD
Sector category	1.1.1. Energy supply	**Institution responsible**	Ministry of public utilities, civil aviation, transportation and energy	**Lead stakeholder**	Mali Barnes
Activities covered	CO_2, Oil, Diesel	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	5,200,000 US dollars	**Geographical area included**	Barbuda	**Methodologies and assumptions**	Unknown
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 7. Affordable and Clean Energy; Decent Work and Economic Growth; 15. Life on Land;				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.				
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.5 Efficient Markets and Appropriate Enabling Business Environment; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications); NC 3.1.				
Wider impacts	Increased resilience to natural disasters; Provision of jobs in renewable energy sector;				
Related challenges	GHG emissions from the energy sector; reliance on imported fuels; vulnerability of the energy supply chain to natural disasters;				
Related Indicators	Installed capacity of renewable energy projects in Barbuda				

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
New Zealand Government	Committed	Grant	Blended funding	Ministry of public utilities, civil aviation, transportation and energy	500,000	USD	-	https://www.stlucianewsonline.com/antigua-new-zealand-providing-more-funds-for-barbuda/
ADFD	Committed	Grant	Blended funding	Ministry of public utilities, civil aviation, transportation and energy	3,000,000	USD	-	https://www.adfd.ae/Lists/PublicationsDocuments/ADFD-ANNUAL-REPORT-2017-En-web.pdf

Action ID	**12**				
Title	Sustainable Energy for the Eastern Caribbean: Street lighting project				
Objective	To replace inefficient sodium bulbs with energy efficient LED lighting at all locations across the island. Also to install additional lighting where there currently is none.				
Description	LED street lighting will be installed across the island, replacing existing sodium bulbs and installing new streetlights on unlit roads.				
Action Type	Mitigation	**Adaptation Priority**	N/A	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	Sep 2017	**Full implementation date**	Mar 2019
Sector category	1.1.2. Energy Combustion	**Institution responsible**	Ministry of public utilities, civil aviation, transportation and energy	**Lead stakeholder**	Mali Barnes
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	6,000,000 USD	**Geographical area included**	Nationwide	**Methodologies and assumptions**	A cost benefit analysis was done to compare the current expenditure of HPS lamps vs the LED equivalent to determine how much energy was saved
Constraints	Disposing of old bulbs was an issue. Technical Capacity in the form of personnel and equipment was an issue too. Both have been resolved.			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 11. Sustainable Cities and Communities				
Related NDC target	N/A				
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology)				
Wider impacts	Improved streetlighting for business and travel.				
Related challenges	GHG emissions from the energy sector				
Related Indicators	Sodium street lighting replaced by LED lighting				

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
CDB	Committed	Concessionary loan	Blended funding	Ministry of public utilities, civil aviation, transportation and energy	5,000,000	USD	-	Ministry of public utilities, civil aviation, transportation and energy
CDB	Committed	Grant	Blended funding	Ministry of public utilities, civil aviation, transportation and energy	1,000,000	USD	-	Ministry of public utilities, civil aviation, transportation and energy

Action ID	13				
Title	Energy audit of public buildings				
Objective	To assess and reduce the energy consumption from 3 facilities - the airport, the government complex and the hospital. The project will involve an assessment of the energy usage as well as engage on a programme of behavioural change to address any energy wastage.				
Description	To assess and reduce the energy consumption from 3 facilities - V. C. Bird International Airport, the government complex and Mount St. John's Medical Centre. The project will involve an assessment of the energy usage as well as engage on a programme of behavioural change to address any energy wastage. This is the first step for energy efficiency in public buildings project.				
Action Type	Mitigation	**Adaptation Priority**	N/A	**Mitigation Priority**	Unknown
Status of implementation	Planning	**Start date**	2019	**Full implementation date**	TBD
Sector category	1.1.2. Energy Combustion	**Institution responsible**	Ministry of public utilities, civil aviation, transportation and energy	**Lead stakeholder**	Mali Barnes
Activities covered	CO_2, Oil, Diesel	**Mitigation scenario**	With additional measures	**Type of policy instrument**	Research
Estimated Action Costs	Unknown	**Geographical area included**	V. C. Bird International Airport, the government complex and Mount St. John's Medical Centre	**Methodologies and assumptions**	An in-depth walkthrough audit of all 3 facilities with detailed recommendations
Constraints	The technical capacity of the MoE to carry out future audits may be a constraint because of limited human resources. Following up with the requisite installations may also prove problematic due to the limitations of the Works dept.			**Constraint type**	Unknown
Related SDGs	13. Climate Action; 11. Sustainable Cities and Communities; 7. Affordable and Clean Energy				
Related NDC target	N/A				
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology)				
Wider impacts	Reduce the energy intensity of the Government sector and by extension the burden on the utility. Thus, avoiding burning excess fossil fuel. This reduces not only emissions, but the price the average consumer pays per month, as the cost of public buildings				

Related challenges	GHG emissions from public buildings							
Related Indicators	Unknown							
Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
No data available								

Action ID	14				
Title	Integrated Water, Land and Ecosystem Management (IWEco)				
Objective	The overall objective of the project is to contribute to the preservation of Caribbean ecosystems that are of global significance and the sustainability of livelihoods through the application of existing proven technologies and approaches that are appropriate for small island developing states through improved fresh and coastal water resources management, sustainable land management and sustainable forest management that also seek to enhance resilience of socio-ecological systems to the impacts of climate change. This is a regional project through which three specific project activities have been identified to address wastewater management and awareness of land degradation issues. Activities will be executed on the main island of Antigua in an attempt to improve sewage disposal practices and management and improve functions of the national landfill.				
Description	There are six components to this project, component 1 has the most relevance in terms of climate change mitigation impact, however all components contribute towards strengthening sustainable resource management in Antigua and Barbuda. Project component 1.1: Measurable stress reduction in land, soil and watershed quality – 1.1.1. Rapid SLM-related diagnostic analysis on the extent of land degradation related to wastewater and waste oil disposal – 1.1.2. Sewage pre-treatment investment at McKinnons Wastewater Treatment Plant – 1.1.3. Expanded capacity investment at McKinnon's Sewage Treatment plant – 1.1.4. Installed land degradation control measures Other activities include: Upgraded capacity for handling of 455m3/day (100,000 GPD) of sewage waste toward avoided environmental disposals contributing to land degradation. Trained farmers and wastewater plant operators in land degradation and pollution control and mitigation. Trained oil recycling plant operators (via certified training program). Trained professionals in monitoring and assessment protocols. Policy guidelines, legislation to support a financial mechanism for sustainable land management and pollution control and remediation. At least one community-based enterprise developed under the GEF-SGP.				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	2017	**Full implementation date**	2022
Sector category	1.3.2 Land use Change and Forestry; 2.1.4. Practices and Systems – Land Use/Management	**Institution responsible**	Department of Environment	**Lead stakeholder**	Rashauna Adams-Matthew
Activities covered	Wastewater treatment, Land degradation	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	3,812,323 US Dollars	**Geographical area included**	Cedar Grove watershed, Crabbs	**Methodologies and assumptions**	GEF IWEco Inception Workshop presentation

			area, Cooks landfill area		
Constraints	Unknown			**Constraint type**	Unknown
Related SDGs	6. Clean water and sanitation; 13. Climate action; 14. Life below water; 15. Life on land				
Related NDC target	By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks.; By 2030, all waterways are protected to reduce the risks of flooding and health impacts.				
Related national strategies	NC 3.1 Sustainable Environmental Management				
Wider impacts	Improved ecosystem health can lead to benefits for the tourism industry				
Related challenges	GHG emissions from wastewater treatment plants; Ineffective and inefficient sewage disposal systems and methods; marine pollution, lack of treatment facilities;				
Related Indicators	Unknown				

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
No data available								

Action ID	**15**				
Title	GEF7 Antigua and Barbuda Sustainable Low-emission Island Mobility project				
Objective	Promotion of low emission public and private transportation systems in Antigua and Barbuda that are resilient to the projected impacts of climate change				
Description	This project has four components: 1. Institutionalization of low-carbon and climate resilient electric mobility 2. Short term barrier removal through low-carbon e-mobility and climate resilient renewable energy demonstrations 3. Preparing for scale-up and replication of low-carbon electric mobility and climate-resilient renewable energy 4. Long-term environmental sustainability of low-carbon electric mobility				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Planning	**Start date**	2019	**Full implementation date**	2023
Sector category	1.1.2.1. Transport	**Institution responsible**	Department of Environment	**Lead stakeholder**	-
Activities covered	CO_2, NO_x, PM_{10}, Petrol, Diesel	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	12,980,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	GEF 7 PIF document
Constraints	High price of electricity and electric vehicles imposes a barrier to the success of electric mobility;			**Constraint type**	Financial
Related SDGs	13. Climate Action; 11. Sustainable Cities and Communities				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.				
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.5 Efficient Markets and Appropriate Enabling Business Environment; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)				
Wider impacts	Improved air quality				

Related challenges	Emissions from the transport sector
Related Indicators	GHG emissions mitigated from the transport sector

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Committed	Grant	Multilateral cooperation	Department of Environment	3,537,050	USD	-	GEF-7 Project Identification Form
Italian Government	Committed	Grant	Co-financing	Department of Environment	625,000	USD	-	GEF-7 Project Identification Form
NREL	Committed	In kind	Co-financing	Department of Environment	25,000	USD	-	GEF-7 Project Identification Form
GoAB	Committed	Grant and in kind	Co-financing	Department of Environment	2,885,000	USD	-	GEF-7 Project Identification Form
Municipalities/City Council Administrations	Committed	In kind	Co-financing	Department of Environment	150,000	USD	-	GEF-7 Project Identification Form
Developers, financing institutions, technology suppliers	Committed	In kind and debt/equity	Co-financing	Department of Environment	6,000,000	USD	-	GEF-7 Project Identification Form
UNEP Country Office	Committed	Grant and in kind	Co-financing	Department of Environment	50,000	USD	-	GEF-7 Project Identification Form

Action ID	**16**				
Title	Redonda Restoration Programme and Offshore Islands Conservation Programme				
Objective	To remove the Invasive Alien Species from the Caribbean's Top Priority Island to conserve critically endangered populations of endemic reptiles and globally significant seabird populations. On the offshore islands, IAS were removed to prevent the extinction of the critically endangered Antigua Racer Snake, and preserve important bird and biodiversity areas on the offshore islands within the North Eastern Marine Management Area.				
Description	Redonda Restoration Programme: 1. Relocation of feral goats to mainland Antigua 2. Eradication of rats 3. Biodiversity monitoring (lizards, birds, marine to see changes from IAS removal) 4. Biosecurity (procedures to ensure the island is not re-invaded by rats) Offshore Island Conservation Programme: 1. Eradication of rats, goats and mongooses from 15 offshore islands 2. Racer snake population censuses to monitor increases 3. Biodiversity Monitoring 4. Biosecurity Measures				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	2016	**Full implementation date**	TBD
Sector category	1.3.2 Land use Change and Forestry	**Institution responsible**	Environmental Awareness Group	**Lead stakeholder**	Shanna Challenger/ Natalya Lawrence
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	Unknown	**Geographical area included**	North East Marine Management Area (NEMMA) and Redonda	**Methodologies and assumptions**	Unknown
Constraints	NGO - Lack of continuous funding, unsustainable development within the NEMMA, reinvasion by rats on islands within NEMMA due to local lack of biosecurity protocols, capacity shortage			**Constraint type**	Financial, technical
Related SDGs	13. Climate Action 14. Life Below Water, 15. Life On Land				
Related NDC target	N/A				

Related national strategies	NC 3.1.1 Ecosystems Management
Wider impacts	Helps Antigua to be a beacon on invasive alien species removal and island restoration and serve as inspiration for other Caribbean islands. Prevents endemic species from reaching extinction
Related challenges	Invasive alien species; land degradation
Related Indicators	Restoration of vegetated land

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
No data available								

Action ID	**17**				
Title	Soil Management for Integrated Landscape Restoration and Sustainable Food Systems: Phase 1 (SOILCARE Phase 1)				
Objective	Aims to improve soil management in small island developing states in the Caribbean. To Strengthen Caribbean SIDS with the necessary tools for adopting policies, measures and reforming legal and institutional frameworks to ensure that losses in productive land is balanced by gains so that a position of net loss of productive land is achieved, including through the restoration of degraded land to productive usage and the enhancement of existing food and agricultural systems.				
Description	This project is improving soil management in Caribbean SIDS, including, inter alia, specific initiatives on soil organic carbon, agro-biodiversity, national soil surveys, strengthening of the legal and institutional framework for Soil Management in Caribbean SIDS. The main outputs are: (i) digital soil information database, (ii) published Caribbean Soil & Land Outlook, (iii) SLM approaches in agriculture implemented and (iv) SLM approaches in watershed restoration.				
Action Type	Cross-cutting	**Adaptation Priority**	Medium	**Mitigation Priority**	Medium
Status of implementation	Idea	**Start date**	2019	**Full implementation date**	2022
Sector category	1.3.1. Agriculture	**Institution responsible**	Partnership Initiative for Sustainable Land Management (PISLM); Ministry of Agriculture and Ministry of Lands	**Lead stakeholder**	Jason Williams
Activities covered	Food and water security, Agricultural practices & land use planning	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	500,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	Unknown
Constraints	Getting commitment from the other Caribbean countries to implement the regional scope			**Constraint type**	Technical, Organisational
Related SDGs	13. Climate Action 14. Life Below Water, 15. Life On Land				
Related NDC target	N/A				

Related national strategies	NC 3.1.1 Ecosystems Management; NC 3.1.2 Water Resource Management							
Wider impacts	Unknown							
Related challenges	Will update the soils information database (land productivity & soil organic carbon) that will better inform the land degradation calculations as well as the GHG inventory							
Related Indicators	Unknown							
Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Needed	Grant	Multilateral cooperation	Ministry of Environment & Ministry of Agriculture	500,000	USD	-	Jason Williams

Action ID	18
Title	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda
Objective	Antigua and Barbuda, already an arid island state, lie in a zone that is expected to receive 30 – 50% less rainfall in 2009 compared to late twentieth century rainfall norms. Surface water will be an increasingly unreliable source of potable freshwater in Antigua and Barbuda due to climate change impacts, with implications for both household storage and cisterns, and national supplies from surface water catchments. Saltwater intrusion is already causing abandonment of coastal groundwater wells. With the increased frequency of droughts as a result of climate change, there is need for an integrated approach to use available best practises for water generation, water capture, distribution, storage and reuse, while respecting the natural balance of water needs for the forest and natural ecosystem systems and sectors such as farming. The project is to ensure consistent water supply for the people of Antigua and Barbuda. The mitigation component of this project is to install renewable energy systems for water pumping and generation.
Description	The activities outlined in the project are: - Increase natural storage of water In Potworks water catchment area and integrated water management in the farming community; - Improve distribution lines to reduce losses; - Install 2MW of off grid electricity for water pumping and generation (this component is to make the project carbon neutral; - Ecosystems approach to wastewater recycling in the McKinnon's Watershed - Expand sewage treatment system in the McKinnon's area and recycle water from hotels and homes; - Installation of an additional Desalination Plant using appropriate technology for the island using RE for water generation and wastewater recycling The outputs from the project are expected to be: - Increase in water storage capacity - Improved water catchment systems - Generation of electricity for critical water services - 2MW wind energy - Improved wastewater quality enabling wastewater reuse - Rehabilitated ecosystems services improve water quality and reduce filtration Expected outcomes from these outputs are: - Access to adequate and equitable sanitation and hygiene for all and paying special attention to the needs of women and girls and those in vulnerable situations - Reduced exposure to various climate impacts through off grid renewable energy available to operate Reverse Osmosis plants, pumps and the sewage treatment systems - Protected and restored water-related ecosystems, enhancing the capacity of ecosystems to adapt to and offer protection from projected climate extremes - Integrated water resources management implemented, and communities and business water supply can cope with projected climate-induced drought The expected impacts of these outcomes are: - Reduction in and improved stability of prices and improved reliability of access to local agriculture products

	- Reduced vulnerability in all communities to the impacts of climate change - Restored biodiversity and restoration of ecosystem services of the MckInnons Watershed - Safe and affordable drinking water for Antigua and Barbuda				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Planning	**Start date**	TBD	**Full implementation date**	TBD
Sector category	1.4.2. Wastewater; 2.7. Water Resources; 1.1.1. Energy supply	**Institution responsible**	Department of Environment	**Lead stakeholder**	Jamila Gregory
Activities covered	Food and water security, Infrastructure and built environment	**Mitigation scenario**	With additional measures	**Type of policy instrument**	Project
Estimated Action Costs	65,000,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	GCF Concept Note
Constraints	Limited financial resources			**Constraint type**	Financial
Related SDGs	7. Affordable and Clean Energy; 13. Climate Action; 14. Life Below Water				
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.; By 2030, 100% of electricity demand in the water sector and other essential services will be met through off-grid renewable sources.				
Related national strategies	NC 1.5 Efficient Markets and Appropriate Enabling Business Environment; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications); NC 3.1.2 Water Resource Management				
Wider impacts	Reduced exposure of the population to water shortages; Guaranteed water access to farming and informal sectors; Reduced impact on the Watersheds and risk of damage from saltwater intrusion; Regain of economic growth lost due to extreme weather events;				
Related challenges	Inadequate national supply of water due to climate change induced drought, rising sea levels, and increased temperatures				
Related Indicators	GHG emissions from electricity generation attributed to desalination; Installed off-grid renewable energy capacity; Increased access to water for general population during/after climate-induced water stress events; Increased resilience of water system to climate shocks/stressors				
Action finance					

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GCF	Needed	Grant	Multilateral cooperation	Department of Environment	32,000,000	USD	-	https://www.greenclimate.fund/documents/20182/893456/19960_-_Sustainable_Integrated_Water_Resources_Management_to_Build_Resilience_to_Climate_Change_in_the_Water_Sector_of_Antigua_and_Barbuda.pdf/515c863d-1e26-d8ed-ab8f-f95739f5907b
GCF	Needed	Loan	Multilateral cooperation	Department of Environment	10,000,000	USD	-	
Ministry of Finance and others	Needed	Grant	Co-financing	Department of Environment	23,000,000	USD	-	

Action ID	**19**				
Title	Resilience to hurricanes, floods and droughts in the building sector in Antigua and Barbuda (GCF Build)				
Objective	To increase the resilience of the population in Antigua and Barbuda to extreme climate events, the proposed project will implement climate-resilient technologies and interventions in public and community buildings (hereafter referred to as 'public buildings') and will strengthen institutional, technical and financial capacity within the GoAB to enable climate-resilient building development in the long term. Project activities will: i) ensure that critical services remain operational during and following extreme climate events; and ii) bring about reduced maintenance costs of buildings owing to the installed climate-proofing interventions. Through the proposed project, the private sector will also gain access to funding for climate-proofing of their buildings. Climate proofing may also include the installation of off-grid renewable energy systems, which represents the mitigation aspect of this climate action.				
Description	The proposed project will increase climate-resilient sustainable development through enhancing the resilience of Antigua and Barbuda's building sector to extreme climate events such as hurricanes and tropical storms. The proposed transformative approach will shift the country's building sector away from reactive development — involving costly recovery actions after an extreme climate event — towards a proactive approach in which buildings are adapted to withstand the increased frequency of high-intensity hurricanes. This proactive approach will include direct investments into critical public service and community buildings to climate-proof them against Category 4 and 5 hurricanes, as well as mainstreaming climate resilience into the building sector and relevant financial mechanisms to facilitate the upscaling of such interventions across all buildings in the country. The effectiveness of climate-proofing interventions will be enhanced by formalising communication protocols between the ABMS and relevant government agencies to facilitate early action within the building sector to respond to extreme climate events. This will include strengthening the capacity of ABMS to collect, process and manage climate data, thereby improving the accuracy and reliability of early warnings. The combined effect of project interventions will result in a standard of climate resilience for Antigua and Barbuda's building sector being established that can be readily scaled up and replicated nationally and regionally. Proposed project outputs are described below with detailed descriptions of all project activities described in Section E.6 of this Funding Proposal.				
Action Type	Adaptation	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under GCF Review	**Start date**	2021	**Full implementation date**	2026
Sector category	1.1.1. Energy supply	**Institution responsible**	Department of Environment	**Lead stakeholder**	Government of Antigua and Barbuda
Activities covered	Health and well-being, Food and water security, Infrastructure and built environment	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	Unknown	**Geographical area included**	Nationwide	**Methodologies and assumptions**	GCF Concept Note
Constraints	Financial resources available within a SIDS such as Antigua and Barbuda for funding climate-proofing measures in the building sector; and Technical capacity for the design,			**Constraint type**	Financial, Technical

	implementation and maintenance of adaptation interventions in the building sector		
Related SDGs	3. Good health and well-being; 6. Clean Water and Sanitation; 7. Affordable and Clean Energy; 9. Industry, Innovation and Infrastructure; 11. Sustainable Cities and Communities; 13. Climate Action;		
Related NDC target	By 2030, all buildings are improved and prepared for extreme climate events, including drought, flooding and hurricanes.; By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.; By 2030, 100% of electricity demand in the water sector and other essential services will be met through off-grid renewable sources.		
Related national strategies	NC 3.1.3 Disaster Risk Management and Climate Change Resilience; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)		
Wider impacts	Reduced cost of damages; More rapid recovery post-hurricane disasters; Work opportunities in construction, installation and maintenance of climate-proofing interventions; Provision of critical services during and following extreme climate events		
Related challenges	Lack of infrastructure resilient to the effects of natural disasters.		
Related Indicators	Resilient buildings		

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GCF	Requested	Grant	Multilateral cooperation	Department of Environment	26.08M from GCF 13.02M co-financing from Gov A&B	USD	2021	https://www.greenclimate.fund/documents/20182/893456/17880_-_Resilience_to_hurricanes_floods_and_droughts_in_the_building_sector_in_Antigua_and_Barbuda.pdf/6024818c-8aae-46d1-95ec-27a000f8f2ae

Action ID	**20**				
Title	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed				
Objective	The project will implement concrete adaptation interventions in Antigua's northwest watershed. The project goal is to reduce vulnerability of the community, by increasing the ability of the watershed to handle extreme rainfall, while increasing the resilience of the built environment simultaneously to cope with the multiple stressors of climate change.				
Description	The project will achieve its objectives by: 1) restoring 3 km of waterways, 2) providing concessional loans to households and small businesses for adaptation, including off-grid renewable energy systems and 3) engaging community groups through grants and contracts to continue project interventions. This integrated approach will ensure that the community as a whole will be able to withstand projected climate change impacts while the ecosystems can accommodate increased rainfall.				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	2017	**Full implementation date**	2021
Sector category	2.7. Water Resources; 2.2.5. Vulnerability and Risk Management; 1.1.1. Energy supply	**Institution responsible**	Department of Environment	**Lead stakeholder**	Joan Sampson
Activities covered	CO_2, Waterway restoration, Residential adaptation	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	10,000,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	Department of Environment database
Constraints	Limited financial resources available within a SIDS small market and tax base; insufficient historical demonstration to policy makers of the benefits of cost-effective adaptation interventions focused on ecosystems; and few institutions and donors that			**Constraint type**	Financial, institutional
Related SDGs	6. Clean Water and Sanitation; 7. Affordable and Clean Energy; 13. Climate Action; 14. Life Below Water				
Related NDC target	By 2030, all buildings are improved and prepared for extreme climate events, including drought, flooding and hurricanes.; By 2030, all waterways are protected to reduce the risks of flooding and health impacts.				

Related national strategies	NC 3.1.3 Disaster Risk Management and Climate Change Resilience; NC 3.1.2 Water Resource Management; NC 1.6 Adequate Infrastructure (Roads, Ports, Transport, Energy, Water, and Telecommunications)
Wider impacts	Improvement of water ways will bring benefit to aquatic ecosystems;
Related challenges	Increased rainfall and flooding
Related Indicators	Homes equipped with water storage facilities; Homes installed with hurricane shutters and rain water harvesting; Number of people requiring shelters during droughts; Vulnerable homes with back up renewable energy systems; Shelters with back up renewable

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
AF	Committed	Grant	Multilateral cooperation	Department of Environment	997,000	USD	2017	https://www.adaptation-fund.org/project/integrated-approach-physical-adaptation-community-resilience-antigua-barbudas-northwest-mckinnons-watershed/

Action ID	**21**				
Title	The Path to 2020 – Antigua and Barbuda				
Objective	To actualise protection and sustainable use of biodiversity and protected areas, under the umbrella of the newly passed Environmental Protection and Management Act (EPMA) of 2015. It aims to improve management of landscapes and seascapes to enhance protection and sustainable use of globally significant biodiversity in protected areas and surrounding communities.				
Description	The project involved three different components to reach its objective: - Strengthening regulations, institutions and financing mechanisms; - Expansion of protected areas in support of species conservation; - Pilot livelihood financing mechanisms for sustainable use of biodiversity and plant genetic resources				
Action Type	Cross-cutting	**Adaptation Priority**	Medium	**Mitigation Priority**	Medium
Status of implementation	Under implementation	**Start date**	2018	**Full implementation date**	2022
Sector category	1.3.2 Land use Change and Forestry; 2.2. Biodiversity	**Institution responsible**	Department of the Environment	**Lead stakeholder**	N/A
Activities covered	Increased biodiversity, CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	8,229,153 US Dollars	**Geographical area included**	3,035 Hectares added to Shekerley Mountains protected areas	**Methodologies and assumptions**	GEF project document: https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
Constraints	Reluctance to address institutional fragmentation; lack of financial resources; conflict between conservation and land use; communities and farmers unwillingness to participate; climate change;			**Constraint type**	Environmental; financial; institutional
Related SDGs	5. Clean Water and Sanitation; 18. Decent Work and Economic Growth 14. Life Below Water; 15. Life On Land; 13. Climate Action				
Related NDC target	N/A				
Related national strategies	NC 3.1.1 Ecosystems Management; NC 3.1 Sustainable Environmental Management				
Wider impacts	Reduced chance of extinction of species				

Related challenges	Land degradation, biodiversity loss
Related Indicators	Management effectiveness and financial sustainability scores; Expansion of protected areas in support of species conservation; Useful and sustainable species

Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
GEF	Committed	Grant	Multilateral cooperation	Department of Environment	2,729,153	USD	-	https://www.thegef.org/sites/default/files/project_documents/ID9402_Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
Department of Environment	Committed	Cash	Co-financing	UNEP	4,210,000	USD	-	
UNEP	Committed	In kind	Co-financing	UNEP	250,000	USD	-	
IICA	Committed	In kind	Co-financing	UNEP	91,791	USD	-	
Ministry of Agriculture	Committed	In kind	Co-financing	UNEP	800,000	USD	-	
CARDI	Committed	In kind	Co-financing	UNEP	150,000	USD	-	

Action ID	**22**				
Title	Community led renewable energy initiatives				
Objective	This action represents the wide range of initiatives that are being led by members of civil society and the community. The objective of this action is for the community to lead on accessing green finance for the installation of various renewable energy projects ensuring energy resilience at all levels of Antiguan society.				
Description	Ten community led groups have accessed green finance for the implementation of solar energy systems, these include: - Precision Centre church community: 14 kWh solar energy system powering church lighting and hydroponics farm funded by a GEF/SGP fund. - St Anthony's School: 18 kWh system with grant funds from GEF/SGP -Antigua and Barbuda Network of Rural Women Producers: 1kwh solar energy system on their Agro processing facility on Seatons main road with support from GEF/SGP - Ruth's Place guest accommodation: Currently 6 kWh of solar energy with plans for scaling up to a 12 kWh system with grant funds from the Caribbean Export Development Agency. - Villa Church of Christ: 1 kWh solar energy system with support from Organisation of American States (OAS) and the Department of Environment (DOE) - Vibrant Faith Ministries church community: 2 kWh solar energy system with support from OAS and the DOE - Antigua & Barbuda Association of Persons with Disabilities (ABAPD) headquarters: 1 kWh solar energy system with support from OAS and the DOE - Potters Seventh Day Adventist Church: 1 kWh solar energy system with support from OAS and the DOE - Sis Glo's Jams and Jellies: 1 kWh solar energy system with support from OAS and the DOE - House of Refuge Ministries church community: 1 kWh solar energy system with support from OAS and the DOE				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	2012	**Full implementation date**	Ongoing
Sector category	1.1.1. Energy Supply	**Institution responsible**	GEF/SGP	**Lead stakeholder**	Ruth Spencer
Activities covered	CO_2	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	116,000 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	Estimates from Ruth Spencer, this is probably an underestimate as it omits the cost of the smaller 1 kWh solar energy systems.
Constraints	Awareness of funding mechanisms			**Constraint type**	Financial

Related SDGs	13. Climate Action; 7. Affordable and Clean Energy;
Related NDC target	By 2030, achieve an energy matrix with 50 MW of electricity from renewable sources both on and off grid in the public and private sectors.
Related national strategies	NC 1.4.5 Technological Adaptation and Innovation (Including Green Technology); NC 1.5 Efficient Markets and Appropriate Enabling Business Environment;
Wider impacts	Reduced reliance on imported fossil fuels; lower energy prices
Related challenges	Emissions from energy combustion; high energy prices; high social costs of disconnections from the grid impacting single women, children and youth.
Related Indicators	Unknown

Action finance

Name of funder	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Year	Data Source
No data available								

Action ID	**23**
Title	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy
Objective	To implement cost-effective adaptation measures in the community via interventions at the institutional, farm- and environment level to simultaneously build natural, institutional and social adaptive capacity.
Description	The project will be delivered through four key components: 1. Strengthening institutional capacity and mechanisms for climate risk information processing and dissemination (drought risk management, early warning, desertification and agro-ecological production planning) 2. Increasing the technical capacity of youth, technicians and agricultural-based community groups to design and implement solutions to climate vulnerability. 3. Investment/grant program for farmers to develop resilience to climate in livestock, crop and post-production systems, using designs concepts developed by youth and agricultural technicians 4. Community-based adaptation mainstreaming, governance and management to sustain resilience project interventions The primary aim of this project is to increase resilience in the agriculture sector, however improved efficiency of resource use and reduced loss of soil organic matter will contribute towards mitigation of GHG emissions.

Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Planning	**Start date**	TBD	**Full implementation date**	TBD
Sector category	1.3.1. Agriculture	**Institution responsible**	Department of Environment; IICA;	**Lead stakeholder**	Jason Williams
Activities covered	Food and water security, Agricultural practices & land use planning	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Education; Project
Estimated Action Costs	11,494,625 US Dollars	**Geographical area included**	Nationwide	**Methodologies and assumptions**	Concept note document
Constraints	Lack of funding mobilised			**Constraint type**	Financial
Related SDGs	11. Sustainable Cities and Communities; 13. Climate Action; 4. Quality Education				
Related NDC target	N/A				
Related national strategies	NC 1.2 Penetrating Export Markets; NC 1.7 Adequate Skills and Capacity to Support Sustainable Development; NC 3.1 Sustainable Environmental Management; NC 3.1.3 Disaster Risk Management and Climate Change Resilience				
Wider impacts	Reduced cost of produce				
Related challenges	Export production costs; limited water supply; low production and productivity; pest and disease problems; soil quality degradation; high labour and energy costs; loss of arable land and over-exploitation of marine food sources				
Related Indicators	Upgrading observation and monitoring infrastructure; Allocation of grant packages to farmer groups; Adoption of soil and water conservation practises;				

Action finance

Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
Unknown	Needed	Grant	Unknown	Department of Environment	11,494,625	US Dollars	Unknown	Concept note document

Action ID	**24**				
Title	Use of protected culture technologies for the production of high value vegetable crops to build resilience against impacts of climate change in the Agricultural Sector				
Objective	To demonstrate the effectiveness of the use of protective culture technology to reduce crop production vulnerability to direct and indirect climatic stresses (drought, heavy rainfall, floods, pests and diseases).				
Description	Phase 1 consists of capacity building for greenhouse technologies and the establishment of one greenhouse with two crops (bell peppers and zucchini on a rotational basis. Phase 2 involves up scaling the demonstration to include up to 6 greenhouses demonstrating benefits of the technology on other crops (cucurbits and the following herbs and spices; chives, basil, thyme and cilantro). Phase 3 involves establishing a rainwater harvesting system, composting and vermiculture. Due to unforeseen circumstances in 2017 this project had to be put on hold. It has not been resumed since then.				
Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	Unknown	**Full implementation date**	Unknown
Sector category	1.3.1. Agriculture	**Institution responsible**	Ministry of Agriculture	**Lead stakeholder**	Gregory Bailey
Activities covered	Food and water security, Agricultural practices & land use planning	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Project
Estimated Action Costs	814,000 US Dollars	**Geographical area included**	Sanderson's Estate	**Methodologies and assumptions**	Project document
Constraints	Unknown			**Constraint type**	N/A
Related SDGs	11. Sustainable Cities and Communities; 13. Climate Action; 2. Zero Hunger				

Related NDC target	N/A							
Related national strategies	NC 1.7 Adequate Skills and Capacity to Support Sustainable Development; NC 3.1 Sustainable Environmental Management; NC 3.1.3 Disaster Risk Management and Climate Change Resilience							
Wider impacts	Reduced cost of produce; smaller quantity of food imported;							
Related challenges	Vulnerability to direct and indirect climatic stresses including drought, heavy rainfall, floods, pests and diseases and loss or severe damage to infrastructure; high cost of importing food;							
Related Indicators	N2O emissions avoided through targeted fertilizer application; Construction of greenhouses							
Action finance								
Name of funder	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Year**	**Data Source**
USAID	Committed	Grant	Bilateral cooperation	Ministry of Agriculture	744,000	US Dollars	Unknown	Project document
Ministry of Agriculture	Committed	In kind	Co-financing	Ministry of Agriculture	70,000	US Dollars	Unknown	Project document
Action ID	25							
Title	Agricultural Technology Cooperation Project between China and Antigua and Barbuda							
Objective	To share knowledge and technology between China and Antigua and Barbuda with the aim of providing training to registered farmers and technicians, improving agricultural practises and building greenhouses.							
Description	LPHT will dispatch 8 agricultural experts to work in Antigua and Barbuda for 3 years, the experts include an agronomy expert, 1 vegetable cultivation expert, an agricultural machinery expert, a plant protection expert, a laboratory expert, 1 vegetable/tissue culture expert, a fruit crop specialist and a translator. To establish seven greenhouses; two for experimental/tissue culture hardening demonstrations and five for commercial production. Build one intelligent and one ordinary greenhouse at Green Castle Station and five ordinary greenhouses at ADC. Conduct plant nursery and technical demonstrations etc. in fruit and vegetable cultivation and conduct research on biological control of pests and diseases in fruit and vegetables. Carry out related training for registered farmers and technicians to build capacity of the personnel of Antigua and Barbuda with a total of 700 training opportunities.							

Action Type	Cross-cutting	**Adaptation Priority**	Unknown	**Mitigation Priority**	Unknown
Status of implementation	Under implementation	**Start date**	02/05/2018	**Full implementation date**	01/05/2021
Sector category	1.3.1. Agriculture	**Institution responsible**	Ministry of Agriculture	**Lead stakeholder**	Gregory Bailey
Activities covered	Food and water security, Agricultural practices & land use planning	**Mitigation scenario**	With existing measures	**Type of policy instrument**	Education; Project
Estimated Action Costs	Unknown	**Geographical area included**	Green Castle, Christian Valley, Dunbars and Cades Bay	**Methodologies and assumptions**	Project document
Constraints	Unknown			**Constraint type**	N/A
Related SDGs	11. Sustainable Cities and Communities; 13. Climate Action; 2. Zero Hunger				
Related NDC target	N/A				
Related national strategies	NC 1.7 Adequate Skills and Capacity to Support Sustainable Development; NC 3.1 Sustainable Environmental Management; NC 3.1.3 Disaster Risk Management and Climate Change Resilience				
Wider impacts	Reduced cost of produce; smaller quantity of food imported;				
Related challenges	Vulnerability to direct and indirect climatic stresses including drought, heavy rainfall, floods, pests and diseases and loss or severe damage to infrastructure; high cost of importing food;				
Related Indicators	N2O emissions avoided through targeted fertilizer application; Construction of greenhouses;				
Action finance					

Name of funder	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Year	Data Source
No data available								

7.2 MITIGATION ANNEX B: INDICATOR REGISTRY

This annex contains the Indicator Registry, a full list of available information on climate change action indicators. Each indicator is identified using a unique ID and is linked to one or more actions. Baseline, ex-anti and ex-post assessments have been made where data is available. Visual display of the data is also presented in a chart where available (see I8). This will provide a consistent reference library for monitoring the GHG impacts, progress and wider impacts of the listed climate change actions.

Indicator ID	**I1**	Name of indicator	**GHG emissions mitigated from the transport sector**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	GEF7 Antigua and Barbuda Sustainable Low-emission Island Mobility project		
Description	CO_2eq emissions avoided through improvements to sustainable mobility.		
Data source	GEF PIF document		
Unit	tCO_2		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	0	Baseline	GEF PIF document
2018	0	Ex-Post	GEF PIF document
2023	0.119	Ex-Anti	GEF PIF document

Indicator ID	**I2**	Name of indicator	**GHG emissions mitigated from the energy sector**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	SPPARE component 3: Renewable Energy in Support of Protected Areas System; GISS: Grid-Interactive Solar PV Systems for Schools and Clinics; Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project		
Description	Through the increase in renewable energy capacity, Antigua and Barbuda have set a target of mitigating 100 000 tonnes of CO_2 equivalent emissions from entering the atmosphere		
Data source	SPPARE PIR document		
Unit	tCO_2 mitigated		
Indicator Data			
Year	**Value**	**Type**	**Reference**

2015	0	Baseline	SPPARE PIR document
2019	Unknown	Ex-Post	SPPARE PIR document
2030	100,000	Ex-Anti	SPPARE PIR document

Indicator ID	**I3**	Name of indicator	**Securement of land as new protected area**
Indicator type	Progress	**Parent Indicator**	Carbon sequestration
Related actions	SPPARE component 2: Improve Management Effectiveness of Sustainable Pilot Protected Area – Boggy Peak National Park.		
Description	Area of land outlined and secured as a new protected area		
Data source	SPPARE PIR document		
Unit	Hectares		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	SPPARE PIR document
2019	1,719	Ex-Post	SPPARE PIR document
2019	1,719	Ex-Anti	SPPARE PIR document

Indicator ID	**I4**	Name of indicator	**Annual CO_2 savings from land restoration and avoided land degradation**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	SPPARE component 4: Enhance Forest Management		
Description	CO_2 sequestered as a result of afforestation, land protection and forest fires avoided		
Data source	SPPARE PIR document		
Unit	tCO_2 sequestered per year		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	SPPARE PIR document
2019	Unknown	Ex-Post	SPPARE PIR document
2020	43,216	Ex-Anti	SPPARE PIR document

Indicator ID	**I5**	Name of indicator	**Trees planted**

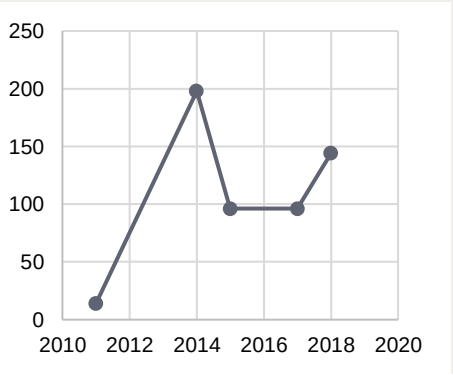
Indicator type	Progress	**Parent Indicator**	Carbon sequestration
Related actions	SPPARE component 4: Enhance Forest Management		
Description	Number of trees planted as part of the forest restoration and afforestation activities.		
Data source	SPPARE PIR document		
Unit	Number of trees		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	SPPARE PIR document
2019	Unknown	Ex-Post	SPPARE PIR document
2020	20,000	Ex-Anti	SPPARE PIR document

Indicator ID	**I6**	Name of indicator	**GHG emissions mitigated from waste**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda		
Description	CO_2eq emissions avoided through waste management practises aligned with the circular economy approach.		
Data source	GCF Concept Note		
Unit	tCO_2eq emissions avoided		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	0	Baseline	GCF Concept Note
2019	0	Ex-Post	GCF Concept Note
2039	472,000	Ex-Anti	GCF Concept Note

Indicator ID	**I7**	Name of indicator	**Creation of new jobs in the circular economy**
Indicator type	Wider impacts	**Parent Indicator**	Job creation
Related actions	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda		
Description	New jobs created through the development of the circular economy approach		
Data source	GCF Concept Note		
Unit	Number of new jobs created		

Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	0	Baseline	GCF Concept Note
2019	0	Ex-Post	GCF Concept Note
2039	500	Ex-Anti	GCF Concept Note

Indicator ID	**I8**	Name of indicator	**Reduction in landfill fires**
Indicator type	Wider impacts	**Parent Indicator**	Waste management improvements
Related actions	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda		
Description	Through reduced use of landfill, it is expected that there will be fewer landfill fires and associated negative effects.		
Data source	GCF Concept Note		
Unit	Landfill fire hours per year		

Indicator Data				
Year	**Value**	**Type**	**Reference**	**Graph**
2011	14	Historic	1st Tire Fire - Elliott Lincoln	
2014	198	Historic	2nd Tire Fire and Sanitary Landfill - Elliott Lincoln	
2015	96	Historic	Sanitary Landfill – Elliott Lincoln	
2017	96	Historic	Bulk - Elliott Lincoln	
2018	144	Baseline	Bulk and Sanitary Landfill - Elliott Lincoln	
2019	3	Ex-Post	Sanitary Landfill - Elliott Lincoln	
2039	Unknown	Ex-Anti	GCF Concept Note	

Indicator ID	**I9**	Name of indicator	**Reduction in discharge of nutrient rich landfill leachate and vinasse into waterways.**
Indicator type	Wider impacts	**Parent Indicator**	Waste management improvements
Related actions	Circular economy approach to reducing emissions in the waste sector of Antigua and Barbuda		

Description	Reduction of the discharge of nutrient rich landfill leachate and vinasse into waterways benefitting coastal communities, fishermen and the marine ecosystem.		
Data source	GCF Concept Note		
Unit	Concentration of landfill leachate and vinasse in waterways		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	Unknown	Baseline	GCF Concept Note
2019	Unknown	Ex-Post	GCF Concept Note
2039	Unknown	Ex-Anti	GCF Concept Note

Indicator ID	**I10**	Name of indicator	**GHG emissions from electricity generation attributed to desalination**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda		
Description	Reduced emissions from electricity generation attributed to desalination by using renewable energy.		
Data source	GCF Concept Note		
Unit	tCO_2eq emitted from desalination plants		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	Unknown	Baseline	GCF Concept Note
2019	Unknown	Ex-Post	GCF Concept Note
TBD	Unknown	Ex-Anti	

Indicator ID	**I11**	Name of indicator	**Installed off-grid renewable energy capacity**
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda		
Description	Progress towards renewable energy installation for water pumping and generation		
Data source	GCF Concept Note		
Unit	MW of renewable energy installed.		
Indicator Data			

Year	Value	Type	Reference
2017	0	Baseline	GCF Concept Note
2019	Unknown	Ex-Post	GCF Concept Note
TBD	2	Ex-Anti	GCF Concept Note

Indicator ID	I12	Name of indicator	**Increased access to water for general population during/after climate-induced water stress events**
Indicator type	Wider impacts	**Parent Indicator**	Water sector resilience
Related actions	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda		
Description	Average water supply available in the immediate during stressed period (e.g. drought) relative to normal periods		
Data source	GCF Concept Note		
Unit	Percentage of people with access to water during climate-stressed events		
Indicator Data			

Year	Value	Type	Reference
2017	Unknown	Baseline	GCF Concept Note
2019	Unknown	Ex-Post	GCF Concept Note
TBD	100	Ex-Anti	GCF Concept Note

Indicator ID	I13	Name of indicator	**Increased resilience of water system to climate shocks/stressors**
Indicator type	Wider impacts	**Parent Indicator**	Water sector resilience
Related actions	Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda		
Description	More resilient response to unexpected/ long periods of drought		
Data source	GCF Concept Note		
Unit	Cubic meters of water being stored in storage tanks and reservoirs		
Indicator Data			

Year	Value	Type	Reference
2017	Unknown	Baseline	GCF Concept Note
2019	Unknown	Ex-Post	GCF Concept Note
TBD	Unknown	Ex-Anti	

Indicator ID	I14	Name of indicator	Installed capacity of renewable energy projects in Antigua
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	10 MW Solar project		
Description	MW of renewable energy capacity installed through solar energy farms		
Data source	Ministry of Energy		
Unit	MW of renewable energy installed.		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	Ministry of Energy
2019	8.3	Ex-Post	Ministry of Energy
TBD	10	Ex-Anti	Ministry of Energy

Indicator ID	I15	Name of indicator	Installed capacity of renewable energy projects in Barbuda
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	Green Barbuda Project		
Description	KW of solar energy capacity installed through modular hybrid power plant		
Data source	Ministry of Energy		
Unit	Kw of solar energy capacity installed		
Indicator Data			
Year	**Value**	**Type**	**Reference**
Unknown	Unknown	Baseline	Ministry of Energy
2019	0	Ex-Post	Ministry of Energy
Unknown	720	Ex-Anti	Ministry of Energy

Indicator ID	I16	Name of indicator	Sodium street lighting replaced by LED lighting
Indicator type	Progress	**Parent Indicator**	Energy efficiency measures
Related actions	Street lighting project		
Description	Progress towards replacing sodium bulbs with LED lighting.		

Data source	Ministry of Energy		
Unit	% of sodium bulb streetlighting replaced with LEDs.		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	0	Baseline	Ministry of Energy
2019	0	Ex-Post	Ministry of Energy
Unknown	100	Ex-Anti	Ministry of Energy

Indicator ID	**I17**	Name of indicator	**Installed solar energy output**
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project		
Description	Installed output of grid-interactive solar PV		
Data source	Department of Environment		
Unit	kWh per year		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	Department of Environment
2019	Unknown	Ex-Post	Department of Environment
TBD	280,000	Ex-Anti	Department of Environment

Indicator ID	**I18**	Name of indicator	**CO_2 emissions avoided**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	Sustainability Energy Facility / Caribbean Development Bank (SEF/CDB) project		
Description	CO_2 emissions avoided as a result of solar PV systems installed		
Data source	Department of Environment		
Unit	tCO_2		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	Department of Environment

2019	Unknown	Ex-Post	Department of Environment
2037	5,460	Ex-Anti	Department of Environment

Indicator ID	**I19**	Name of indicator	**Renewable energy systems installed on schools**
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	Grid-Interactive Sustainable School Project (GISS)		
Description	Progress towards the total number of schools with renewable energy systems installed		
Data source	Department of Environment		
Unit	Number of schools		

Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	Department of Environment
2019	Unknown	Ex-Post	Department of Environment
TBD	16	Ex-Anti	Department of Environment

Indicator ID	**I20**	Name of indicator	**Electric charging stations installed**
Indicator type	Progress	**Parent Indicator**	Installation of sustainable mobility infrastructure
Related actions	Electric School Bus Pilot Project		
Description	Progress towards the installation of electric charging stations for vehicles.		
Data source	Department of Environment		
Unit	Number of electric charging stations installed		

Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	Department of Environment
2019	0	Ex-Post	Department of Environment
TBD	2	Ex-Anti	Department of Environment

Indicator ID	**I21**	Name of indicator	**Restoration of vegetated land**
Indicator type	Progress	**Parent Indicator**	Carbon sequestration

Related actions	Redonda restoration programme and offshore restoration programme		
Description	Progress towards the restoration of Redonda Island, resulting in the recovery of natural vegetation.		
Data source	Environmental Awareness Group		
Unit	Hectares		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2016	Unknown	Baseline	Environmental Awareness Group
2019	Unknown	Ex-Post	Environmental Awareness Group
TBD	Unknown	Ex-Anti	

Indicator ID	**I22**	Name of indicator	**CO_2 emissions mitigated due to energy efficiency improvements**
Indicator type	GHG impact	**Parent Indicator**	GHG emissions mitigated
Related actions	Energy for Sustainable Development in the Caribbean (ESD Project)		
Description	GHG emissions avoided as a result of improvements to energy efficiency.		
Data source	GEF PIF document: https://www.thegef.org/project/energy-sustainable-development-caribbean-buildings		
Unit	kt CO_2		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2012	0	Baseline	GEF PIF document: https://www.thegef.org/project/energy-sustainable-development-caribbean-buildings
2019	Unknown	Ex-Post	GEF PIF document: https://www.thegef.org/project/energy-sustainable-development-caribbean-buildings
2027	1,470	Ex-Anti	GEF PIF document: https://www.thegef.org/project/energy-sustainable-development-caribbean-buildings

Indicator ID	**I23**	Name of indicator	**Homes equipped with water storage facilities**
Indicator type	Progress	**Parent Indicator**	Water sector resilience
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards homes equipped with 2 weeks' worth of water stored on-site with filtration and pump equipment		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		

Unit	% of homes equipped with 2 weeks' worth of water stored on-site with filtration and pump equipment		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	50	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I24**	Name of indicator	**Homes installed with hurricane shutters and rain water harvesting**
Indicator type	Progress	**Parent Indicator**	Water sector resilience
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards percentage of homes (approximately 200) benefitting from the installation of hurricane shutters and rain water harvesting		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	% of homes benefitting from the installation of hurricane shutters and rain water harvesting		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	Unknown	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	5	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I25**	Name of indicator	**Number of people requiring shelters during natural disasters**
Indicator type	Progress	**Parent Indicator**	Water sector resilience
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards reducing the number of persons requiring shelters during droughts, with priority for vulnerable populations including single mothers, older persons and children, particularly special needs children		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		

Unit	% reduction in the number of people requiring shelters during droughts		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	Unknown	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	50	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I26**	Name of indicator	**Vulnerable homes with back up renewable energy systems**
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards the number of vulnerable homes with back up renewable energy systems		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	% of vulnerable homes with back-up RE (for essential services including pumping water)		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	Unknown	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	5	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I27**	Name of indicator	**Shelters with back up renewable energy systems**
Indicator type	Progress	**Parent Indicator**	Installation of renewable energy systems
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards the number of shelters with back up renewable energy systems		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	% of shelters		

Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	Unknown	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	30	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I28**	Name of indicator	**Mosquito larvae in local water bodies**
Indicator type	Wider impacts	**Parent Indicator**	Ecological indicators
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Reduction in number of mosquito larvae in the northwest McKinnon's watershed area		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	% reduction in mosquito larvae abundance		

Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	30	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I29**	Name of indicator	**Exposure to public awareness materials**
Indicator type	Progress	**Parent Indicator**	Knowledge dissemination
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards the families and businesses exposed to the public awareness knowledge products of the project		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	% of families and businesses exposed to the project's public awareness material		
Indicator Data			

Year	Value	Type	Reference
2017	Unknown	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	30	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I30**	Name of indicator	**Community groups trained**
Indicator type	Progress	**Parent Indicator**	Capacity building
Related actions	An integrated approach to physical adaptation and community resilience in Antigua and Barbuda's northwest McKinnon's watershed		
Description	Progress towards the number of community groups trained in the management and maintenance of the adaptation interventions in the waterways		
Data source	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf		
Unit	Number of community groups trained in the management and maintenance of adaptation interventions		
Indicator Data			

Year	Value	Type	Reference
2017	0	Baseline	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2019	Unknown	Ex-Post	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf
2021	3	Ex-Anti	https://www.adaptation-fund.org/wp-content/uploads/2016/04/Antigua_and_Barbuda_proposal_for_posting-1.pdf

Indicator ID	**I31**	Name of indicator	**Management effectiveness and financial sustainability scores**
Indicator type	Progress	**Parent Indicator**	Management effectiveness and financial sustainability
Related actions	The Path to 2020		
Description	Progress towards increasing management effectiveness and financial sustainability scores for the 17,704 hectares of protected areas, by 20%		
Data source	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf		
Unit	% increase in management effectiveness and financial sustainability scores		
Indicator Data			

Year	Value	Type	Reference

2015	0	Baseline	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2019	Unknown	Ex-Post	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2021	20	Ex-Anti	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf

Indicator ID	**I32**	Name of indicator	**Expansion of protected areas in support of species conservation**
Indicator type	Progress	**Parent Indicator**	Carbon sequestration
Related actions	The Path to 2020		
Description	Expansion of protection and sustainable use of globally significant biodiversity in protected areas and surrounding communities		
Data source	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf		
Unit	Increase in hectares of protected areas		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2019	Unknown	Ex-Post	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2021	3,035	Ex-Anti	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf

Indicator ID	**I33**	Name of indicator	**Useful and sustainable species**
Indicator type	Progress	**Parent Indicator**	Ecological indicators
Related actions	The Path to 2020		
Description	Increasing the number of species and traditional varieties, of global significance sustainably used at the farm level		
Data source	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf		

Unit	Increase in the number of species over baseline		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2015	0	Baseline	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2019	Unknown	Ex-Post	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf
2021	10	Ex-Anti	GEF PIF document https://www.thegef.org/sites/default/files/project_documents/ID9402__Antigua_and_Barbada_Path_to_2020_PIF_3-28-2016_.pdf

Indicator ID	**I34**	Name of indicator	**Resilient buildings**
Indicator type	Progress	**Parent Indicator**	Climate Change Resilience
Related actions	Resilience to hurricanes, floods and droughts in the building sector in Antigua and Barbuda (GCF Build)		
Description	Number and value of physical assets made more resilient to climate variability and change, considering human benefits		
Data source	GCF Concept Note https://www.greenclimate.fund/documents/20182/893456/17880_-_Resilience_to_hurricanes__floods_and_droughts_in_the_building_sector_in_Antigua_and_Barbuda.pdf/6024818c-8aae-46d1-95ec-27a000f8f2ae		
Unit	Number and value of physical assets		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2017	0	Baseline	GCF Concept Note https://www.greenclimate.fund/documents/20182/893456/17880_-_Resilience_to_hurricanes__floods_and_droughts_in_the_building_sector_in_Antigua_and_Barbuda.pdf/6024818c-8aae-46d1-95ec-27a000f8f2ae
2019	Unknown	Ex-Post	GCF Concept Note https://www.greenclimate.fund/documents/20182/893456/17880_-_Resilience_to_hurricanes__floods_and_droughts_in_the_building_sector_in_Antigua_and_Barbuda.pdf/6024818c-8aae-46d1-95ec-27a000f8f2ae
2024	17	Ex-Anti	GCF Concept Note https://www.greenclimate.fund/documents/20182/893456/17880_-_Resilience_to_hurricanes__floods_and_droughts_in_the_building_sector_in_Antigua_and_Barbuda.pdf/6024818c-8aae-46d1-95ec-27a000f8f2ae

Indicator ID	**I35**	Name of indicator	**Upgrading observation and monitoring infrastructure**

Indicator type	Progress	**Parent Indicator**	Agricultural infrastructure improvements
Related actions	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy		
Description	Automation of observation and monitoring infrastructure for receiving and transmitting data effectively		
Data source	Concept Note		
Unit	Number of meteorological stations upgraded		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	Unknown	Baseline	Concept Note
TBD	Unknown	Ex-Post	Concept Note
TBD	7	Ex-Anti	Concept Note

Indicator ID	**I36**	Name of indicator	**Allocation of grant packages to farmer groups**
Indicator type	Progress	**Parent Indicator**	Agricultural infrastructure improvements
Related actions	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy		
Description	Grant packages allocated to (at least 10% of) farmer groups and other targeted stakeholders with a focus on women in agriculture for building climate-resilient agriculture through investments in production and post-harvesting/ value-added (equipment and infrastructure) with the aim of diversifying income.		
Data source	Concept Note		
Unit	% of farmer groups		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	Unknown	Baseline	Concept Note
TBD	Unknown	Ex-Post	Concept Note
TBD	10	Ex-Anti	Concept Note

Indicator ID	**I37**	Name of indicator	**Adoption of soil and water conservation practises**
Indicator type	Progress	**Parent Indicator**	Agricultural infrastructure improvements
Related actions	Developing climate resilient farming communities in Antigua and Barbuda: A Food and Nutrition Security Strategy		

Description	The adoption and establishment of soil and water conservation practices including low-till, organic mulching and residue reuse, mixed cropping, production of fodder, biobeds, mixed cropping, fodder production and rain harvesting. This could include modified greenhouses to minimise impacts of water stress (drought and flood) on crop production and productivity.		
Data source	Concept Note		
Unit	Number of farmers		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	Unknown	Baseline	Concept Note
TBD	Unknown	Ex-Post	Concept Note
TBD	84	Ex-Anti	Concept Note

Indicator ID	**I38**	Name of indicator	**N_2O emissions avoided through targeted fertilizer application**
Indicator type	GHG impact	**Parent Indicator**	Reduced emissions from agricultural sector
Related actions	Use of protected culture technologies for the production of high value vegetable crops to build resilience against impacts of climate change in the Agricultural Sector; Agricultural Technology Cooperation Project between China and Antigua and Barbuda		
Description	Through the precise application of fertilizer direct to the root zone and using drop systems, N2O emissions can be minimised.		
Data source	Project document		
Unit	t CO2eq		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2019	Unknown	Baseline	
TBD	Unknown	Ex-Post	
TBD	Unknown	Ex-Anti	

Indicator ID	**I39**	Name of indicator	**Construction of greenhouses**
Indicator type	Progress	**Parent Indicator**	Agricultural infrastructure improvements
Related actions	Use of protected culture technologies for the production of high value vegetable crops to build resilience against impacts of climate change in the Agricultural Sector		
Description	Greenhouses will be established in order to improve national food production capacity.		

Data source	Project document		
Unit	Number of greenhouses		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2013	Unknown	Baseline	Project document
TBD	TBD	Ex-Post	Project document
TBD	6	Ex-Anti	Project document

Indicator ID	**I40**	Name of indicator	**Construction of greenhouses**
Indicator type	Progress	**Parent Indicator**	Agricultural infrastructure improvements
Related actions	Agricultural Technology Cooperation Project between China and Antigua and Barbuda		
Description	Greenhouses will be established in order to improve national food production capacity.		
Data source	Project document		
Unit	Number of greenhouses		
Indicator Data			
Year	**Value**	**Type**	**Reference**
2018	Unknown	Baseline	Project document
TBD	TBD	Ex-Post	Project document
2021	7	Ex-Anti	Project document