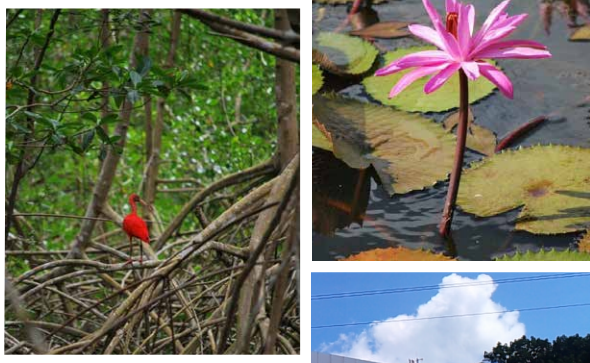
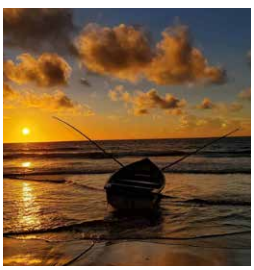
Government of the Republic of Trinidad and Tobago

FIRST BIENNIAL UPDATE REPORT

of the Republic of Trinidad and Tobago





TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

September 2021

Trinidad and Tobago's First Biennial Update Report

In fulfilment of its commitment under the
United Nations Framework Convention on Climate Change

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Ministry of Planning and Development
Multilateral Environmental Agreements Unit
Level 7, Tower C, International Waterfront Complex
1A Wrightson Road,
Port of Spain
Trinidad and Tobago
Contact: Kishan.Kumarsingh@planning.gov.tt

First Biennial Update Report of the Republic of Trinidad and Tobago
under the United Nations Framework Convention on Climate Change

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The following contributing authors are acknowledged:
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Government of the Republic of Trinidad and Tobago

MINISTRY OF PLANNING AND DEVELOPMENT

First Biennial Update Report to the United Nations Framework Convention on Climate Change

We would like to recognise the partners who have contributed to the project outlined in this publication, the United Nations Development Programme in Trinidad and Tobago and the Global Environment Facility, for their support and financial contribution.

FOREWORD

HON. CAMILLE ROBINSON-REGIS

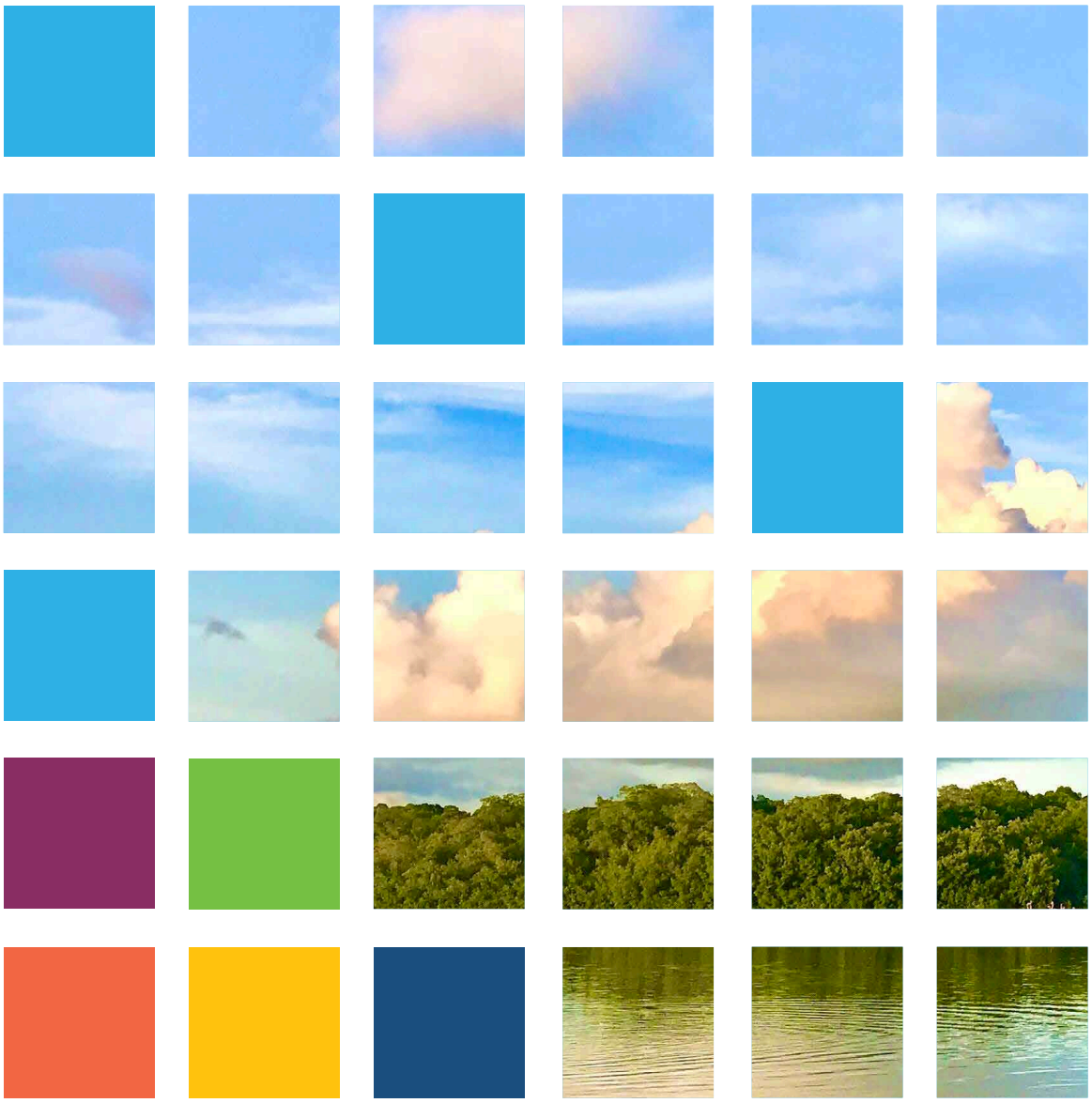
THE REPUBLIC OF TRINIDAD AND TOBAGO as a small island developing state recognises the global climate emergency and the existential threat that it poses. Trinidad and Tobago is already experiencing the adverse impacts of climate change such as sea level rise, increased ambient temperature and extreme weather systems, and is fully aware that climate change has the potential to undermine its priority sustainable development objectives such as poverty eradication, a healthy environment, health care and leaving no one behind. Trinidad and Tobago therefore recognises that climate change is a national development issue and is building climate resiliency in its development planning and developmental paradigm by integrating climate risks into sectoral strategies and action plans, as well as by pursuing a low carbon development pathway, as envisioned in its National Climate Change Policy (NCCP) and VISION 2030 national development plan.

The global climate policy framework provides for each country to play a part in contributing to the global climate problem, and Trinidad and Tobago is taking proactive action. Trinidad and Tobago was among the first set of countries to submit its Nationally Determined Contribution (NDC) under the Paris Agreement and has continued to advance the national climate agenda. In this regard, Trinidad and Tobago has developed a functional monitoring, reporting and verification system for tracking its national greenhouse gas emissions and the achievement of the NDC; an NDC financial investment and implementation plan; and instituted a state-funded compressed natural gas (CNG) fuel switching programme in the transportation sector, which is already yielding greenhouse gas reductions in that sector.

At the domestic policy level, the Government is creating the requisite policy, legislative, administrative and institutional enabling environment as part of its climate action agenda. This includes, inter alia, updating the NCCP to include the provisions of the Paris Agreement; facilitating renewable energy as an increasing part of the energy mix; the development of an e-mobility policy as CNG is a transition fuel and the long-term objective is sustainable transportation; development of a just transition of the workforce policy to address socio-economic challenges that may arise; and development of a legal framework for mandatory reporting of greenhouse gas emissions and mitigation plans.

Trinidad and Tobago therefore continues to play its responsible role in the multilateral policy framework to constructively collaborate with the international community and international partners in order to foster sustainable solutions to climate change.

Hon. Camille Robinson-Regis
Minister of Planning and Development
TRINIDAD AND TOBAGO



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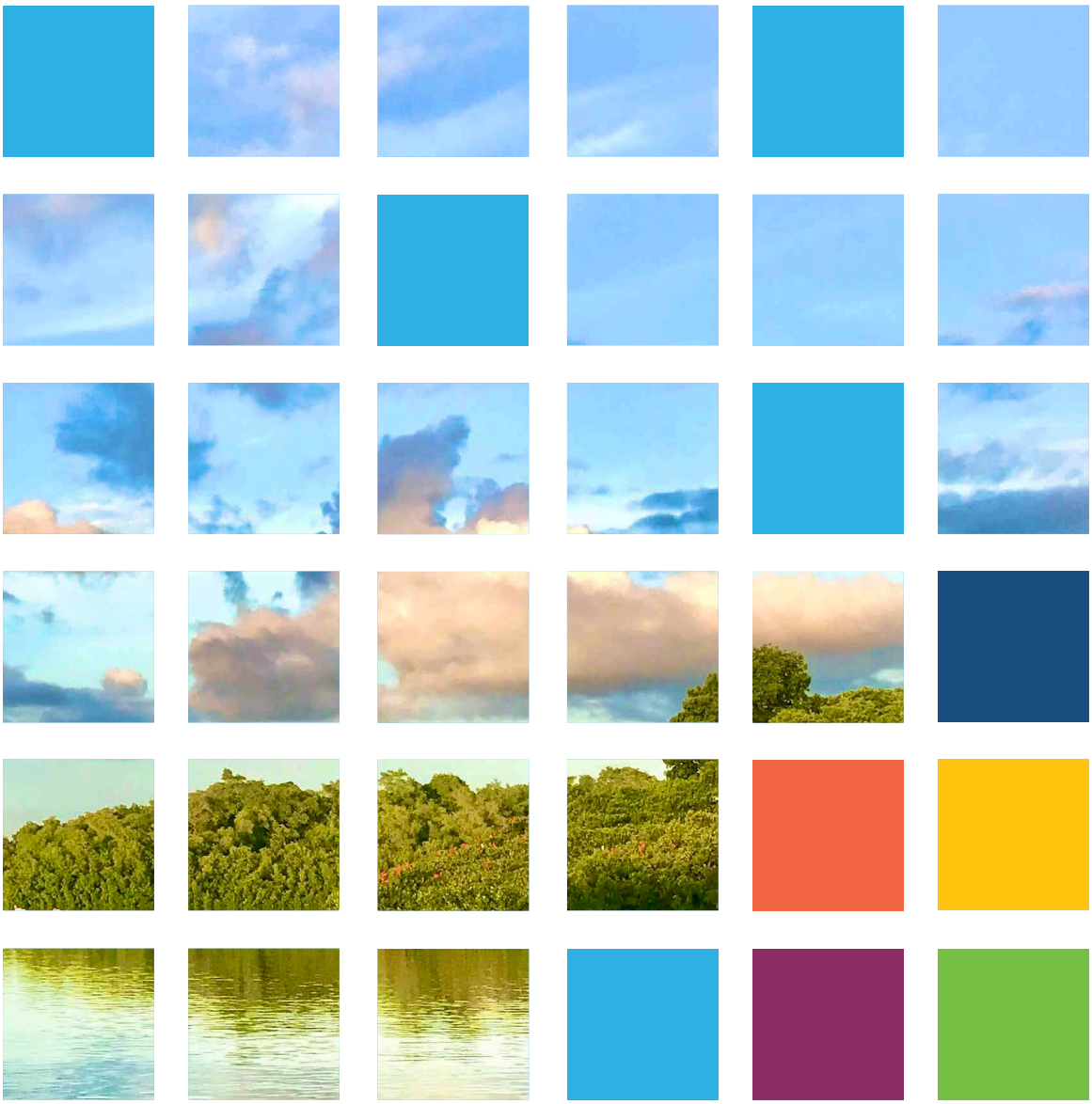

ACRONYMS AND ABBREVIATIONS

AFOLU	Agriculture Forestry and Other Land Uses
AR5	Fifth Assessment Report (Intergovernmental Panel on Climate Change)
AWOS	Automated Weather Observing System
AWS	Automatic Weather Stations
BaU	Business as Usual
BaUC	Business as Usual Conservative
BaUO	Business as Usual Optimistic
BIOS	Basic Input/Output System
BOD	Biological Oxygen Demand
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CARIBCAN	Caribbean-Canada Trade Agreement
CARICOM	Caribbean Community
CCPG	Combined Cycle Power Generation
CCS	Carbon Capture and Storage
CDB	Caribbean Development Bank
CDF	CARICOM Development Fund
CNC	Caribbean Nitrogen Company
CNG	Compressed Natural Gas
CP/COP	Conference of Parties
CRS	Carbon Reduction Strategy
CSO	Central Statistical Office (Trinidad and Tobago)
DTU	Technical University of Denmark
€	Euros
EMA	Environmental Management Authority
ENSO	El Niño-Southern Oscillation
ETF	Enhanced Transparency Framework
EU	European Union
EV	Electric Vehicle
FAO	The Food and Agriculture Organization
FOD	First Order Decay
FAOSTAT	The Food and Agriculture Organization of the United Nations Statistics Division
FIT	Feed-In Tariff
GCCA+	Global Climate Change Alliance Plus
GCF	Green Climate Fund
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GHGMI	Greenhouse Gas Management Institute
GNI	Gross National Income

GoRTT	Government of the Republic of Trinidad and Tobago
GWP	Global Warming Potential
HDI	Human Development Index
ICAO	International Civil Aviation Organization
ICAT	Initiative for Climate Action Transparency
ICT	Information and Communication Technology
IDB	Inter-American Development Bank
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IPPU	Industrial Processes and Product Use
ITCZ	Intertropical Convergence Zone
KCA	Key Category Analysis
KMS	Knowledge Management System
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
MALF	Ministry of Agriculture, Land and Fisheries (Trinidad and Tobago)
MCA	Multi-Criteria Analysis
MCF	Methane Correction Factor
MEA	Multilateral Environmental Agreements
MEAU	Multilateral Environmental Agreements Unit (Trinidad and Tobago)
MEEI	Ministry of Energy and Energy Industries (Trinidad and Tobago)
MOU	Memorandum of Understanding
MiC	Mitigation Conservative
MiO	Mitigation Optimistic
MPD	Ministry of Planning and Development (Trinidad and Tobago)
MPD-EPPD	Ministry of Planning and Development's Environmental Planning and Policy Division (Trinidad and Tobago)
MPU	Ministry of Public Utilities (Trinidad and Tobago)
MRF	Materials Recovery Facility
MRV	Monitoring, Report and Verification
NA	Not Available
NAO	North Atlantic Oscillation
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NDS	National Development Strategy (Trinidad and Tobago)
NE	Not Estimated
NO	Not Occurring
NGOs	Non-governmental Organisations
NISWRMP	National Integrated Solid Waste Resource Management Policy
NMS	National Management System
NMVOC	Non-methane Volatile Organic Compounds
NTFC	National Trade Facilitation Committee (Trinidad and Tobago)
ODS	Ozone Depleting Substance
PAYD	Pay-As-You-Drive

PET	Polyethylene terephthalate
PG	Power Generation
PIA	Piarco International Airport (Trinidad and Tobago)
PLIPDECO	Point Lisas Industrial Port Development Corporation
PoS	Port of Spain
PPA	Power Purchase Agreement
PTSC	Public Transport Service Corporation
PV	Photovoltaic
QA/QC	Quality Assurance/Quality Control
Rs	Reduce, reuse, recycle
RE	Renewable Energy
RIC	Regulated Industries Commission (Trinidad and Tobago)
SA	Sectoral Approach
SDG	Sustainable Development Goals
SIDS	Small Island Developing States
SNC	Second National Communication
SWDS	Solid Waste Disposal Sites
SWM	Solid Waste Management
SWMCOL	Solid Waste Management Company Limited (Trinidad and Tobago)
T&TEC	Trinidad and Tobago Electricity Commission
THA	Tobago House of Assembly
TNA	Technology Needs Assessment
TNC	Third National Communication
ToR	Terms of Reference
T&T	Trinidad and Tobago
TTD	Trinidad and Tobago Dollars
TF	Transfer Station
TFA	Trade Facilitation Agreement
TTMS	Trinidad and Tobago Meteorological Service
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
USDOE	United States Department of Energy
UTT	The University of Trinidad and Tobago
UWI	The University of the West Indies
VNR	Voluntary National Review
WASA	Water and Sewerage Authority (Trinidad and Tobago)
WEO	World Economic Outlook
WMO	World Meteorological Organization
WRI	World Resources Institute
WTO	World Trade Organization

CHEMICAL TERMS

CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon Equivalent
CO_x	Carbon oxide
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose
Gg	Gigagrams
MCF	Methane correction factor
Mt CO_2e	Metric tonnes of carbon dioxide equivalents
N_2O	Nitrous Oxide
HFC	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride
NO_2	Nitrogen dioxide

MEASUREMENT UNITS

bcm	Billion cubic metres
BTU	British Thermal Unit
Gg	Gigagrams
GWh	Gigawatt-hours
MSCF	Thousand Standard Cubic Feet
ha	Hectare
hm	Hectometer
km²	Square kilometres
kW, kWh	Kilowatt, kilowatt-hour
kV	Kilovolt
l	Litres
m³	Cubic metre
MIGD	Million imperial gallons of water per day
Mmcf	Million cubic feet
Wp	Watt-peak

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INTRODUCTION

Trinidad and Tobago is pleased to present its First Biennial Update Report on climate change in fulfilment of its reporting commitment under the United Nations Framework Convention on Climate Change (UNFCCC). The report was compiled according to "UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention" (Annex III of UNFCCC decision 2/CP.17).

EXECUTIVE SUMMARY

Trinidad and Tobago is the most industrialised country in the English-speaking Caribbean with an economy based mainly on oil and gas. Although it produces less than one percent of global greenhouse gas emissions, its fossils-based economy gives it a high GHG emissions per capita.

As a Small Island Developing State that is vulnerable to the impacts of climate change, Trinidad and Tobago was among the first countries to sign and ratify the United Nations Framework Convention on Climate Change in 1994, joining the global movement to stabilise and reduce atmospheric concentrations of greenhouse gases which threaten its future and that of the planet.

In 2015, Trinidad and Tobago adopted a Carbon Reduction Strategy on the basis of which its Nationally Determined Contribution (NDC) to emissions reduction has been calculated.

In 2016 T&T signed the Paris Agreement committing to an overall cumulative emissions reduction of 15 percent relative to a BaU baseline by 2030 from its three major emitting sectors - power generation, transport and industry. In absolute terms, this is an equivalent of one hundred and three million tonnes (103,000,000) of CO_2e.

With specific regard to its public transportation sector, Trinidad and Tobago has also committed to unconditionally reducing cumulative sector emissions by 30 percent or one million, seven hundred thousand tonnes (1,700,000) CO_2e compared to 2013 levels by December 31, 2030.

In moving towards these objectives, T&T has had to resolve data challenges in building a GHG Inventory along with supporting infrastructure to the standard required by the UNFCCC.

In March 2019, the country marked a milestone when it launched the Knowledge Management System (KMS) which is a core component of the Monitoring, Reporting and Verification system for tracking its GHG emissions.

Details of the KMS project are covered in Chapter 2 while the methodology, strategies and institutional framework for the GHG Inventory are outlined in Chapter 3.

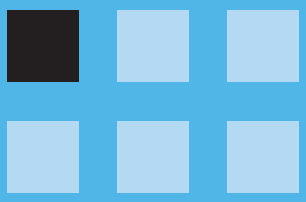
Along with this it has conducted a Mitigation Analysis Report and developed an action plan based on a comprehensive study of the national emissions profile and the contributions of the five emitting sectors identified under the UNFCCC—power generation, industry, transport, waste and AFOLU.

Chapter 4 of this report identifies the climate change mitigation actions that are currently being planned and implemented by Trinidad and Tobago as well as existing measures and projections of the future using "Business as Usual" scenarios based on trends and measures.

Other information considered relevant to the achievement of the objectives of the Convention is presented in Chapter 5.

Despite recording steady progress, Trinidad and Tobago's path towards meeting its emissions reductions targets is constrained by data gaps and financial, technical and capacity-building needs. These are outlined in Chapter 6.

At the national level, Trinidad and Tobago is working at building an alliance of partners involving stakeholders from all sectors, including civil society, industry and government. An important element in this is public education and the raising of public awareness about climate change, the impact of carbon emissions and the power of each to make a difference through conservation, technological innovation, policy, legislation and investment in change.



CHAPTER ONE
NATIONAL CIRCUMSTANCES

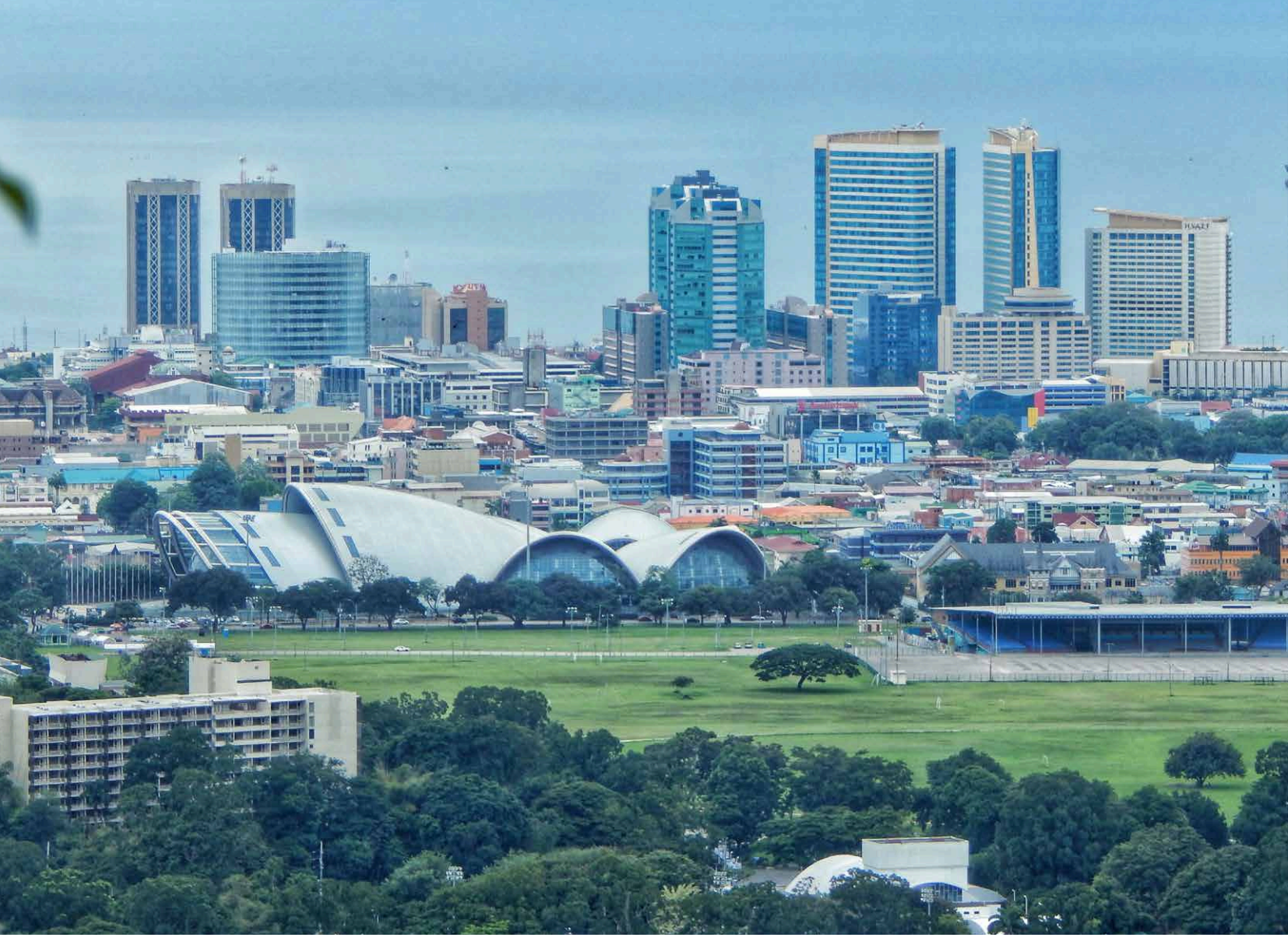


Photo Credit: Nandani Bridglal

▲ View of the Port of Spain cityscape, 2016

1.1 Geographic Profile

Trinidad and Tobago is a country of two islands located at the southernmost end of the Caribbean archipelago. Situated between 10° and 11.5° North Latitude and 60° to 62° West Longitude, it shares maritime borders with Venezuela, Grenada and Barbados. The country's total area is 5,128 km² of which Trinidad accounts for 4,828 km² and Tobago for 300 km².

Their geology indicates that the two islands were once part of the South American mainland. Remnants of this connection survive in the string of small islands off the north western peninsula of Trinidad and in its flora and fauna which are similar to that of Venezuela.

A defining feature of Trinidad is the mountainous Northern Range which runs along the island's northern coastline and rises 940 metres to its highest peak, El Cerro Del Aripo. Beyond the foothills of the Northern Range are the undulating plains of Central Trinidad and a series of rolling hills in the south.

Geologically, Tobago is a continuation of Trinidad's Northern Range with its dominant feature being the Main Ridge, a 29-kilometre spine which runs from southwest to northeast across the island before sloping down to the island's sandy beaches. Its highest point is Pigeon Peak which rises to 550 metres in the air. The Main Ridge Forest Reserve has been legally protected since 1776 and is described as the first act of the modern environmental movement.

The islands have a tropical rainforest ecosystem similar to that of Guyana and Venezuela on the South American mainland.

Both have many natural aquifers and rivers, some of which flow into mangrove coastlines. Natural events have given both islands stunning formations that attract international attraction. Trinidad's La Brea Pitch Lake is the world's largest natural and most significant deposit of asphalt. Estimated at 10 million

FIGURE 1.1 Map of Trinidad and Tobago
Source: Geoatlas, worldometer.info

tons, the Pitch Lake was created during the Pilocene movement as oil ascended from the intersection of two faults deep below the centre of the lake. Tobago's coral reefs, the most famous of which is Buccoo Reef with its abundance of colourful marine life, is the result of the confluence of the Guyana and the North Equatorial currents combined with occasional infusions of nutrient-rich water from the Orinoco River during the rainy season.

Land Use

Approximately 44 percent of Trinidad and Tobago is forested while 10 percent is under agriculture. The remaining 45 percent is occupied by housing, commerce, industry and recreation, among other things.

The islands' unique tropical ecosystems nurture a rich biodiversity around which a thriving eco-tourism sector has developed and supports coastal and other rural communities. As the world's second largest nesting site for leatherback turtles, Trinidad draws turtle-watchers from all over the world to Grand Riviere, Matura and other beaches along its north east coast.

Other eco-tourism activities include mangrove tours in the Caroni and Nariva Swamps; scuba diving at Buccoo Reef, Speyside and other areas in Tobago; bird-watching, wildlife-spotting and sight-seeing tours in Trinidad's Northern Range and Tobago's Main Ridge Forest Reserve. Together, these two forested areas support the largest number of rare plant species globally. The Northern Range is also home to rare species of birds at the Asa Wright Nature Centre, internationally recognised as a birdwatcher's paradise.

While these activities promote biodiversity conservation, the pollution of coastal waters remains a problem, particularly in parts of the Gulf of Paria.[1]

Trinidad and Tobago's ecosystem is interlinked with the livelihood of its people. Forests, inland freshwater systems of streams and rivers, and coastal and marine systems, contribute directly and indirectly to their well-being through the provision of food and other products and by creating a healthy, harmonious and aesthetically enjoyable environment.

A wide range of ecological services are provided by the country's forests which:

- regulate water regimes by intercepting rainfall and controlling its flow through the hydrological system;
- maintain soil quality while providing organic materials through leaf and branch fall;

1 Institute of Marine Affairs, *State of the Marine Environment Report—Trinidad and Tobago* (2016).

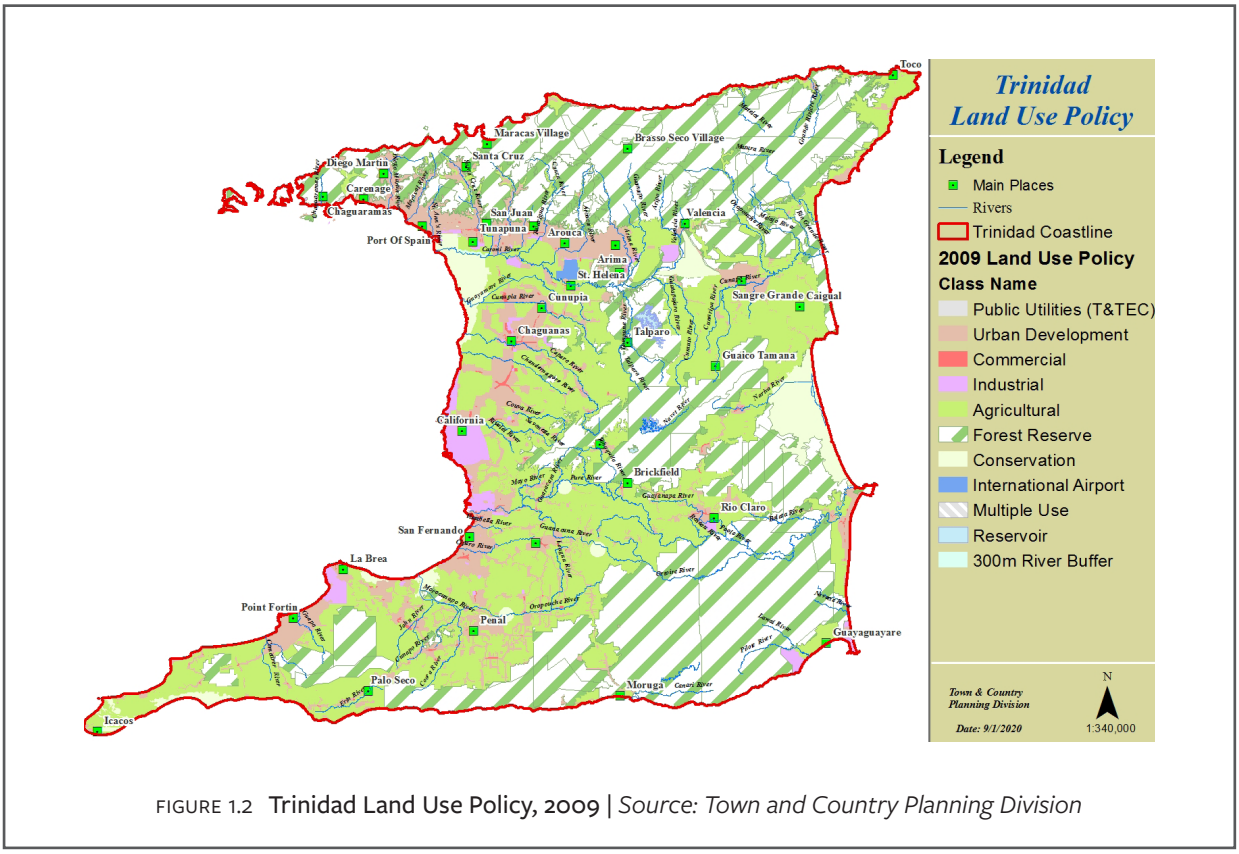


FIGURE 1.2 Trinidad Land Use Policy, 2009 | *Source: Town and Country Planning Division*

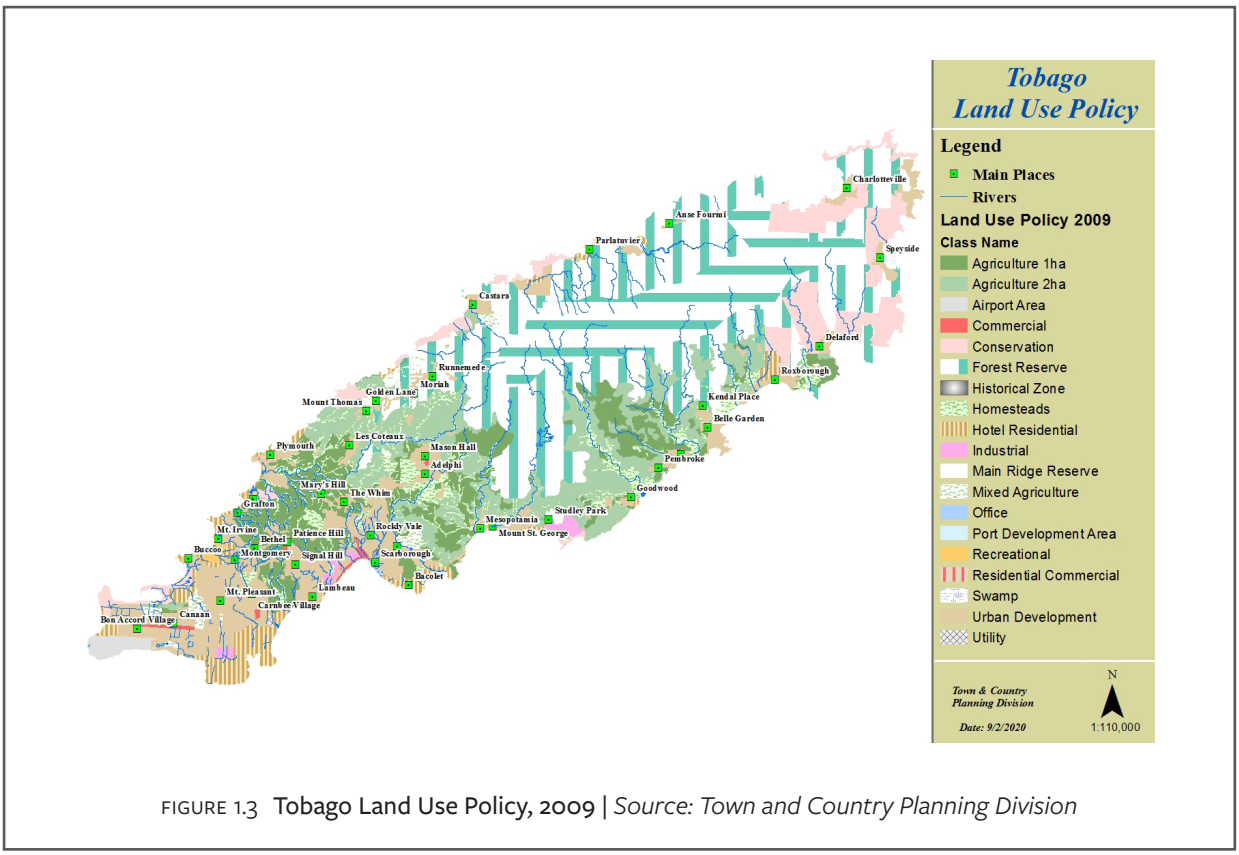


FIGURE 1.3 Tobago Land Use Policy, 2009 | *Source: Town and Country Planning Division*

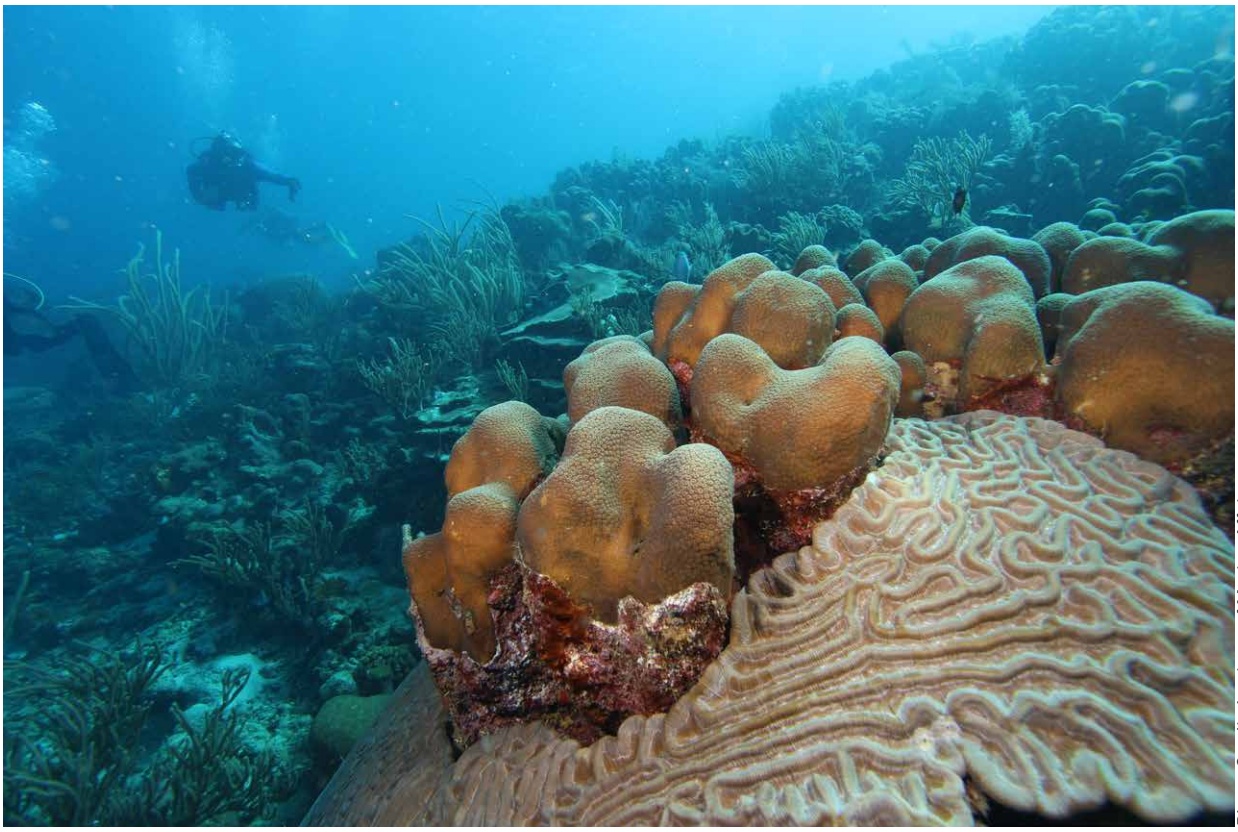


Photo Credit: Institute of Marine Affairs

▲ Speyside coral reefs, Tobago, 2015

- limit erosion and protect soil from the direct impact of rainfall;
- modulate climate; and
- serve as key components of biodiversity, both in themselves and as a habitat for other species.

The estimated monetary value (2010) of a number of ecosystem services at the scale of a square hectare of forest per year in Trinidad and Tobago is provided in **TABLE 1.1**.[2]

In Trinidad, 60–80 percent of the surface water comes from the forests of the Northern Range and is used for human consumption and economic activities, particularly in the food, beverage and tobacco industries.

In the country's jurisdictional space which covers surface area, archipelagic waters, territorial sea and exclusive economic zone, the sea is 15 times greater than the land surface area.[3] This area not only accommodates Trinidad's valuable oil and gas sector, which is the largest contributor to GDP, but also includes ecosystems which support other main contributors to GDP such as the commercial fishing industry and the tourism industry of Tobago, in particular. These

TABLE 1.1 Estimated Value of Ecosystem Services (ES) from Forests in Trinidad, 2010 | *Source: Environmental Management Authority, 2012* ▼

Ecosystem Service	ES value (USD per hectare per year)
Climate regulation	1,088
Erosion control	346
Flood Prevention	5
Water Purification	359
Sustainable timber	397
Total	2,195

2 Environmental Management Authority, *2012 Annual Report* (2012).

3 Institute of Marine Affairs, *State of the Marine Environment Report—Trinidad and Tobago* (2016).

Photo Credit: Tobago House of Assembly

▲ Buccoo Reef is the largest coral reef in Tobago, 2015

▼ Fishing Vessels anchored in the Mudflats of the Brickfield Fishing Facility, 2018

Photo Credit: Lorraine Barrow, Institute of Marine Affairs

ecosystems also provide indirect services such as shoreline protection, sediment control and water purification.

Mangroves in Trinidad are adversely impacted by human activities since most are located in the western part of the island where more than 70 percent of the population lives. Similarly, the largest mangrove areas in Tobago are in the southwest which is also the most populated and developed part of the island.[4]

The projections indicate that these important ecosystems will be adversely impacted by climate change. Loss and damage of the mangroves will decrease their effectiveness in shoreline protection while negatively impacting the quality of the marine water.

Coral reefs are an important breeding ground and habitat for a wide variety of commercially exploited seafood species. They provide subsistence and commercial fishing resources and are especially important for lobster and a number of other species. However, coral cover around Tobago has been declining since 1985[5] as a result of unregulated coastal development, polluted run-off and changing watershed and land use.[6] Climate change is also contributing to the loss of hard corals, particularly due to bleaching events.[7] Hard corals in Buccoo, Culloden and Speyside were severely bleached in 1998, 2005 and 2010.

Marine fisheries are an important socio-economic activity for many coastal communities, both as a source of income and for subsistence. In 2006, annual direct estimates were reported to be between 640,000–912,000 USD per year (4.1–5.8 million TTD), based on revenue earned from the sale and processing of harvested fish resources.[8] In addition, annual indirect economic benefits from the repair of equipment associated with fishing activities such as nets, fish pots and boats were estimated at between 118,000 and 235,000 USD (between 755,200 and 1.5 million TTD). Given the challenges of data collection in Tobago the actual income is believed to be even higher.[9] Recreational fishery also exists but little is known about this activity due to the dearth of data.[10]

1.2 Climate Profile

Trinidad and Tobago's climate is largely influenced by its island characteristics, proximity to the equator, prevailing northeast trade winds, the surrounding ocean and the mountain chains that modify the weather systems as they traverse the country. All of these factors contribute to a mixture of tropical climate types with two distinct climatic seasons referred to as the dry and wet seasons. Localised differences in these seasons across the two islands are primarily due to land-size, orography, elevation and orientation.

The country's two distinct climatic seasons can be characterised as follows[11]:

- *Dry season*, with characteristics of a *Tropical Maritime* climate, occurs from January to May and is cooler with warm days and cool nights with mostly localised rainfall of relatively low amounts in the form of showers which are influenced by the islands' proximity to the sea and daytime convection.
- *Wet season*, with characteristics of a *Modified Moist Equatorial* climate, occurs from June to December and is warmer with more hot, humid days and nights, relatively low wind speeds and increased rainfall, which often causes flooding. Rainfall during this period is highly variable in space and time and is characterised by a bimodal pattern due to equatorial and tropical weather systems such as the Intertropical

4 Institute of Marine Affairs, *State of the Marine Environment Report—Trinidad and Tobago* (2016).
5 Ibid.
6 Ibid.
7 Ibid.
8 World Resources Institute, *Coastal Capital: Economic Valuation of Coral Reefs in Tobago and St. Lucia* (2008). www.wri.org/publication/coastal-capital-economic-valuation-coral-reefs-tobago-and-st-lucia.
9 Ibid.
10 Institute of Marine Affairs, *State of the Marine Environment Report—Trinidad and Tobago* (2016).
11 Trinidad and Tobago Meteorological Service. www.metoffice.gov.tt.

Convergence Zone (ITCZ), tropical waves and tropical cyclones among others. Subsumed within the wet season is the North Atlantic Hurricane season, during which the country is occasionally threatened or impacted by tropical cyclones.

Trinidad and Tobago's climate has a high variability from one year to the next. Both seasons are also variable and prone to extremes of droughts, dry spells, hot days, hot spells, bushfires, intense rainfall and floods. These extremes can significantly impact communities, infrastructure, the economy and the natural environment. This annual and seasonal climate variability is influenced by changes in large-scale atmospheric circulations such as the El Niño–Southern Oscillation (ENSO), the Atlantic Intertropical Convergence Zone, the Madden Julian Oscillation, the North Atlantic Oscillation (NAO), and the North Atlantic High Pressure System, among others, which can lead to extreme weather and climate events.

Temperature Distribution

Across both islands, temperatures are generally constant with relatively small annual and seasonal variations. Trinidad and Tobago has an average temperature of about 27.4 °C, with an average maximum temperature of 31.7 °C and an average minimum temperature of 22.5 °C. On average, the month of September is the warmest month of the year with an average maximum temperature of 32.6 °C, followed by April with an average of 32.5 °C. The heat season, March to October, during which maximum temperatures often exceed 33 °C, has great influence on the country's cooling needs, which impact energy use. For example, Piarco, where the country's reference climate station is located, experiences on average annually 547 cooling degree-days (when daily mean temperature is greater than 26° C).[12]

Trinidad and Tobago's climate is experiencing ongoing and consistent warming trends, as shown in **FIGURE 1.4**. The average annual temperature has warmed by about 2.1 °C over the period 1946 to 2019, at a rate of 0.28 °C per decade. This is approximately two and a half times the global average. The year 2019 was about 1.1 °C above the long-term 1961–1990 levels and since 1993, annual temperatures have averaged 0.5 °C to 2.1 °C higher than the 1961–1990 average. Slightly stronger trends are observed during the wet season than the dry season. Notably, seven of the last ten years ranked among the twelve warmest years. In Trinidad and Tobago, record warm years have usually corresponded with moderate to strong El Niño events. Consequently, 2010 is the warmest year on record followed by 2016 and 2015, all of which were El Niño years.

The decade of 2010 to 2019 was warmer than any previous decade and has been 1.4 °C warmer than

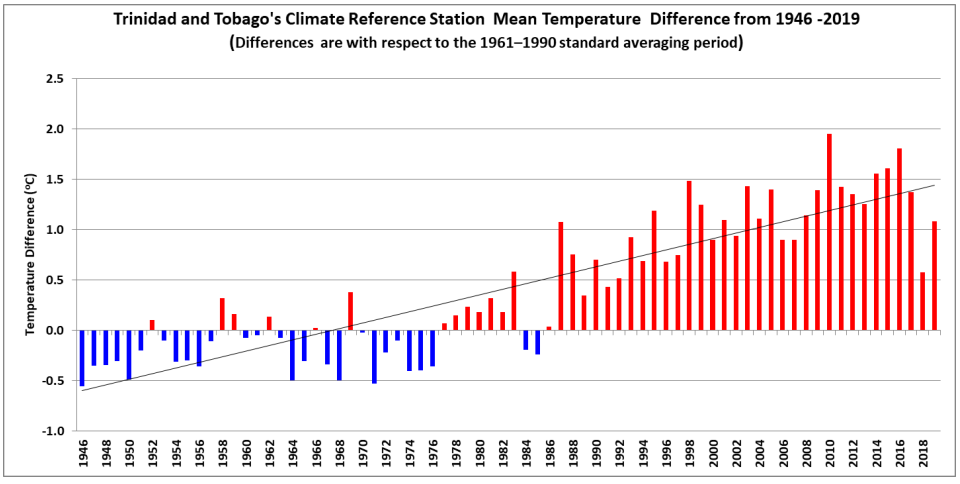


FIGURE 1.4 **Trinidad and Tobago climate reference station surface temperature anomalies, 1946–2019.** Anomalies are with respect to the 1961–1990 standard averaging period | *Source: Trinidad and Tobago Meteorological Service, 2020*

12 Trinidad and Tobago Meteorological Service. www.metoffice.gov.tt.

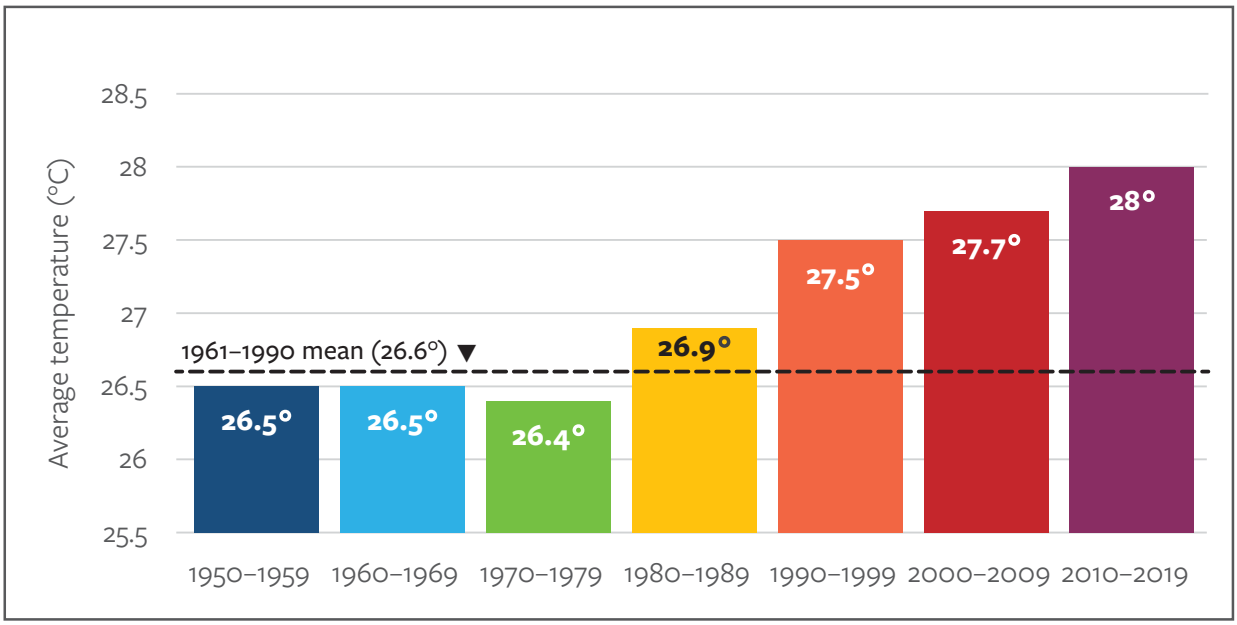


FIGURE 1.5 Decadal Surface Temperature Changes 1950–2019 (70 years)
Data source: Trinidad and Tobago Meteorological Service, 2019

the 1961–1990 average (**FIGURE 1.5**). An increase in very hot days (maximum temperature > 33.9 °C) and warm nights (minimum temperature > 24.9 °C) has also been observed.

Precipitation Distribution

Due to the small variation in temperatures, Trinidad and Tobago's climate is best described by its rainfall pattern. Annual rainfall differs considerably, both spatially and temporally across the two islands. The northeastern and eastern areas are usually the wettest year-round, while the western and southwestern areas are the driest. Some areas in the northeast average as much as 2,000 to 3,000 millimetres (mm) of rainfall a year in contrast to parts of the much drier western region which record as little as 1,300 mm a year (**FIGURE 1.6**). The wet season accounts for 75–80 percent of the annual rainfall. Averaged over the country, the total rainfall in the dry season is 412 mm while the wet season is 1,586 mm, giving an annual total of 1,998 mm.

Due to the high variability, rainfall trends across the country are less obvious and more difficult to assess than temperature trends. However, within recent years Trinidad and Tobago has become drier. Since 1946, total annual rainfall at the country's climate reference station at Piarco has decreased slightly, but the decrease has been more pronounced over the last 38 years from 1982–2019.

The June–July–August (JJA) season is typically the wettest period for the country and produces the highest rainfall maxima in the bimodal rainfall pattern. However, shifts in seasonal rainfall have been observed. Since 1946, JJA rainfall has decreased with JJA of the last decade (2010–2019) experiencing 11 percent less rainfall than that of the JJA for the period

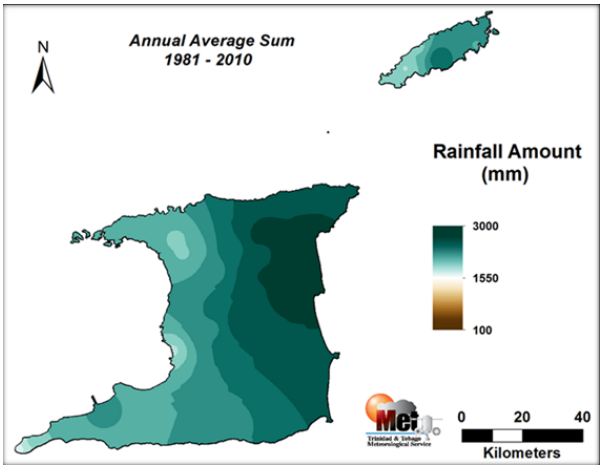


FIGURE 1.6 Trinidad and Tobago's average annual rainfall 30-year climatology (1981–2010) | *Source: Trinidad and Tobago Meteorological Service* ▲

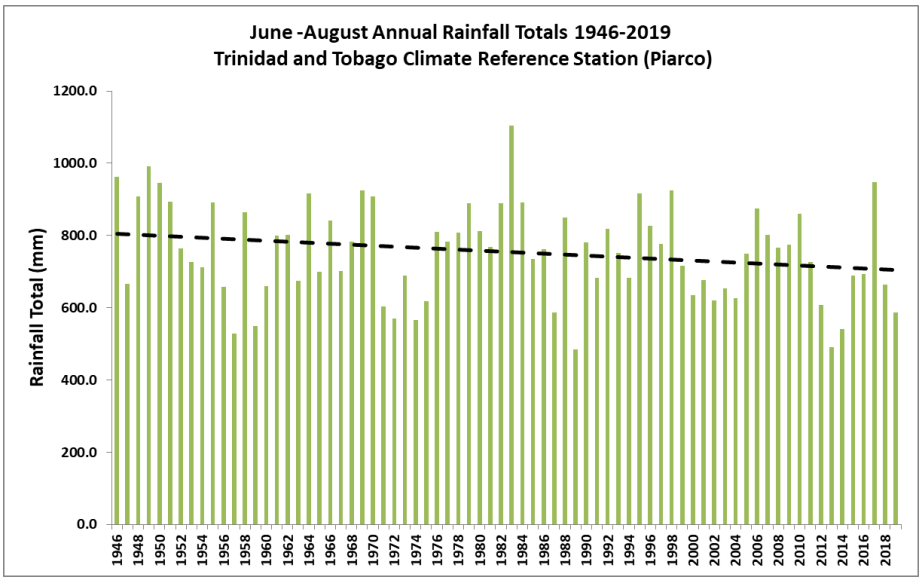


FIGURE 1.7 Seasonal rainfall totals for June to August (JJA), 1946–2019, at Trinidad and Tobago Climate Reference Station (Piarco) | *Source: Trinidad and Tobago Meteorological Service, 2019*

1961–1990 period (**FIGURE 1.7**). This contrasts with the monthly rainfall totals for October at Piarco which have increased since 1946 (**FIGURE 1.8**) and is statistically significant.[13]

Heavy rainfall over a day or less can cause localised flooding and damage to infrastructure, while moderate to heavy multi-day rainfall events can produce widespread flooding over large portions of the country. Observed trends in extreme rainfall have high spatial variability across the country but consistent changes have been found in some of the extreme rainfall indices at the country's climate reference station at Piarco.

The annual 3-day maximum rainfall totals at the climate reference station at Piarco show a significant increasing trend over the period 1960–2018 (**FIGURE 1.9**). Similarly, the figures show that the top one percent of heaviest rainfall events at the station have contributed more rainfall to the annual totals over the same period.

Based on available station data, there appear to be spatially detectable trends in Annual 1-day and Annual 3-day maximum rainfall events across the country for the period 1981–2016 although the direction of the trends is not consistent spatially. Some stations

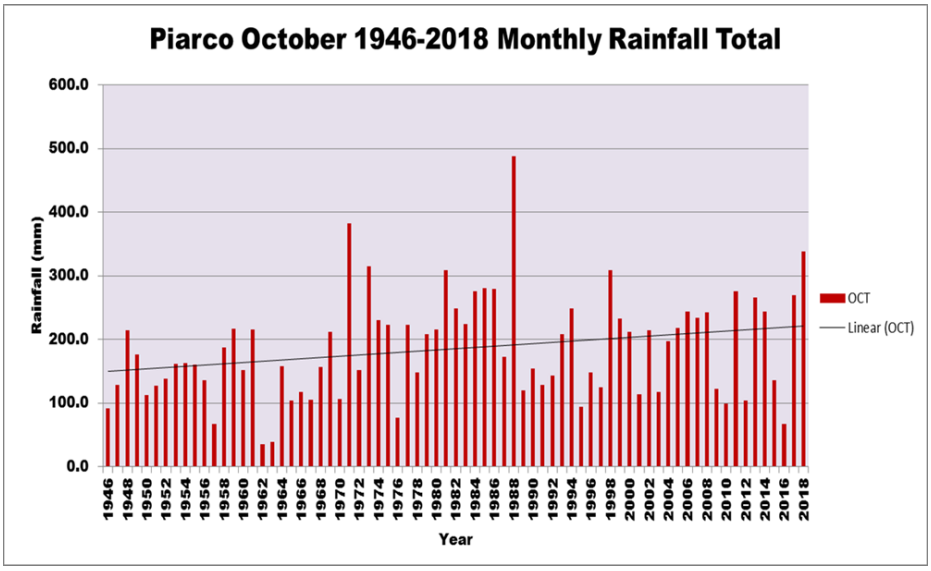


FIGURE 1.8 Monthly rainfall totals for October at Piarco, Trinidad for the period October 1946–2018 | *Source: Trinidad and Tobago Meteorological Service, 2019*

13 Trinidad and Tobago Meteorological Service. www.metoffice.gov.tt.

Photo Credit: Kishan Ramcharan

▲ Blanchisseuse, North Coast Road, Trinidad, 2019

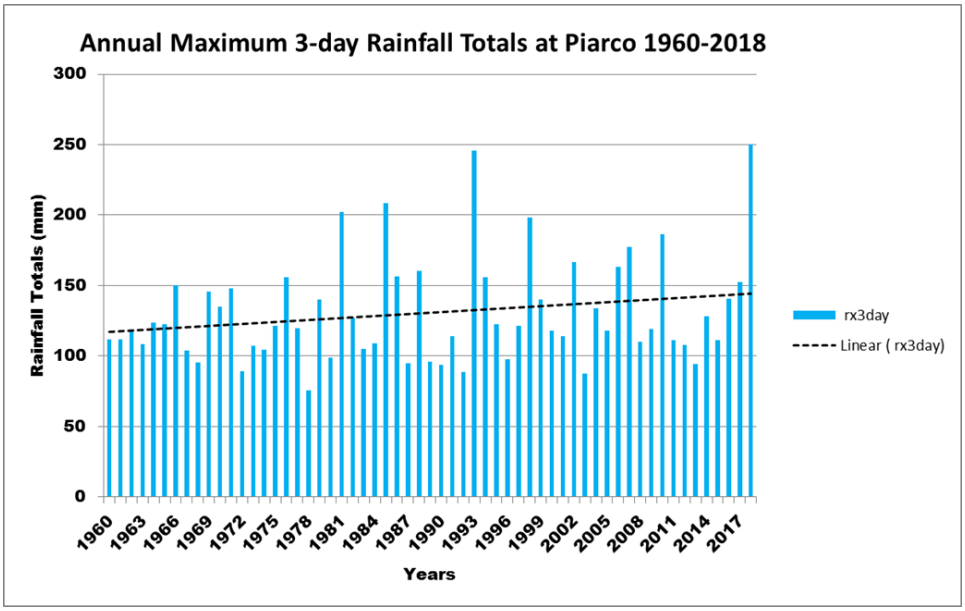


FIGURE 1.9 Annual maximum 3-day rainfall totals at Piarco, Trinidad for the period 1960–2018 | *Source: Trinidad and Tobago Meteorological Service, 2019*

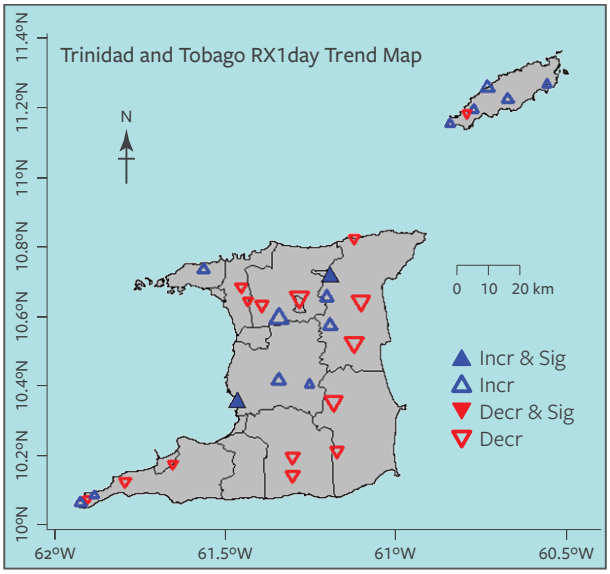


FIGURE 1.10 ▲ **Annual maximum 1-day rainfall totals at Piarco, Trinidad for the period 1960–2018.** Triangles are scaled according to the magnitude of the trend. Solid blue triangles correspond to an increasing trend that is significant at the 5 percent level and unfilled blue triangles correspond to an increasing trend that is not significant. Solid red triangles correspond to a decreasing trend that is significant at the 5 percent level and unfilled red triangles correspond to a decreasing trend that is not significant. *Source: Trinidad and Tobago Meteorological Service*

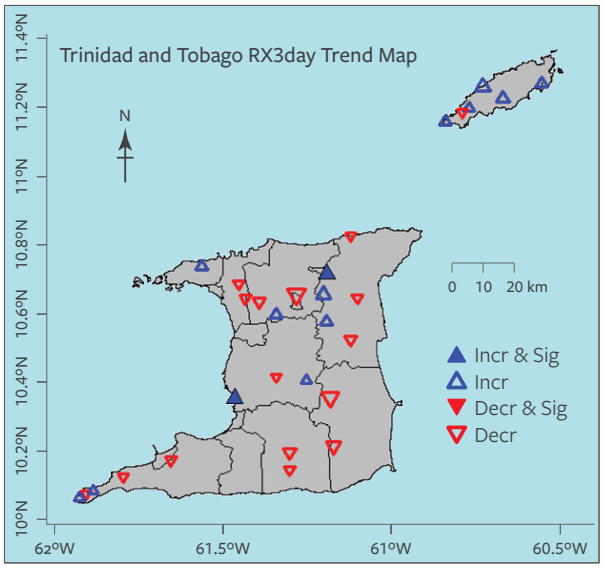


FIGURE 1.11 ▲ **Annual maximum 3-day rainfall totals at Piarco, Trinidad for the period 1960–2018.** Triangles are scaled according to the magnitude of the trend. Solid blue triangles correspond to an increasing trend that is significant at the 5 percent level and unfilled blue triangles correspond to an increasing trend that is not significant. Solid red triangles correspond to a decreasing trend that is significant at the 5 percent level and unfilled red triangles correspond to a decreasing trend that is not significant. *Source: Trinidad and Tobago Meteorological Service*

(about 50 percent) show trends towards higher totals in both indices while other stations show trends towards lower totals. However, the number of stations with significant trends is limited to only two (**FIGURE 1.10** and **FIGURE 1.11**).

1.3 Population Profile

Trinidad and Tobago has an estimated population of 1,363,985[14], which places it at 159 on the world's population ranking. The 2019 population density is 272 people per square kilometre. About 96 percent of the population lives in Trinidad and is concentrated on the western half of the island, while the remaining four percent lives in Tobago, mostly on the southern half of the island. Most of Trinidad's population, 52.4 percent, is urban with an estimated 544,000 persons living in the capital city of Port of Spain and adjacent areas.[15]

Population censuses are conducted in Trinidad and Tobago every 10 years by the Central Statistical Office (CSO). The 2019 Census quantified the estimated population at 1.36 million with a gender breakdown of 50.2 percent (681,946) male and 49.8 percent (677,247) female as shown in **FIGURE 1.12**. The birth rate stood at 11.77 per 1,000 women and the death rate at 8.26 per 1,000 persons. The crude natural growth rate is estimated at 4.09 with a very minimal population change of 0.4 percent.

Population

Over the past decade, there has been an increasing number of immigrants moving to Trinidad and Tobago. **FIGURE 1.13** shows places of settlement by migrants.

According to the Human Development Index (HDI), Trinidad and Tobago's score is 0.799, setting the country in the high human development category with a rank of 63 out of 189 countries. Over the last two

14 Government of the Republic of Trinidad and Tobago, *Review of the Economy 2019* (2019).
15 Trinidad and Tobago's Central Statistical Office. https://cso.gov.tt.

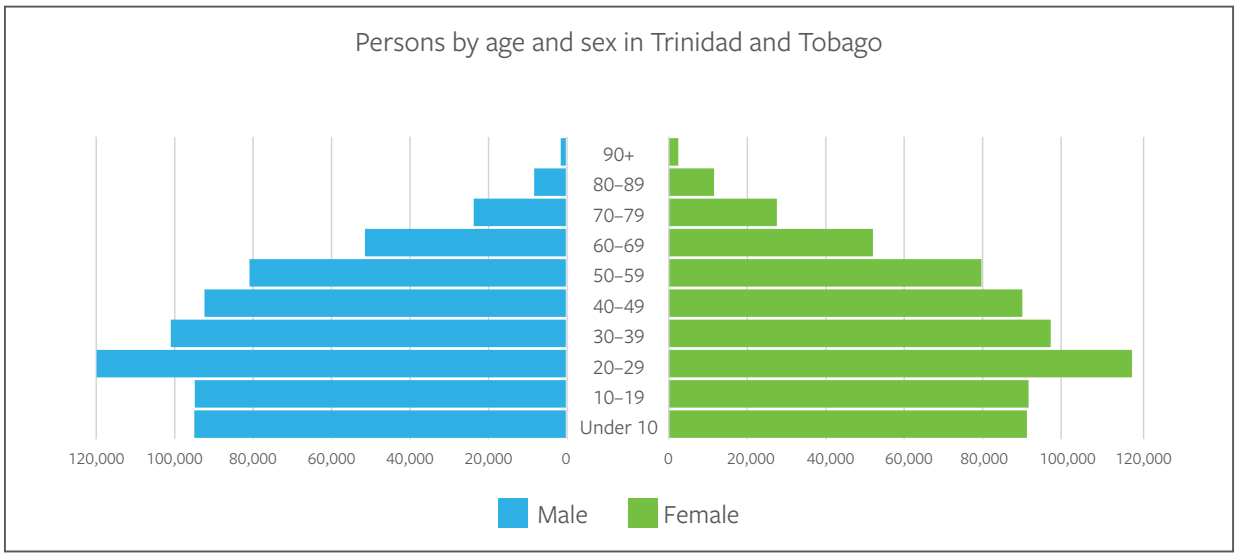


FIGURE 1.12 **Break-down of the male/female population distribution taken from the 2011 Census**
Data source: http://cso.gov.tt/census/2011-census-data/

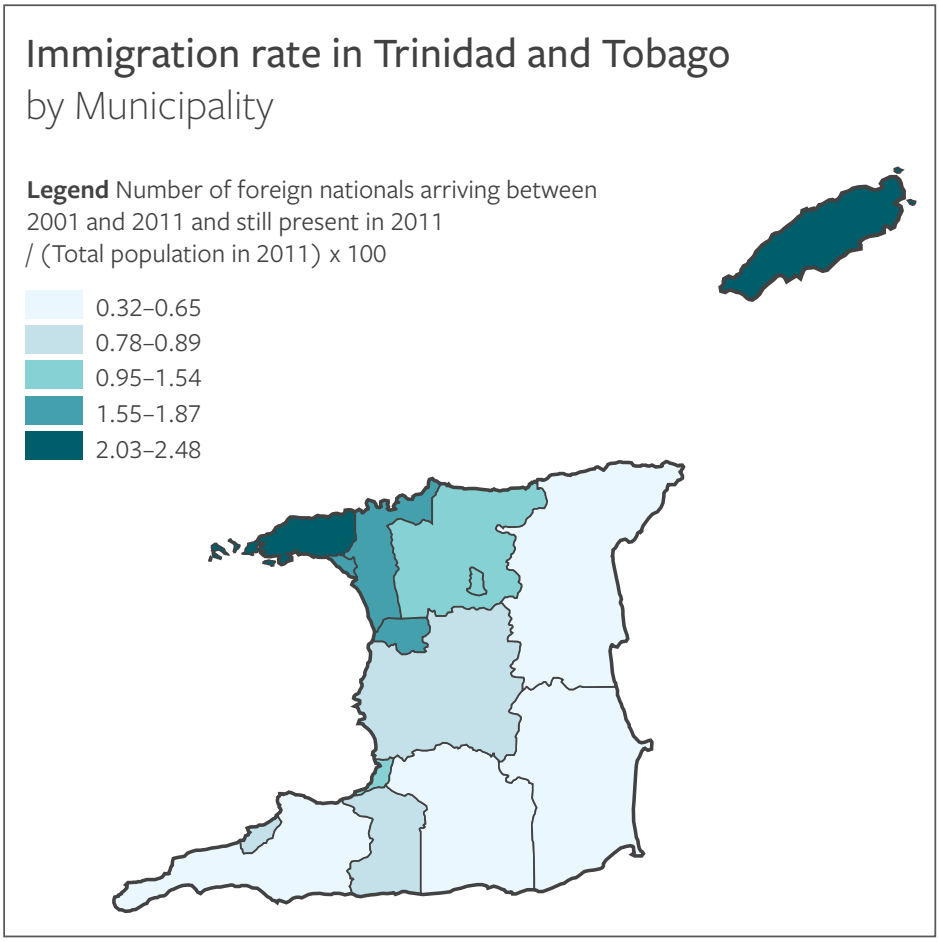


FIGURE 1.13 **Map of Trinidad and Tobago showing migration settlement densities**
Data source: http://cso.gov.tt/census/2011-census-data/

TABLE 1.2 Population, Labour Force and Employment (Mid-year) | *Source: Review of the Economy, 2019*

	2013*	2014*	2015*p	2016*p	2017*p	2018*p	2019*c
Total Population	**1,340,557**	**1,345,343**	**1,349,667**	**1,353,895**	**1,356,633**	**1,359,193**	**1,363,985**
% change	0.4	0.4	0.3	0.3	0.2	0.2	0.4
Total Male	**672,596**	**674,997**	**677,166**	**679,288**	**680,661**	**681,946**	**684,350**
% change	0.4	0.4	0.3	0.3	0.2	0.2	0.4
Total Female	**667,961**	**670,346**	**672,501**	**674,607**	**675,972**	**677,247**	**679,635**
% change	0.4	0.4	0.3	0.3	0.2	0.2	0.4
Dependency Ratio[1] (%)	42	42	42	42	42	42	42
Non Institutional Pop. 15 yrs and over	1,059,600	1,063,400	1,065,100	1,068,500	1,071,300	1,073,300†	-
Labour Force**	650,200	658,600	645,300	638,300	633,900	630,200†	-
Persons Employed	626,300	636,900	623,300	613,100	603,400	606,100†	-
Persons Unemployed	23,900	21,800	22,000	25,300	30,500	24,100†	-
Participation Rate[2] (%)	61.4	61.9	60.6	59.7	59.2	58.7†	-
Unemployment Rate (%)	3.7	3.3	3.4	4	4.8	3.8†	-
Births per 1,000 persons	13.98	13.7	14	12.83	12.82	12.67	11.77
Deaths per 1,000 persons	7.74	7.91	8.58	8.23	8.59	8.58	8.26
Crude Natural Growth Rate per 1000	6.24	5.79	5.42	4.6	4.23	4.09	3.51

Source: Central Statistical Office

1 The dependency ratio is the ratio of dependents (i.e. persons under 15 years of age or 65 years and over) to the total working age population (15 to 64 years).

2 The participation rate is the portion of the non-institutional population, aged 15 years and over, that is part of (participates in) the labour force.

* Figures based on 2011 census.

** Figures based on CSSP estimates.

† For the period January to June 2018.

p Provisional

decades, there has been progress in the country's HDI indicators, with life expectancy at birth currently being 73.4 years; mean years of schooling and expected years of schooling of 11.0 and 13.0 years respectively; and the increment on Gross National Income (GNI) per capita having increased by 183.3 percent to US$28,497.[16]

TABLE 1.2 and **TABLE 1.3** reveal the population, labour force and employment for the period 2013–2019.

1.4 Economic Profile

Due to the COVID-19 pandemic, global growth in 2020 is estimated to have contracted by 3.5 percent, with an expected recovery of 5.5 percent in 2021 with the assumption of vaccine-powered strengthening of economic activity and continued policy support from large economies. Forecasts for growth in Latin America and the Caribbean point to a 4.1 percent recovery in 2021, following the deep contraction of 7.4 percent in 2020.[17]

Economic statistics in Trinidad and Tobago are published by the Central Statistical Office (CSO), complemented by data provided by the Ministry of Finance. The CSO is the official source of national statistics and has continued to revise its methodology for calculating GDP based on the 2012 constant prices model. The adjustments are shown in **TABLE 1.4**, provided by the CSO.

16 United Nations Development Programme, *Human Development Report 2019, Inequalities in Human Development in the 21st Century, Trinidad and Tobago* (2019).

17 International Monetary Fund, *World Economic Outlook Update, January 2021* (2021).

TABLE 1.3 Mid-year Estimates of Population by Age | *Source: Review of the Economy, 2019*

	2012[p]	2013[p]	2014[p]	2015[p]	2016[p]	2017[p]	2018[p]	2019[p]
Total Population[1]	1,335,194	1,340,557	1,345,343	1,349,667	1,353,895	1,356,633	1,359,193	1,363,985
Non-Institutional Population[2]								
All Ages								
Under 15	274,892	275,996	276,982	277,872	278,742	279,306	279,833	280,820
15–19	98,911	99,308	99,662	99,983	100,296	100,499	100,688	101,043
20–24	114,857	115,319	115,730	116,102	116,466	116,701	116,922	117,334
25–29	124,185	124,684	125,129	125,531	125,925	126,179	126,417	126,863
30–34	106,150	106,577	106,957	107,301	107,637	107,855	108,058	108,439
35–39	93,039	93,413	93,746	94,047	94,342	94,533	94,711	95,045
40–44	86,629	86,976	87,287	87,568	87,842	88,020	88,186	88,497
45–49	96,633	97,021	97,368	97,681	97,987	98,185	98,370	98,717
50–54	87,655	88,007	88,321	88,605	88,883	89,062	89,231	89,545
55–59	73,611	73,906	74,170	74,408	74,642	74,793	74,934	75,198
60–64	58,964	59,201	59,412	59,603	59,790	59,911	60,024	60,235
65 and over	119,668	120,149	120,578	120,965	121,344	121,590	121,819	122,248

Source: Central Statistical Office. Figures for 2012–2019 are based on 2011 census. p = provisional.
1 Refers to all persons whose usual residence is Trinidad and Tobago, inclusive of: Household or Non-institutionalised population usually resident in the country and who were present on Census Night; Household or Non-institutionalised population usually resident in the country who were abroad for less than 6 months on Census Night; Population in institutions and Workers camps, Street Dwellers; and Trinidad and Tobago students studying abroad.
2 Comprises households found in private dwellings.

The economy of the country is based mainly on its industrial activities. The oil and gas sector account for the largest portion of GDP, contributing about 40 percent of GDP. Trinidad and Tobago is the most industrialised economy in the English-speaking Caribbean and ranks among the highest GDP per capita in Latin America and the Caribbean with a GDP of approximately 23.25 billion USD and a per capita GDP of 17,012.6 USD in 2019.[18]

TABLE 1.4 Revision of GDP by the Central Statistical Office (CSO) | *Source: Review of the Economy, 2019, p. 33*

	2013	2014	2015	2016	2017	2018
Original GDP, Current Prices (TT$ Mn)	174,660.6	176,109.0	160,210.0	145,026.7	150,847.0	158,504.5
Revised GDP, Current Prices (TT$ Mn)	175,679.9	176,992.7	159,836.1	148,617.2	152,368.1	161,200.2
Original GDP Growth Rate (%)	5.4	0.8	–9.0	–9.5	4.0	5.1
Revised GDP Growth Rate (%)	6.1	0.7	–9.7	–7	2.5	5.8
Original GDP, Constant Prices (TT$ Mn)	169,010.2	167,371.3	170,347.0	159,258.7	156,301.6	159,223.6
Revised GDP, Constant Prices (TT$ Mn)	169,339.6	167,794.3	170,853.5	160,095.8	156,394.2	156,010.7
Original GDP Growth Rate (%)	2.0	–1.0	1.8	–6.5	–1.9	1.9
Revised GDP Growth Rate (%)	2.2	–0.9	1.8	–6.3	–2.3	–0.2

18 Data sourced from the Central Statistical Office and converted to USD by the Central Bank of Trinidad and Tobago.

TABLE 1.5 **Imports and exports in TTD for period 2011–2020** | *Source: Ministry of Trade and Industry and Central Statistical Office* ▼

Year	Imports (TTD)	Exports (TTD)
2011	60,723,317,991	95,633,877,722
2012	74,563,286,350	82,711,135,376
2013	81,021,477,713	120,226,778,093
2014	72,024,591,281	93,057,839,644
2015	58,883,269,421	68,542,183,455
2016	53,697,650,711	50,906,732,120
2017	46,776,390,065	59,256,064,408
2018	52,203,238,048	71,297,242,705
2019 (provisional)	42,730,974,360	48,575,730,272
2020 (Jan–Nov)	32,835,798,543	37,168,226,793

Other contributors to the country's economy include the food and beverage industry, manufacturing, cement production and downstream energy industries such as Liquefied Natural Gas (LNG), ammonia, methanol and steel. Although accounting for a small portion of the economy, agriculture also has a place.

Imports and exports also reflect the changes to the economy as seen in **TABLE 1.5,** which shows the total imports and exports for the period 2011–2020. The figures for 2020 cover the 11-month period from January–November.

Gross Domestic Product[19]

In 2020, nominal GDP is forecasted to fall to 147,757.2 million TTD, down from 2019's nominal GDP at Purchaser Prices of 156,756.0 million TTD. Having commenced the production of quarterly GDP in 2019, the CSO reported that real GDP during the first half of 2020 contracted by 5.9 percent. Real GDP in the first quarter of 2020 declined by 1.9 percent. However, as more restrictive measures were put in place to minimise the spread of coronavirus at the end of March 2020, real economic activity fell by 10.0 percent in the second quarter of the year. Over the first three quarters of 2020, labour productivity across all industries registered a (year-on-year) increase of 3.9 percent. Meanwhile, latest available data point to an increase in the unemployment rate to 4.2 percent during the first half of 2019, up from the country's 2018 average unemployment rate of 3.9 percent.

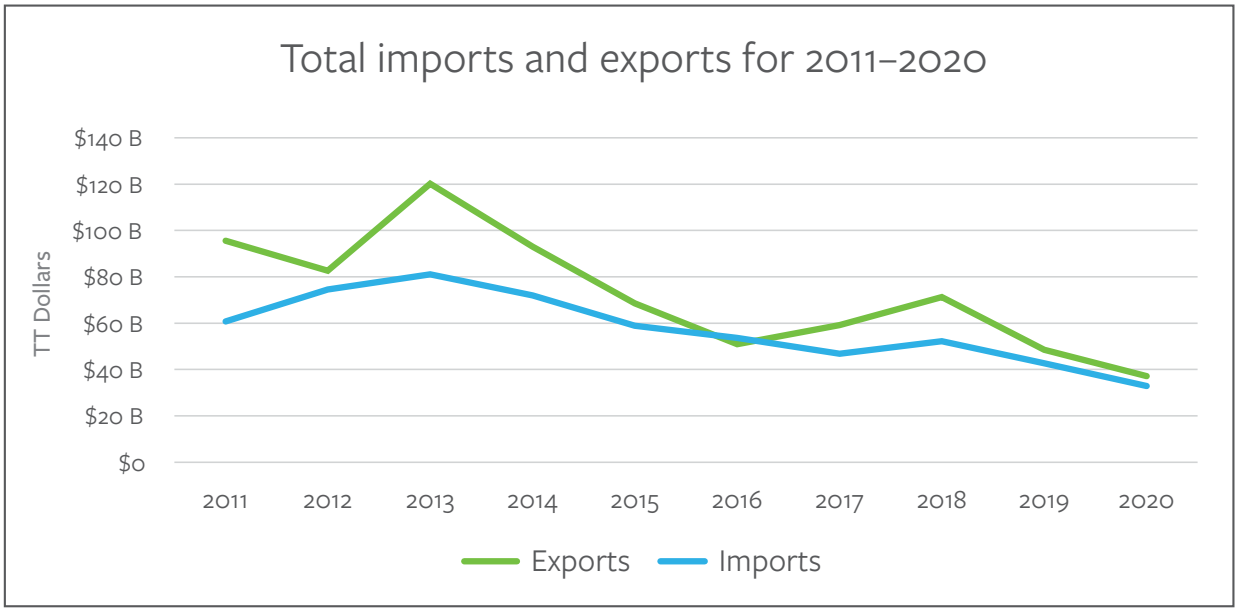


FIGURE 1.14 **Total imports and exports for 2011–2020** | *Data source: Central Statistical Office*

19 Excerpts from Government of the Republic Trinidad and Tobago, *Review of the Economy 2020* (2020).

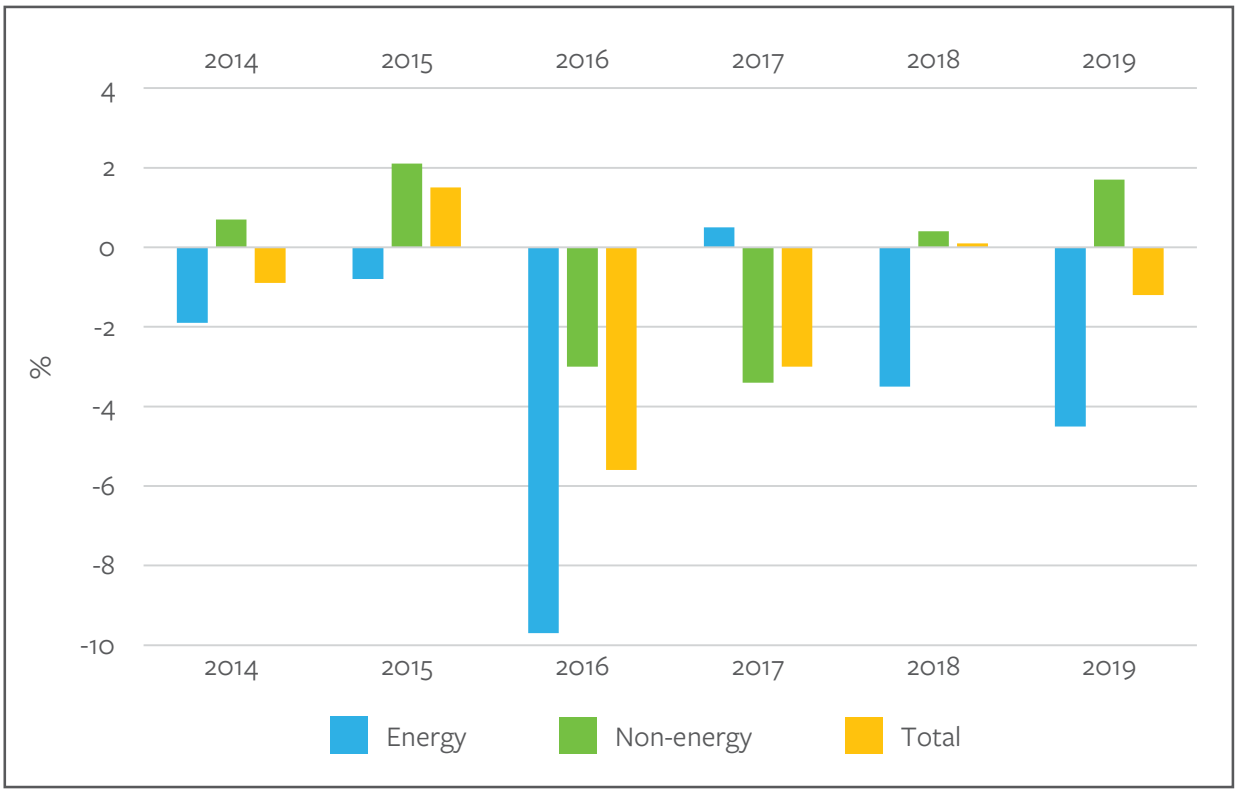


FIGURE 1.15 **Real GDP growth rates for the period 2014–2019** | *Data source: Central Statistical Office*

In 2020, like most other countries, the COVID-19 pandemic resulted in Trinidad and Tobago's economy being deeply impacted by the sharp decrease in major energy commodity prices and the precipitous fall in global demand, which significantly reduced export opportunities for manufactured goods and energy products. Moreover, tourism was gravely impacted as Trinidad and Tobago closed its borders.

Notwithstanding the effects of the pandemic, Manufacturing and Mining and Quarrying had the greatest impact on the out-turn for real GDP during the first two quarters of calendar 2020. The Manufacturing sector contracted by 1.5 percent and 5.8 percent in the first and second quarters of 2020, respectively. Mining and Quarrying contracted by 5.1 percent in the first quarter of 2020, followed by a deeper contraction of 8.9 percent in the second quarter. The sector's performance was mainly driven by overall decreases in real economic output in the following sub-industries during the first half of the year: Crude Oil Exploration and Extraction; Condensate Extraction; Natural Gas Exploration and Extraction; and Petroleum Support Services.

Also contributing to the negative economic performance over the January to June 2020 period was a 2.6 percent fall in real output in Trade and Repairs in the first quarter, which further deteriorated by 23.7 percent in the following quarter.

The closure of international borders, including the borders of Trinidad and Tobago in the first quarter of 2020, coupled with restrictions to inter- and intra-island travel, devastated the domestic tourism sector. The Transport and Storage sector recorded a 6.6 percent fall in real economic activity in the first quarter and contracted by 35.9 percent in the second quarter—the single largest contraction of any such sector for the year. Similarly, Accommodation and Food Services contracted by 4.2 percent over the first quarter and by a further 20.3 percent over the second quarter. This reflected a reduction in restaurant and accommodation services due to the restrictions placed on the opening and operations of restaurants, hotels and guest houses during the period.

Real output in Electricity and Gas also fell by 2.9 percent and 9.8 percent in the first and second

TABLE 1.6 Selected macro-economic indicators, Trinidad and Tobago 2011–2020
Extracted from Economic Bulletin March 2016 Volume XVIII Vol. 1, Central Bank of Trinidad and Tobago and Economic Bulletin January 2021 Volume XXIII Vol. 1, Central Bank of Trinidad and Tobago

Indicator	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020[p]
Real GDP Growth (%)	–0.3	1.3	2.2	–0.9	1.5	–5.6	–3	0.1	–1.2	n.a.
Energy Sector	–3.9	–2.8	1.6	–1.9	–0.8	–9.7	0.5	–3.5	-4.5	n.a.
Non-energy sector	3.2	2.3	3.1	0.7	2.1	–3	–3.4	0.4	1.7	n.a.
Inflation (%, end of period)	5.3	7.2	5.6	8.5	1.5	3.1	1.3	1.1	0.4	0.8
Unemployment (% of labour force)	4.9	5	3.7	3.3	3.4	4	4.8	3.9	4.2[1]	n.a.
Central government fiscal balance (% GDP)	–0.7	–1.3	–2.9	–2.5	–1.7	–5.3	–9	–3.6	–2.6[r]	–11.2[re]
External current account balance (% GDP)	7	14.9	20.3	15	8.2	–3.5	6.3	6.8	4.6	2.3^
Public sector debt (% GDP)	31.2	39.4	38.2	40.2	47.1	58.3	61.8	60.4	65.5	80.9
Net Official Reserves (US$M) (net of HSF)	9,822.7	9,370.7	10,175.9	11,497.1	9,933.0	9,465.8	8,369.8	7,575.0	6,929.0	6,953.8

1 For the first half of 2019
^ For the period January to September 2020
p Provisional
r Revised
re Revised Estimates
n.a. Not Available

quarters of 2020, respectively. This reflected an overall reduction in the distribution of natural gas during the period due to the temporary cessation of operations at some petrochemical plants as a result of COVID-19 restrictions and the global slump in economic activity.

Construction activity, however, grew by 7.1 percent in the first quarter of 2020, due to major ongoing capital projects. Subsequently, real output in the sector fell by 7.0 percent in the second quarter on account of a temporary halt in construction activity due to the COVID-19 pandemic.

Notwithstanding this, Financial and Insurance Activities grew robustly in the first and second quarters, expanding by 5.1 percent and 6.0 percent, respectively. This was on account of increases in commercial banking activity, primarily in the areas of credit and deposits. Non-Bank Financial Institutions also recorded growth during the first half of the year.

Trade

In recent years, Trinidad and Tobago, along with the rest of the CARICOM Region, has devoted considerable human and financial resources to negotiating trade agreements involving numerous countries and regions. The aim of these has been to remove barriers to trade to allow goods to move more freely among the parties concerned. Currently, Trinidad and Tobago is a party to nine multilateral, regional and bilateral trade agreements.

By and large, efforts to build its trade capacity were facilitated by buoyant revenues received from

TABLE 1.7 List of trade agreements | *Source: Ministry of Trade and Industry*

Name of Trade Agreement	Type/Date signed	Countries involved
CARIBCAN[1]	Bilateral: 28th November 1986	Commonwealth Caribbean and Canada
Agreement Between CARICOM and the Government of the Republic of Venezuela on Trade and Investment	Bilateral: 13th October 1992	CARICOM and Venezuela
Agreement on Trade, Economic and Technical Cooperation between CARICOM and the Government of the Republic of Colombia	Bilateral: July 24, 1994	CARICOM and Colombia
World Trade Organization[2]	Multilateral: 1st January 1995	CARICOM and WTO members
CARICOM–Dominican Republic Free Trade Agreement	Bilateral: 22nd August 1998	Caribbean and USA
United States–Caribbean Basin Trade Partnership Act (CBTPA)	Bilateral: 1st October 2020	Caribbean and USA
Caribbean Basin Economic Recovery Act (CBERA)	January 1984	Caribbean and USA
Trade and Economic Co-operation Agreement between CARICOM and the Government of the Republic of Cuba	Bilateral: 5th July 2000	CARICOM and Cuba
CARICOM–Costa Rica Free Trade Agreement	Bilateral: 9th March 2004	CARICOM and Costa Rica
CARIFORUM–EU Economic Partnership Agreement	Regional: 30th October 2008	CARIFORUM and EU
Partial Scope Trade Agreement between Trinidad and Tobago and Panama	Bilateral: 3rd October 2013	Trinidad and Tobago and Panama

1 Non-reciprocal trading arrangement.
2 On 1 January, 1995 the WTO replaced the General Agreement on Tariffs and Trade (GATT) as the organization overseeing the multilateral trading system. Trinidad and Tobago had been a member of GATT since 23 October 1962

its lucrative energy sector. In 2013/2014, the country's exports of oil, natural gas and petrochemicals contributed 58 percent to government revenue. However, in September 2014, Trinidad and Tobago experienced an exogenous shock to its economy when oil prices fell dramatically. Due to the ongoing volatility of energy prices in the international markets, Mid-Year Revised projections for fiscal 2015 were predicated on an average oil price of 45 USD per barrel of crude compared to the earlier 80 USD per barrel projection in the 2015 budget statement.

Trade Agreements

During Fiscal 2019, Trinidad and Tobago signed on to, and ratified, both new and existing agreements. Some of the key agreements are identified below. This is in keeping with its mandate to pursue an agenda of negotiating new and existing free trade agreements to support development of the country's export-competitive structure.

» CARIFORUM-UK Economic Partnership Agreement: Trinidad and Tobago, as part of the Caribbean Forum of African, Caribbean and Pacific

States (CARIFORUM) negotiated and signed an Economic Partnership Agreement (EPA) with the United Kingdom (UK). The Agreement was signed by His Excellency Orville London, Trinidad and Tobago's High Commissioner to the United Kingdom, on April 1, 2019. The CARIFORUM-UK EPA is a roll-over agreement of the CARIFORUM-European Union (EU) EPA and aims to preserve the Region's preferential trading relationship with the UK in the event of the UK's departure from the European Union.

» **WTO Agreement on Trade Facilitation:** Trinidad and Tobago, through its National Trade Facilitation Committee (NTFC) has been working towards implementing the World Trade Organization (WTO) Agreement on Trade Facilitation (TFA). The benefits of implementing the TFA include greater transparency in import and export procedures and the reduction of bureaucratic processes and procedures at the nation's ports, thereby contributing to greater efficiency and improved export competitiveness.

The national implementation of the TFA is also being pursued under the Inter-American Development Bank-funded programme for Strengthening of the Single Electronic Window for Trade and Business Facilitation under the Ministry of Trade and Industry (MTI). In particular, the following projects assist with meeting Trinidad and Tobago's commitments under the TFA:

- Consultancy for Business Process Re-engineering to assist with achieving common border procedures and uniform documentation requirements
- Development of a trade information portal to assist with meeting transparency obligations
- Implementation of an electronic funds transfer framework
- An integrated risk management for customs control
- Legislation to give effect to the TFA in Trinidad and Tobago

» **TT-Panama Partial Scope Trade Agreement (PSTA):** In Fiscal 2018, the Cabinet approved a five-year National Implementation Plan for the Agreement (October 2018–September 2022) which sets out, among other things, to establish Agreement Coordinators to serve as contact points for communication; set up the Joint Administration Commission to oversee all matters covered by the Agreement; implement tariff reductions; and conduct stakeholder awareness sessions on the opportunities and requirements under the Agreement. In Fiscal 2019, both Trinidad and Tobago and Panama identified their Agreement Coordinators and are working to convene the First Meeting of the Joint Administration Commission under the Agreement.

1.5 Energy

Trinidad and Tobago is highly dependent on its fossil fuels for electricity generation. Its natural gas reserves are estimated at 664 billion cubic metres from which 99 percent of the country's electricity is generated. The industrial sector heavily utilises natural gas as a feedstock and for heat and, in the transportation sector, for fuel as Compressed Natural Gas (CNG) and Liquified Natural Gas (LNG). As a result of the abundance of these resources, there is minimal uptake of renewable energy sources throughout the country.

At present, the Trinidad and Tobago Electricity Commission (T&TEC) remains the sole entity responsible for the transmission, distribution and maintenance of electricity throughout the country which has an electrification rate of 99.8 percent.

T&TEC was vertically integrated until 1994 when its electricity generation assets were divested into Powergen with T&TEC as the majority shareholder. Today, electricity generation is divided among T&TEC and other Independent Power Producers (IPPs) as shown in **TABLE 1.8**. A 33kV cable supplies electricity from Trinidad to Tobago, although Tobago has enough generation capacity to cover its load demand.

T&TEC serves approximately 492,000 customers, broadly divided into residential, commercial and industrial classes. The total customer base has seen consistent growth of approximately 1.5 percent annually for the past three years based on T&TEC's actual

TABLE 1.8 Overview of Power Producers | *Based on information from Trinidad and Tobago Electricity Commission (T&TEC) and validation from Ministry of Public Utilities (MPU)*

Owner	Location	Installed Capacity (MW)
T&TEC	Cove Eco-Industrial and Business Park, Lowlands, Tobago	84
Powergen	Pt. Lisas	824 (862)
	Penal	210 (236)
Trinity Power Ltd.	Pt. Lisas	225
Trinidad Generation Unlimited (TGU)	La Brea	720
TOTAL		**2101 (2137)**

figures.[20] According to *T&TEC's Annual Performance Indicator Report for the Year 2017* as published by the Regulated Industries Commission (RIC), the per capita energy usage (6,516) is consonant with comparable GDP per capita countries and attributable to its high level of industrialisation and very low electricity rates. However, 2018 and 2019 saw consecutive declines in energy consumption. **TABLE 1.9** gives a breakdown of how the energy purchased by T&TEC is utilised.

The industrial sector is responsible for just over 50 percent of the country's electricity consumption, followed by the domestic sector with 31 percent. A further look into the industrial sector reveals that most of the load is utilised by a small number of large industrial entities. Further, the bulk of the industrial load may be carried by a few very large industries. It should be noted that the increase in new electricity customers has not resulted in a commensurate increase in kWh consumption.

Despite an increase of 6,116 new customers in 2019, electricity consumption fell by approximately 400 million kWh. Most of the decline, 89.2 percent, occurred in the residential sector where electricity consumption declined by 357 million kWh despite the fact that the majority of new customers, 5,784, were residential. Following upon the decrease of 211 million kWh in 2018, this decline indicated a downward trend in residential energy consumption. The reduction is attributable to a significant number of residential customers being in receipt of a 25 percent rebate on electricity bills below 300 TTD. Between 2018 and 2019 the number of these customers increased by 2,000. Electricity consumption among commercial and industrial customers also decreased by 30 million kWh due to the closure of Arcelor Mittal's steel plant in Point Lisas. The downward trend in electricity consumption is expected to continue as a result of energy conservation measures coupled with more

TABLE 1.9 Electrical Energy Usage
Based on information from MPU ▼

Energy use	Number of Customers	Approximate % of Load
Residential	433,627	30.9
Commercial	54,349	10.3
Industrial	4028	50.6
Street Lighting, pole use and unmetered	102	1.9
Losses	-	6.3
TOTAL	**492,106**	**100**

20 Trinidad and Tobago Electricity Commission, *Monthly Corporate Performance Report, December 31, 2019* (2019).

Photo Credit: Trinidad and Tobago Electricity Commission (T&TEC)

▲ Implementation of Grid tied Solar installation at T&TEC, Mt Hope, Trinidad. 10 PV panels were installed, 2012

efficient energy practices.[21] **TABLE 1.10** outlines the electrical power sold yearly for the period 2016–2019.

The delaying factor in implementing renewable energy generation, which is central to GHG mitigation, has been the preferential cost of natural gas for electricity production. Trinidad and Tobago's domestic electricity rates, for example, are 5–10 times less than those of other CARICOM countries.[22] However, it is a barrier that can be overcome as the country's depleting natural gas reserves drive the implementation of renewable energy generation. Further, as the price of solar energy levelises with the country's electricity tariffs, renewable-sourced power generation will become much closer to reality.

In 2017 the RIC began consultations for a rate re-evaluation for T&TEC. However, since then, there has been no definitive move to implement actual increases. Historically, the imposition of increases in utility rates is linked with the risk of negative political fall-out for the government overseeing such an increase. However the similarly politicised issue of fuel subsidies in the transportation sector has been gradually reduced and removed. Low electricity rates

TABLE 1.10 Electrical power sold for 2016–2019
Source: Ministry of Public Utilities, 2019 ▼

Year	kWh sold	Year	kWh sold
2016	8,669,111,737	**2018**	8,463,412,741
2017	8,564,536,980	**2019**	8,401,569,265

21 Based on information from T&TEC, with validation from the Ministry of Public Utilities.
22 Regulated Industries Commission, *T&TEC Annual Performance Indicator Report* (2018).

TABLE 1.11 Renewable Energy Past Initiatives in Trinidad and Tobago
Source: Framework for Development of a Renewable Energy Policy for Trinidad and Tobago

Year	Project	Location	Agencies	Comments
1994/1995	Experimental 10kW Wind turbine	Bacolet, Tobago	T&TEC	Revealed some favourable results but project was short-lived.
2004	Demonstration Solar PV	Chickland, Freeport, Cumaca Village, Valencia and Paria, Blanchisseuse	T&TEC	Off-grid PV systems shown to be quite competitive for small loads and performed satisfactorily
2006–2008	Pilot Solar Water Heating Project	10 host-homes at various locations in Trinidad and Tobago	MEEI, BPTT, THA & TDC with the UNDP as Project Manager	Represented the first real attempt to deepen inter-agency cooperation in facilitating a local RE project
Ongoing	Research activity particularly solar & wave	N/A	UWI & UTT	

not only harm the adoption of renewable energy (RE) technologies but also keep the utility in a perpetual state of debt, adversely affecting its operations and inhibiting grid modernisation. Despite this, there has been a general recognition by the Government of the Republic of Trinidad and Tobago (GoRTT) and the utility that RE integration is inevitable. Plans for sizeable pilot RE installations have been developed through the Ministry of Energy and Energy Industries in collaboration with Ministry of Public Utilities and other relevant stakeholders.

Renewable Energy

In its National Development Strategy (2016) the Government committed to the addition of 10 percent of renewable energy to the national power supply by 2021. The creation of an enabling environment to facilitate the inclusion of renewable energy is being developed with the implementation of several projects already underway.

Some of the past achievements as it relates to the renewable energy sector are listed in **TABLE 1.11**.

The Government has instituted several incentive-based initiatives to achieve greater energy efficiency through the use of renewable energy, as summarised in **TABLE 1.12**.

In July 2012, the GoRTT entered into a policy-based loan agreement with the Inter-American Development Bank (IDB) with respect to the development of a Sustainable Energy Framework. The framework consisted of three main components:

1. Preparing the Sustainable Energy Programme by identifying a regulatory framework to promote the use of Renewable Energy (RE), Energy Efficiency (EE) and carbon reduction

TABLE 1.12 Government's Incentives for Renewable Energy | *Source: Ministry of Finance*

Solar	Wind	Energy Efficiency (EE)
25% Tax Credit on Solar Water Heaters (SWH)	0% VAT on Wind Turbines	150% allowance for the design and installation of energy-saving systems by an Energy Service Company (ESCO)
150% Wear & Tear Allowance for SWH: SWH plant, machinery and equipment, and Solar PV Systems	150% Wear & Tear Allowance for Wind Turbines and supporting equipment	ESCO can write off value of assets in two years: a) 75% depreciation on plant, machinery and equipment acquisition b) 25% Wear & Tear Allowance in following year.
Conditional Duty Exemptions for SWH Manufacturers		
0% VAT on SWH & Solar PV Systems		

2. Provision of technical assistance to the GORTT in the area of EE
3. Development of a comprehensive action plan for implementing recommended interventions; exploration of alternatives for renewable energy funding with a special focus on Tobago; and specific studies to point the way forward for future investment in green energy in the country

This activity was completed in 2014 and has guided the direction of future RE and EE studies and programmes.

In May 2013, the then Ministry of Energy and Energy Affairs (MEEA) collaborated with the United States Department of Energy (USDOE) on the establishment of a Regional Renewable Energy Research Center. The major focus was placed on capacity-building, policy, and regulation. A Memorandum of Understanding (MoU) between the MEEA and USDOE to effect this development was signed by the parties. In July 2015, the Caribbean Centre for Renewable Energy and Energy Efficiency was established in Barbados as the implementation hub for sustainable energy activities and projects within the Caribbean region.

It was envisioned that the Centre would work closely with the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) on common sustainable energy issues and solutions for Small Island Development States (SIDS). The Centres are part of a wider Global Network of Regional Sustainable Energy Centres which was created in collaboration with regional organisations and communities. After receiving the required number of ratifications, the legal agreement establishing the CCREEE went into force on May 19, 2018.

The United Nations Environment Programme (UNEP) has collaborated with the Ministry of Energy and Energy Affairs to undertake a Feed-In Tariff (FIT) study and develop a toolkit suited to the needs of Trinidad and Tobago. This toolkit is comprised of policy design options, a law drafters' guide, and recommendations on the financing of FITs and capacity-building. The initiative aims at building domestic capacity and providing technical assistance to the Ministry in developing a nationally appropriate FIT framework (policy and regulatory), as part of the national priorities on renewable energy. A Feed-In Tariff Policy is currently being developed through an Inter-Agency Committee.

In 2017, the Ministry of Energy and Energy Industries also received technical support from the European Union via its Technical Assistance Facility for the Sustainable Energy for All Initiative. A sustainable Roadmap and Implementation Plan 2021/2030 was prepared for Trinidad and Tobago.

Finally, in March 2018 the GoRTT sought to find companies willing to invest in Renewable Energy by placing a call for expressions of interests for both utility-scale renewable energy projects greater than 3 MW and Waste-to-Energy Projects. A request for proposals for a utility-scale project on a build, own, operate basis was issued in 2019. Proposals were received and evaluated by an Inter-Agency Committee. In 2020 the GoRTT announced that Lightsource BP and Shell had emerged as the successful bidder to build, own and operate solar plants to add 112.5 MW to the electricity grid. Negotiations are underway to finalise the project agreements before the start of construction. Further, an indicative target of 30% RE by 2030 was announced in the *Public Sector Investment Programme 2021* document (Ministry of Planning and Development [MPD], 2020b). The GoRTT is also pursuing the installation of Electric Vehicle (EV) Solar Chargers at the Queen's Park Savannah (QPS) which are part of a larger project which includes the construction of a Carport with Solar PV at the Grand Stand of the QPS.

1.6 Transportation

Transportation in Trinidad and Tobago is organised into three categories—Sea, Land and Air.

Sea

Transportation via sea occurs through many ports across the islands of Trinidad and Tobago. The 'Sea Bridge' is the sea-based route between them for domestic, commercial and industrial supplies and services. This service is provided by four main vessels:

1. T&T Spirit, commissioned in 2007, accommodates 865 persons and 180 vehicles.
2. MV Cabo Star, acquired in 2017, serves as the main cargo and vehicle transport for domestic and commercial use and accommodates 130 persons and 300 vehicles.
3. MV Galleons Passage, commissioned in 2018, accommodates 400 persons and 60 cars.
4. The APT James, commissioned in January 2021, accommodates 926 passengers and 250 vehicles.

The sea bridge operates daily with some restrictions on cargo transport between the Port of Port of Spain in Trinidad and the Port of Scarborough in Tobago.

The port at Port of Spain is the country's largest port installation, serving the needs of passengers between the islands and domestic and international cargo transportation. Two passenger ferries operate daily from Port of Spain to Scarborough under the aegis of the Trinidad and Tobago Ferry Service. Additionally, a Water Taxi Service operates between Trinidad's two main cities of San Fernando and Port of Spain. The Port of Scarborough in Tobago serves as a terminal for cruise ships which are important for the island's tourism economy.

The country also has other important ports for oil transportation, such as the ports at Brighton, Chaguaramas, Pointe-a-Pierre and Point Fortin. The Port of Brighton is important for oil and asphalt loading. There are also oil terminals at Chaguaramas, Pointe-a-Pierre and Point Fortin. Port of Point Lisas is a deepwater port that principally accommodates the energy-based industries at the Point Lisas Industrial Estate. Port Point Lisas opens to the Gulf of Paria along the western coast of Central Trinidad, 32 km south of Port of Spain and 20 km east of Venezuela. It is referred to as the "Gateways to the Americas", catering for containerised cargo from around the world. It has six berths and its services include import/export of containers; breakbulk cargo; transshipment; and provision of stevedoring services. This port also handles large volumes of steel and project cargo, mainly for new plants on the adjacent estate, making it one of the top breakbulk ports in the Caribbean.[23]

The main public entity in charge of sea transport is the Maritime Services Division of the Ministry of Works and Transport. Its objectives are to ensure the safety and security of Trinidad and Tobago's ships worldwide and shipping in Trinidad and Tobago waters; to ensure the control and prevention of vessel source pollution in Trinidad and Tobago waters; and to facilitate the growth of the national maritime sector through the necessary regulatory, advisory, administrative and developmental frameworks.

Land

In general, the country's public road transport system is based on subsidy policies which fall short of the population's demand. Consequently, the road transport sector consists mainly of private vehicles with a car to people ratio of almost 1:1. Among the demand push factors responsible for the high volume of vehicles were the decommissioning of the rail system during the mid-1960s followed by the national windfall from high oil prices consequent to the oil embargo initiated by the Organization of Petroleum Exporting Countries (OPEC) in 1974.

To address the traffic congestion caused by the number of vehicles on the nation's highways the National Renewable Energy Committee has recommended the introduction of a more comprehensive and reliable mass transit system inclusive of a rapid rail network whose many benefits would include the reduction of GHG emissions.[24]

The increase in the demand for other communication routes has led to intensive development of a highway network that connects east and west as well as north and south communities in both islands. However, traffic congestion has become a persistent feature of the transportation system because the volume of vehicles outstrips road capacity. Other

23 Point Lisas Industrial Port Development Corporation, *PLIPDECO Annual Report 2012* (2012).
24 Ministry of Energy and Energy Affairs, *Downstream Gas Industry Annual Report 2012* (2012).

Photo Credit: Wilfred Watson, Courtesy of the Public Transport Service Corporation (PTSC)

▲ PTSC Bus at Stollmeyer's Castle, 2012

impediments are the poor state of secondary roads, low connectivity and access management.

The Highways Division of the Ministry of Works and Transport (MOWT) is responsible for major roads and highways. It provides physical infrastructure necessary for the safe and efficient movement of people, goods and services on land. The Division undertakes the planning, design, construction, preservation, maintenance and repairs of national bridges and road network, and is responsible for 2,156 kilometres of the 9,592 kilometres or 21 percent of roads throughout Trinidad. It also has responsibility for 1,200 bridges and 2,500 culverts in the road network under its purview.

Air

Trinidad and Tobago has two airports. The main airport is the Piarco International Airport which is located at Piarco in Trinidad, approximately 26 km

from the capital of Port of Spain. A secondary airport, the A.N.R. Robinson International Airport, is located at Crown Point in Tobago. The national airline is state-owned Caribbean Airlines Limited which replaced British West Indian Airways in 2007. Caribbean Airlines operates domestic, regional and international flights.

Public Transport Service Corporation (PTSC)

The PTSC is a Statutory Corporation charged with the responsibility of operating omnibus services throughout Trinidad and Tobago. In October 2010, the PTSC's operational core fleet consisted of 336 buses of 21 different bus types from 10 different manufacturers.

The Corporation has an unpublished schedule which requires 255 buses operating on 107 routes throughout Trinidad and Tobago. However, on a typical day, approximately 185 buses are available for service. This represents a demand shortfall of about 30 percent with resulting delays and long waiting times for peak period passengers. Moreover, the schedule assumes that on any given day 25 percent of the operational fleet will not be available for scheduled services. PTSC estimates its daily ridership at 75,000 passengers utilising 1,143 round trips per day.[25]

Additionally, the PTSC, acting on behalf of the Ministry of Education, contracts 363 maxi-taxis which provide charter services to students attending schools in rural areas. Some 32,000 students utilise this service per day.

The Corporation's fare box and ancillary income amount to 40 percent of its annual operating income of 238.7 million TTD (2009) with the remaining 60 percent coming from government loans of 140.8 million TTD. This yields an average subsidy per passenger of 5.00 TTD.[26]

Facilities for operators and patrons of taxis and maxi-taxis are usually non-existent since on-street stands offer no amenities. Thus, there is always competition, and sometimes conflict, for the limited road space between moving vehicles, pedestrians, and parked transit vehicles.

Shelter and basic toilet facilities are offered only at the City Gate public transport hub and the Route 1 stand, both at South Quay in Port of Spain.

The Government of Trinidad and Tobago is currently developing an e-mobility policy in line with its policy objective of sustainable transportation.

25 All-Inclusive Project Development Services Limited and SoftCom Ltd, *"A Framework for Implementation of National Transport Projects," National Infrastructure Development Company, Port of Spain, Trinidad and Tobago* (2010).
26 Ibid.

FIGURE 1.16 **Development and Exploratory Drilling** | *Data source: Review of the Economy, 2019*

1.7 Industry

With its economy driven mainly by industrial activities, Trinidad and Tobago is very different from the other countries of the Caribbean. Its major industries are Oil and Gas, Manufacturing, Food and Beverage, Agriculture and Tourism.

Oil and Gas

For over 100 years, Trinidad and Tobago has been involved in Oil and Gas production. The country's economy was built mainly around this sector which is globally recognised as one of the world's largest producers of natural gas following its monetisation in the 1990s.

Drilling activities aimed at bringing new oil wells on stream continue in an attempt to maintain a steady level of production. For the period October 2018–July 2019, a total of 35 wells were drilled by various petroleum companies in Trinidad and Tobago. The companies De Novo, EOG, BHP Billiton and Lease Operators Limited conducted Development and Exploratory Well Drilling on both land and deepwater. **FIGURE 1.16** shows comparative drilling data for the period October 2017–July 2018 and October 2018–July 2019.

Further exploration and extraction continue with BPTT developing its holdover fields of natural gas. One example of a successful exploration is in BPTT's Angelin Field which is expected to yield more gas than originally estimated. Other companies such as BHP Billiton, Shell, EOG and Perenco are striving for success in their fields.

In 2018, state-owned oil company Petrotrin was shut down following a restructuring exercise that resulted in the creation of Trinidad Petroleum Company Limited and four subsidiaries:

1. Heritage Petroleum Company Limited (Heritage) which assumed the exploration and production operations of Petrotrin and into which Petrotrin's operating assets were transferred.
2. Paria Fuel Trading Company (Paria) which was established to ensure the uninterrupted importation, storage and distribution of refined fuels to domestic and regional markets.
3. Guaracara Refining Company Limited which holds the refinery's assets and is responsible for their security and maintenance.
4. Legacy Petrotrin which holds all Petrotrin's non-core assets, such as land, clubs and bungalows.

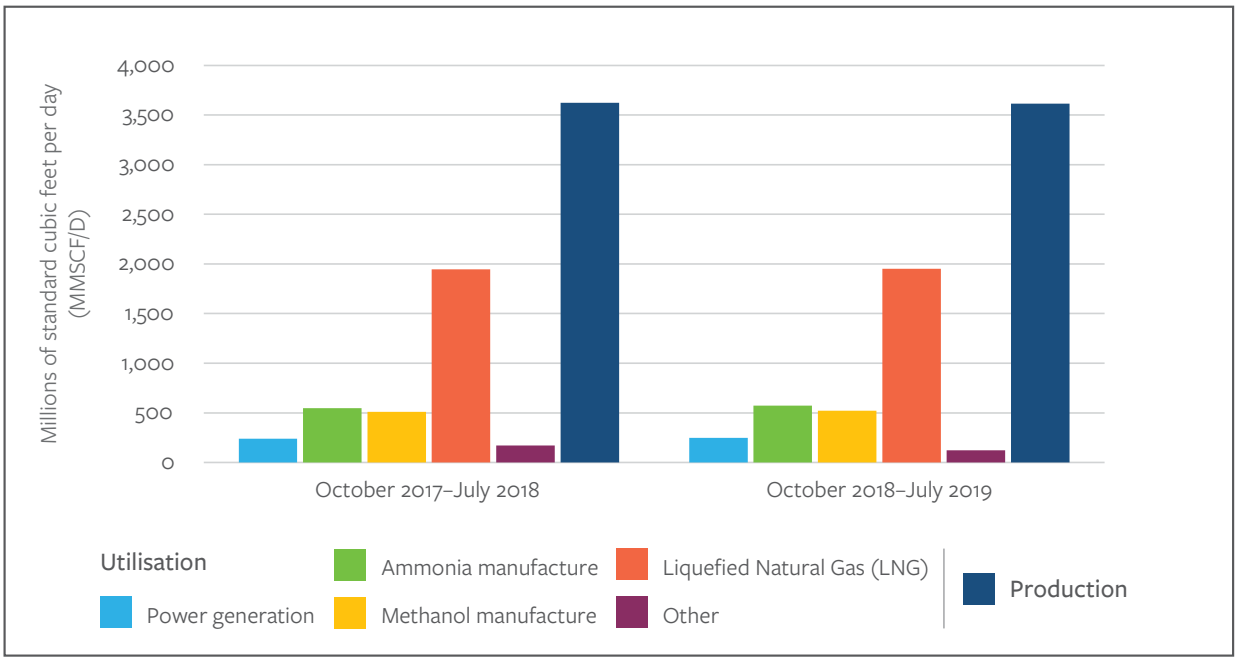


FIGURE 1.17 **Natural Gas Production and Utilisation** | *Data source: Review of the Economy, 2019*

Oil and gas prices are always heavily scrutinised by the Government since its expenditure and planning are based on their price projections. **TABLE 1.13** reflects prices over the period October 2013–July 2019.[27]

A decline in natural gas production was observed throughout 2018–2019 despite new fields being commissioned into production. This marginal decline was due to the decline in production within mature fields. **FIGURE 1.17** represents the change in natural gas production for the period 2017–2019.

Natural gas is mainly used by Atlantic LNG which accounts for about 54 percent of total output. Ammonia manufacturing follows with about 16 percent while methanol manufacturers utilise 14.5 percent of the natural gas supply. Electrical power generation utilises 6.9 percent.

Natural Gas Liquids (NGLs) are produced by Phoenix Park Gas Processors Limited (PPGPL) and are comprised of propane, butane and natural gasoline. A steady decline in production can be observed in **FIGURE 1.18** for the period October 2014–July 2019 which is attributed to lower production numbers upstream.

Manufacturing

The manufacturing sector is comprised of several sub-sectors ranging from downstream petrochemical products, food and beverage, clothing and textiles, light industry and cement production. Their total contribution to GDP is about 16 percent of total industrial output.

TABLE 1.13 **Oil and Gas Prices for period October 2013–July 2019** | *Source: Review of the Economy, 2019*

	Oct '13/ Sep '14	Oct '14/ Sep '15	Oct '15/ Sep '16	Oct '16/ Sep '17	Oct '17/ Sep '18	Oct '17/ Jul '18	Oct '18/ Jul '19
Crude Oil (Spot Price US$/Barrel) ▼							
West Texas Intermediate	99.30	56.49	41.35	49.33	64.01	62.98	57.84
European Brent	107.23	60.56	42.14	51.16	69.52	68.28	66.33
Natural Gas (US$/Thousand Cubic Feet) ▼							
Henry Hub	4.41	3.05	2.29	3.02	2.94	2.93	3.02

27 Government of the Republic of Trinidad and Tobago, *Review of the Economy* (2019).

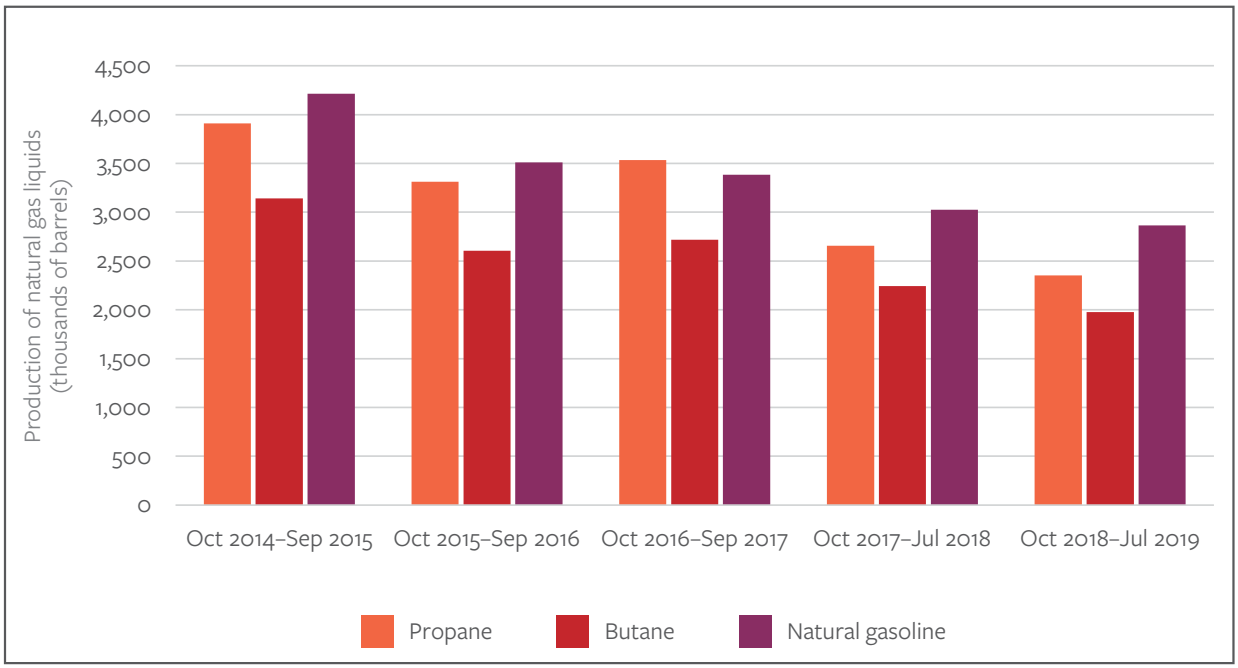


FIGURE 1.18 Production of NGLs (Propane, Butane and Natural Gasoline) | *Data source: Review of the Economy, 2019*

Tourism

Although of less economic value than the oil and gas and downstream petrochemical sectors, tourism is significant, particularly to the economy of Tobago. **TABLE 1.14** presents visitor arrivals for the period 2015–2019.[28]

Further Developments

Launched in September 2019, the Ministry of Trade and Industry's Trinidad and Tobago Trade Policy (2019–2023) provides a national roadmap for reducing dependency on traditional export markets through diversification of manufacturers' productivity, with greater focus on Research and Development in product development.

TABLE 1.14 Air Arrivals, Cruise Vessels and Passenger Arrivals | *Source: Review of the Economy, 2019*

TYPE	2015	2016	2017	2018	Jan–May 2018	Jan–May 2019
TOTAL VISITOR ARRIVALS	**519,330**	**491,232**	**464,744**	**501,088**	**260,633**	**232,639**
Trinidad	432,338	418,368	408,018	413,416	190,103	192,615
Tobago	86,992	72,864	56,726	87,672	70,530	40,024
International Air Arrivals (No. of persons)	**439,749**	**408,782**	**394,650**	**375,485**	**164,029**	**166,179**
Trinidad	417,314	389,404	375,202	356,044	154,151	154,527
Tobago	22,435	19,378	19,448	19,441	9,878	11,652
Cruise Passengers (No. of persons)	**79,581**	**82,450**	**70,094**	**125,603**	**96,604**	**66,460**
Trinidad	15,024	28,964	32,816	57,372	35,952	38,088
Tobago	64,557	53,486	37,278	68,231	60,652	28,372
Cruise Ships (No. of ships)	**70**	**62**	**60**	**75**	**55**	**36**
Trinidad	18	21	22	27	16	16
Tobago	52	41	38	48	39	20

28 Government of the Republic of Trinidad and Tobago, *Review of the Economy 2019* (2019).

The Trade Policy outlines initiatives to: (i) increase the value and volume of non-energy exports of goods and services; (ii) enhance the facilitative and enabling environment for trade, business and investment; (iii) grow the production and export of high value-added goods and services; and (iv) increase the country's share of CARICOM trade, inclusive of trade in services. Key developments during fiscal 2019 which positively impacted the manufacturing sector included the provision of grant funding and financial support; participation at a WTO Trade Policy Review; finalisation of a Trade Agreement; the hosting of specialised trade missions; and construction of a manufacturing facility.

The Grant Fund Facility is an initiative designed to assist small and medium-sized enterprises (SMEs) in eight designated sectors (manufacturing, agriculture and agro-processing, financial services, maritime services, creative industries, software design and applications, fish and fish processing, and aviation services) with the acquisition of machinery and equipment.

The Grant Fund Facility finances 50 percent of the cost of acquisition, up to a maximum of 250,000 TTD (37,313 USD) per beneficiary. During fiscal 2019, eight companies received grants totalling approximately 1.57 million TTD (234,328 USD) in various sub-sectors including printing and publishing; cocoa processing inclusive of the manufacture of chocolate; food and agro-processing; and manufacture of packaging material, among other things. To complement this initiative, the Research and Development Facility (RDF) provides financial support to promote research, development and innovation by local manufacturers. Twenty-six applications were received during Fiscal 2019, of which three were approved with total disbursements of 1.14 million TTD (170,149 USD).

1.8 Waste

Solid and Other Waste

With population growth, increased urbanisation, industrial expansion and increased consumerism, waste generated per capita is expected to increase. The *Trinidad Solid Waste Management Programme: Waste Characterisation & Centroid Study Final Report, September 2010* estimated that the landfills managed by the Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL) at Beetham, Guanapo and Forres Park receive approximately 700,000 tonnes of waste per year which represent 95 percent of the waste generated annually in the country.

SWMCOL is responsible for developing and managing these three waste disposal sites in Trinidad while the Tobago House of Assembly (THA) is responsible for the island's only waste disposal site at Studley

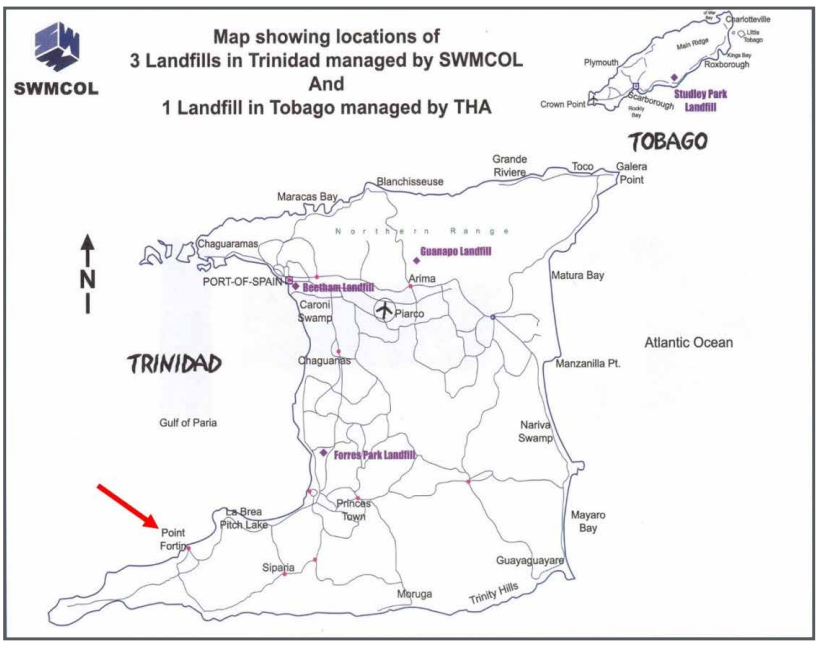


FIGURE 1.19 Locations of Landfill Sites in Trinidad and Tobago
Source: SWMCOL, 2019

Photo Credit: Kishan Ramcharan

▲ Lopinot La Pastora valley, deep in the heart of the Northern Range, Trinidad, 2019

Park. In Trinidad, the Guapo disposal site was managed by the Point Fortin Borough Corporation until 2012 when a private firm, Earth Company Limited, took over its operations.

FIGURE 1.19 shows the locations of the disposal sites in Trinidad and Tobago.

In Trinidad and Tobago, Solid Waste Management (SWM) is handled by various institutions. These institutions perform many different tasks and currently operate unregulated. The institutions are involved in various aspects of the SWM and operate with their own priorities and agendas. Following are the main SWM agencies with their associated responsibilities.

» **Ministry of Public Utilities through SWMCOL:** Overall responsibility for SWM in Trinidad while SWMCOL manages the Beetham, Guanapo and Forres Park waste disposal sites in Trinidad. It is also overseeing finalisation of the Beverage Containers Deposit Refund Policy.

» **Ministry of Rural Development and Local Government through the Municipal/Regional Corporations:** Responsible for municipal waste collection and transportation in Trinidad and the associated monitoring of solid waste contractors. Point Fortin Borough Corporation is a special case as it also manages the Guapo disposal site.

» **Tobago House of Assembly:** Management of municipal waste collection in Tobago and the Studley Park disposal site in Tobago.

» **Ministry of Planning and Development:** Management of the Multilateral Environmental Agreements (MEAs) to which Trinidad and Tobago is a signatory. Many of these relate to waste such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Disposal, and the Stockholm Convention on Persistent Organic Pollutants.

» **Ministry of Health:** Monitoring of waste management at health establishments such as public hospitals, health centres and licensed private hospitals. It also responds to public health complaints and concerns. The Regional Health Authorities which fall under the Ministry of Health are responsible for the management of waste from all major hospitals and health centres in their respective regions.

» **Environmental Management Authority (EMA):** Responsible for developing and implementing legislation for the management of wastes as described in Sections 55 to 58 of the Environmental Management Act, Chap. 35:05. Rules may be prescribed in accordance with Section 26 of the Environmental Management Act. The EMA also coordinates the National Recyclable Solid Waste Collection.

» **Ministry of Trade and Industry:** Receives and evaluates applications for scrap metal licence under the Old Metal and Marine Stores Act (scrap metal collection) and the Export Negative List (export of scrap metal). The EMA also regulates scrap metal dealers through the Certificate of Environmental Clearance (CEC) process.

» **Ministry of Energy and Energy Industries (MEEI):** Receives applications from the oil and gas sector for the importation of industrial chemicals in oil and gas exploration.

TABLE 1.15 provides estimates of the combined quantity of solid waste disposed annually at the SWMCOL Managed Landfills in Beetham, Guanapo and Forres Park.

A waste composition assessment was conducted in 2010 at all three sites in Trinidad. The results of this survey for Trinidad are shown in **FIGURE 1.20**.[29]

TABLE 1.15 Quantity of Solid Waste Disposed 2006–2017 | *Source: SWMCOL* ▼

Year	Quantity (tonnes)	Year	Quantity (tonnes)
2006	560,887	**2012**	505,926
2007	594,641	**2013**	558,617
2008	633,871	**2014**	682,526
2009	629,414	**2015**	862,107
2010	548,393	**2016**	767,536
2011	500,489	**2017**	505,926

29 CBCL Limited, *Trinidad Solid Waste Management Program Waste Characterization and Centroid Study* (Ministry of Local Government, 2010).

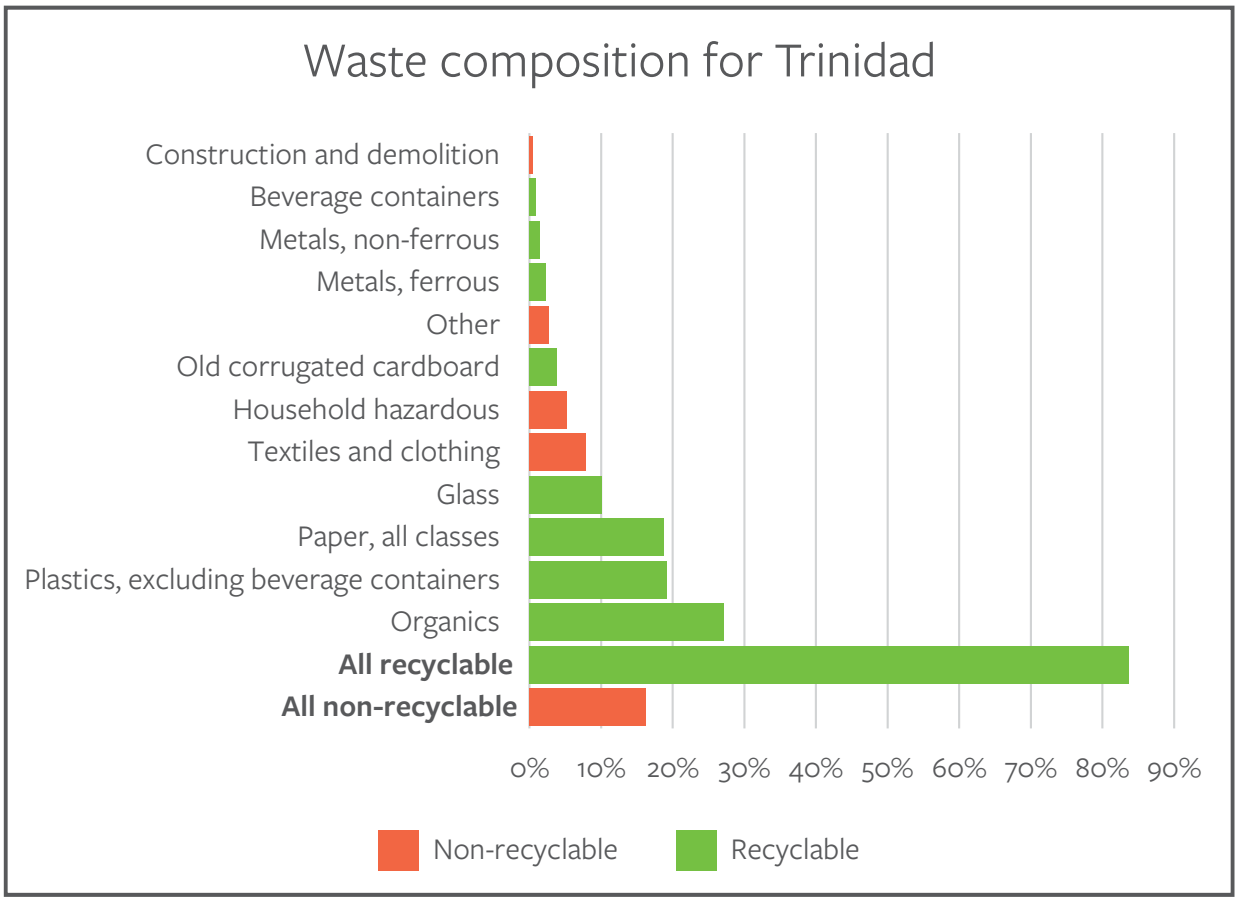


FIGURE 1.20 **Waste composition for Trinidad** | *Data source: CBCL Centroid Study, 2010*

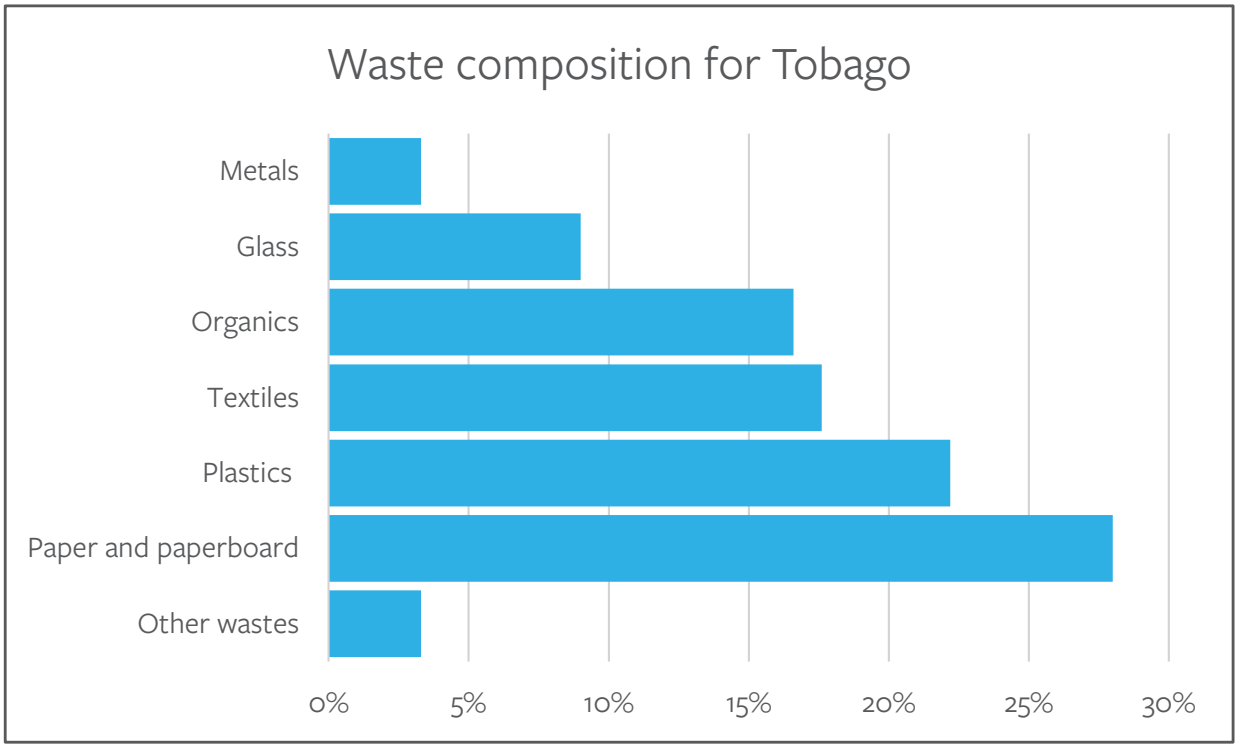


FIGURE 1.21 **Waste composition for Tobago** | *Data source: Simmons and Associates, 2013*

TABLE 1.16 Black Water Disposal 2012–2017
Source: SWMCOL ▼

Year	Black water disposed (gallons)	Year	Black water disposed (gallons)
2012	6,110,985	**2015**	5,453,390
2013	6,567,190	**2016**	5,266,865
2014	7,416,760	**2017**	7,817,990

Data collection for this report took place between April and May 2010.

FIGURE 1.21 shows overall waste composition in Tobago from the residential as well as the Industrial, Commercial, and Institutional sectors (ICI). It was derived from a series of studies, the first of which was a baseline study conducted between 13–19 September 2010. The second study was conducted from 15–21 March 2012 to capture the anticipated spike in garbage generation prior to the Easter period. The third study, conducted from 12–19 December 2012, attempted to capture information representative of waste generated during the Christmas holiday cleaning season.

The landfills also accept black water—faecal waste—for disposal. **TABLE 1.16** outlines an estimated quantity of black water disposed in the Beetham landfill for the period 2012–2017.

Recycling in Trinidad and Tobago

Each disposal site has organised ad hoc waste recycling activities which target paper, cardboard, glass, batteries, copper wire and scrap metals. Limited provisions are also made on site for sorting and recycling certain waste, such as the collection/sorting of glass bottles at the Beetham Landfill. High volume recycling of glass, paper, newspapers, batteries, electronic waste (e-waste) and scrap metals are also done by some private and public entities.

SWMCOL has implemented various programmes for the recycling of post-consumer glass, plastic, tetra-packs and aluminium beverage containers in the Public, Private and Institutional sectors. The company's PET wash plant provides further processing of plastic to flakes and is pursuing further downstream processing options.

A Beverage Containers Deposit Refund Policy is currently being considered by the Cabinet which, if successfully implemented, will ensure that this waste stream is diverted from landfills and recycled.

Wastewater

The Water and Sewerage Authority (WASA) is the main regulatory authority for water and wastewater in Trinidad and Tobago. It is a vertically integrated state-owned Statutory Authority which was established by an Act of Parliament in 1965 with the responsibility to manage the country's water supply and services.

WASA has the mandate to deliver water supply in a safe, reliable and efficient manner. The asset base of WASA's water production consists of 41 surface water treatment plants, 55 groundwater treatment facilities, 37 rural intakes and spring sources, 229 wells, 70 service reservoirs, and 9 raw water impounding reservoirs. WASA also owns/manages 111 pumping stations and an estimated 5,800 km of pipeline ranging from 20 mm to 1,350 mm in diameter. In 2015, an estimated 59 percent of the water managed by WASA came from surface water sources while 23 percent came from groundwater sources with the remaining 18 percent from desalinated water plants.[30]

Increased water demand prompted WASA to purchase water from two desalination companies, the Desalination Company of Trinidad and Tobago Ltd (Desalcott) and Seven Seas Water, a US-owned company. Desalcott is located at the Point Lisas Industrial Estate where its primary clients operate. In 2012, WASA re-negotiated its contract with Desalcott to secure an additional 40 million imperial gallons of water per day (MIGD) to supply Central and Southern Trinidad.

Seven Seas Water is located at Point Fortin and has been supplying water to WASA since 2013. In 2015 its output was increased to 6.7 MIGD in order to augment the water supply to the south western peninsula of Trinidad.

30 Regulated Industries Commission, *T&TEC Annual Performance Indicator Report* (2018).

Photo Credit: Kishan Ramcharan

▲ Teak Plantation, Penal, Trinidad, 2019

Photo Credit: Kishan Ramcharan

▲ Land clearing for Agriculture, Trinidad, 2020

Another important function of WASA is the collection, transmission, treatment and disposal of wastewater. Its public sewerage systems in Port of Spain, San Fernando, Arima, Point Fortin and Scarborough handle approximately 30 percent of the country's wastewater needs. In addition to these decentralised sewage treatment plants, WASA operates 33 other plants and an estimated 1,522 hectometres of main sewers. By mandate, WASA also has the responsibility to adopt and refurbish more than 150 wastewater facilities from private developers and other government authorities.

WASA's customers are categorised as residential and commercial. In 2015, its water customer base was 411,777 while its wastewater customer base was 77,245. In recent years, the Malabar wastewater treatment was upgraded while the San Fernando wastewater plant is under renovation.

1.9 Agriculture, Forestry and other Land Use

Among the national sectors, Agriculture, Forestry and Other Land Use (AFOLU) is unique in incorporating activities that can lead to either GHG emissions/sources or GHG sequestration/sinks. Mitigation options for this sector fall into three categories:

- Reduction/prevention of emissions to the atmosphere
- Sequestration—especially the enhancement of carbon uptake by terrestrial reservoirs
- Reduction of specifically CO_2 emissions by the replacement/substitution of fossil fuel and other energy-intensive products

TABLE 1.17 Domestic Production of Agricultural Products | *Source: Review of the Economy, 2019*

Type	2014	2015	2016	2017	2018	2017 (Oct–Dec)	2018 (Oct–Dec)
Root crops ('000 kgs)	**10,276.9**	**9,744.2**	**12,687.1**	**9,357.4**	**9,453.1**	**2,132.0**	**2,053.7**
of which:							
Cassava	2,673.2	2,293.9	2,661.6	1,333.3	2,060.0	81.0	168.0
Dasheen	4,059.7	1,916.8	2,395.8	3,224.3	2,511.0	934.0	496.0
Eddoes	921.2	2,504.8	4,680.3	2,013.1	2,080.4	995.0	1,143.6
Ginger	561.7	539.4	801.6	857.1	366.8	0.0	1.0
Sweet Potato	1,986.2	2,473.6	2,132.1	1,908.1	2,425.3	122.0	245.1
Copra ('000 kgs)	**44.01**	**44.57**	**51.87**	**19.47**	**88.70**	**2.17**	**33.74**
Rice (paddy) ('000 kgs)	**2,912.0**	**1,900.0**	**1,822.9**	**1,619.9**	**584.8**	**764.0**	**228.0**
Vegetables ('000 kgs)	**15,505.3**	**20,731.8**	**20,857.8**	**24,595.0**	**24,094.4**	**6,980.0**	**3,919.4**
Tomato	1,415.6	2,698.0	2,223.3	2,645.1	1,678.2	438.0	126.0
Cabbage	343.6	593.7	433.7	434.9	755.5	7.0	173.0
Cucumber	1,184.6	1,173.3	1,101.5	803.9	741.1	206.0	130.0
Melongene	1,164.8	905.5	1,713.4	913.3	488.2	110.0	63.0
Bodi	979.9	1,261.8	1,612.7	1,965.6	587.3	218.0	120.0
Ochro	977.5	1,027.4	1,065.9	1,351.9	1,729.2	333.0	480.0
Lettuce	2,062.2	2,807.1	1,994.1	1,702.0	1,335.3	483.0	465.0
Pumpkin	2,130.0	3,279.0	3,031.7	1,884.2	4,532.9	402.0	534.0
Pak choi	663.0	1,904.6	921.9	1,464.4	846.0	112.0	74.0
Water Melon	474.4	746.6	536.9	547.8	402.8	19.0	35.0
Sweet Pepper	525.0	490.0	563.5	447.7	1,003.5	175.0	147.0
Celery	764.6	1,152.2	3,192.0	6,670.7	4,818.3	3,156.0	175.0
Cauliflower	107.1	198.9	187.6	158.7	131.6	1.0	24.0
Chive	2,016.5	1,782.0	1,384.0	2,473.9	2,448.1	873.0	944.4
Hot Pepper	314.1	398.3	503.8	718.0	2,203.7	216.0	250.0
Dasheen Bush	58.1	235	153.1	224.0	306.9	49.0	101.0
Sorrel	324.3	78.4	238.7	188.9	85.8	182.0	78.0
Fruits ('000 kgs)	**3,662.5**	**3,246.4**	**2,607.5**	**3,611.2**	**5,133.70**	**907.0**	**1,168.0**
of which:							
Pineapple	1,428.10	1,371.9	1,274.2	1,980.0	2,463.2	565.0	659.0
Pawpaw	1,799.2	1,355.1	941.9	1,269.6	1,312.2	277.0	370.0
Poultry ('000)							
Broilers (number sold)	34,136.3	32,160.8	31,708.0	33,267.0	31,889.0	9,660.0	7,797.0
Broilers (kgs)	58,826.7	56,099.7	60,696.0	63,906.0	65,039.0	18,068.0	17,483.0
Small ruminants ('000)							
Mutton (kgs)	74.2	77.3	60.0	70.0	48.9	25.4	17.2
Sheep (number sold)	5.1	6.1	5.6	10.6	3.2	2.1	1.0
Goat Meat (kgs)	34.7	53.7	46.4	71.8	55.6	21.0	15.5
Goat (number sold)	2.4	5.0	4.5	7.0	3.4	1.4	1.0
Dairy ('000)							
Milk (Litres)	3,941.8	3,730.6	2,323.7	2,428.4	3,456.3	530.2	688.2
Beef/Veal (kgs)	326.3	287.1	285.0	225.9	96.9	36.9	11.8
Pigs ('000)							
Pork (kgs)	2,619.3	1,778.1	1,910.4	2,178.1	2,378.7	807.7	781.0
Pigs (number sold)	61.0	50.2	47.7	42.7	46.6	16.3	19.3

The two main subcomponents of this sector within Trinidad and Tobago are Agriculture and Forestry which are expanded to include conversion to and from each other, and other land uses.

Overview of Agriculture and Forestry in Trinidad and Tobago

According to Trinidad and Tobago's *Review of the Economy 2018* (Ministry of Finance, 2018), the Agriculture and Forestry (and Fishing) sector continues to be a small contributor to economic growth, generating 0.9 percent of National GDP, with a growth rate of 9.6 percent. However, this sector provides employment for approximately four percent of the labour force and is critical to the rural socio-economy.

Robust growth within the Agriculture, Fishing and Forestry Sector produced a noticeable increase of 19 percent by first quarter 2019. **TABLE 1.17** depicts the production of selected crops and livestock for the period 2014–2018.[31]

Forestry

The state manages over 192,000 hectares of forests which are distributed across 36 forest reserves, 11 game sanctuaries and state lands. As of June 2019, 1,500 Ha of teak and pine plantations provided raw materials for 122 sawmillers and 130 furniture shops. Also, 113 contracts were awarded for harvesting 50,000 Hoppus Feet of teak; 171,000 Hoppus Feet of Pine; and 13,000 Hoppus Feet of mixed species. The national Reforestation and Watershed Rehabilitation Programme (NRWRP) replanted a total of 112,100 plants on 203 Ha of land during the period October 2018–August 2019.

Fisheries

A total of 102 non-artisanal, large-scale vessels were registered in Fiscal 2019 of which 88 were for Trinidad and 14 for Tobago, with an associated 418 fishers. Commercial small-scale fishing vessels are estimated at 2,525 with a breakdown of 1,939 for Trinidad and 586 for Tobago, and 5,050 associated fishers.

In Fiscal 2018, production from longline fleet was estimated at 1.326 metric tonnes, representing a 10.3 percent increase from 1,202 metric tonnes in fiscal 2017.

Aquaculture currently has 42 registered commercial fish farmers, with approximately 50 percent operating at full capacity. The ornamental aquaculture component is vibrant with 60,906 fishes being exported and 45,820 fishes being imported.

Agriculture Subcomponent

The most up-to-date agriculture policies for Trinidad and Tobago are in an Action Plan dated 2012 to 2015 which does not acknowledge climate change as an issue requiring attention (Ministry of Food Production, Land and Marine Affairs, n.d.). These policies are deemed outdated and there is no mention of plans or activities that could be considered as mitigating/adaptive precautions or responses to already changing climate conditions. In addition, there is a paucity of information indicating impacts of climate change upon specific agricultural commodities which would assist in assessing and developing mitigation suggestions. In the absence of this, the GoRTT provides financial relief to farmers who are affected by floods and other natural disasters.

A major barrier in developing robust mitigation proposals for the Agriculture subsector is the chronic lack of reliable data and information. This has led to many data gaps which must be filled before greenhouse gas emissions for this sector can be inventoried and assessed with any confidence. This problem has been cited by several sources, including being listed as a reason for the AFOLU's omission from the NDC. There is also little to no documentation or sharing on what, if any, climate adaptive, mitigative or resilient practices are carried out within this subsector. For example, despite the National Environment Policy's reference to the empowerment of agencies regarding the management of agricultural waste and fires, little could be found regarding details of plans or actions.

Yet, a literature search revealed that GHG emissions data on various aspects of Trinidad and Tobago's agricultural activities are available for the period 1998

31 Government of the Republic of Trinidad and Tobago, *Review of the Economy 2019* (2019).

to 2017 from the FAOSTAT database, although there is little information on how the data were generated. The challenge is compounded by the associated caveat that "Aggregate may include official, semi-official, estimated or calculated data" for almost every data category. Also, a recent Food and Agriculture Organization (FAO) document[32] also makes reference to two emissions assessments of the agricultural sector for 1990 and 2005 from which the largest emissions were attributed to enteric fermentation in domestic livestock (CH_4) and the burning of agricultural residues (CO_x). A comparison of both assessments revealed higher levels of emissions during 1990 compared to 2005 for both CH4 (3.69 Gg vs 3.21 Gg) and CO_x (19.01 Gg vs 5.48 Gg). Here, the major decline in the burning of agricultural residue is associated with the discontinuation of sugar production in 2003. This document also refers to estimates of net emissions in Agriculture in 2016 at 295 Gg.

Poor performance within various components of the Agriculture sector in 2017, such as decreases in the production of root crops and some vegetables, has been attributed to unacknowledged factors linked to climate conditions such as tropical storm Bret (2017), other unfavourable weather conditions, ensuing floods and the incidence of pests and diseases.

There are, however, other problem areas which can potentially create opportunities for developing mitigative (and adaptive) solutions. These include, but are not limited to the already identified gaps/shortfalls: (i) out-dated technology and low levels of mechanisation; (ii) a lack of greenhouse and other similar means of enhancing control of exposure to changing climate conditions; (iii) high cost of fertilisers; (iv) non-prevalence of agricultural insurance; (v) overuse and misuse of chemical fertilisers and pesticides; and (vi) absence of official safety standards and facilities for testing residual pesticide/chemical levels.

Given its responsibility for climate change issues, the Ministry of Planning and Development is implementing a project as part of the Green Climate Fund Readiness Portfolio titled "Improving the monitoring system for climate change impacts on the agriculture sector in Trinidad and Tobago". This is being done in collaboration with the Food and Agriculture Organization (FAO) and the Ministry of Agriculture, Land and Fisheries. The project aims to develop a framework for collecting and analysing agricultural and associated activity data, including food import dependency, hydrological, and meteorological data to allow for visualisation and assessment of greenhouse gas emissions in addition to reporting gender sensitive climate impacts on agriculture and food systems, and to strengthen the capacity of key stakeholders to use the collected data to improve resilience to climate change.

Forestry Subcomponent

Overall, forest cover across Trinidad and Tobago is approximately 44 percent collectively,[33] with an estimated 20 percent of this area being under private ownership. These values may have variances because of discrepancies in assessment methods and even basic definitions of what constitutes forested land.

Forest cover is reported to be increasing due to the reclamation of cocoa and coffee plantations which had been abandoned between the 1960s and early 1980s, and ongoing attempts to reforest denuded and semi-denuded areas through such initiatives as the 'Northern Range Restoration Project' which was launched by the GoRTT in the 1970s. Pockets of reforestation have also been carried out by NGOs and private entities such as the National Gas Company.

However, despite these increases, a forest loss rate of 0.8 percent per year from 1990 to 2000 has been reported.[34] Additionally, T&T's National Wetlands

32 Green Climate Fund with the Food and Agriculture Organization of the United Nations for Republic of Trinidad and Tobago, *Readiness Proposal* (2019).

33 Government of the Republic of Trinidad and Tobago, *National Forest Policy* (2011), 35(3), 720–726. https://agriculture.gov.tt/wp-content/uploads/2021/03/National-Forest-Policy-2011.pdf

34 Food and Agriculture Organization of the United Nations, *Forests and climate change in the Caribbean* (2014), 39. http://www.fao.org/documents/card/en/c/c34802da-3b5c-4c32-998b-1ee2ad750ade/

Policy[35] reported a disappearance of more than 50 percent of original wetlands across the country. The above-mentioned increases in forest cover are believed to be counterbalanced by annual occurrences of deforestation from multiple sources such as, but not limited to increasing physical development (e.g. roads, pipelines and public infrastructure); agriculture; settlement; quarrying; squatting, and especially forest fires which have been identified as the main cause of deforestation.

Further, as more and more state forests are set aside for conservation purposes, privately-owned forests have become the dominant source of native timber, while the Forestry Division remains the larger provider of timber from teak and Caribbean Pine monocultures. With private forests constituting approximately one-fifth of forested land across T&T and over 1,200 'forest farmers' actively planting commercial timber species on their holdings, it is critical that the development of forest mitigation policies include these private stakeholders.

Mainstreaming of climate change responses into the AFOLU sectoral plans and policies has not yet occurred. A review of the literature revealed no example of detailed, proactive plans or actions from the GoRTT which specifically seek climate mitigation as an objective. Several national policies relevant to forest management such as the National Forest Policy,[36] the National Environmental Policy,[37] the National Protected Areas Policy,[38] and the National Policy and Programmes for Wetlands Conservation in Trinidad and Tobago[39] may mention climate change and the related need to develop sustainable management policies towards adaptation. However, there is no further elaboration of plans or activities on how this could be achieved. The National Climate Change Policy[40] did go one step further with its reference to forests as carbon sinks and the need to preserve and enhance these sinks.

Despite this paucity of detailed mitigation plans, there have been actions under programmes within the National Forestry Division which are contributing towards mitigation and adaptation of climate impacts. These include the Re-afforestation Programme, Agroforestry Programme, Fire Prevention Unit, and the Wetlands Management Project. Additionally, there are examples of mitigation activities being undertaken by a few private entities such as the prevention of deforestation by the Asa Wright Nature Centre and the reforestation of some areas previously cleared for the installation of a gas pipeline by the National Gas Company. The latter went on to calculate and project the resulting carbon that could be sequestered from the reforestation of these areas.

Finally, while the National Environmental Policy mentions a commitment to critical issues related to the mitigation of soil and land degradation, the literature review reveals no details of specific plans, actions or policies related to soil conservation and management. It is, however, noteworthy that an assessment of land degradation between 2000 and 2015 has been reported in the document *National Report: Land Degradation Neutrality Target Setting Programme* (MPD, 2020a). This can be used as the first step towards the development of relevant mitigation strategies.

TABLE 1.18 shows the Agricultural Sector Contributions to the economy for the period 1991–2011. The following are noted:

35 National Wetlands Committee, Forestry Division and Ministry of Public Utilities and the Environment, *National Wetland Policies—Trinidad and Tobago: National Policy and Programmes on Wetland Conservation for Trinidad and Tobago* (2001).

36 Government of the Republic of Trinidad and Tobago, *National Forest Policy* (2011).

37 Government of the Republic of Trinidad and Tobago, *National Environmental Policy* (2006). https://www.protectedareastt.org.tt/index.php/resources/publications/policy-documents/228-national-environmental-policy

38 Government of the Republic of Trinidad and Tobago, *National Protected Areas Policy* (2011).

39 National Wetlands Committee, Forestry Division and Ministry of Public Utilities and the Environment, *National Wetland Policies—Trinidad and Tobago: National Policy and Programmes on Wetland Conservation for Trinidad and Tobago* (2001).

40 Government of the Republic of Trinidad and Tobago, *National Climate Change Policy* (2011).

TABLE 1.18 Agriculture Sector Contributions for the Period 1991–2011
Source: Central Bank of Trinidad and Tobago, Annual Economic Survey, 2011

Year	GDP (Market Prices, TT$M)	GDP at Current Market Prices by Sector of Origin (TT$M)	Annual Change of Agri. GDP (Current Market Prices, %)	Sectoral Composition of GDP at Current Market Prices	Agriculture Labour Force (Persons)	Agriculture Share of Labour Force (%)
1991	22,558.6	762.2	3.4	3.4	51,100	11.7
1992	23,117.6	8701.6	5.2	3.5	49,100	10.8
1993	24,490.5	815.6	1.7	3.3	45,675	10.8
1994	29,311.7	651.4	–30.1	2.2	52,590	11.7
1995	31,697.0	733.1	12.5	2.3	47,800	10.1
1996	34,448.1	668.7	–8.8	1.9	42,275	9.0
1997	36,552.4	864.7	29.3	2.4	46,900	9.3
1998	38,197.1	828.3	–4.2	2.2	41,200	8.1
1999	41,044.9	891.3	7.6	2.2	46,800	9.1
2000	513,370.6	697.2	–16.0	1.4	36,400	7.2
2001	55,007.3	707.6	1.5	1.3	40,100	7.8
2002	55,365.6	787.2	11.2	1.3	36,100	6.9
2003	66,168.3	674.6	–14.3	1.2	31,400	5.9
2004	83,652.5	637	–5.6	0.8	26,000	4.6
2005	100,682.0	487.3	–23.5	0.5	25,000	4.4
2006	115,951.2	657.3	34.9	0.6	25,700	4.4
2007	136,952.5	509.0	–22.6	0.4	22,400	3.8
2008	175,287.2	640.7	25.9	0.4	25,300	4.3
2009	124,358.8	739.3	15.4	0.6	23,300	3.9
2010	132,960.6	869.3	17.6	0.7	21,000	3.6
2011	143,880.7	926.5	6.6	0.6	20,500	3.5

- The Agricultural Share of GDP at Current Market Prices in 1991 had a value of 3.4 percent and drastically declined to a value of 0.6 percent in 2011.
- During the period of 1991–2011 the Agricultural Share of Labour Force decreased from 11.7 % to 3.5 %.

Forest

Since 2010, there has been a marked increase in research to improve the accuracy of data collection regarding the areas under forest cover in Trinidad and Tobago. In 2005, the Food and Agriculture Organization (FAO) reported that the estimates for forest cover included only data on state forests and not private forests (FAO, 2010).

According to the GoRTT (2013), total forested area in T&T declined from 256,346 Ha in 1970 to 226,413 Ha in 2010—a decrease of approximately 12 percent. Between 2010 and 2015, there was a reported increase in forested area on both islands of approximately 234,000 Ha. The increase in forest cover in T&T over the 2010–2015 period is attributed in part to the regeneration of secondary forest on abandoned sugar cane lands, abandoned cocoa and coffee plantations, and the increase in the cultivation of timber.[41] According to the Forestry Division (2016), it is estimated that

41 Government of the Republic of Trinidad and Tobago, *Trinidad and Tobago's 5th National Report of Trinidad and Tobago to the United Nations Convention on Biological Diversity* (2016)

TABLE 1.19 Total Forested Area (Ha) by Forest Class for the Period 1970–2010
Source: Food and Agriculture Organization of the United Nations, Forestry Department, Global Forest Resources Assessment Country Report for Trinidad and Tobago, 2010

National Classes	1970	1994	1990	2000	2005	2010
Evergreen Seasonal Forest	98,180	88,718	90,295	86,352	84,381	82,410
Semi-Evergreen Seasonal	13,928	12,586	12,810	12,251	11,971	11,691
Deciduous Seasonal Forests	3,617	3,268	3,326	3,181	3,108	3,035
Dry Evergreen Forests	495	447	455	435	425	415
Seasonal Montane Forests	926	837	852	815	796	778
Montane Forests	21,619	19,535	19,882	19,014	18,580	18,146
Swamp Forests	16,789	15,171	15,441	14,767	14,429	14,092
Secondary Forests	22,650	20,467	20,831	19,921	19,466	19,012
Teak and Pine Plantations	16,308	15,000	15,000	15,000	15,000	15,000
Other Plantations	5,306	5,306	5,306	5,306	5,306	5,306
Bamboo	528	528	528	528	528	528
Water	1,613	1,613	1,613	1,613	1,613	1,613
Other Areas Within Forests	53,729	72,212	69,349	76,505	80,086	83,662
Private Lands	201,312	201,312	201,312	201,312	201,312	201,312
Total Forest Owned by State	255,688	255,688	255,688	255,688	255,688	255,688
Private Forest	56,000	56,000	56,000	56,000	56,000	56,000
Total Land Area (Ha)	**513,000**	**513,000**	**513,000**	**513,000**	**513,000**	**513,000**

forests now cover approximately 45.7 percent of the total land area in T&T. Of this, primary forests account for 26.6 percent. Of the total forested area, 55.94 percent belongs to the state and 44.06 percent are private lands.[42] Based on figures presented in T&T's 2014 MDG report,[43] total forest cover in T&T in 2012 was reported to be approximately 48 percent.[44]

Forest Types

The predominant forest in Trinidad and Tobago is seasonal evergreen which accounts for 82,410 hectares or 36.4 percent of the total. According to the 5th National Report to the Convention on Biological Diversity[45] 55.2 percent of the total forested area of Trinidad and Tobago is seasonal evergreen.[46] The two main species of canopy trees in the lowland areas are the *Carapa guianensis* (Crappo) and *Eschweilera subglandulosa* (Guatecare). Tropical evergreen sub-montane and montane forests occur in the Northern Range of Trinidad. There are about 14,092 hectares of fragmented swamp forests and mangrove relics around the coast. **TABLE 1.19** and **TABLE 1.20** show the total forested area (Ha) by forest class and the total forests (including total secondary forests) for the period 1970–2010, respectively.

According to the FAO Report (2010) all lands lost from forests are categorised as 'Other areas within forests'. The subset of data (**TABLE 1.19**) highlights

42 Ibid.
43 Government of the Republic of Trinidad and Tobago, *Trinidad and Tobago Millennium Development Goals Report* (2014).
44 Government of the Republic of Trinidad and Tobago, *Trinidad and Tobago's 5th National Report of Trinidad and Tobago to the United Nations Convention on Biological Diversity* (2016).
45 Ibid.
46 Food and Agriculture Organization of the United Nations, *Global Forest Resources Assessment 2010: Country Report: Trinidad And Tobago* (2010).

Photo Credit: Kishan Ramcharan

▲ Forest fires are commonplace during the dry season—Aftermath of bush fire, 2020

TABLE 1.20 Total Secondary Forests for the Period 1970–2010 | *Source: Food and Agriculture Organization of the United Nations, Forestry Department, Global Forest Resources Assessment Country Report for Trinidad and Tobago, 2010* ▼

Year	Total Forested Area (Ha)	Total Secondary Forest (Ha)	Secondary Forests as a % of Total Forested Area
1970	256,346	22,650	8.84
1990	240,726	20,467	8.50
1994	237,863	20,831	8.76
2000	233,570	19,921	8.53
2005	229,989	19,466	8.46
2010	226,413	19,012	8.40

the rate of loss of forested areas over the period 1970–2010. Also, according to the FAO Report (2005) the estimated annual deforestation rate between 1990 and 2000 in Trinidad and Tobago was 2,000 hectares or 0.8 percent of the forest area.

Major factors influencing the loss of forests in Trinidad and Tobago are improper land use from agricultural practices on hillsides, housing developments on mountains, non-legal settlement (squatting), commercial or illegal felling of trees, forest fires and natural disasters such as hurricanes.[47]

Planted Forests

The total area of planted forest was estimated at 20,306 hectares in 2010. Of this, 15,000 hectares were under *Pinus caribaea* (Caribbean Pine) and *Tectona*

47 Government of the Republic of Trinidad and Tobago, *Second National Communication of the Republic of Trinidad and Tobago Under the United Nations Framework Convention on Climate Change* (2013).

grandis (teak) which was introduced from Myanmar in 1913. The remaining 5,306 hectares were cultivated with other commercial forest species. Planted forests constitute about 8.97 percent of Trinidad and Tobago's total forested area.

Forest Fires

Forest fires are a perennial problem of the annual dry season when bush fires destroy hundreds of hectares of forest as a result of land-clearing for agriculture and general negligence. **TABLE 1.21** provides statistics on forest fires in Trinidad from 1987–2018.

Sustainable Forest Management (SFM) Policy Framework

The Republic of Trinidad and Tobago has long had a systematic approach to SFM. Examples of this are its application of block management and shelterwood systems for over 60 years. However, it lacks a system of Criteria and Indicators (C&I) suited to its needs which is an important part of any SFM policy framework. The GoRTT is moving to modernise its approach to SFM with the recent adoption of the National Forest Policy which seeks to redress some of the shortcomings through streamlined institutional arrangements and updated regulatory frameworks.

Relevant Environmental Management Policies and Programmes

Trinidad and Tobago has a number of environmental management programmes. These are:

National Environment Policy (2018)

The NEP provides the overarching framework for environmental management. Subsequent national and sectoral policies with bearing on environmental or natural resource management; detailed procedures on environmental management; and concrete actions towards environmental sustainability in Trinidad and Tobago will therefore be grounded in the principles and broader approaches embodied in this NEP. The achievement of policy actions will be driven by the action of each citizen across the public, private, governmental, and non-governmental sectors.

TABLE 1.21 Forest Fires in Trinidad from 1987–2018
Source: Forestry Division ▼

Year	Number of Fires	Area Burnt (Ha)	Average Area Burnt (Ha)
1987	502	21,420.00	42.67
1988	583	5,495.00	9.43
1989	146	970.00	6.64
1990	234	1,100.00	4.70
1991	229	680.00	2.97
1992	431	2,710.00	6.29
1993	228	1,570.00	6.89
1994	256	2,600.00	10.16
1995	516	7,745.00	15.01
1996	178	2,664.00	14.97
1997	156	446.00	2.86
1998	764	10,289.00	13.47
1999	167	988.00	5.92
2000	91	927.00	10.19
2001	464	5,309.00	11.44
2002	62	273.00	4.40
2003	347	4,723.00	13.61
2004	136	1,493.00	10.98
2005	270	1,696.00	6.28
2006	210	1,245.80	5.93
2007	452	3,566.50	7.89
2008	226	1,534.10	6.79
2009	133	544.10	4.09
2010	754	12,477.80	16.55
2011	42	101.00	2.40
2012	58	205.20	3.54
2013	533	2,786.50	5.23
2014	310	2,342.68	7.56
2015	497	3,367.67	6.78
2016	467	4,195.70	8.98
2017	498	4,734.13	9.51
2018	218	1,829.64	8.40
2019	288	2,003.80	6.96
TOTAL	**10,446**	**114,032.60**	**10.92**

The NEP includes:

- Environmental priorities for Trinidad and Tobago. There are six priority areas delineated:
  1. Protecting Environmental & Human Health through Pollution Control
  2. Sustainably Managing Natural Assets
  3. Improving the Local Environment
  4. Evolving a Greener Economy
  5. Fostering an Environmentally Responsible Society
  6. Addressing Climate Change & Environmental and Natural Hazards
- Implementation and mainstreaming framework to achieve policy actions
- Monitoring and evaluation of the NEP and action plan

National Integrated Water Resources Management Policy (2017)

Its goals include, among others, the integration of water resources management to contribute to sustainable development and the protection of environmental quality and ecological systems. Some of the key activities proposed under the Watershed Management Policy are:

- the prevention of the conversion of forest reserve to other uses;
- protection of critical watershed areas including source protection, restoration, conservation, flood buffers, slope stabilisation, intake protection, sedimentation reduction;
- establishment of zoned uses for critical watersheds;
- promotion of ecologically and technologically

Photo Credit: Kishan Ramcharan

▲ Quarrying site at Santa Cruz Hillside, Trinidad, 2020

appropriate agro-forestry, soil conservation, reforestation;
- development of approaches to control negative practices such as quarrying and deforestation; and
- development of a programme to address non-point pollution from storm water, agricultural runoff and septic tanks.

National Wildlife Policy (2013)

The National Wildlife Policy was formally approved by Cabinet in December 2013. It provides guidance on the sustainable management of undomesticated animals and plants, whether introduced, resident or migratory, their parts or derivatives, and their habitats.

Wildlife management in Trinidad and Tobago has several legally designated protected areas/categories. One such category is the Wildlife or Game Sanctuaries as designated under the Conservation of Wildlife Act (Chap. 67:01). These sanctuaries are intended to protect wild animal species by restricting hunting and collection of animals within and from such sanctuaries (Ministry of Legal Affairs, 2009). The Act prescribes for the facilitation of the development and adoption of appropriate wildlife habitat and species management to produce a stable ecosystem and populations. Strategies include:

- conservation of natural habitats;
- recovery to a safe status of all wildlife species threatened with extinction; and

- management of habitats and migratory wildlife species for their intrinsic scientific and recreational value.

National Protected Areas Policy (2011)

The purpose of this policy is to establish an appropriate framework for the selection, legal designation and management of a national system of protected areas. The three objectives pursued in designating and managing protected areas are:

- to conserve the country's natural heritage, genetic, species and ecosystem diversity, evolutionary and ecosystem processes and biogeochemical processes;
- to conserve the country's cultural and historical heritage; and
- to optimise the contribution of protected areas to sustainable livelihood and human well-being, including opportunities for education and recreation.[48]

National Forest Policy (2011)[49]

The purpose of the National Forest Policy is to guide the sustainable management of the forest resources of Trinidad and Tobago, including the use of these resources and the impacts and consequences of these resources.

The policy objectives include:

- optimising the contribution of forest resources to livelihoods;
- enhancing native genetic, species and ecosystem diversity; and
- maintaining and enhancing the natural productivity of forest ecosystems (watershed functions, catchment area functions, etc) to provide important ecosystem services.[50]

National Climate Change Policy 2011

The National Climate Change Policy was laid in Parliament in 2011 and seeks to address, inter alia, the impacts of climate change including sectoral vulnerability and mitigation potential in major emitting sectors; current and proposed legislation related to mitigation and the identification of gaps in the legislation; and finally a Strategy and Action Plan.

The objectives of the National Climate Change Policy include:

- Reducing or avoiding greenhouse gas emissions from all emitting sectors;
- Enhancing carbon sinks;
- Protection of the natural environment and human health;
- Conserving and building resilience of human and natural systems to adapt to the adverse impacts of climate change including through capacity building, the application of cleaner and energy efficient technologies and relevant research and development;
- Enhanced agricultural production and food security;
- Educating the wider public on the potential impacts of climate change and the recommended adaptation strategies;
- Conserving and guaranteeing a sustainable supply of potable water.

The National Climate Change Policy (2011) made provisions for revision after five years therefore, the intent is to have a revised Policy by mid-2022. The revision which will take into consideration the new commitments of Trinidad and Tobago to the Paris Agreement of the UNFCCC inclusive of the commitments made in the NDC, the results of national risk and vulnerability assessments as well as the latest science from the Intergovernmental Panel on Climate Change (IPCC) and other recognised bodies.

48 Government of the Republic of Trinidad and Tobago, *National Protected Areas Policy* (2011).
49 Government of the Republic of Trinidad and Tobago, *National Forest Policy* (2011). http://www.biodiversity.gov.tt/home/legislative-framework/policies/national-forest-policy-2011.html.
50 Ibid.

National Tourism Policy of Trinidad and Tobago (2010)

This policy acknowledges global warming impacts on climate change and its potential for negatively affecting the tourism industry. The effects of climate change can be manifested in the form of beach erosion, coral bleaching, water and food shortages, ecosystem collapse, sea level rise and extreme weather events.

The National Tourism Policy Goals are sustainably based, people-centered, innovation and investment-driven, and supported by the private sector.[51]

National Policy and Programmes on Wetland Conservation for Trinidad and Tobago (2002)

Trinidad and Tobago acceded to the Ramsar Convention on Wetlands in April 1993. This international Convention which currently has 130 Contracting Parties at present is an inter-governmental treaty aimed at conserving wetlands of international importance. Trinidad and Tobago's accession to the Convention on Wetlands signalled to the world its commitment to promoting the wise use of its wetlands.

In January 1995, Trinidad and Tobago established a National Wetland Committee with representatives of relevant Government ministries and non-governmental organisations. The result of the committee's work was the National Wetland Policy for Trinidad and Tobago for guiding the integration of wetland conservation and wise use into national planning. The policy was approved by Cabinet on 11 July 2001.

The policy also requires that the government protect, manage and restore wetlands in order to sustain and enhance their ecological and socio-economic values for future generations.

Some of the major objectives related to the protected wetland areas include:

- the encouragement of public protection of outstanding examples of wetlands in private ownership;
- persuading the management of all privately-owned wetlands to promote the protection of their functions;
- promoting the use of publicly-protected wetlands as examples for education and awareness; and
- integrating the management of wetlands with watershed and catchment area management.[52]

Photo Credit: Tobago House of Assembly

▲ Reforestation Plantation, Courland, Tobago 2020

Three sites have so far been declared Ramsar Sites: the Buccoo Reef/Bon Accord Lagoon in Tobago and,

51 Ministry of Tourism, *National Tourism Policy of Trinidad and Tobago* (2010).

52 Government of the Republic of Trinidad and Tobago, *National Policy and Programmes on Wetland Conservation for Trinidad and Tobago* (2002).

in Trinidad, the Caroni Swamp and the Nariva Swamp Managed Resource Protected Area which was also declared an Environmentally Sensitive Area in 2006. Together they have a combined acreage of 15,919 hectares (Ramsar Sites, 2012).

National legislation—both draft and in force—relevant to climate change issues include the following:

- Air Pollution Rules 2014
- Water Pollution Rules (2019)
- Draft Waste Rules 2018 and the Waste Management (Registration and Permitting) Rules 2018
- Certificate of Environmental Clearance Rules (2001)
- Environmentally Sensitive Areas Rules (2001)
- Environmentally Sensitive Species Rules (2001)

1.10 Development priorities and objectives

The National Development Strategy (NDS) more familiarly known as Vision 2030 aims to address the development issues and challenges being faced by Trinidad and Tobago such as crime, an ageing population, the impacts of climate change, loss of biodiversity, pollution, degradation of ecosystems, flooding, poor service delivery, and a greater need for transparency and accountability. The NDS aims to address these developmental challenges in establishing the foundation for catapulting the country onto a path of sustained economic and social progress. The NDS articulates the broad policy framework for development, the national vision to 2030 and national development priorities, and the main strategic initiatives for achieving them. The NDS outlines the following five key themes for development which are in strong alignment with the Sustainable Development Goals (SDGs) of the United Nations:

1. Putting people first: Nurturing our greatest asset
   - Goal 1. Grounding the society in principles of social justice
   - Goal 2. Improving Social Services Delivery to better serve the needs of vulnerable groups
   - Goal 3. Providing citizens with access to adequate and affordable housing
   - Goal 4. Building a national healthcare system that is sustainable, modern and delivers higher standards of healthcare
   - Goal 5. Empowering the population to lead healthy lifestyles
   - Goal 6. Protecting and supporting families
   - Goal 7. Creating a modern, relevant national education and training system

2. Delivering good governance and service excellence
   - Goal 1. Grounding the society in the principles of social justice.
   - Goal 2. Transforming the Public Service through modern, effective and efficient management systems
   - Goal 3. Delivering customer-focused public service
   - Goal 4. Modernising the country's legal, regulatory and law enforcement systems

3. Improving quality infrastructure and transportation
   - Goal 1. Building a safe and operationally efficient transport system
   - Goal 2. Improving the management of the public utility system with better access for all
   - Goal 3. Creating an inter-connected, well maintained transport infrastructure
   - Goal 4. Implementing a modern and well-maintained ICT system

4. Building globally competitive businesses
   - Goal 1. Maintaining macroeconomic stability
   - Goal 2. Developing a business environment that is conducive to entrepreneurship
   - Goal 3. Making Trinidad and Tobago a more attractive destination for investment and trade
   - Goal 4. Manufacturing high-value products and services with which the private sector can compete in export markets

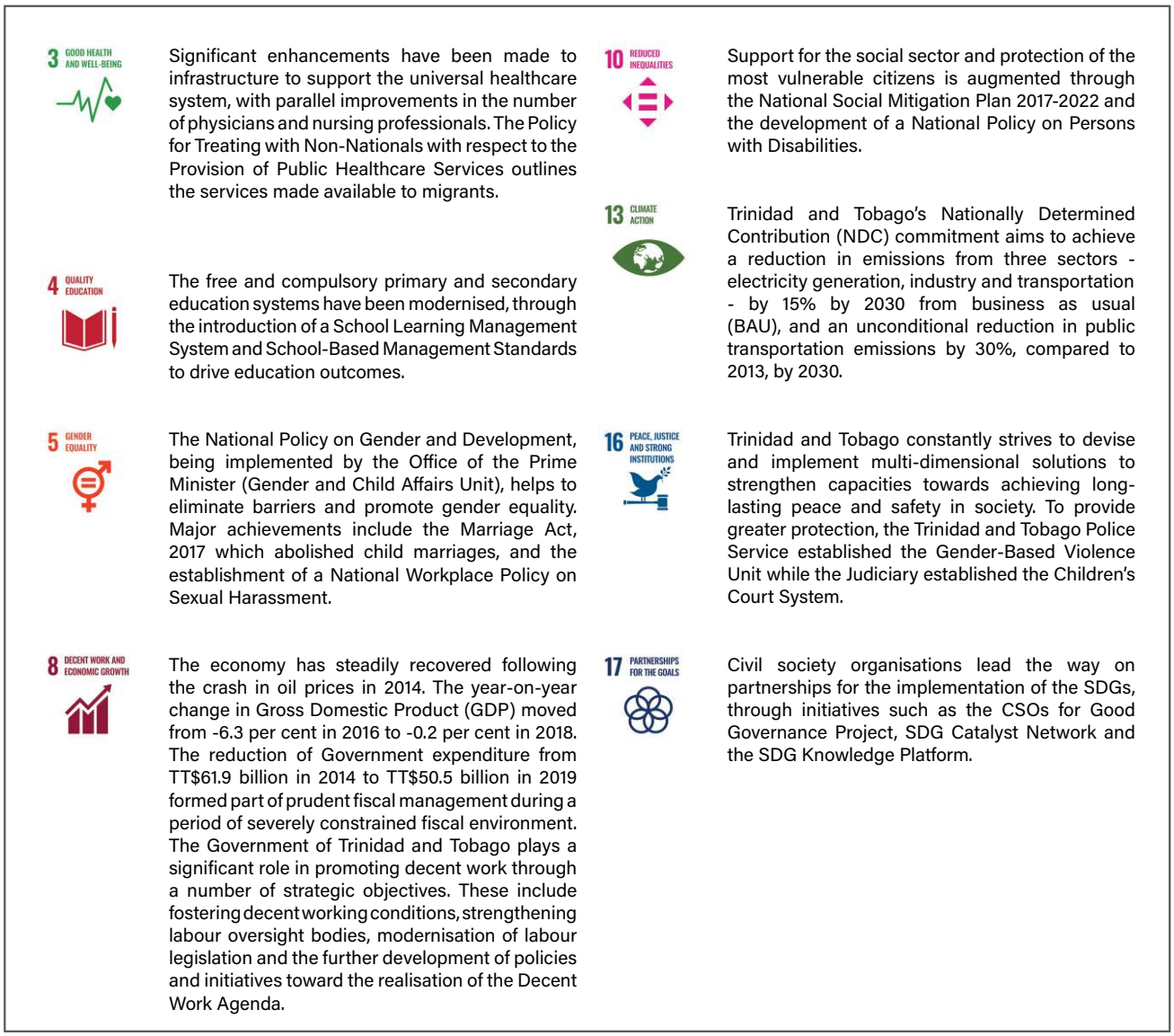


FIGURE 1.22 Trinidad and Tobago Sustainable Development Goals progress snapshot
Source: Trinidad and Tobago Voluntary National Review, p. 8

5. Placing the environment at the centre of social and economic development
   - Goal 1. Strengthening of environmental governance and management systems
   - Goal 2. Reducing the national carbon footprint
   - Goal 3. Assessing the national vulnerability to climate change
   - Goal 4. Implementing comprehensive waste and pollution management systems
   - Goal 5. Improving natural resource management

The NDS provides the overarching framework for policy and strategy development in Trinidad and Tobago. All sectoral policies and supporting legislation are expected to be congruent with it.

A number of national policies and strategies have been updated or are under revision or development in order to achieve the above goals. These include, inter alia, the following:

1. National Environmental Policy (2018)
2. National Climate Change Policy (2011, being revised)
3. Carbon Reduction Strategy (2015)
4. Nationally Determined Contribution and its Implementation Plan

5. Just Transition Policy (under development)
6. National Tourism Policy (draft)
7. Trinidad and Tobago Trade Policy (2019)
8. National Consumer Policy for Trinidad and Tobago (2018)
9. Integrated Coastal Zone Management Policy (draft)
10. National Guidelines for Trinidad and Tobago's Air Conditioning and Refrigeration Sector (2018)
11. National Biodiversity Strategy and Action Plan for Trinidad and Tobago (2017)
12. National Performance Framework (2017–2020)
13. Trinidad and Tobago's National ICT Plan ICT Blueprint (2018–2022)
14. National Policy on Gender and Development—A Green Paper (2018)

Progress towards the Sustainable Development Goals

In 2020, at the United Nations High Level Political Forum, Trinidad and Tobago presented its first Voluntary National Review on Sustainable Development (Ministry of Planning and Development, 2020c). This report gives an account of the country's progress towards sustainable development through accounting for the SDGs as enshrined in Vision 2030. The VNR's SDG Progress Snapshot is provided in **FIGURE 1.22**.

Challenges

1. Dependence on oil and natural gas and oil-gas price cycle: The economy remains highly dependent on oil and natural gas. Thus, while Trinidad and Tobago benefits from rising oil and natural gas prices, it is also severely affected when these prices collapse. The dependence on oil and natural gas has had the perverse effect of compromising growth and development of the non-energy economy which is heavily oriented toward imports of consumption and intermediate goods, with a few exceptions in food and beverage manufacture.
2. Ageing population and migration: Trinidad and Tobago has an ageing population whose median age is 32.6 years and with 13 percent of the total population being 60 years and over. Further, Trinidad and Tobago's popularity as a migrant destination is placing greater pressure on state resources.
3. Food security and sustainability: Trinidad and Tobago imports the bulk of its food and is subject to the volatility of international commodity prices.
4. Low productivity: In many areas of national life, in both private and public sectors, productivity is demonstrably low. This affects the country's competitiveness, not only by increasing the cost of production but also by increasing the cost of doing business.
5. Dependency and entitlement: The response of public policy to the inadequate pace of private sector job creation and lack of diversification has been to institute "make work" programme to provide temporary employment. The number of such programmes has increased whilst the number of persons engaged in them has also increased. The unintended consequence of this is increased dependency and notions of entitlement.
6. Weak institutions: There are weaknesses in many public institutions such as the Police Service, Prisons Service, Immigration, Customs, and Land Management.
7. Crime and criminality: Trinidad and Tobago has been plagued by high rates of serious crimes, especially murders, some of which are linked to domestic violence, gang activity and the drug trade. The policing response has been inadequate and the criminal justice system has also not adjusted to meet the challenge of rising crime due to resource and system inadequacies.
8. Climate change and natural resources management: As a Small Island Developing State, Trinidad and Tobago is particularly vulnerable to the impacts of climate change. This vulnerability is amplified by the inability to reap the benefits of economies of scale and its dependence on oil

and natural gas. Various pollution issues affect the country, such as air, water and sea pollution.

9. **Rapid advances in technology:** With the exception of the energy sector, Trinidad and Tobago does not produce significant quantities of technologically advanced goods, services and exports. The country is hindered by low adoption rates of ICT services in the government and business sector and the absence of a proper legal and regulatory framework for ICT goods and services.
10. **Managing a diverse society:** Significant challenges remain in managing a society which is very diverse in terms of class, religion, culture and ethnicity. Political and social consequences often arise because of perceived bias and allegations of unfairness as everyone may not have the same access to opportunities or have their issues and challenges addressed.

1.11 Priorities related to mitigation of climate change

Trinidad and Tobago has begun the development of its long term strategy. Business-as-usual projections to 2050 have been developed for the major emitting sectors (power generation; transportation; industry; waste; and AFOLU (agriculture, forestry and other land use). Mitigation intervention options have also been identified with the long term aim of achieving carbon neutrality in the second half of the century.

Trinidad and Tobago submitted its Nationally Determined Contribution under the Paris Agreement in 2015 with the stated aim of achieving an overall reduction of 15 percent in cumulative emissions from the power generation, transport and industry sectors by 2030 from business-as-usual or 103 $MtCO_2e$, conditional on international financing. It also committed to unconditionally reducing (through domestic financing) its public transportation cumulative emissions by 30 percent or 1.7 $MtCO_2e$ by 2030.

Power generation, transport and industry are the three main emitting sectors of the economy as evidenced from the most recent greenhouse gas inventory (see Chapter 3) and, as such, are the priority areas for mitigation. Although business-as-usual emissions projections have been developed for the other emitting sectors, data quality remains a challenge including the collection of relevant activity data to facilitate estimates of their emissions and, by extension, to formulate meaningful mitigation options. However, some interventions have already been identified, including waste recycling, reduced use of plastics and research into waste-to-energy which is already underway.

To facilitate the implementation of the National Climate Change Policy, as well as the tracking of the NDC, the required administrative, institutional, policy and legislative framework is being addressed through the following:

1. Incorporation of NDC objectives and low carbon development into the national development process framework
2. Cabinet appointment of a high-level Ministerial committee to provide high-level guidance to NDC implementation, supported by a technical advisory committee on NDC achievement and implementation
3. Development of an NDC Implementation Plan to guide the committees cited above
4. Development of a Financial Investment Plan to identify financial options for implementing the NDC and guide the aforementioned committees
5. Development, testing and operationalisation of a national mitigation monitoring, reporting, and verification (MRV) system supported by a Knowledge Management System (KMS) as the main depository of data and information. The MRV/KMS systems are also being enhanced to incorporate the enhanced transparency framework of the Paris Agreement in order to ensure compliance with the Agreement. These systems will track NDC implementation, mitigation actions and their efficacy, as well as support received.
6. Incorporation of the MRV/KMS system into law in order to mandate the reporting of greenhouse gas emissions and the submission of mitigation, monitoring and evaluation plans by

all emitting entities. To this end, training has been conducted to ensure the highest quality assurance of data supplied, and once satisfied, emissions data will be uploaded into a public registry to ensure transparency.

7. Training in data collection protocols and quality assurance procedures to improve data quality in the AFOLU and waste sectors
8. Development of an e-mobility policy by mid-2021 to address emissions in the transportation sector
9. Development of a Just Transition of the Workforce Policy around mid-2021 which has already had the benefit of wide stakeholder consultation, including on gender issues
10. A technology needs assessment for NDC, including a barrier analysis which is expected to be completed by mid-2021
11. Capacity-building of civil society organisation through education, awareness and training

The enhanced MRV/KMS system will also enable Trinidad and Tobago to track the implementation of its National Climate Change Policy in pursuit of a low carbon trajectory. In this regard, the policy is being updated to incorporate the provisions of the Paris Agreement. This is expected to be completed by mid-2021. The updating process is being conducted with the widest possible stakeholder involvement, particularly those identified in the preamble of the Paris Agreement. Stakeholder engagement is conducted primarily thorough the climate change focal point network, which is an interactive platform that hosts representatives from government ministries and agencies, non-governmental organisations, civil society organisations, the private sector, industries, fiduciary organisations, and trade unions.

Notwithstanding the above initiatives undertaken and the progress being made in reducing emissions by 31,509 tonnes in the transportation sector in line with the unconditional component of the NDC (see case study 1.1 on transportation fuel switching), challenges remain. These include economic diversification away from a fossil fuel-based economy, mainstreaming climate change into sectoral policies, and financing mitigation activities. Trinidad and Tobago already generates all of its power from natural gas, and efforts to further reduce emissions from this sector are being pursued, including through increased generating efficiency and an accelerated deployment of renewable energy.

To this end a utility-scale solar energy plant is being planned, with a generating capacity of 112.5 MW which would make it among the largest in the Caribbean. Additionally, solar energy is to be deployed at Piarco International Airport and through selected rural and urban installations which will serve as demonstration projects (see case studies 1.2 and 1.3).

As the country aims for a low carbon development trajectory while maintaining its vibrant industrial base, other initiatives are being pursued. These include the development of a hydrogen-based industry, given the country's industrial and manufacturing experience and research conducted by national universities on the potential for carbon capture (use) and storage with a view to identifying additional mitigation potential in the industrial sector.

Various other national policies also support mitigation through the conservation and preservation of natural ecosystem sinks, such as coastal mangroves and inland forests.

Quantifying these reservoirs should become more precise with the development and implementation of appropriate quality assurance and data collection procedures. The other challenges should be overcome, at least in part, through the implementation of an effective administrative, institutional, policy and legislative framework.

CASE STUDIES

Case Study 1.1: Fuel Switching in Transportation

While Compressed Natural Gas (CNG) is the cleanest fossil fuel for transportation it is recognised as a transitionary fuel as the country moves towards a sustainable transportation paradigm. To facilitate the transition, Trinidad and Tobago has embarked on a state-funded fuel switching programme at a cost of approximately 72 million USD to encourage the switch to CNG.

With the closure of the country's only oil refinery, CNG is now the only locally-produced fuel as well as the cleanest vehicular fuel available locally. Its price of approximately 15 cents US per lge also makes it particularly attractive to cost-conscious customers. The target market for CNG is high mileage users in the public transportation sector such as maxi-taxis and other mini buses, taxis and public buses. The public is also being encouraged to convert through a sponsored conversion strategy for switching vehicles from liquid fuels (gasoline, diesel) to CNG. To further incentivise the conversions, the government will launch a financing initiative through at least two financial institutions under which motorists will have access to small loans to make their vehicles CNG-ready. This will eliminate the need for sponsored conversions.

The number of conversions has been growing at a rapid rate.

In 2018, CNG litre sales grew by 48 percent over 2017 with accelerated growth. In 2019, sales more than doubled over 2018 with an increase of 106 percent. In 2020, despite the impact of Covid-19, CNG sales grew by a further 24 percent over 2019.

Such continuous growth has been achieved despite several implementation challenges including an inadequate network of CNG service stations and a lack of public awareness regarding the benefits of CNG, including its environmental and climate benefits.

Current implementation activities include:

1. the construction of 22 CNG stations with a target of serving approximately 18,055 vehicles powered by natural gas by the end of 2021 (sedan equivalents); and
2. conversion of existing liquid fossil fuel vehicles.

To date the following have been achieved:

1. the expansion of over 900 percent in Natural Gas Vehicles (NGV) between 2014 and December 2020 during which the number of vehicles grew from 1,522 vehicles to approximately 10,000
2. the equipping of 18 service stations to supply CNG, with a target of 22 stations by the end of 2021
3. reduction of approximately 31,509 tonnes of carbon dioxide has been achieved to date.

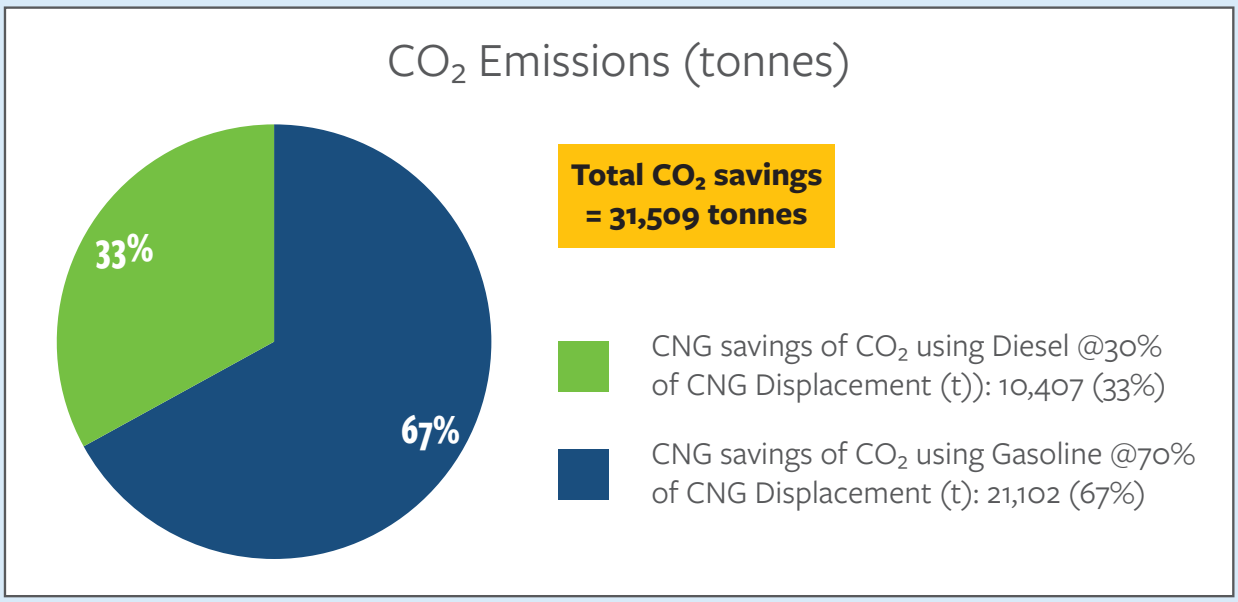


FIGURE 1.23 Total CO_2 savings from CNG usage

Case Study 1.2: Renewable Energy Through Solar Power—Pilot Project

Background

The Global Climate Change Alliance Plus (GCCA+) is a European Union (EU) flagship initiative that helps climate vulnerable countries address and increase resilience to climate change. The overall objective of the GCCA+ Project is to assist Trinidad and Tobago in the achievement of its commitments to the global community under the Paris Agreement, as laid out in its Nationally Determined Contribution (NDC). Specifically, the project is designed to increase the availability and use of energy from renewable sources and improve efficiency levels in the consumption of energy. Funded by the EU and implemented by the UNDP, this €2.4 million project was launched in November 2019 and is expected to be rolled out over the 42 months to April 2023.

The uptake of renewable energy in Trinidad and Tobago is challenged by:

» **Low and subsidised electricity rates:** This discourages the adoption of energy efficiency measures and creates a viability gap for generating renewable energy.

» **Inadequate policy and legislative framework:** These include gaps in current policies and regulations such as lack of appropriate incentives for generating renewable energy as well as for small-scale renewable energy producers connected to the grid etc.

» **Capacity gaps in technical expertise for solar energy generation and maintenance:** This is relative to the projected needs of scaled-up renewable energy generation.

» **Lack of awareness of the benefits of renewable energy:** A public that is better informed on the subject would be more motivated to seek out the economic, social and environmental advantages of renewable energy and energy efficiency.

» **Solar technology is new in the local context** and the business model for scale-up still needs to be fully established in T&T.

This project will address the barriers to the implementation of renewable energy through incremental interventions encapsulated in a strategy with four (4) main outputs:

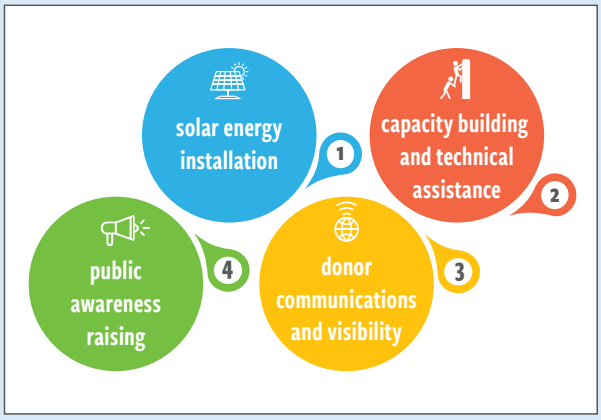


FIGURE 1.24 Project Outputs ▲

1. Installation of solar energy systems in public utilities and remote communities with the increased capacity to maintain solar power systems.
2. Support to the implementation of the new, RE/EE-conducive policy, legislative and regulatory framework.
3. Public awareness-raising on energy efficiency, correct pricing, and renewable energy.
4. Donor Communications and Visibility.

Twelve sites, representing a cross-section of non-governmental, community-based, and environmental conservation organisations were chosen based on specific criteria for small-scale, roof-mounted, solar photovoltaic (PV) installations. Apart from the carbon emissions avoided nationally, beneficiaries of this pilot installation will realise greater energy efficiency with reduced carbon emissions and will be supported by the upskilling of local technical assistance teams through capacity-building and specialised know-how to maintain the installations.

Raising public awareness is a critical aspect of the project and once installations are complete, they will become live reference points for others who may wish to adopt similar approaches to power generation and energy efficiency. Interactions at the community level and contributions to the national agenda to progress renewable energy are key deliverables that will signal the project's success and progress towards achieving T&T's NDC.

Case Study 1.3: Solar Park at Piarco International Airport

The Airports Authority of Trinidad and Tobago ("the Authority") is currently implementing a Solar Park at the Piarco International Airport (PIA), Trinidad and Tobago. This Solar Park, which is funded by the European Union, will produce renewable energy at a minimum of 1,443,830 kWh annually and potentially avoid 1,010 tonnes of CO_2 emissions annually. The project is supported by the European Union's Global Climate Change Alliance Plus (GCCA+) programme in Trinidad and Tobago.

Background

The Airports Authority's Strategic Plan has, as one of its main objectives, the upgrade of airport operations to the highest standards through enhanced systems and processes that ensure environmental compliance. The installation of a Solar Park is one project among several environmentally friendly initiatives and strategic approaches to mitigate the negative effects of climate change, and to reduce energy costs.

The appeal of the Solar Park was enhanced by the desire to contribute to Trinidad and Tobago's Nationally Determined Contribution (NDC). This project improves Trinidad and Tobago's resilience to climate change by introducing renewable energy as an energy source for electricity generation not only to the airport but to the country.

Context

The Solar Park, which will be located just north of the PIA, emanated from a feasibility study which was supported by the International Civil Aviation Organization (ICAO) and the EU. The study focused on capacity-building for CO_2 mitigation from international aviation and the use of renewable energy sources within the aviation sector in Trinidad and Tobago.

The Solar Park is expected to produce a minimum annual generation capacity of 1,443,830 kWh with the potential to avoid an annual emission of 1,010 metric tonnes of CO_2. The power produced from the site is expected to contribute to 7.1 percent of the Authority's current annual electrical consumption with capacity for future expansion, and facilitated through ground-mounted, hurricane (category 5) proof solar panels.

The Authority has been actively taking strides, supported by the EU, to commit to climate action initiatives in fulfilment of its corporate social responsibility to the environment and to future generations.

Project Objectives

The project objectives are:

5. the supply of solar-generated power to the Authority's estate power distribution system, effectively producing renewable energy at a minimum of 1,443,830 kWh annually;
6. the reduction of fossil fuel-based electrical consumption and its associated cost, resulting in a reduction in CO_2 emissions of at least 1,010 tonnes of CO_2 annually;
7. increased communication and visibility on reduction of carbon emissions through improved Corporate Social Responsibility programmes.

Key Messages

- The Solar Park will generate a clean, sustainable, green, renewable source of energy that is key to fighting climate change.
- The Solar Park project contributes towards the achievement of Trinidad and Tobago's NDC, and also to its goals to reduce the aviation carbon footprint as laid out by the ICAO.
- The EU supports Trinidad and Tobago in the implementation of a solar park as a climate action initiative.
- The Solar Park project at PIA is one of the major projects for renewable energy in Trinidad and Tobago.

CHAPTER TWO
INSTITUTIONAL ARRANGEMENTS RELATED TO NATIONAL CLIMATE MITIGATION MONITORING, REPORTING AND VERIFICATION (MRV) SYSTEM

Photo Credit: Keegan Callender, Ministry of Planning and Development

▲ Launch Event: Knowledge Management System (KMS) and the Monitoring, Reporting and Verification (MRV) Pilot Project, 2019

The Government of the Republic of Trinidad and Tobago (GoRTT) through its Ministry with responsibility for the Environment has designed and operationalised a comprehensive National Climate Mitigation Monitoring, Reporting and Verification (MRV) System which is intended to:

- facilitate the inventorying of greenhouse gases from all emitting entities for the purposes of international reporting such as the Biennial Update Report (BUR) and Biennial Transparency Report (BTR), domestic tracking of national climate policy, and implementation of the Nationally Determined Contribution (NDC);
- facilitate tracking of resources deployed in mitigating greenhouse gas emissions whether internationally and/or domestically sourced;
- inform mitigation options for reducing emissions;
- determine regulatory interventions as appropriate.

The MRV system is facilitated through a series of System Templates and guides to assist the submission of data by emitting entities. These emitting entities include facilities and processes in the following sectors:

- Power Generation
- Road Transportation
- Domestic Air Transportation
- Domestic Sea Transportation
- Industrial Processes and Product Use
- Agriculture
- Land Use and Land Use Change
- Forestry
- Waste
- Wastewater

Within the MRV System, a Quality Assurance/ Quality Control (QA/QC) protocol and guidance document has been developed to ensure transparency, accuracy, consistency, completeness, and comparability of Trinidad and Tobago's GHG inventories.

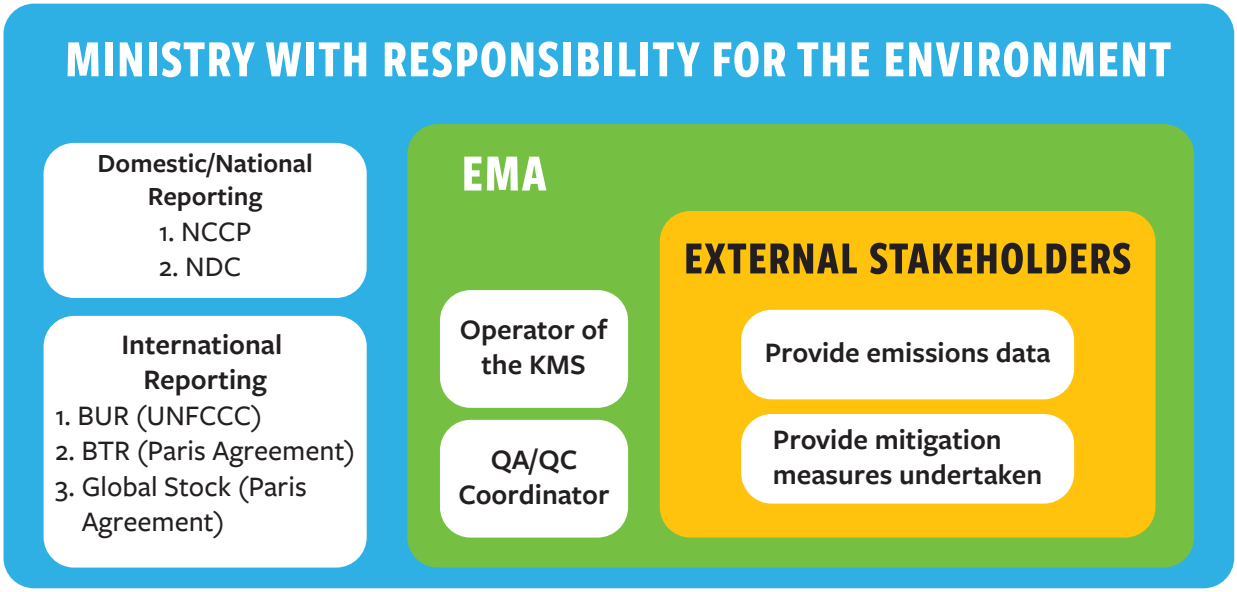


FIGURE 2.1 MRV system

The guidance document includes checklists for inventory and QA/QC coordinators, sector leads and specific management roles outlining the QA/QC procedures required.

The MRV's Knowledge Management System (KMS) was pilot-tested and the required adjustments are being made. The following sections describe the system's operationality which will be integrated into the legislative framework.

2.1 National Institutional Arrangements for MRV

The Knowledge Management System (KMS), which is the data repository and, therefore, the backbone of the MRV System, is housed at the Environmental Management Authority (EMA). As a regulatory agency, the EMA is the operator of the KMS and is responsible for collecting, collating and verifying all data related to greenhouse gas emissions, mitigation actions and financial support received for climate change-related initiatives. The Ministry with responsibility for the Environment which monitors, coordinates and reports on climate change, climate change impacts and climate change initiatives in Trinidad and Tobago is the official coordinator for MRV. One aspect of its responsibility is the verification of the information collected within the KMS prior to its approval for external use and official reporting to the UNFCCC, and for informing policy options nationally.

FIGURE 2.1 illustrates the MRV System.

2.2 Overall coordination of MRV

Trinidad and Tobago's MRV System has three components: MRV of emissions, MRV of mitigation actions, and MRV of support/resources utilised. The institutional framework of the MRV System includes the coordinating entity, host of the KMS and data suppliers (emitting entities) as described below.

1. Coordinating Entity of the MRV System

The designated coordinating entity for the National Climate Mitigation MRV System of Trinidad and Tobago is the Ministry with responsibility for the Environment which is responsible for:

- overall coordination of the National MRV System;
- receiving reports from the EMA to facilitate international reporting and to inform policy interventions as appropriate.

2. Host/Manager of the KMS

The EMA, as the host/manager of the KMS, is responsible for:

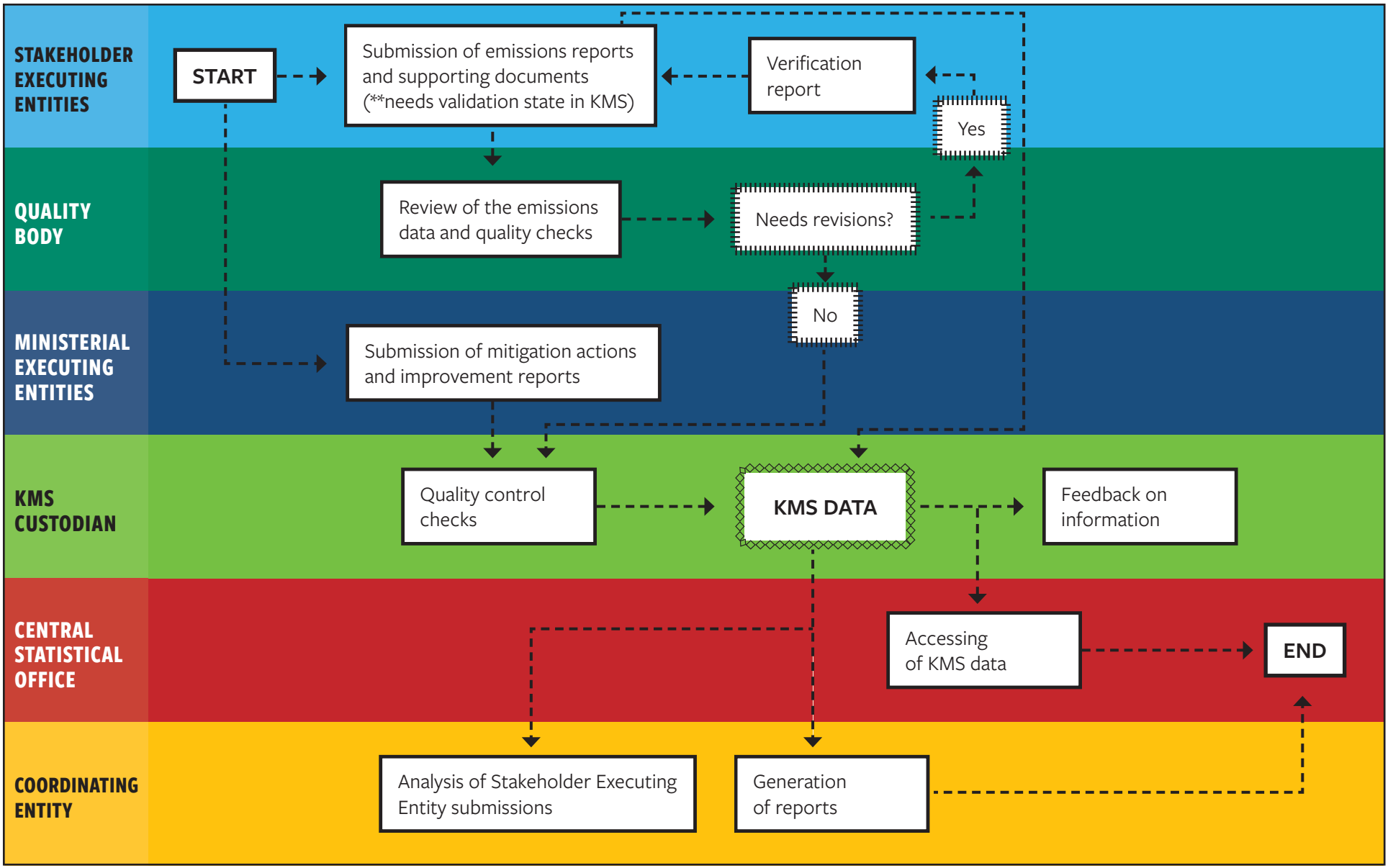


FIGURE 2.2 Data flows in the MRV System

- conducting QA/QC on submitted data/inventories and information by emitting entities;
- using the MOU and Confidentiality Agreement templates with the relevant stakeholders to ensure timely data flow and improve on data gaps;
- review and completion of the relevant QA/QC and data archiving system documents;
- ensuring optimum KMS functionalities within the MRV System;
- review and documentation of steps through consistent monitoring to identifiy barriers and facilitate future improvements;
- uploading of approved and verified data into a public registry;
- maintaining the public registry;
- ensuring independent verification of emissions as required.

Data and inventories compiled by emitting entities and uploaded to the KMS through a secure portal are subjected to the necessary QC/QA checks by the EMA. Once approved by the EMA, the information will be uploaded and used to develop reports, including National Communications, Biennial Update Reports (BURs), and Biennial Transparency Reports (BTRS) for submission to the UNFCCC Secretariat. The approved information will also be uploaded into a public registry.

3. Emitting entities and entities which coordinate and report on mitigation actions

Emitting entities are those involved in specified activities under the IPCC guidelines which give rise to greenhouse gas emissions. They provide all information related to greenhouse gas emissions and climate change mitigation activities to the KMS. Among their responsibilities are:

- the use and completion of the recommended MRV System templates;
- utilisation of the recommended methodology to compile inventories;
- application of QA/QC checks on inventories prior to submission using the required templates.

FIGURE 2.2 shows the data flow and the interaction with the KMS and relevant users within the system.

2.3 MRV of Mitigation actions

As the host of the KMS, the EMA is charged with the following duties with respect to the MRV of mitigation actions at the national level:

- Establishing reporting requirements for mitigation actions and relevant quality control procedures
- Uploading data and information from emitting entities involved in mitigation efforts into the KMS
- Collating data and information to be used in analyses
- Establishing procedures for monitoring and evaluating whether mitigation efforts have achieved their targets
- Submission of results regarding quality control, data analyses, and review of findings, for incorporation into the reporting processes at both the national and international level.

2.4 MRV of International Support and Domestic Resources

As the host/manager of the KMS, the EMA is responsible for coordinating the monitoring, reporting and verification of all international and domestic funding support for national mitigation actions. The main aspects of support and resource allocations to be addressed in this component of the MRV System include:

- sources of resources provided;
- type of entity providing resources such as public concessional (official development aid), private capital or investment;
- international and domestic intermediaries involved in channelling resources such as bilateral or multilateral banks and agencies through which finance is transferred, Government Ministries, public-private partnerships, etc.;

Photo Credit: Kishan Ramcharan

▲ Forestry Officers measure diameter of felled tree, Trinidad, 2020

- instruments for distributing resources such as grants, loans, guarantees, domestic policy support, domestic budget allocations, domestic mandates, etc.;
- detailing of the intended uses of the resources with a description of the mitigation activity;
- projected outcomes associated with the use of the resources provided, including both mitigation and sustainable development benefits.

2.5 Data/information gaps

As outlined in the national MRV System Implementation Plan, all entities including the coordinating body (currently the Ministry of Planning and Development), the host of the KMS (EMA) and executing agencies (ministries and stakeholders) are responsible for critically analysing their relationships and for collaborating with each other to identify and address data gaps and improve the flow of information through the MRV System. In addition, the Implementation Plan Templates such as the Coordinating Entity Checklist and the QA/QC Templates include actions for identifying and addressing data gaps.

CHAPTER THREE
THE NATIONAL GHG INVENTORY
(GREENHOUSE GAS EMISSIONS AND REMOVALS)

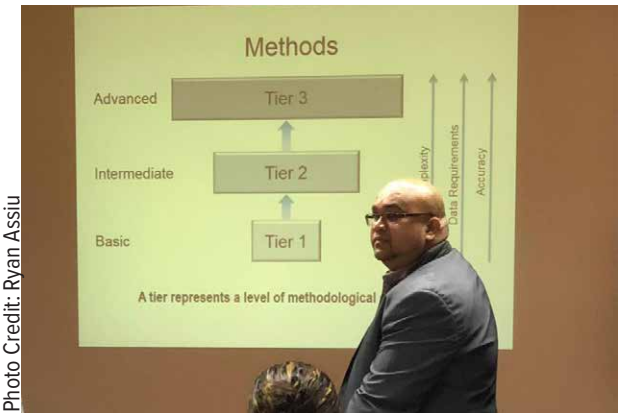


Photo Credit: Ryan Assiu

▲ Dr. Donnie Boodlal, GHG Consultant, delivering GHG Inventorying Training modules, September 25–28, 2018

Photo Credit: Ryan Assiu

▲ Cross section of participants in attendance at the GHG Inventorying Training Workshop, September 25–28, 2018

3.1 Introduction

This chapter provides an overview of Trinidad and Tobago's national Greenhouse Gas (GHG) emissions levels and the approaches used to estimate them. The information is reported in accordance with the accounting principles of Transparency, Accuracy, Consistency, Completeness and Comparability (TACCC) as stated in article 4.13 of the Paris Agreement.

This process identifies gaps for further action and capacity-building while the level of transparent reporting on the processes and experiences provides learning opportunities.

The United Nations Framework Convention on Climate Change (UNFCCC) Decision 2/CP.17 recommends that the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines be used for compiling GHG Inventories of non-Annex I Parties. However, for this inventory, Trinidad and Tobago utilised the IPCC 2006 Guidelines which improve on the 1996 IPCC Guidelines by providing more up-to-date default factors and detailed guidance for many inventory categories. Since the reporting on indirect GHGs, such as non-metallic volatile organic compounds, is not mandatory, these were not included due to data limitations.

The time series reported in this inventory is the period 2006–2018. This fulfills the mandate that the latest inventory year of the time series be no more than four years earlier than the current reporting year. In this case, the latest reporting year (2018) is within four years of the current reporting year 2021.

3.2 Overview of Current Inventory Management System

For the compilation of this inventory, no formalised national inventory management team was as yet established; however, the Ministry of Planning and Development acted as a coordinating entity to facilitate the required data collection and management since the country's MRV/KMS system was being developed and tested. The following are some of the key elements of the process:

- A GHG consultant was procured by the United Nations Development Programme (UNDP) and the Ministry of Planning and Development (MPD) to conduct the national GHG inventory for T&T from 2006–2018 using the IPCC 2006 Guidelines. The consultant's Terms of Reference (ToR) included the preparation of this chapter.
- The consultant reported to a Steering Committee which represented a wide cross-section of stakeholders from the UNDP, academia, Government and NGOs along with various sectoral experts. One of the Committee's responsibilities was to monitor tasks in line with the ToR to ensure that the deliverables were being achieved.
- The project had a designated project manager who facilitated all communications between the consultant and Steering Committee members. In addition, the Ministry of Planning and Development was responsible for coordinating and archiving data and documents related to the GHG inventory.

- The GHG consultant served as technical lead across all four sectors mentioned in the 2006 IPCC Guidelines (Energy, Industrial Processes & Product Use [IPPU], Waste, and Agriculture, Forestry & Other Land Use [AFOLU]).
- The consultant was responsible for quality control, key category analysis and uncertainty estimations.
- The results, assumptions and expert judgements were shared with sectoral experts and modified as required, based on feedback.
- GHG Inventory training sessions for capacity-building were conducted for key sectoral stakeholders and regulators. The training objective was to begin institutionalising the GHG Inventory process and procedural elements in preparation for the formalisation and full operation of the MRV/KMS system and, by extension, the next inventory cycle.
- The final draft inventory was subjected to an independent QA/QC analysis by a competent third party.

3.3 Inventory Overview: Scope and Methodology

This is Trinidad and Tobago's first BUR, with inventory estimates reported for the time series 2006–2018. This period continues from the last reported inventory year (2007) in the Second National Communication (SNC). Additional key points to be noted are:

- This chapter was done in conformity with the relevant UNFCCC reporting guidelines to the extent permitted by capacities and national circumstance.
- The inventory estimates were calculated in accordance with the 2006 IPCC Guidelines.
- Estimates were conducted on a gas-by-gas basis for CO_2, CH_4 and N_2O and reported as aggregated GHGs in CO_2 equivalents using the GWPs provided by the IPCC in its Fifth Assessment Report (AR5).
- To the extent capacities permit, emissions from international aviation and marine bunker fuels are also reported separately as a memo item in the inventory.
- For fuel combustion activities, sectoral and reference approaches are reported for all years (2006–2018).
- No recalculations or revisions were performed on the time series from base year to 2005 due to the unavailability of previous data sets and information.
- An uncertainty analysis was done using all default factors which found a level uncertainty of 9 percent and a trend uncertainty of 10 percent for the reported inventory.

Accordingly, the detailed results for Trinidad and Tobago, with all the sector models and comprehensive analyses, are available from the party on request. To accompany this chapter, a Technical Annex is provided with the summary tables.

3.4 Data Collection Methods

A series of meetings was held with the Steering Committee and the Project Management team to comprehensively identify the required activity data sets and relevant providers. The process of identifying requisite data was guided by the methodologies selected, using the decision trees provided in the 2006 IPCC guidelines. Once these data sets were identified the team selected suitable data providers, extracting from their knowledge of stakeholders previous inventory exercises and related projects and experiences. This list of data providers was further refined and updated after various stakeholder consultations and following recommendations from a GHG Inventory Quality Assurance Workshop which was organised by the UNFCCC and the Food and Agriculture Organization (FAO).

Primary data collection commenced incorporating a survey methodology and a request for specific activity data based on the sectoral guidance as outlined in the 2006 IPCC guidelines. Correspondence between the Permanent Secretary of the Ministry of Planning and Development (MPD) and data providers accompanied the requests to assist in easing the flow of the requested data.

During the primary data collection drive, formal written reminders and clarifications were sent

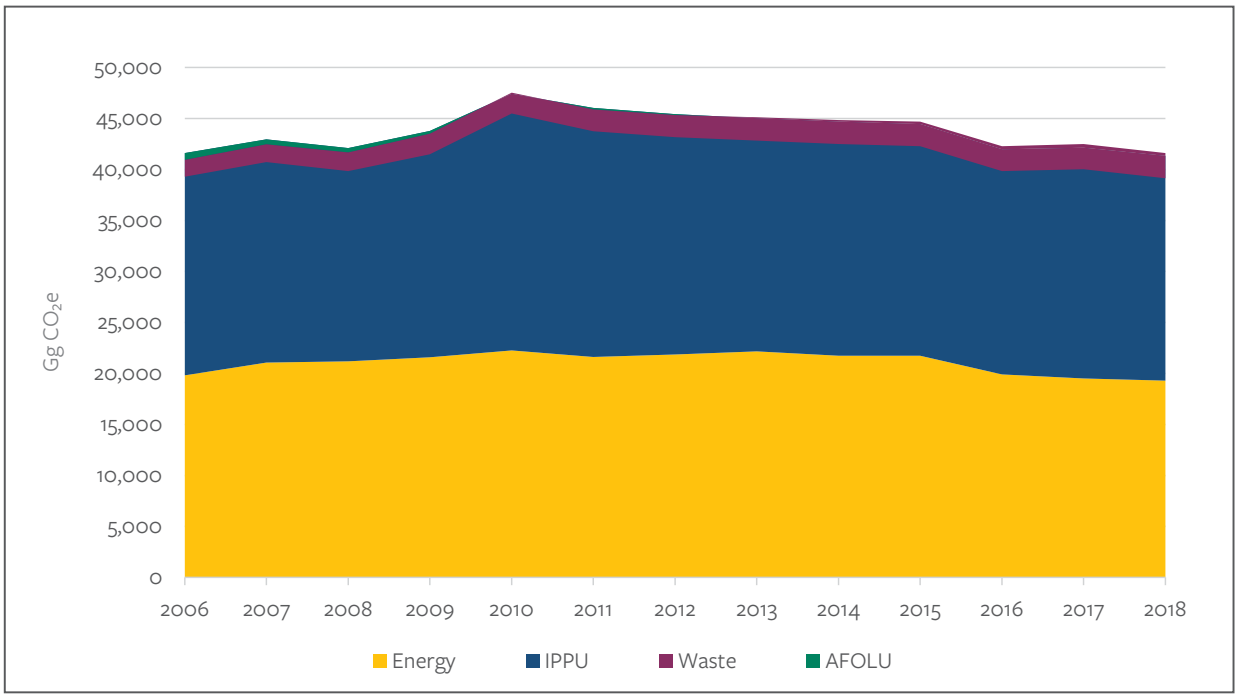


FIGURE 3.1 Total Gg CO_2e Emissions for T&T's Sectors (2006–2018)

out as necessary. All activity data sets are archived accordingly. Data were submitted directly to the MPD, which would be transferred and archived at the Environmental Management Authority (EMA) which is the custodian and manager of the country's KMS/MRV system. All archived data will be available for future GHG Inventory reporting cycles.

3.5 Quality Assurance and Quality Control Practices

Quality Assurance and Quality Control (QA/QC) are integral components of the IPCC 2006 guidelines since QA/QC practices contribute towards credible and reliable GHG inventories. Related to this, a robust quality assurance workshop was conducted by the UNFCCC and FAO during the period February 11–15, 2019, during which all the collected data and preliminary results (up to that date) were analysed. This current inventory benefitted tremendously from the rigorous exercise. As such, the findings and recommendations of this report include outcomes and recommendations from the UNFCCC and FAO teams.

In addition to the team's recommendation, the following QA/QC activities were devised and used by the consultant to further enhance the QA/QC of this inventory:

- cross-checking of activity input data for transcription errors
- cross-checking of unit conversion data to eliminate errors
- cross-checking emission factor and global warming potential (GWP) data with that listed in the 2006 IPCC guidelines and Fifth Assessment Report (AR5) for the purpose of consistency
- checks for unit consistency and labels in all sheets
- cross-checking other estimated parameters such as fuel density, etc., with those listed and documented
- checks for time series consistency for the reporting period (2006–2018)
- checks to confirm that assumptions were clearly documented
- checks to ensure consistency between data for different categories
- checking of each category and sub-category for completeness and/or omissions

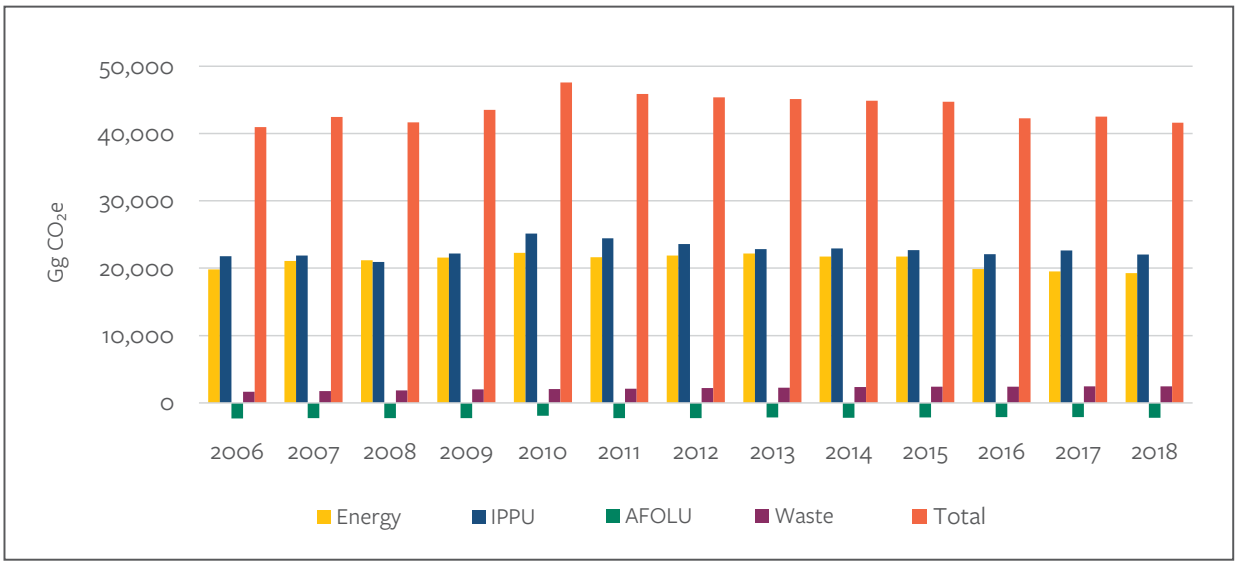


FIGURE 3.2 Total Gg CO_2e Emissions for T&T's Sectors (2006–2018) Showing Sources and Sinks

Further, the related Excel models were also used in a simultaneous exercise on emissions projections baseline setting, which provided an opportunity for independent analysis and comments before their incorporation into the inventory.

For this inventory cycle, no elaboration of internal QC checks from the data suppliers' side is presented. This is one area that has been marked for improvement in future reporting cycles and is later elaborated upon in the section on improvement plans. However, in many cases it was possible to verify submitted data with that from the national database using the MEEI bulletin reports, specifically for Energy and IPPU sub-categories. Notwithstanding this, some discrepancies persist that could not be resolved by the stakeholders. These are either outlined as relevant in the sectoral results sections or in the data gaps and improvement sections, presented at the end of this report.

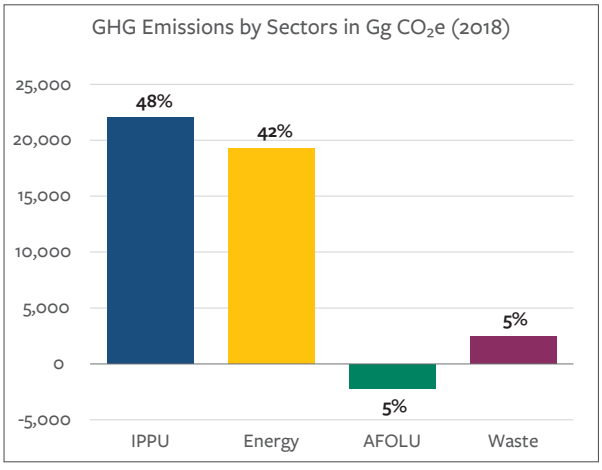


FIGURE 3.3 Total CO_2e Emissions for T&T (2018) ▲

3.6 Overview: Total General Results (Sectoral Analysis)

Trinidad and Tobago submitted its Second National Communication (SNC) in 2013 and its First National Communication (FNC) in 2001, both of which reported GHG inventories. However, the data sets used for these were not available for analysis in the production of this report. In addition, total overall summary tables were not embedded in the respective GHG inventory chapter of these previous submissions to allow their use in this report. Where sectoral values were reported in the FNC and SNC, they are appropriately referenced in this report.

For this reporting period, **FIGURE 3.1** and **FIGURE 3.2** illustrate the total GHG emissions for T&T (expressed in Gg CO_2e) over the inventory period (2006–2018) for the different sectors. In **FIGURE 3.1**, the sectoral results are summarised cumulatively and in **FIGURE 3.2** the same results are summarised via a bar chart. In **FIGURE 3.3**, the absolute emissions are presented to illustrate the relative size of each sector as it relates to GHG sources and sinks, the AFOLU sector being the only net sink for T&T.

TABLE 3.1 T&T's Emissions compared with Global Values (2018) ▼

Sector	T&T's Emissions	Global Values
IPPU	48%	6%
Energy	42%	73%
Waste	5%	3%
AFOLU	5%	18%
Total	**100**	**100**

These figures show that the total emissions in T&T increased over the period 2006–2010, followed by a general decrease from 2010 onwards. The decrease per annum from 2010 to 2018 is 867.4 Gg. This general trend and decrease are largely due to a decline in productivity of T&T's dominant IPPU and energy sectors as a result of lower natural gas supplies. Together, these two sectors contribute to approximately 90 percent of total emissions over the time series (see **FIGURE 3.3** for an example using 2018 data). This pattern is indicative of nations that are categorised as industrialised. This industrialised status is further exemplified when T&T's GHG emissions are compared with global values, as shown in **TABLE 3.1** where the carbon intensity of the combined IPPU and Energy sectors for T&T is more dominant compared to the AFOLU and waste sectors. This is mostly due to the large contribution of the IPPU sector in T&T.

The percentage change over the time series is presented in **TABLE 3.2**. As previously stated, although there was a general increase followed by a general decrease over 2006–2018, the resulting percentage change over the same period illustrated a 1.38 percent decrease in total emissions in 2018 when compared with 2006. Although the associated emissions in the waste sector increased by 49.49 percent, this overall percentage decrease occurred largely due to decreases in the Energy, IPPU and AFOLU sectors. The relatively significant growth of emissions in the waste sector was mainly due to its estimation using the First Order Decay (FOD) model which had not been used in previous estimations.

3.7 Overview: Total General Results (Gas Analysis)

FIGURE 3.4 illustrates the total GHG emissions for T&T (expressed in Gg CO_2e) over the inventory period for the different GHGs. From this figure, one can see that the related emissions in T&T over this period are largely dominated by CO_2 of approximately 85 percent, followed by CH_4 of approximately 12.5 percent and N_2O

TABLE 3.2 GHG Emissions in T&T in Gg CO_2e and Percentage Change over the Time Series

	2006	2007	2008	2009	2010	2011	2012
Sector	**Gg CO_2-eq**						
Energy	19817.22	21062.05	21194.72	21590.48	22265.95	21606.92	21860.55
IPPU	23020.14	23174.96	21721.89	22885.54	26145.28	25517.89	24646.09
AFOLU	–2304.13	–2237.62	–2276.62	–2278.84	–1917.98	–2272.17	–2262.06
Waste	1647.12	1737.00	1836.15	2007.91	2045.08	2111.80	2184.96
Total	**42180.34**	**43736.39**	**42476.15**	**44205.10**	**48538.34**	**46964.44**	**46429.55**

	2013	2014	2015	2016	2017	2018	% change (2006 & 2018)
Sector	**Gg CO_2-eq**						
Energy	22181.02	21736.61	21740.90	19896.85	19498.44	19285.16	–2.68
IPPU	23812.88	23788.01	23119.13	22077.59	22641.14	22043.79	–4.24
AFOLU	–2177.54	–2197.56	–2161.15	–2128.13	–2106.34	–2192.42	–4.85
Waste	2274.75	2351.99	2427.99	2430.52	2450.16	2462.32	49.49
Total	**46091.10**	**45679.04**	**45126.86**	**42276.82**	**42483.41**	**41598.85**	**–1.38**

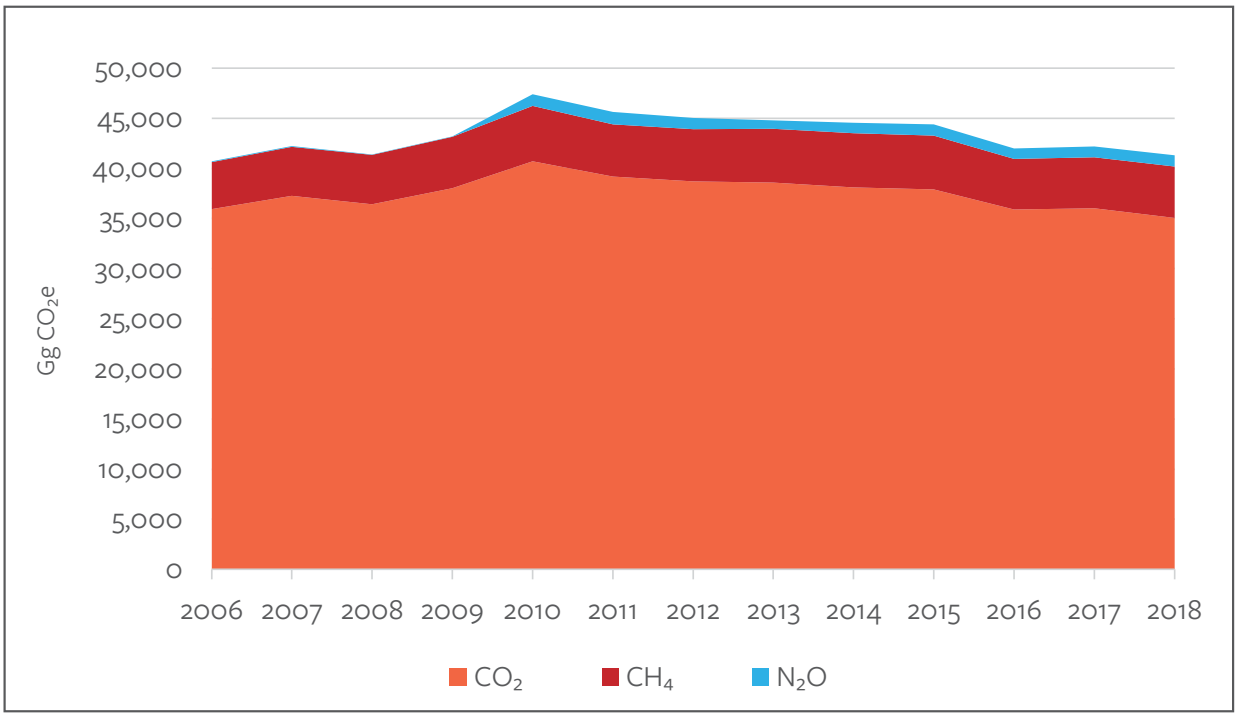


FIGURE 3.4 Gg CO_2e Emissions in T&T by Different Primary GHGs (2006–2018)

of approximately 2.5 percent. The "F" Gases were not included in these tables but are now being assessed and should be submitted as a supplementary report.

TABLE 3.3 illustrates how the percentage values changed for the reported GHGs over the time horizon, with the biggest percentage change occurring in N_2O, owing to the introduction of Nitric Acid Production in 2010.

Key Category Analysis (KCA)

As 2018 is the latest year in this time series, Approach 1 key category analysis (level) was completed for 2018

TABLE 3.3 GHG Gases in Gg CO_2e for T&T (2006–2018)

	2006	2007	2008	2009	2010	2011	2012
Sector				Gg CO_2-eq			
CO_2	37163.50	38480.32	37219.34	38702.01	41536.63	40276.28	39762.34
CH_4	4684.38	4907.99	4905.68	5141.15	5527.22	5193.18	5215.53
N_2O	332.46	348.07	351.13	361.93	1474.49	1494.98	1451.68
Total	**42180.34**	**43736.39**	**42476.15**	**44205.10**	**48538.34**	**46964.44**	**46429.55**

	2013	2014	2015	2016	2017	2018	% change (2006 & 2018)
Sector				Gg CO_2-eq			
CO_2	39506.84	38901.15	38290.87	35855.02	35945.37	35017.64	–5.77
CH_4	5392.51	5403.54	5346.29	5024.48	5099.80	5145.88	9.85
N_2O	1191.76	1374.35	1489.69	1397.33	1438.24	1435.33	331.73
Total	**46091.10**	**45679.04**	**45126.86**	**42276.82**	**42483.41**	**41598.85**	**–1.38**

TABLE 3.4 Approach 1 Level Key Category Analysis for T&T (2018)

A	B	C	D	E	F
IPCC Category	Greenhouse gas	2018 Ex,t (Gg CO_2 Eq)	|Ex,t| (Gg CO_2 Eq)	Lx,t	Cumulative Total of Column E
Ammonia Production	Carbon dioxide (CO_2)	16382.81152	16382.81152	0.350830094	0.350830094
Energy Industries—Gaseous Fuels	Carbon dioxide (CO_2)	12342.93811	12342.93811	0.264318132	0.615148226
Petrochemical and Carbon Black Production	Carbon dioxide (CO_2)	3404.605	3404.605	0.072907992	0.688056218
Forest land Remaining Forest land	Carbon dioxide (CO_2)	-2708.317277	2708.317277	0.057997323	0.746053541
Road Transportation	Carbon dioxide (CO_2)	2563.393972	2563.393972	0.054893859	0.8009474
Solid Waste Disposal	Methane (CH_4)	2199.213816	2199.213816	0.047095115	0.848042515
Natural Gas	Methane (CH_4)	2068.623745	2068.623745	0.044298591	0.892341105
Natural Gas	Carbon dioxide (CO_2)	1594.198628	1594.198628	0.034139003	0.926480109
Nitric Acid Production	Nitrous Oxide (N_2O)	1025.63745	1025.63745	0.021963537	0.948443645
Iron and Steel Production	Carbon dioxide (CO_2)	553.0938	553.0938	0.01184424	0.960287885
Petrochemical and Carbon Black Production	Methane (CH_4)	327.2486	327.2486	0.007007873	0.967295758
Cement production	Carbon dioxide (CO_2)	322.7229408	322.7229408	0.006910958	0.974206716
Wastewater Treatment and Discharge	Methane (CH_4)	268.4697296	268.4697296	0.005749151	0.979955867
Oil	Carbon dioxide (CO_2)	179.1350371	179.1350371	0.003836091	0.983791958
Non-Specified—Gaseous Fuels	Carbon dioxide (CO_2)	178.123455	178.123455	0.003814429	0.987606387
Energy Industries—Liquid Fuels	Carbon dioxide (CO_2)	128.462289	128.462289	0.002750959	0.990357346
Oil	Methane (CH_4)	91.81791835	91.81791835	0.001966237	0.992323583
Enteric Fermentation	Methane (CH_4)	80.693508	80.693508	0.001728013	0.994051596
Water-borne Navigation—Liquid Fuels	Carbon dioxide (CO_2)	70.54319081	70.54319081	0.001510649	0.995562244
Emissions from biomass burning	Methane (CH_4)	41.69359413	41.69359413	0.000892848	0.996455093
Urea application	Carbon dioxide (CO_2)	33.89906667	33.89906667	0.000725932	0.997181025
Road Transportation	Nitrous Oxide (N_2O)	33.35102101	33.35102101	0.000714196	0.997895221
Manure Management	Methane (CH_4)	24.7501436	24.7501436	0.000530013	0.998425234
Iron and Steel Production	Methane (CH_4)	22.123752	22.123752	0.00047377	0.998899004
Road Transportation	Methane (CH_4)	19.46903803	19.46903803	0.00041692	0.999315924
Emissions from biomass burning	Nitrous Oxide (N_2O)	11.62306248	11.62306248	0.000248902	0.999564826
Energy Industries—Gaseous Fuels	Methane (CH_4)	6.160468217	6.160468217	0.000131923	0.99969675
Energy Industries—Gaseous Fuels	Nitrous Oxide (N_2O)	5.830443134	5.830443134	0.000124856	0.999821606
Glass Production	Carbon dioxide (CO_2)	5.5427295	5.5427295	0.000118695	0.999940301
Oil	Nitrous Oxide (N_2O)	0.742143128	0.742143128	1.58926E-05	0.999956193
Water-borne Navigation—Liquid Fuels	Nitrous Oxide (N_2O)	0.504559934	0.504559934	1.08049E-05	0.999966998
Civil Aviation	Carbon dioxide (CO_2)	0.381012902	0.381012902	8.15921E-06	0.999975157
Natural Gas	Nitrous Oxide (N_2O)	0.32384738	0.32384738	6.93504E-06	0.999982092
Energy Industries—Liquid Fuels	Nitrous Oxide (N_2O)	0.275647827	0.275647827	5.90287E-06	0.999987995
Water-borne Navigation—Liquid Fuels	Methane (CH_4)	0.186591976	0.186591976	3.99578E-06	0.999991991
Energy Industries—Liquid Fuels	Methane (CH_4)	0.145625267	0.145625267	3.1185E-06	0.99999511
Non-Specified—Gaseous Fuels	Methane (CH_4)	0.088902972	0.088902972	1.90381E-06	0.999997013
Non-Specified—Gaseous Fuels	Nitrous Oxide (N_2O)	0.084140313	0.084140313	1.80182E-06	0.999998815
Wastewater Treatment and Discharge	Nitrous Oxide (N_2O)	0.032109891	0.032109891	6.87618E-07	0.999999503
Other (please specify)	Methane (CH_4)	0.0200928	0.0200928	4.30278E-07	0.999999933
Civil Aviation	Nitrous Oxide (N_2O)	0.002884812	0.002884812	6.17769E-08	0.999999995
Other Sectors—Liquid Fuels	Carbon dioxide (CO_2)	0.000163669	0.000163669	3.50489E-09	0.999999998
Civil Aviation	Methane (CH_4)	7.62026E-05	7.62026E-05	1.63184E-09	1
Other Sectors—Liquid Fuels	Methane (CH_4)	6.54676E-07	6.54676E-07	1.40196E-11	1
Other Sectors—Liquid Fuels	Nitrous Oxide (N_2O)	3.71762E-07	3.71762E-07	7.96111E-12	1

TABLE 3.5 Sectoral Results—T&T's Energy Sector

	Emissions (Gg)			Emissions (Gg)						
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
1—Energy	**17057.18**	**78.09**	**0.16**				**0.00**	**0.00**	**0.00**	**0.00**
1.A—Fuel Combustion Activities	15283.84	0.93	0.15				NE	NE	NE	NE
1.B—Fugitive emissions from fuels	1773.33	77.16	0.00				NE	NE	NE	NE
1.C—Carbon dioxide Transport and Storage	NO						NO	NO	NO	NO

as illustrated in **TABLE 3.4**, with key categories shown in red. Categories within the Energy and IPPU sectors dominate the highlighted key categories with Ammonia Production and Gaseous Energy Fuels combining to account for over 60 percent of emissions. Other notable categories outside the Energy and IPPU sectors include Solid Waste Disposal and Forest Land Remaining Forest Land. It should also be noted that this KCA (level) was carried out using the IPCC 2006 software whilst the other tables in the report were completed using Excel calculation sheets. This contributed to a slight difference in total values reported due to the rounding-off of decimal places. KCA (trend) was not completed during this report but will be completed during the next reporting cycle.

3.8 The Energy Sector

The sectoral summary results for energy are presented in **TABLE 3.5**. In addition, the general emission trend, based on the sectoral approach can be seen in **FIGURE 3.5**. This figure illustrates a gradual increase in energy sector emissions from 19,817 Gg CO_2e in 2006, to 22,266 Gg CO_2e in 2010, followed by a general decrease from 2010 onwards to 19,285 Gg CO_2e in 2018. This mirrors the same trend presented earlier for total emissions.

This emission trend in energy sector emissions can be mirrored with natural gas usage in the country (**FIGURE 3.6**). As such, natural gas usage can be identified as the main driver of emissions within T&T's energy sector.

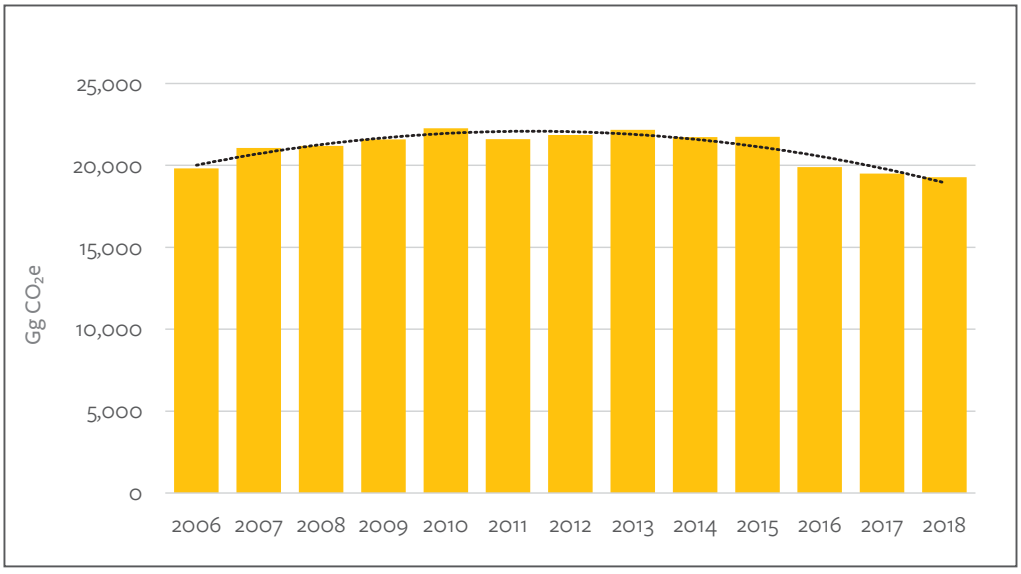


FIGURE 3.5 Total CO_2e Emissions in T&T's Energy Sector in Gg (2006–2018)

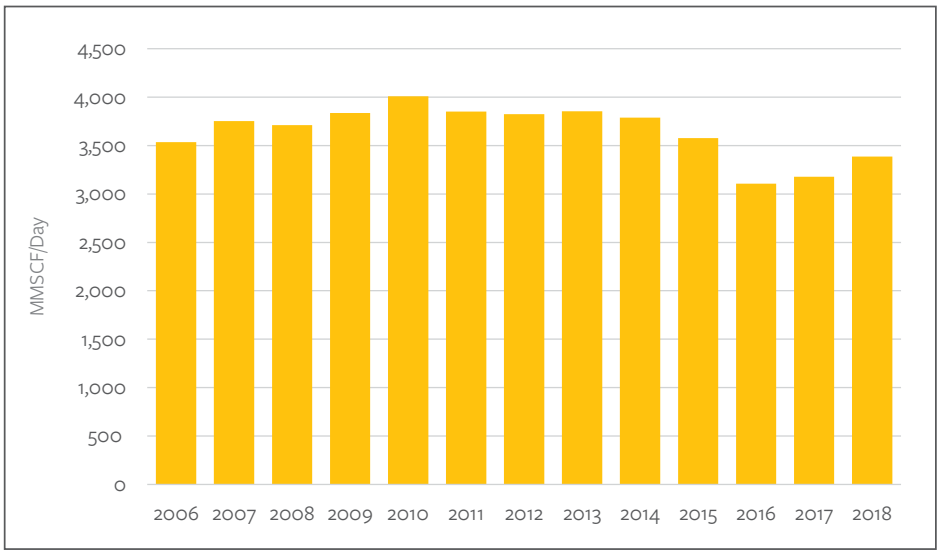


FIGURE 3.6 Natural Gas Consumption in T&T, MMSCF/Day (2006–2018)

For the latest inventory year in this time series (2018), the energy sector sub-categories are shown in **FIGURE 3.7** and a key category analysis is illustrated in **TABLE 3.6**.

With respect to trends in the power generation sub-category, emissions gradually increased at an average rate of 213.17 Gg CO_2e per annum, from 5,856 Gg CO_2e in 2006 and peaking in 2012 at 7,135 Gg CO_2e, before decreasing steadily at a similar average rate of 232.17 per annum to 5,742 Gg CO_2e in 2018. Overall, when compared with 2006, the associated emissions in 2018 decreased by 2 percent.

When examining the same for the transport sector sub-category, emissions gradually increased at an average rate of 62 Gg CO_2e per annum from 2,560 Gg CO_2e in 2006, peaking in 2015 at 3,268 Gg CO_2e, before decreasing drastically at an average rate of 193.3 per annum to 2,,688 Gg CO_2e in 2018. In spite of this recent decreasing trend overall, the associated emissions in 2018 increased by 5 percent when compared with 2006. International bunkers are reported separately in the detailed sheets which are available upon request.

A comparison of the results of the Reference Approach (RA) and Sectoral Approach (SA) shows a difference of 10 percent between the RA of 21.3 Gg and the SA of 19.3 Gg. This same difference is typical for recent years with a steady decline of 21 percent having

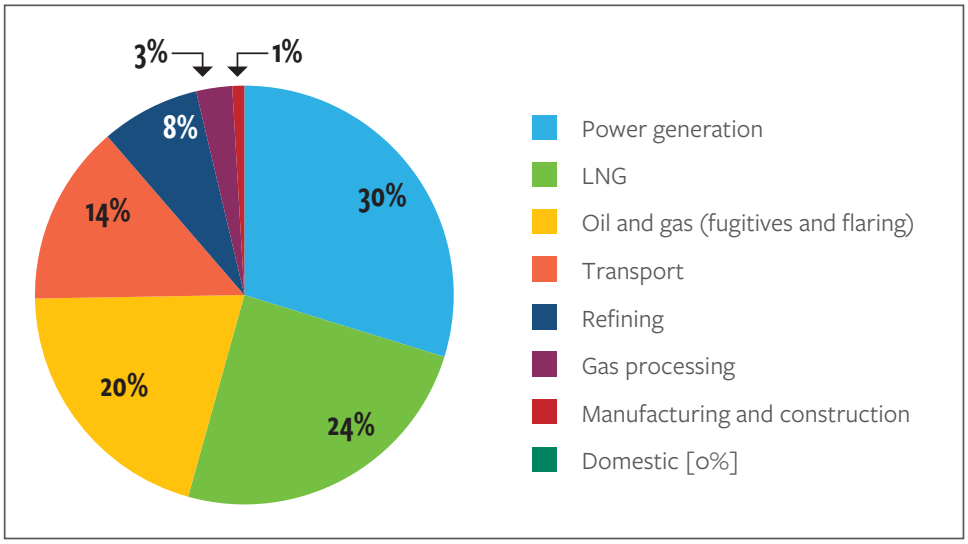


FIGURE 3.7 Sub-sectoral Breakdown of T&T's Energy Sector Emissions (%), 2018

TABLE 3.6 Key Category Analysis—Energy Sector

Categories	Emissions (Gg CO_2e)	Percentage	Cumulative Percentage
Power Generation	5,742	29.77222	29.77222
Oil and Gas (Fugitives and Flaring)	3,935	20.40215	50.17438
LNG	4,736	24.56056	74.73494
Transport	2,688	13.93756	88.67250
Refining	1,471	7.62748	96.29998
Gas Processing	535	2.77363	99.07361
Manufacturing and Construction	179	0.92639	100.00000
Domestic Cooking (LPG)	0.0002	0.00000	
Total	**19,285**	**100**	

been recorded in 2006. This is a marked improvement from that reported in the SNC. This improvement can be attributed to improved data sets being available during this reporting period when compared with that for the SNC. As such, it was possible to identify excluded totals used in other sectors, such as IPPU.

Key Assumptions and Guiding Statements (Energy Sector)

The following guiding statements and assumptions were applied in estimating the results for the energy sector.

- Since fuel densities can vary based on compositions, temperatures and pressures, the fuel density values used were based on average values at normal room temperature and pressure.
- For associated emissions with respect to stationary combustion, the following applied:
  - + Since country-specific emission factors were not available, the associated default factors were applied using the Tier 1 approach.
  - + Auto-generation was taken into account.
  - + Since data were not disaggregated for the sub-categories under manufacturing and construction, these related emissions were "Included Elsewhere (IE)" as applicable and reported under "non-specified".
  - + Related activity data were acquired through primary data collection in units of volume.
  - + Prevailing activity data gaps were then filled using national statistics.
- For associated emissions with respect to mobile combustion, the following applied:
  - + Since country-specific emission factors were not available, associated default factors were applied using the Tier 1 approach.
  - + Only fuel sales activity data were available and these were acquired through primary data collection in units of volume.
  - + Prevailing activity data gaps were then filled using national statistics.
  - + Since fuel sales data were not disaggregated within categories, the reported values under road transportation all include off-road, agriculture and military as part of transport emissions, as a whole.
  - + Fuel blending (diesel oil with kerosene) was integrated into these estimations.
  - + Although fuel smuggling has been reported by the media, this could not be integrated into the estimate since the relevant volumes are not known.
  - + Gasoline vehicles were assumed to be low mileage and light duty, as categorisation data were not readily available for motor gasoline.
  - + Diesel road vehicles were assumed to be heavy duty diesel trucks as categorisation data were not readily available for diesel.
- For associated emissions with respect to fugitive emissions, since country-specific emission factors were not known, IPCC defaults (lower limits for developing countries) were used.

TABLE 3.7 Sectoral Results—T&T's IPPU Sector

	Emissions (Gg)			Emissions (Gg)						
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
2—Industrial Processes and Product Use	**20668.78**	**12.48**	**3.87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2.A—Mineral Industry	328.27	NE	NE				NE	NE	NE	NE
2.B—Chemical Industry	19787.42	11.69	3.87	NE	NE	NE	NE	NE	NE	NE
2.C—Metal Industry	553.10	0.79	NE	NE	NE	NE	NE	NE	NE	NE
2.D—Non-Energy Products from Fuels and Solvent Use	NE	NE	NE				NE	NE	NE	NE
2.E—Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F—Product Uses as Substitutes for Ozone Depleting Substances				NE	NE		NE	NE	NE	NE
2.G—Other Product Manufacture and Use	NO	NO	NO	0	0	0	NO	NO	NO	NO
2.H—Other	NO	NO	NO				NO	NO	NO	NO

3.9 The IPPU Sector

TABLE 3.7 illustrates the sectoral results for T&T's IPPU sector while **FIGURE 3.8** illustrates the associated emissions and trends for this sector over the inventory period. As with total emissions and energy sector emissions, this sector also appears to be driven by natural gas consumption, owing to the intensities of the ammonia and methanol-related emissions which, together, account for over 90 percent of sectoral emissions. To further exemplify this, a detailed breakdown of this sector is presented in **FIGURE 3.9**, followed by a key sub-category analysis in **TABLE 3.8** with the key sub-categories, all natural gas-based, shown in red.

Key Assumptions and Guiding Statements

The following guiding statements and assumptions were applied in estimating the results for the IPPU sector.

- For associated emissions with respect to ammonia production:
  - + Data were not received from all stakeholders and the ensuing data gaps were filled using national statistics from the Ministry of Energy and Energy Industries, and the Central Bank of Trinidad and Tobago.
  - + A Tier 1 level of estimation was used with country-specific emission factors that are

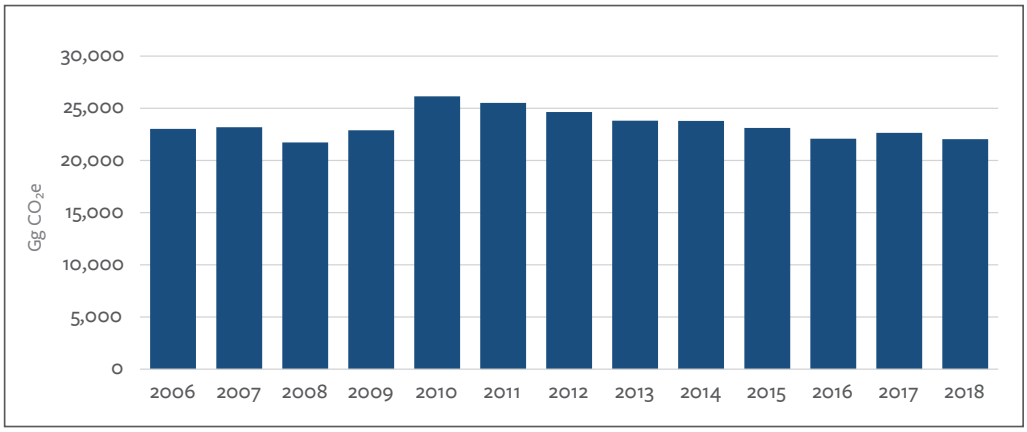
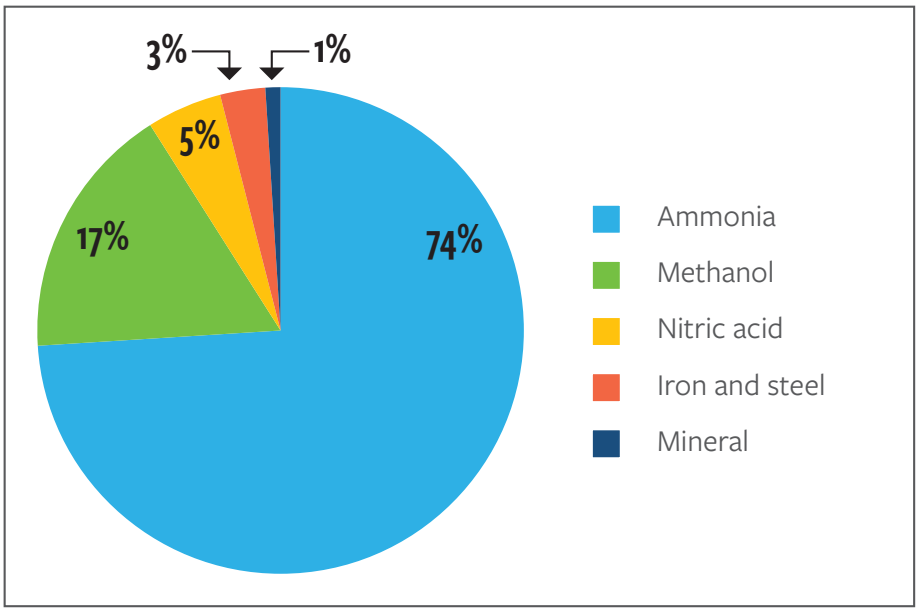


FIGURE 3.8
Total Gg CO_2e Emissions in T&T's IPPU Sector (2006–2018)

FIGURE 3.9 Sub-sectoral Breakdown of T&T's IPPU Sector Emissions (%), 2018



expected to be validated before the next reporting cycle.

- For associated emissions with respect to methanol production:
  - + Data were not received from all stakeholders and the ensuing data gaps were filled using national statistics from the Ministry of Energy and Energy Industries, and the Central Bank of Trinidad and Tobago.
  - + A Tier 1 level of estimation was used with country-specific emission factors[1] that are expected to be validated before the next reporting cycle.
- For associated emissions with respect to cement production, the following applied:
  - + Since only cement production and clinker fraction data were received, a Tier 1 level of estimation was applied.
- For Iron and Steel, a Tier 1 estimation was done using data received from both manufacturing facilities. However, one manufacturing facility ceased operations in 2015 and this is reflected in the data files as zeros.
- Due to the unavailability of activity data for this reporting period, it was not possible to estimate emissions from activities such as Lime Production, Non-energy Products from Fuel and Solvent Use. These areas are expected to be included in future reporting cycles.
- The "*F*" Gases were not included in these tables but are being assessed and should be submitted as a supplementary report.
- All other categories were also estimated using a Tier 1 approach with default emission factors.

TABLE 3.8 Key Category Analysis—T&T's IPPU Sector ▼

IPPU Key Category Analysis, 2018		Percentage	Cumulative
Ammonia	16383	74.31940989	74.31940989
Methanol	3732	16.92927719	91.24868709
Nitric Acid	1026	4.652728255	95.90141534
Iron and Steel	575	2.60943178	98.51084712
Mineral	328	1.489152877	100
Total	**22043.79**	**100.00**	

1 The country-specific emission factor will be validated for the next reporting cycle and therefore, subject to that validation, the current estimated emissions will need to be interpreted in that context. Accordingly, the next reporting cycle would therefore contain any revisions to this estimate.

TABLE 3.9 Sectoral Results—T&T's AFOLU Sector

	Emissions (Gg)			Emissions (Gg)						
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
3—Agriculture, Forestry, and Other Land Use	**-2674.42**	**5.26**	**0.04**	**0.00**	**0.00**	**0.00**	**0.35**	**22.79**	**0.00**	**0.00**
3.A—Livestock		3.77	NE				NE	NE	NE	NE
3.B—Land	-2708.32		NE				NE	NE	NE	NE
3.C—Aggregate sources and non-CO_2 emissions sources on land	33.90	1.49	0.04				0.35	22.79	NE	NE
3.D—Other	NO	NO	NO				NO	NO	NO	NO

3.10 The AFOLU Sector

The sectoral summary is presented in **TABLE 3.9** and the trends in emissions for T&T's AFOLU sector over the time horizon are presented in **FIGURE 3.10**. From this, we can see that this sector is a net sink owing to the large contribution of the forestland biomass sub-category. A related key category analysis is presented in **TABLE 3.10** with the key categories shown in red.

Key Assumptions and Guiding Statements (AFOLU Sector)

Estimation of T&T's emissions from the AFOLU sector was very challenging owing to large data gaps over the reported time series. As such, this is one area identified for data collection and data archiving capacity-building.

In order to compute associated emissions, a fair number of assumptions, expert judgement and

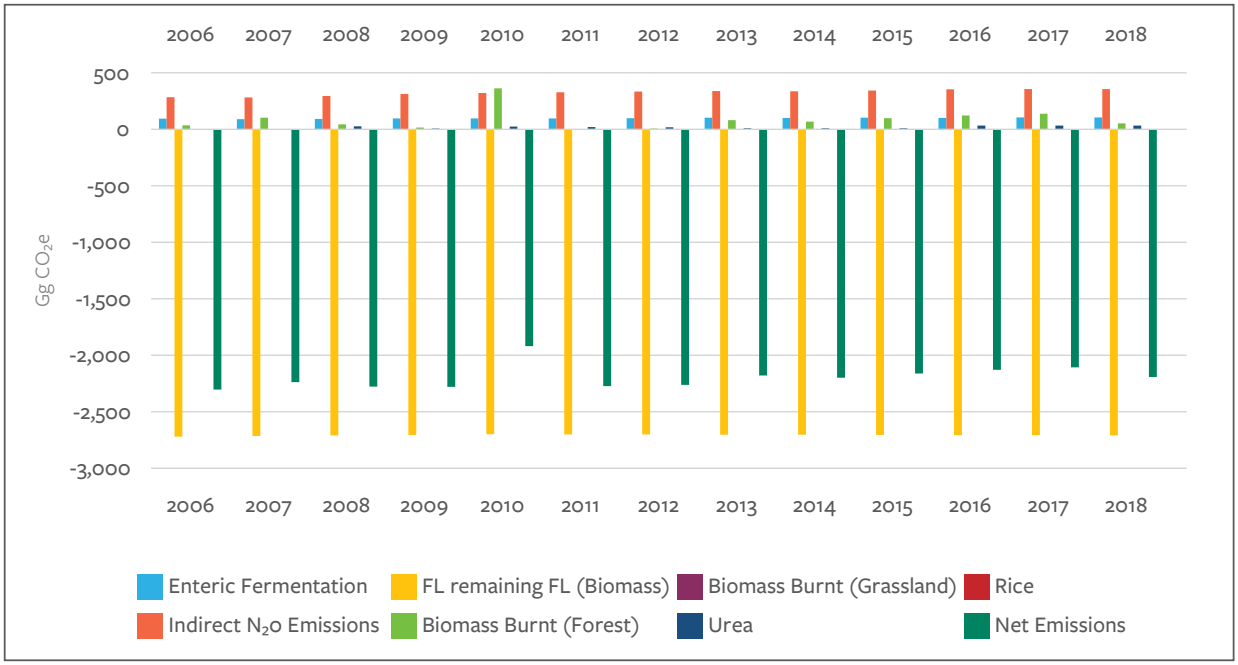


FIGURE 3.10 Total Gg CO_2e Emissions in T&T's AFOLU Sector (2006-2018)

TABLE 3.10 Key Category Analysis for AFOLU Sector (2018)

Sub-categories	Total	%	Cumulative %
FL remaining FL (Biomass) (Gg CO_2e)	2708.313857	83.12536388	83.12536388
Indirect N20 Emissions (Gg CO_2e)	356.9006682	10.95423185	94.07959573
Enteric Emissions (Gg CO_2e)	105.4764945	3.237354475	97.31695021
Biomass Burnt (Forest) (Gg CO_2e)	53.26199137	1.63475234	98.95170255
Urea (Gg CO_2e)	33.89906667	1.040452621	99.99215517
Rice (Gg CO_2e)	0.200928	0.006167015	99.99832218
Biomass Burnt (Grassland) (Gg CO_2e)	0.054665122	0.001677818	100
TOTAL	**3258.107671**	**100**	

omissions had to be adopted. An outline of these assumptions, judgements and some useful guiding statements are provided below and were necessary where country-specific data were not available. These assumptions are consistent with that prescribed in the IPCC 2006 methodology.

- Emissions from enteric fermentation and manure management were quantified largely from activity data gathered from FAOSTAT and default emission factors from the IPCC 2006 methodology.
- Since the data for cattle were not obtained in a disaggregated manner, a 50:50 split was assumed with respect to dairy cows and other cattle.
- To acquire default factors for livestock as needed, the Latin America Region was assumed to apply to T&T.
- With respect to manure management, daily spread was assumed for all categories.
- With respect to land use, though some data were acquired from the Forestry Division of the Ministry of Agriculture, Land and Fisheries (MALF), data sets from the FAOSTAT were more complete and were consequently used.
- Data on the nature of conversion between land categories were not available. As such, this was not integrated into the estimations.
- The definitions of each land type were taken as outlined in the IPCC 2006 methodology as country-specific formal definitions were not yet formulated.
- The Tropical Rain Forest Ecological zone was applied for all land categories.
- Croplands were further divided into two sub-categories for assessing carbon stock changes and associated GHG emissions and removals. These were woody and non-woody. The basis for the division was provided by the Forestry Division of the MALF.
- Grasslands were further divided into two sub-categories for assessing carbon stock changes and associated GHG emissions and removals. These were woody and non-woody. The basis for the division was provided by the Forestry Division of the MALF.
- No data were available to estimate loss in biomass due to removals, fuel wood or disturbances (FAO and otherwise) and as such, this was not factored into the estimation.
- High clay content mineral soil type was assumed in accordance with the IPCC 2006 methodology.
- Since liming data were not available by land area, this was not integrated into the estimations.

TABLE 3.11 Sectoral Results—T&T's Waste Sector

	Emissions (Gg)			Emissions (Gg)						
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
4—Waste	**0.00**	**88.13**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
4.A—Solid Waste Disposal		78.54					NE	NE	NE	NE
4.B—Biological Treatment of Solid Waste		NE	NE				NE	NE	NE	NE
4.C—Incineration and Open Burning of Waste	NE	NE	NE				NE	NE	NE	NE
4.D—Wastewater Treatment and Discharge		9.59	0.00				NE	NE	NE	NE
4.E—Other (please specify)	NO	NO	NO				NO	NO	NO	NO
5—Other	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A—Indirect N_2O emissions from the atmospheric deposition of nitrogen in NO_x and NH_3			NE				NE	NE	NE	NE
5.B—Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

3.11 The Waste Sector

The sectoral analysis summary is presented in **TABLE 3.11** and the trends in emissions for this sector over the time horizon is presented in **FIGURE 3.11**, followed by a key sub-category analysis in **TABLE 3.12**. These all illustrate that the main sub-categories for T&T's waste sector are the municipal solid waste, which follows the FOD model, and industrial wastewater, owing to the extent of industrialisation in T&T.

Key Assumptions and Guiding Statements (Waste Sector)

The following guiding statements and assumptions applied in estimating the results for the Waste sector and were necessary where country-specific data were not available. These assumptions are consistent with that prescribed in the IPCC 2006 methodology.

- For associated emissions with respect to solid waste, the following applied:

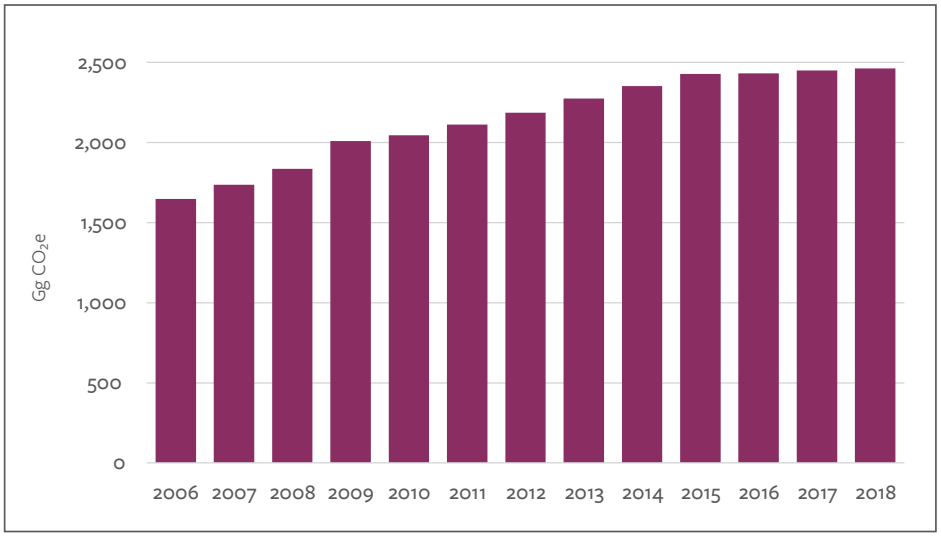


FIGURE 3.11 Total Gg CO_2e Emissions in T&T's Waste Sector (2006—2018)

TABLE 3.12 Key Category Analysis—T&T's Waste Sector (2018)

Sub-Categories	Gg CO_2e	Percentage	Cumulative %
Solid Waste	2193.088422	89.0658686	89.0658686
Liquid Industrial	223.9770456	9.096172281	98.16204088
Liquid Domestic	45.2247264	1.836669921	99.9987108
Indirect N_2O	0.031744274	0.001289201	100
Total	**2462.321938**	**100**	

- + The first order decay model (Tier 1) was used.
- + Activity data were received from the SWMCOL for waste characterisation but the default waste characterisation data were used as the submitted data varied by grouping categories with that needed in the FOD model.
- + Country-specific values were used for waste generation rate, and percentage of industrial waste going to the SWDS with the intention that these would be validated by the next reporting cycle.
- + Activity data were generated over a 50-year time horizon using waste generation rates and population size.
- + The IPCC waste model was used.
- + A delay time of six months was assumed.
- + IPCC default values were applied for DOC_f, MCF, methane fractions, and methane generation rates.
- + Country-specific data were used to define the distribution of waste by waste management type.
- + Based on guidance from the local stakeholder, it was assumed that one percent of industrial solid waste entered the landfills[2].
- + No methane recovery was applied.

- For associated emissions with respect to domestic wastewater, the following applied:
  - + Default BOD values were used (kgBOD/cap/year).
  - + These activity data were then combined with IPCC defaults for maximum methane correction capacity (0.6) and methane correction factor (0.3) to estimate the emission factor for T&T.
  - + Three income groups were used (rural, urban high and urban low) with the default distribution of 25 percent, 19 percent and 56 percent, respectively, to combine with IPCC's default utilisation rates to estimate the associated emission levels.
- For associated emissions with respect to industrial wastewater the following applied:
  - + Due to limited activity data, only three sub-categories (beer & malt, pulp & paper and organics) were estimated.
  - + It was assumed that 75 percent of the sludge from the waste basins are removed annually.
  - + Since country-specific factors were not available, the IPCC defaults were consistently applied in making an estimate that could be improved upon for future reporting.
- For associated emissions with respect to indirect N_2O emissions, the following applied:
  - + It was assumed that all nitrogen is discharged with the effluent.
  - + It was assumed that N_2O production in rivers and estuaries is directly related to the nitrogen that is discharged into the river.
  - + The IPCC defaults were consistently applied since country-specific factors were not available.
  - + Related activity data and protein consumption rates were sourced from FAOSTAT.

2 Subject to the expected more accurate estimations, this assumption, and the resulting emissions estimate, may be subject to revision in the next reporting cycle.

3.12 Data/Information Gaps

Every effort was made to ensure a complete inventory. However, due to data limitations and gaps, some sub-categories could not be estimated in this inventory cycle or were included elsewhere. These are well noted and are listed below so that the gaps can be addressed in future reporting cycles.

- With respect to the energy sector:
  - manufacturing industry and construction (1.A.2) were Included Elsewhere (IE) under Non-specified stationary (1.A.5) as this data could not be appropriately disaggregated; and
  - road transportation (1.A.3.b) could not be disaggregated further into the different sub-categories.
- With respect to the IPPU sector, the following sub-categories were Not Estimated (NE) as the data were not readily available and the effort required to gather the data in this cycle was disproportionate with the expected change in results:
  - lime production (2.A.2)
  - non-energy products from fuels and solvents (2D)
  - product uses as substitutes for ozone depleting substance (2F)
- With respect to the AFOLU sector, the following categories were NE as data were not available:
  - all land conversions
  - emissions related to wetlands, settlements and other land
  - liming emissions
  - soil-related emissions
  - harvested wood-related emissions
- With respect to the waste sector, the following sub-category was NE as data were not available:
  - incineration and open burning (4C)

3.13 Improvement Plans

As articulated before, the GHG Inventory assignment for T&T's BUR-1 followed a consultant-based model. However, the country integrated many key procedural elements during the project to enable a transition towards institutionalising the inventory process for future reporting cycles. Some of these key aspects are listed as follows:

- The MRV/KMS system has been established and the enabling legislative environment is being created to facilitate mandatory reporting of GHG emissions.
- Training of key stakeholders, including the Ministry of Planning and Development's Environmental Planning and Policy Division (MPD-EPPD), the Environmental Management Authority (EMA) and sectoral experts in GHG Inventorying, using the IPCC 2006 guidelines and associated software
- Training of key sectoral stakeholders in the related activity data sets to assist in providing the activity data in the format required for GHG inventory
- Constituting the appropriately trained ministries, departments and agencies into a formalised GHG inventory National Management System (NMS) referred to as the Monitoring, Reporting and Verification (MRV) system
- All relevant ministries, departments, agencies and sectoral experts were appropriately trained with the MRV system and in the use of the KMS. In addition, related pilot projects were launched to test the system.
- Continued efforts towards the introduction of GHG inventory curriculum in relevant universities that could be pursued to assist with the integration into GHG-NMS for future GHG inventory support.

While there is recognition of good progress, the following gaps have been identified and will be addressed before the next inventory cycle.

- The need for more training with respect to activity data sets in the format required for GHG inventories in the AFOLU and Waste sectors
- The need for more training with respect to uncertainties in activity data to enable data providers to report such as required for GHG inventories
- The need to develop sectoral disaggregated category manuals, based on 2006 IPCC guidelines, as national sectoral workbooks for future GHG inventory training, preparation and institutional memory.

CHAPTER FOUR
MITIGATION ACTIONS

Photo Credit: Ministry of Energy and Energy Industries

▲ Solar PV and Solar Stills, Parvati Girls' Hindu College, Debe Trinidad, 2014

4.1 Background

This chapter covers the climate change mitigation actions being implemented and planned by Trinidad and Tobago. Accordingly, it covers existing measures as well as future projections based on "Business as Usual" scenarios according to identified trends and measures.

Programmes and measures implemented or planned

In the power generation, industry, transport, waste and AFOLU sectors, the following mitigation actions, measures and policies were identified and are detailed in the following tables.

Power Generation

TABLE 4.1 Measures for Electrical Generation Sector

Nº	Name of Measure	Description of the measure
1	Solar Photovoltaic (PV) installation at the Queen's Park Savannah	To construct a solar PV installation at the Queen's Park Savannah with electric vehicle (EV) charging stations
2	Piarco Solar Park	To construct a solar park at the Piarco International Airport
3	Rural Solar Electrification	This is a government-assisted electrification programme designed for households located far from the national grid, with a combined income below a defined ceiling and for whom it would not be economically feasible for T&TEC to extend the power grid.
4	Energy Conservation and Efficiency Policy and Action Plan for Trinidad and Tobago	To develop a national policy document to guide all consumers in becoming more energy efficient and conservative.
5	RE Pilot Installations at T&TEC and UTT	Implementation of Grid-tied solar and wind installations at T&TEC Mt. Hope and UTT O'Meara.
6	Optimisation of Spinning Reserves at T&TEC	The utility working with the IPPs to optimise spinning reserves to improve the efficiency of generation
7	T&TEC Domestic Bill Rebate	An automatic 25% rebate for customers with bills less than 300 TTD
8	Feed-in Tariff (FIT) Policy for the integration of Renewable Energy into the national grid	MPU: Implementation of tariffs to allow utility customers to export renewable energy-sourced power to the national grid
9	Large-scale Renewable Energy (RE) installation (10% Utility Scale Solar)	Implementation of up to 130 MW of electricity generation from RE sources. The share of renewable generation will be at least 10% by 2050, given the established policy goal of achieving 10% RE by 2021. It should be noted that this is a conservative representation as increased penetration of RE between 2021 and 2050 is also possible.
10	New Single Cycle Units in Tobago	Acquisition of new high efficiency Single-cycle generators in Tobago
11	Light Bulb Replacement Programme	An estimated 1.6 million LEDs could boost the country's energy efficiency by replacing conventional bulbs.

POWER GENERATION MEASURE 1. **Solar PV installation at Queen's Park Savannah**

Description	To construct a solar PV installation at the Queen's Park Savannah with EV Charging Stations				
Nature	Action/awareness	**Sectors**	Power generation, Transportation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	Tentatively 800–900kW installed capacity with up to 5 stations				
Objectives	To raise awareness of Electrical Vehicles and Renewable Energy				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Procurement and installation				0%
Schedule	NA				

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		

Responsible entity	T&TEC, MPU, MEEI
Appropriateness and effectiveness	Increasing the number of EVs powered from solar energy would directly reduce the emissions from the transport sector, without increasing those in the power generation sector. This measure would be effective in raising awareness about EVs and is expected to contribute to the enabling infrastructure as the country phases in EVs.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	Free charging, or at nominal fees, may be attractive to hired passenger vehicles in the area and help to reduce fares if combined with appropriate incentives for EV acquisition, in addition to serving as a demonstration project for potential sources of sustainable revenue.
Financing instruments	UAE Caribbean RE Fund (CREF)
Methodologies, assumptions or other considerations	No battery storage is planned for the installation at this time.

POWER GENERATION MEASURE 2. Piarco Solar Park

Description	To construct a solar park at the Piarco International Airport				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	500–700kW installed capacity				
Objectives	To gain experience in managing solar installations in high reliability contexts To offset 5–7% of airport electrical load				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Licence	0%
	2. Request for Consultancy Services	0%
	3. Evaluation	0%
	4. Installation 2021	100%

Schedule

NA

Task	**2018**		**2019**		**2020**		**2021**		**2022**		**2023**		**2024**		**2025**		**2026**		**2027**		**2028**		**2029**		**2030**		**2031**		**2032**		**2033**		**2034**		**2035**	
Instal-lation																																		

Responsible entity	MPU, MEEI, T&TEC
Appropriateness and effectiveness	• Offsetting the power required from fossil fuel generation with solar power would directly reduce GHG emissions from power production. • The Piarco International Airport is Trinidad and Tobago's primary air transport hub and demands a very high level of reliability. Therefore, the percentage of renewable energy at Piarco for the airport's own use must be carefully analysed. The facility also has sufficient land space that can be utilised for the project. As the first point of entry for tourists, the implementation of the facility would also signal the country's efforts at sustainability to the tourism sector.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	EU/ICAO
Methodologies, assumptions or other considerations	Approximately 18-20% of peak capacity can be expected as an annual average from the facility.

POWER GENERATION MEASURE 3. Rural Solar Electrification

Description	This is a government-assisted electrification programme designed for households located far from the national grid, with a combined income below a defined ceiling and for whom it would not be economically feasible for T&TEC to extend the power grid.				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	NA				
Objectives	To gain expertise in managing distributed RE resources and distribution level integration				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Approximately 10 installations have been completed.				NA
Schedule	NA				

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		

Responsible entity	MPU, T&TEC, MEEI
Appropriateness and effectiveness	Offsetting the power required from fossil fuel generation with solar power would directly reduce GHG emissions from power production, as well as minimise environmental impact through the creation of utility corridors.
Synergies and/ or trade-off with adaptation	Distributed renewable energy can increase the resilience of the energy system, such as in post-disaster circumstances. Storage capacity can also contribute additional functionality to the rural RE systems.
Synergies and/ or trade-off with other development aspects	Rural areas are generally inhabited by low-income households and currently, a few areas experience an intermittent power supply while others have no power supply.
Financing instruments	EU GCCA+
Methodologies, assumptions or other considerations	Security of equipment is a major concern of residents in these areas and should be addressed in the implementation plans. Community solar, which can be more easily monitored, may be a better option in this regard.

POWER GENERATION MEASURE 4. **Energy Conservation and Efficiency Policy and Action Plan (Awaiting Cabinet Approval)**

Description	To develop a national policy for energy efficiency in the residential and commercial sectors				
Nature	Policy	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	NA				
Objectives	To influence behavioural change regarding energy consumption				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. The Policy and Action Plan has been developed and is currently awaiting Cabinet approval.				0%

Schedule

NA

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		

Responsible entity	MPU
Appropriateness and effectiveness	• Energy conservation and effectiveness translate directly into GHG reductions through reduced electricity power production and consumption. • Due to relatively low and subsidised electricity rates, energy consumption is inefficient. In combination with rate adjustments to reflect true market rates, efficient energy consumption and production can result in reduced greenhouse gas emissions.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	MPU, GoRTT, International financing
Methodologies, assumptions or other considerations	Policy implementation will be in tandem with rate adjustments.

POWER GENERATION MEASURE 5. RE Pilot Installations at T&TEC and UTT

Description	Implementation of grid-tied solar and wind installations at T&TEC Mt. Hope and UTT O'Meara				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	2 x 2.2 kW installations of solar PV				
Objectives	To gain experience with grid-interconnected RE systems				
Tasks and estimated progress	**Task**				**Estimated progress**
	Completed				100%
Schedule	Completed				
Responsible entity	T&TEC				
Appropriateness and effectiveness	Offsetting fossil fuel generation with renewable energy directly leads to GHG reductions through the burning of less fuel. These projects are necessary to begin building experience with RE installations on a small scale before larger installations are attempted.				
Synergies and/or trade-off with adaptation	NA				
Synergies and/or trade-off with other development aspects	NA				
Financing instruments	T&TEC				
Methodologies, assumptions or other considerations	NA				

POWER GENERATION MEASURE 6. Optimisation of Spinning Reserves at T&TEC

Description	The utility working with the IPPs to optimise spinning reserves thereby making generation more efficient				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To improve the overall utility heat rate by allowing generation to be dispatched more efficiently				
Tasks and estimated progress	**Task**				**Estimated progress**
	Completed				100%
Schedule	Completed				
Responsible entity	T&TEC				
Appropriateness and effectiveness	Spinning reserve policies affect the loading of generators and hence their efficiencies which are load dependent. By reducing the stipulated spinning reserve levels, generators can be more heavily loaded resulting in greater efficiency.				
Synergies and/or trade-off with adaptation	NA				
Synergies and/or trade-off with other development aspects	NA				
Financing instruments	NA				
Methodologies, assumptions or other considerations	NA				

Solar PV Lighting, ► Malabar Community Centre, Trinidad, 2015

Photo Credit: Ministry of Energy and Energy Industries

POWER GENERATION MEASURE 7. T&TEC Domestic Bill Rebate

Description	Customers with bills less than 300 TTD are automatically given a 25% rebate				
Nature	Policy/Action	**Sectors**	Power generation	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	Intended to reach 220k customers (more than 50%)				
Objectives	The objective of this action was to provide economic relief to persons with low incomes and to serve as a conservation incentive.				
Tasks and estimated progress	**Task**				**Estimated progress**
	Completed				100%
Schedule	Completed				
Responsible entity	T&TEC				
Appropriateness and effectiveness	Incentivising low usage is a conservation measure which will encourage users below the threshold to stay below it and those on the border to reduce consumption. Additionally, it may encourage higher income users who can afford to offset their load using RE installations to do so.				
Synergies and/ or trade-off with adaptation	N/A				
Synergies and/ or trade-off with other development aspects	This action is primarily for economic relief but also contributes to GHG mitigation as the number of low-energy users is increasing since the programme commenced in December 2016.				
Financing instruments	T&TEC (through rebates)				
Methodologies, assumptions or other considerations	N/A				

POWER GENERATION MEASURE 8. **Feed-in Tariff (FIT) Policy for the Integration of Renewable Energy into the National Grid**

Description	Revision of the draft FIT Policy (2015), to support the uptake of grid-tied RE electricity generation				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To incentivise distribution level RE installations by allowing customers to sell power to the utility				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. 1st draft				100%
	2. Legal Counsel review at MPU and MEEI				100%
	3. Acceptance and Implementation				100%

Schedule

NA

Task	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Task 1																		
Task 2																		
Task 3																		

Responsible entity	T&TEC, MPU, RIC, MEEI
Appropriateness and effectiveness	Feed-in tariffs are a critical part of making RE installations attractive to domestic and commercial customers. Increased RE installations would in turn offset fossil fuel generation and reduce GHG production.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

POWER GENERATION MEASURE 9. Large Scale RE installation

Description	Implementation of up to 130MW of electricity generation from RE sources				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	130MW				
Objectives	To offset up to 10% of the fossil fuel generation and gain experience with large-scale RE integration				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Final Report with Ranking of Bidders submitted to Cabinet	completed
	2. Cabinet approval for preferred bidders to begin negotiations with T&TEC for a PPA	0%
	3. PPA with IPP	0%
	4. Installation	100%

Schedule

NA

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		
Task 4																		

Responsible entity	MEEI, T&TEC
Appropriateness and effectiveness	Renewable energy generation would directly reduce the GHG emissions from fossil fuel generation. Additionally, this project will bring experience in integrating a significant portion of RE into the existing grid.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	This will be the first notable project in diversifying the electricity production mix of the country and will build human resource capacity which would be needed in the future with depleting gas reserves.
Financing instruments	IPP
Methodologies, assumptions or other considerations	NA

POWER GENERATION MEASURE 10. New Single Cycle Units in Tobago

Description	Acquisition of new single cycle generator in Tobago				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	20MW				
Objectives	Meet growing electrical load with 10% efficiency increase compared to older technology				
Tasks and estimated progress	**Task**				**Estimated progress**
	Completed				100%
Schedule	Completed				
Responsible entity	T&TEC				
Appropriateness and effectiveness	Installation of more efficient generation leads to a reduction in GHG emissions.				
Synergies and/ or trade-off with adaptation	NA				
Synergies and/ or trade-off with other development aspects	NA				
Financing instruments	NA				
Methodologies, assumptions or other considerations	This is a new generator commissioned to deal with load growth with an efficiency of approximately 44% (10% better than other installed units).				

POWER GENERATION MEASURE 11. **Light Bulb Replacement Programme**

Description	An estimated 1.6 million LEDs could boost the country's energy efficiency by replacing conventional bulbs				
Nature	Action	**Sectors**	Power generation	**GHG gases**	CO_2 CH_4 N_2O
Quantitative goals	1.6 million LEDs				
Objectives	To offset up to 10% of the fossil fuel generation and gain experience with large-scale RE integration				
Tasks and estimated progress	**Task**				**Estimated progress**
	Request for Tender has been issued				Ongoing. 70% completed

Schedule

NA

Task	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Task 1																		

Responsible entity	MPU, T&TEC, MEEI
Appropriateness and effectiveness	1.6 million LEDs to replace incandescent bulbs. This is expected to reduce GHG in the residential sector and also increase the number of residential households receiving the electricity rebate. This can contribute to an overall reduction of 1% of natural gas usage in the electricity sector.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	GORTT
Methodologies, assumptions or other considerations	LED bulbs can last up to 5–15 years dependent on how they are used. It should be noted that households which cannot afford to replace LEDs are likely to revert to lower cost options when replaced.

▶ Industry

TABLE 4.2 Measures for Industry Sector

Nº	Name of Measures	Description of the measure
1	Energy Audits	Quantification, categorisation and analysis of energy usage required for proper design of mitigation strategies
2	Carbon Capture and Storage (CCS) Studies	Analyse the potential of Trinidad and Tobago for the implementation of CCS technologies to capture CO_2 emissions.
3	Improved Use of Energy and Heat in Industrial Processes	Promote the development of energy efficiency actions and the reduction of produced waste heat in the industrial sector of Trinidad and Tobago (except oil and gas sectors).
4	Measure Complementary to Renewable Energy Sources	Install renewable energy technologies in industrial sites of Trinidad and Tobago to provide supply for low-energy consuming processes.
5	Thermal Desalination	Improve the energy efficiency in Trinidad and Tobago by creating a desalination plant which would use waste heat from industrial sites to produce desalinated water for industrial purposes.
6	Reducing Venting and Flaring	Diminish the consumption of fuels in the oil and natural gas sectors by reducing venting and flaring emissions in the oil and natural gas sectors of Trinidad and Tobago.
7	Efficient Technologies in the Oil and Natural Gas Sector	Implement more efficient technologies in the oil and natural gas sector in order to reduce fuel consumption in the production process.
8	Promotion of Energy Conservation and Lower Waste Generation	Promotion of best practices to reduce the consumption of resources and waste generation in the industrial sector of Trinidad and Tobago
9	Hydrogen Economy	Report that initiatives are being pursued with the private sector to create green hydrogen for petrochemical use and for N_2O abatement.

Photo Credit: Point Lisas Industrial Port Development Corporation Limited (PLIPDECO)

▲ Point Lisas Industrial Estate, Point Lisas, Trinidad, 2018

INDUSTRY MEASURE 1. Energy Audits

Description	Quantification, categorisation and analysis of energy usage required for proper design of mitigation strategies				
Nature	Knowledge	**Sectors**	Industry	**GHG gases**	CO_2, CH_4 , N_2O
Quantitative goals	NA				
Objectives	Reduction of the energy consumption in the industrial sector through the development of energy audits in industries for the implementation of energy efficiency measures				

	Task	**Estimated progress**
Tasks and estimated progress	1. Definition of Programme of Activities to characterise the energy consumption, undertake energy audits and develop awareness-raising campaigns and capacity-building sessions in the industrial sector in Trinidad and Tobago	5%
	2. Development of energy system characterisation studies, including the general use of fuels and particularly the use of heat in companies, in order to map the energy consumption in the industrial sector of Trinidad and Tobago	25%
	3. Definition of scheme for the implementation and funding of energy audits. The development of audits could be established as a legal requirement for industries, as proposed for the housing, commercial and institutional sectors.	35%
	4. Creation or modification of legislation, if applicable	45%
	5. Development of capacity-building sessions on the results of the energy characterisation and the development of energy audits in the industrial sector	50%
	6. Organisation of awareness-raising campaigns for the target sector, focusing on explaining the new legal requirements, the Voluntary Scheme created and the benefits of the development of energy audits and implementation of energy efficiency measures	55%
	7. Selection of pilot industries for the development of energy audits	60%
	8. Development of pilot energy audits and analysis of achieved results	70%
	9. Based on the results of the development of the energy audits, if necessary, corrective actions will be applied.	80%
	10. Beginning of period of application of legislation with compulsory energy audits	100%

Schedule

Short term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1				■														
Task 2				■														
Tasks 3 & 4					■													
Tasks 5 & 6						■												
Tasks 7 & 8						■												
Tasks 9 & 10						■												

Responsible entity	Ministry of Energy and Energy Industries
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 2. CCS Studies

Description	Implementation of CCS technologies to capture CO_2 emissions				
Nature	Knowledge	**Sectors**	Industry	**GHG gases**	CO_2
Quantitative goals	NA				
Objectives	Analyse the potential of Trinidad and Tobago for the implementation of CCS technologies to capture CO_2 emissions.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities for the development of CCS studies, including CCS map for Trinidad and Tobago with possible locations for CCS sites in which the features of every site will be analysed. The report will also include an assessment of the estimated costs for the sites and an assessment of the viability of the technology in the country. This task will also involve an analysis of possible financing sources for the programme from national and international sources. A technical committee has been established to explore aspects of CCS.	30%
	2. Development of CCS analysis and report with a view to defining a roadmap for the implementation of CCS technologies in Trinidad and Tobago	100%

Schedule

Short term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1						■												
Task 2							■											

Responsible entity	Ministry of Energy and Energy Industries, EMA, UTT and UWI
Appropriateness and effectiveness	
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 3. **Improved Use of Energy and Heat in Industrial Processes**

Description	Improving the use of energy and heat in industrial processes through the development of energy efficiency actions and the reduction of the produced waste heat				
Nature	Action	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To promote the development of energy efficiency actions and the reduction of the produced waste heat in the industrial sector of Trinidad and Tobago				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities, including raising awareness for the implementation of energy efficiency measures, including consideration of potential incentives	10%
	2. Definition and development of programme to enhance the implementation of energy efficiency measures	55%
	3. Development of campaigns to raise awareness	75%
	4. Analysis of programme efficacy	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		
Task 4																		

Responsible entity	Ministry of Energy and Energy Industries
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 4. Complementary Renewable Energy Sources

Description	Install renewable energy technologies in industrial sites of Trinidad and Tobago to provide supply for low-energy consuming processes				
Nature	Action	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To install renewable energy technologies at industrial sites in Trinidad and Tobago to provide supply for low-energy consuming processes				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities in order to analyse different renewable energy sources which could provide complementary energy to industrial companies for processes requiring low energy	10%
	2. Conduct analysis of best RE technologies to implement, including generation capacity as well as a cost/ benefit analysis.	25%
	3. Analyse results and select technologies to be promoted, and develop implementation plan.	35%
	4. Establishment of the implementation plan and selection of companies to take part in pilot implementation actions	50%
	5. Execute pilot implementation actions, including analysis of results.	65%
	6. If necessary, implement any lessons learned from the analysis of the results of the pilot actions.	70%
	7. Development of awareness-raising campaign to promote complementary renewable sources campaign among the industries of Trinidad and Tobago	75%
	8. Beginning of voluntary scheme for all industries. It will include a yearly evaluation of the results of the scheme, modifying it according to latest renewable energy trends, the needs of the industry of Trinidad and Tobago and the conclusions of the analysis of the implementation results.	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1						■												
Task 2							■											
Task 3 & 4								■										
Task 5 & 6									■									
Task 7								■	■									
Task 8										■								

Responsible entity	Ministry of Energy and Energy Industries
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 5. Thermal Desalination

Description	Improve energy efficiency in Trinidad and Tobago by creating a desalination plant which would use waste heat from industrial sites to produce desalinated water for industrial purposes				
Nature	Action	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To improve energy efficiency in Trinidad and Tobago by creating a desalination plant which would use waste heat from industrial sites to produce desalinated water for industrial purposes				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities to analyse the availability of waste heat in the industries of Trinidad and Tobago and assess the viability of using that waste heat as a source of energy for water desalination. This analysis will include the quantification of the waste heat available and its conditions, the economic feasibility of the plant and the environmental impact of its implementation.	10%
	2. Development of programme of activities from which the viability of this technology will be determined. If it is not viable due to technical, economic or environmental limitations, the following tasks will not be developed.	40%
	3. Development of project for the construction of the thermal desalination plant which will include both the cost and financing sources to build the plant and develop the piping network to deliver waste heat from industries to it. In this task, the budget of the project will be calculated and the environmental impact of the construction of the plant and its functioning will be assessed.	50%
	4. Securing financing, and building and operational permits	60%
	5. Building the plant and developing the pipe network	90%
	6. Connection of piping system to industrial companies and commissioning of plant. This task will also include the compilation of information on the functioning of the plant regarding the quantity of heat recycled, the economics of it and its environmental impact	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1									■									
Task 2											■							
Task 3													■					
Task 4														■				
Task 5														■				
Task 6																■		

Responsible entity	Ministry of Energy and Energy Industries, EMA
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 6. **Reducing Venting and Flaring**

Description	Reducing venting and flaring by decreasing the consumption of fuels in the oil and natural gas sectors				
Nature	Action	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To decrease the consumption of fuels in the oil and natural gas sectors by reducing venting and flaring emissions in the oil and natural gas sectors of Trinidad and Tobago				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities to assess current venting and flaring practices in the oil and gas sector of Trinidad and Tobago, including the quantification of gas vented and flared, the GHG emissions derived from these activities, the determination of the reduced venting and flaring levels that could be achieved, and the definition of the best scheme for the reduction of venting and flaring activities	10%
	2. Development of programme of activities, including possible incentives, with a view to developing targets for venting and flaring reduction and the best scheme for achieving these targets	35%
	3. Creation/modification of legislation to facilitate implementation	70%
	4. Development of capacity-building sessions for oil and natural gas companies to provide information on practices and technologies to reduce venting and flaring practices without putting security at risk	80%
	5. Execute implementation, analyse efficacy and make adjustments as appropriate.	100%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1					■													
Task 2						■												
Task 3						■												
Task 4							■											
Task 5								■	■	■								

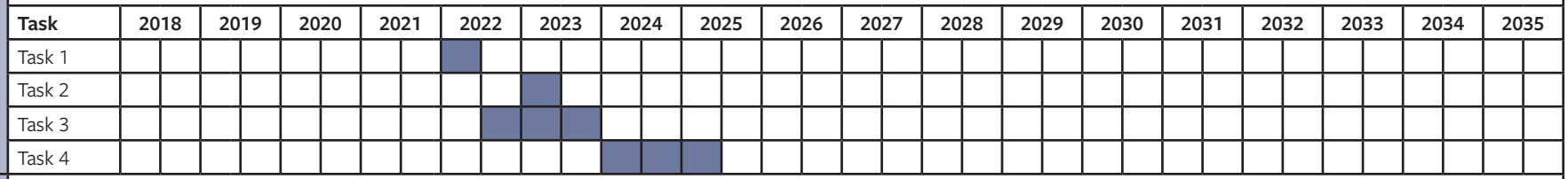
Responsible entity	Ministry of Energy and Energy Industries, EMA
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 7. Efficient Technologies in the Oil and Natural Gas Sector

Description	The implementation of efficient technologies in the oil and natural gas sector to reduce fuel consumption in the production process				
Nature	Action	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	To implement more efficient technologies in the oil and natural gas sector in order to reduce fuel consumption in the production process and to diminish the consumption of fuels in the oil and natural gas sectors by reducing venting and flaring emissions in the oil and natural gas sectors of Trinidad and Tobago				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Definition of programme of activities for the implementation of energy efficiency measures in the oil and natural gas sectors, including the development of awareness campaigns for the promotion of energy efficiency actions, and the identification of funding from national and international sources				10%
	2. Development of implementation plan, including consideration of incentives, as appropriate				55%
	3. Development of awareness campaigns for oil and natural gas industries				75%
	4. Execute implementation, analyse efficacy and make adjustments as appropriate.				100%

Schedule

Medium term



Responsible entity	Ministry of Energy and Energy Industries
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 8. **Promotion of Energy Conservation and Lower Waste Generation**

Description	The promotion of energy conservation and lower waste generation				
Nature	Awareness-raising	**Sectors**	Industry	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Promotion of best practices to reduce the consumption of resources and waste generation in the industrial sector of Trinidad and Tobago				

	Task	**Estimated progress**
Tasks and estimated progress	1. Definition of programme of activities, including the target sectors, the types of energy conservation and lower waste generation options to promote, and the type of awareness-raising actions to be developed, and sources of financing	30%
	2. Develop implementation plan.	85%
	3. Execute implementation, analyse efficacy and make adjustments as appropriate.	100%

Schedule	Medium term																			
	Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
	Task 1						■												
	Task 2						■												
	Task 3						■												

Responsible entity	Ministry of Energy and Energy Industries, EMA
Appropriateness and effectiveness	
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

INDUSTRY MEASURE 9. Hydrogen Economy

Description	Production of blue and green hydrogen for e-fuel conversion for industrial, power generation and transportation				
Nature	Action	**Sectors**	Industry, power generation and transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	In the case of hydrogen (considering that there will be a mix with more biofuels), 5% of consumption can be achieved by 2050 (Replacement of 3,194 TJ of natural gas per year). The study considered the replacement of natural gas with green hydrogen[1], with which no GHG emissions are associated.				
Objectives	Create green hydrogen for petrochemical use and for N_2O abatement				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Establish task force for determining feasibility of blue and green hydrogen programmes and detail plans for development.	10%
	2. If feasible: RFPs, Tendering and contractor selection	35%
	3. Implementation on a phased basis over the long term	60%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1					■													
Task 2						■												
Task 3							■											

Responsible entity	MEEI, MPD, Energy Chamber, Industry stakeholders
Appropriateness and effectiveness	Reduces emissions and reliance on fossil fuel for hydrogen as feedstock for petrochemicals, as well as a potential fuel source for transportation
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	Opportunity for creation of new industries and jobs
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

1 Renewable hydrogen, also known as green hydrogen, is produced by the electrolysis of water from electricity from renewable sources. This process does not emit CO_2 and transforms water into hydrogen and oxygen gas molecules, using electricity produced by renewable sources.

Photo Credit: Mr. Joseph Fleming for the Public Transport Service Corporation (PTSC)

▲ PTSC bus at CNG refuelling station in Trinidad, 2018

Transport

TABLE 4.3 Measures for Transport Sector

Nº	Name of Measures	Description of the measure
1	Fuel-switching to Compressed Natural Gas (CNG)	Promoting a fuel switch to Compressed Natural Gas
2	Parking Management	Energy conservation through parking management
3	Upgrading and Replacement of Aircraft	Upgrading and replacement of aircraft
4	Efficiency in Water Transport	Promotion of energy efficiency in water transport
5	Alternative Fuels in Marine Navigation	Introducing alternative fuels to the Marine Navigation sector
6	Information and Communication Technologies (ICTs)	Promotion of ICTs, such as telecommuting, to avoid the need to travel
7	Low-emission Driving Practices and Standards	Dissemination of low-emission driving practices and standards
8	Policy on e-mobility	An e-mobility policy is being prepared with the aim of phasing in electric vehicles in the public transport and private transport sectors.
9	Air Traffic Management Systems	Implementation of an air traffic management system
10	Public Transport System	Analysis and proposal of actions to improve the public transport system
11	Review of Fuel Subsidies for the Transport Sector	Revision of fuel subsidies for the transport sector

TRANSPORT MEASURE 1. **Fuel-switching to Compressed Natural Gas (CNG)**

Description	Increasing the energy efficiency of vehicles and promoting fuel-switching to Compressed Natural Gas				
Nature	Action	**Sectors**	Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Promotion of cleaner fossil fuels in the transport sector through conversion to CNG-fuelled engines				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Conversion to CNG.				Ongoing

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		

Responsible entity	Ministry of Works and Transport, Public Transport Service Corporation
Appropriateness and effectiveness	NA
Synergies and/ or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 2. Parking Management

Description	Energy conservation through parking management				
Nature	Action	**Sectors**	Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Develop a plan to manage parking practices and establish a framework for parking activities in order to discourage the use of private vehicles in cities.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities, in order to determine the best parking management solutions	10%
	2. Development of programme of activities and implementation plan	35%
	3. Analysis of options, and selection of parking management action(s) to implement	50%
	4. Commence execution of implementation plan.	70%
	5. Continue execution of implementation plan.	85%
	6. Operationalise parking system, analyse efficacy and make adjustments as appropriate.	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		
Task 4																		
Task 5																		
Task 6																		

Responsible entity	Ministry of Works and Transport, Ministry of Planning and Development
Appropriateness and effectiveness	NA
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 3. Upgrade and Replacement of Aircraft

Description	Upgrade and replacement of aircraft				
Nature	Action	**Sectors**	Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Improve the fuel efficiency and upgrade the aircraft fleet of Trinidad and Tobago.				

	Task	**Estimated progress**
Tasks and estimated progress	1. Definition of programme of activities in order to characterise the aviation fleet of Trinidad and Tobago and assess options for improvement	10%
	2. Design the scope for improvement of the aviation fleet of Trinidad and Tobago, including a comparison of the latest trends in international aviation, and conduct an economic assessment of the costs and benefits of upgrading and replacing the aircraft.	35%
	3. Develop and validate roadmap, including potential for greenhouse gas reductions, with air transport companies of Trinidad and Tobago.	70%
	4. Commence implementation including the economic feasibility of the upgrade and replacement of aircraft according to the socio-economic situation, both nationally and internationally.	100%

Schedule	Medium term																			
	Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
	Task 1																		
	Task 2																		
	Task 3																		
	Task 4																		

Responsible entity	Ministry of Finance, Caribbean Airlines
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 4. Efficiency in Water Transport

Description	Promotion of energy efficiency in water transport				
Nature	Action	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Promote energy efficiency practices in water-borne transport in Trinidad and Tobago in order to reduce the fuel consumption of the sector.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Creation of programme of activities to analyse efficiency practices, including possible incentives for implementation in the water-borne transport sector in Trinidad and Tobago	10%
	2. Design an implementation plan for energy efficiency practices.	35%
	3. Development of capacity-building sessions for water-borne transport companies	50%
	4. Commence implementation.	75%
	5. Execute implementation plan, analyse efficacy and make adjustments as appropriate.	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1										■								
Task 2												■						
Task 3													■					
Task 4														■				
Task 5														■				

Responsible entity	Ministry of Works and Transport, Ministry of Energy and Energy Industries
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 5. Alternative Fuels in Marine Navigation

Description	Introducing alternative fuels to Marine Navigation				
Nature	Action	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Introduce the use of LNG or biofuels in the water-borne transport sector of Trinidad and Tobago.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities for assessing the viability of using alternative fuels in the marine transport sector, including potential sources of financing	10%
	2. Development of the programme of activities, including a selection of possible alternative fuels to be used in navigation, the technical implications of their use, mainly regarding vessel mechanics and the cost of implementation	35%
	3. Design an implementation plan with targets.	65%
	4. Update legislation to facilitate the use of alternative fuels in the navigation sector.	80%
	5. Commence execution of the implementation plan with periodic analysis of efficacy and adjustments as required.	100%

Schedule

Long term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		
Task 4																		
Task 5																		

Responsible entity	Ministry of Works and Transport, Ministry of Energy and Energy Industries
Appropriateness and effectiveness	NA
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

Photo Credit: Ministry of Works and Transport

▲ Passengers and vehicles board the inter-island ferry, Trinidad, 2017

▼ Vehicles on highway, Trinidad, 2013

Photo Credit: Ministry of Works and Transport

TRANSPORT MEASURE 6. Information and Communication Technologies (ICTs)

Description	Promotion of ICTs, including telecommuting, to reduce the need for travel				
Nature	Awareness-raising	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4
Quantitative goals	N/A				
Objectives	Promote ICTs to reduce the need to travel.				

	Task	**Estimated progress**
Tasks and estimated progress	1. Design policy elements for maximising ICT applications for services, telecommuting and working from home, including the target sectors, the actions to be promoted and the type of awareness-raising strategies to be developed.	30%
	2. Design implementation plan for policy.	85%
	3. Execute implementation plan, analyse efficacy and make adjustments as appropriate.	100%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		

Responsible entity	Ministry of Works and Transport, Ministry of Rural Development and Local Government
Appropriateness and effectiveness	N/A
Synergies and/ or trade-off with adaptation	N/A
Synergies and/or trade-off with other development aspects	N/A
Financing instruments	N/A
Methodologies, assumptions or other considerations	N/A

TRANSPORT MEASURE 7. **Low-Emission Driving Practices and Standards**

Description	Dissemination of low-emission driving practices and standards				
Nature	Awareness-raising	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Disseminate low-emissions driving practices and standards to reduce GHG emissions from road transport.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Definition of programme of activities to identify and promote low-emissions driving practices and standards, including within the mandatory driving regulations for getting a driving permit, as well as the target sectors	25%
	2. Develop implementation plan.	60%
	3. Execute implementation plan, analyse efficacy and make adjustments as required.	100%

Schedule

Medium term

Task	**2018**		**2019**		**2020**		**2021**		**2022**		**2023**		**2024**		**2025**		**2026**		**2027**		**2028**		**2029**		**2030**		**2031**		**2032**		**2033**		**2034**		**2035**	
Task 1									■																											
Task 2											■																								
Task 3												■																							

Responsible entity	Ministry of Works and Transport
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 8. Policy on e-Mobility

Description	The current dominance of private transportation confirms that any effective strategy to reduce GHGs from the transportation sector must include efforts to decarbonise private transportation, in addition to reducing kilometres travelled. Removing carbon from road commuting can be achieved by expanding public transit, increasing the fuel economy of vehicles, improving fuel quality, and substituting EVs for internal combustion engines.				
Nature	Policy	**Sectors**	Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	An e-mobility policy is being prepared with the aim of phasing electric vehicles into the public and private transport sectors.				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Development of e-mobility policy programme of activities to analyse the options for e-mobility in Trinidad and Tobago. The objective of the analysis will be to establish the roadmap for creating an attractive transport network, characterising the existing network, and developing different options for its improvement. In this task, national and international funding sources available for implementing this action will also be analysed.				20%
	2. Develop implementation plan.				75%
	3. Execute implementation plan, analyse efficacy and make adjustments as appropriate.				100%

Schedule

Medium term

Task	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Task 1																		
Task 2																		
Task 3																		

Responsible entity	Ministry of Works and Transport
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 9. Air Traffic Management Systems

Description	Implementation of an air traffic management system				
Nature	Awareness-raising	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Implementation of air traffic management system to reduce fuel consumption in air transport operations				
Tasks and estimated progress	**Task**				**Estimated progress**
	1. Development of programme of activities to analyse the viability, including sources of funding, of implementing air traffic management systems in Trinidad and Tobago, with a view to identifying opportunities for reducing fuel consumption in air transport.				20%
	2. Execute implementation plan, analyse efficacy and make adjustments as appropriate.				100%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		

Responsible entity	Ministry of Works and Transport
Appropriateness and effectiveness	NA
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 10. Public Transport System

Description	Analysis and proposal of actions to improve the public transport system				
Nature	Policy	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	NA				
Objectives	Analyse and propose actions to improve the public transport system of Trinidad and Tobago to promote its use instead of the use of private vehicles				

	Task	**Estimated progress**
Tasks and estimated progress	1. Development of a programme of activities to analyse the options to improve the public transport system of Trinidad and Tobago	20%
	2. Design implementation plan.	50%
	3. Execute implementation plan, analyse efficacy and make adjustments as required.	100%

Schedule

Short term

Task	**2018**		**2019**		**2020**		**2021**		**2022**		**2023**		**2024**		**2025**		**2026**		**2027**		**2028**		**2029**		**2030**		**2031**		**2032**		**2033**		**2034**		**2035**	
Task 1										■																								
Task 2											■																							
Task 3													■																					

Responsible entity	Ministry of Works and Transport, Public Transport Service Corporation
Appropriateness and effectiveness	NA
Synergies and/ or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

TRANSPORT MEASURE 11. **Revision of Fuel Subsidies for the Transport Sector**

Description	Revision of fuel subsidies for the transport sector																		
Nature	Policy	**Sectors**	Industry and Transport	**GHG gases**	CO_2, CH_4, N_2O														
Quantitative goals	NA																		
Objectives	Review subsidies applied to the fuel used for public and private transportation in Trinidad and Tobago.																		
Tasks and estimated progress	**Task**															**Estimated progress**			
	1. Phased removal of subsidies															100%			
Schedule	Medium term																		
	Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
	Task 1																		
Responsible entity	Ministry of Transport, Ministry of Finance																		
Appropriateness and effectiveness	NA																		
Synergies and/ or trade-off with adaptation	NA																		
Synergies and/or trade-off with other development aspects	NA																		
Financing instruments	NA																		
Methodologies, assumptions or other considerations	NA																		

Photo Credit: Tobago House of Assembly

▲ Staff at the Department of the Environment weigh and record plastic and other garbage collected during the International Coastal Clean Up, 2019

▶ Waste and Wastewater

Photo Credit: Tobago House of Assembly

▲ Tobago Recycling Resource Initiative (TRRI) Facility, 2021

TABLE 4.4 Measures for Waste and Water Sector ▼

Nº	Name of Measures	Sector	Description of the measure
1	Landfill Management	Waste and Water	Landfill Management: Reduction of the volume of waste entering the landfill
2	Landfill Management	Waste and Water	Landfill Management: Establishing sustainable disposal infrastructure and security at these sites
3	Waste Recycling	Waste and Water	Establishment of a national waste recycling programme

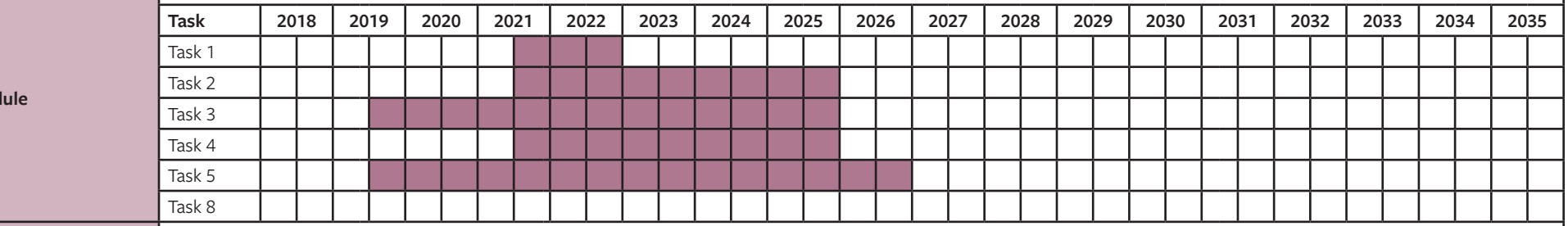
 Landfill Management: Reduction of the volume of waste entering the landfill

Description	Landfill Management: Reduction of the volume of waste entering the landfill				
Nature	Action	**Sectors**	Waste	**GHG gases**	CO_2, CH_4, N_2O
Quantitative goals	Incrementally reduce the volume of waste that is disposed via landfilling: 20 – 50% over the period: 2022-2025				
Objectives					

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Conduct studies to establish baseline for all waste management indicators: Waste Characterisation Study	2%
	2. Design and implement a nation-wide online CSR Strategy to promote the Rs (reduce, reuse, recycle) in waste minimisation methodology	0%
	3. Design and implement Relaunch "*Make Charlie Mad*"—National Educational Campaign on waste diversion and recycling	2%
	4. Design and implement Strategy to relaunch and expand Recycling Programmes in the Government bodies, Corporate Trinidad and the National communities	50%
	5. Establish a series of Transfer Stations (TS) at the Beetham and Guanapo Landfill sites, in the first instance, on a phased basis over the next five (5) years; Currently TS for Beverage Container Recyclables are being processed at MRFs at three of SWMCOL's facilities at a very small rate.	5%
	6. Partner with the Ministry of Health and Municipal Corporations to develop a waste management system for the proper disposal of bio-medical wastes and similar hazardous wastes—This is no longer a Strategic Focus	0%
	7. Partner with the Ministry of Local Government and Rural Development and the Tobago House of Assembly to improve the operational efficiency of the waste collection systems for Trinidad and Tobago—This is no longer a Strategic Focus.	45%
	8. Explore the feasibility of establishing waste-to-energy facilities in conjunction with the Ministry with responsibility for renewable energy and the Trinidad and Tobago Electricity Commission.	70%

Schedule

Medium term



Responsible entity	Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL), Ministry of Public Utilities, Ministry of Health, Ministry of Energy and Energy Industries
Appropriateness and effectiveness	Transfer stations would allow recyclables to be recovered and thus not enter the landfill site where they can decompose to produce methane or pollute the groundwater.
Synergies and/or trade-off with adaptation	NA
Synergies and/or trade-off with other development aspects	Proper waste disposal would have a positive health benefit as it would ensure that leachate is managed and that hazardous wastes do not enter the environment and affect the health of the population
Financing instruments	General taxation, loans from development banks
Methodologies, assumptions or other considerations	Currently the MEEI is evaluating proposals for renewable energy including waste to energy. Based on this, there may need to be changes to these plans, e.g., more transfer stations may be needed

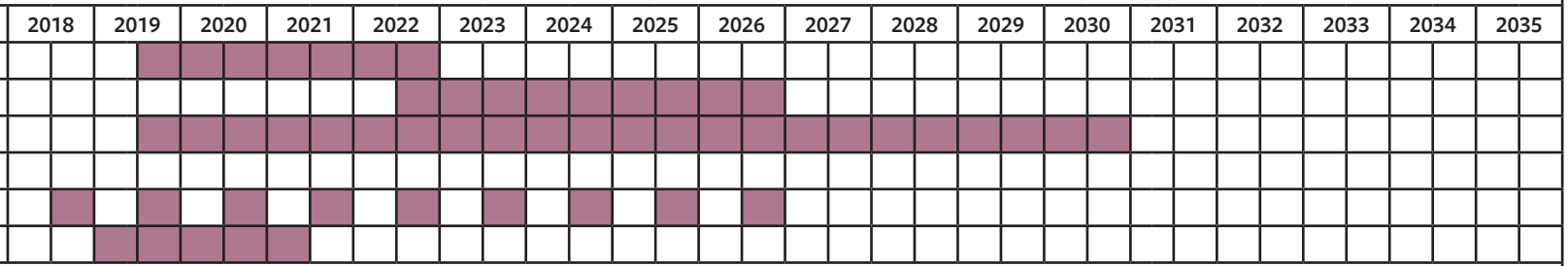
 Landfill Management: Establishing a sustainable disposal infrastructure and security of these sites

Description	Landfill Management: Establishing a sustainable disposal infrastructure and security of these sites				
Nature	Action	**Sectors**	Waste	**GHG gases**	CH_4
Quantitative goals	None given				
Objectives	To promote the preservation of the environment and mitigate adverse health and socio-economic impacts of inadequate landfill security systems. This includes the reduction of the number of landfill fires.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1.Develop engineered designs and construction plans for the establishment of an Engineered Sanitary Landfill at Forres Park.	5% Pre-Design Survey Stage
	2. Construct a sanitary engineered landfill at unused landspace at Forres Park.	0%
	3. Develop and implement remediation plans for Guanapo and Beetham on a phased basis: Conceptual Plan for Guanapo 100% Completed; Environmental Risk Management Plan – 80% Completed.	10%
	4. Collaborate with Municipalities and other agencies to remediate illegal dump-sites—This is not part of SWMCOL's Current Strategic Initiatives	0%
	5. Revise and implement Fire Prevention and Mitigation Plan	100% On-going
	6. Procurement and installation of improved Security Surveillance at Beetham, Guanapo, F/Park Landfills	100%

Schedule

Medium term



Responsible entity	Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL)
Appropriateness and effectiveness	Improvement of infrastructure and security systems would ensure that there is a reduction in pollution and landfill fires.
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	Landfill fires severely affect the health of the surrounding communities and commuters. Implementation of these measures would bring great relief to these persons and also improve the air quality of the areas where these sites are located.
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

Description	Establishment of a national waste recycling programme				
Nature	Action	**Sectors**	Industry and Transport	**GHG gases**	CH_4
Quantitative goals	Reduction of waste being landfilled				
Objectives	Incrementally increase the quantity of recyclable waste diverted from the landfills by 50% over a period of ten (10) years, in correlation with the waste landfilling reduction targets consistent with the NISWRMP.				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Establish a network of Material Recovery Facilities at the Beetham and Forrest Park Landfill sites on a phased basis to sort recyclable materials collected from MSW and to provide a drop-off point for the public to dispose of recyclable materials.	10%
	2. Collaborate with state agencies to sustain the operations of the Beverage Containers Recycling Facility.	35%
	3. Present position papers on Resource Recovery & Recycling; Post Consumer Tyres; e-Waste, Organic and other viable resource recovery lines.	20%
	4. Lobby for supportive legislation—Beverage Container Bill; (Deposit-refund system).	50%
	5. Design and execute Outreach Strategy (Responsible consumption and production / Life Cycle Approach, Circular Economy) in the Manufacturing and Food and Beverage Sectors.	0%
	6. Design and implement strategy to relaunch and expand recycling programmes in the Government bodies, Corporate Trinidad and the national communities.	50%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		
Task 3																		
Task 4																		
Task 5																		
Task 6																		

Responsible entity	SWMCOL, Ministry of Public Utilities, Ministry of Local Government, THA
Appropriateness and effectiveness	NA
Synergies and/ or trade-off with adaptation	NA
Synergies and/ or trade-off with other development aspects	NA
Financing instruments	NA
Methodologies, assumptions or other considerations	NA

Photo Credit: Kishan Ramcharan

▲ Farming in the Caura Valley, Trinidad, 2020

▶ AFOLU

Photo Credit: Tobago House of Assembly

Farming, Goldsborough, Tobago, 2021

TABLE 4.5 Measures for the AFOLU Sector ▼

Nº	Name of Measures	Description of the measure
1	Managed Agroforestry Programme: Exploration and Development of an Agroforestry Programme for Commercial Lumber	Development of an Agroforestry programme
2	Improving Forest Fire Protection Capacity	Sustainable management of Wetland Resources
3	Forest Conservation/ Preservation	Conservation/ preservation of natural forests on State lands
4	Reducing Deforestation	Reverse deforestation trends
5	Reforestation	Reforestation of denuded areas of land
6	Wetlands Management	Sustainable management of wetland resources

AFOLU MEASURE 1. **Managed Agroforestry Programme: Development of an Agroforestry Programme**

Description	Development of agroforestry				
Nature	Awareness-raising	**Sectors**	AFOLU	**GHG gases**	CO_2
Quantitative goals	None given				
Objectives	Education and assistance of private land owners in the development of agroforestry				
Tasks and estimated progress	**Task**				**Estimated progress**
	Education and assistance of private land owners in the development of agroforestry				0%

Schedule

Task	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
					■													

Responsible entity	Ministry of Agriculture, Land and Fisheries
Appropriateness and effectiveness	1. A strategy to increase carbon stocks
	2. A strategy for soil conservation
Synergies and/ or trade-off with adaptation	1. Maximise adaptation synergy including: enhanced soil productivity, nutrient cycling, water conservation, prevention of erosion, flooding, better control of pests and diseases, better functioning of ecosystem services and watersheds etc.
Synergies and/or trade-off with other development aspects	1. Possible increased vulnerabilities due to high reliance on tree products after climate disturbances
	2. Replacing native trees with agroforestry farms generally leads to lower carbon stocks
	3. Discourages deforestation on private land
Financing instruments	Domestic, international and multilateral sources
Methodologies, assumptions or other considerations	NA

AFOLU MEASURE 2. Improving Forest Fire Protection Capacity

Description	Sustainable management of forest resources				
Nature	Action, Awareness and Knowledge	**Sectors**	AFOLU (Forestry)	**GHG gases**	CO_2
Quantitative goals					
Objectives/Tasks	Improving Forest Fire Protection Capacity				

	Task	**Estimated progress**
Estimated progress	1. Implementation of fire programme	Ongoing
	2. Prevention of illegal occupation of lands within the boundaries of forest reserves	Ongoing
	3. Reforestation of impacted areas within forest conservatories	Ongoing
	4. Education of the public on the significance and importance of forests	Ongoing
	5. Implementation of research activities in forests to determine the general status of their fauna and flora	Ongoing

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1				■														
Task 2					■													
Task 3					■													
Task 4				■														
Task 5					■													

Responsible entity	Ministry of Agriculture, Land and Fisheries (Forestry Division)
Appropriateness and effectiveness	1. Forests are critical potential carbon sinks.
	2. Wildlife habitat and biodiversity conservation
Synergies and/ or trade-off with adaptation	Conservation creates natural climate resilience.
Synergies and/ or trade-off with other development aspects	1. Forests have the potential to provide nutrient processing, economies and livelihoods, and fisheries.
Financing instruments	Domestic, international and multilateral sources
Methodologies, assumptions or other considerations	N/A

AFOLU MEASURE 3. Forest Conservation/Preservation

Description	Preservation/conservation of existing natural forests within State Lands.				
Nature	Action and policy	**Sectors**	AFOLU (Forestry)	**GHG gases**	CO_2
Quantitative goals	None given				
Objectives	Conservation of natural forests on State Lands				
Tasks and estimated progress	**Task**				**Estimated progress**
	Implement National Forest Policy				Ongoing

Schedule	Medium term																		
	Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
	Task 1																		

Responsible entity	Ministry of Agriculture, Land and Fisheries (Forestry Division)
Appropriateness and effectiveness	1. Forest conservation is a key mitigation strategy towards the conserving of carbon stocks.
Synergies and/ or trade-off with adaptation	1. Maximises adaptation synergy through water recharge, prevention of erosion, flood control, better functioning of ecosystem services and watersheds, etc. 2. Contributes to increased overall climate resilience of the islands 3. Wildlife biodiversity habitat preservation
Synergies and/or trade-off with other development aspects	1. Aids in the development of an eco-tourism industry 2. Supports the development of Non-Timber Forest Product industries 3. Creation of community-based livelihoods
Financing instruments	Domestic, international and multilateral sources
Methodologies, assumptions or other considerations	N/A

AFOLU MEASURE 4. Reducing Deforestation

Description	Reducing deforestation				
Nature	Action and Awareness	**Sectors**	AFOLU (Forestry)	**GHG gases**	CO_2
Quantitative goals	None given				
Objectives	Reverse deforestation trends				

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Raising awareness of how to prevent forest fires in communities within forest fire hotspots	Ongoing
	2. Building of fire breaks within plantation monocultures and some (unspecified) natural forests	Ongoing
	3. Implementation of National Forest Policy	Ongoing

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1								■										
Task 2								■	■									
Task 3								■										

Responsible entity	Ministry of Agriculture, Land and Fisheries (Forestry Division)
Appropriateness and effectiveness	1. Enhances mitigation potential through sequestration capacity
Synergies and/ or trade-off with adaptation	1. Maximises adaptation synergy through prevention of erosion, flood control, better functioning of ecosystem services and watersheds etc. 2. Increases overall climate resilience of the islands to climate extremes and events such as hurricanes 3. Supports water cycling and buffering against drought
Synergies and/or trade-off with other development aspects	1. Aids in the development of an eco-tourism industry 2. Supports the development of Non-Timber Forest Product industries 3. Creates community-based livelihoods
Financing instruments	Domestic, international and multilateral sources
Methodologies, assumptions or other considerations	Human resource capacity challenges

AFOLU MEASURE 5. Reforestation

Description	Reforestation of denuded areas of land				
Nature	Action, policy and awareness	**Sectors**	AFOLU (Forestry)	**GHG gases**	CO_2
Quantitative goals					
Objectives					

Tasks and estimated progress	**Task**	**Estimated progress**
	1. Implement National Forest Policy	90%
	2. Maintenance and tending to recently reforested areas	100%

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1																		
Task 2																		

Responsible entity	Ministry of Agriculture, Land and Fisheries (Forestry Division); Private entities such as the National Gas Company
Appropriateness and effectiveness	1. Reforestation is critical as a mitigation strategy in order to replenish above and below ground carbon stocks.
Synergies and/or trade-off with adaptation	1. Maximises adaptation synergy including: prevention of erosion, flood control better functioning of ecosystem services and watersheds, etc. 2. Increases overall climate resilience of the islands to climate extremes 3. Supports water recycling—helps to buffer against droughts
Synergies and/or trade-off with other development aspects	1. Aids in the development of an eco-tourism industry 2. Supports the development of Non-Timber Forest Product industries 3. Creates community-based livelihoods
Financing instruments	Domestic and multilateral sources of funding
Methodologies, assumptions or other considerations	Coordinated approach to land use planning and development to minimise competing uses

AFOLU MEASURE 6. Wetlands Management

Description	Sustainable management of wetland resources				
Nature	Action, Awareness & Knowledge	**Sectors**	AFOLU (Forestry)	**GHG gases**	CO_2
Quantitative goals					
Objectives	Management of wetlands				

	Task	**Estimated progress**
Tasks and estimated progress	1. Implementation of fire programme	Ongoing
	2. Prevention of illegal occupation of lands within the boundaries of wetlands	Ongoing
	3. Reforestation of impacted areas within wetland conservatories	Ongoing
	4. Education of the public on the significance and importance of wetlands	Ongoing
	5. Implementation of research activities in wetlands to determine the general status of their fauna and flora	Ongoing

Schedule

Medium term

Task	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Task 1				■														
Task 2					■													
Task 3					■													
Task 4				■														
Task 5					■													

Responsible entity	Ministry of Agriculture, Land and Fisheries (Forestry Division)
Appropriateness and effectiveness	1. Wetlands are critical potential carbon sinks. 2. Wildlife habitat and biodiversity conservation
Synergies and/ or trade-off with adaptation	Conservation creates natural climate resilience.
Synergies and/ or trade-off with other development aspects	1. Wetlands have the potential to provide nutrient processing, economies and livelihoods, and fisheries.
Financing instruments	Domestic, international and multilateral sources
Methodologies, assumptions or other considerations	N/A

Photo Credit: Kishan Ramcharan

▲ View from Cumberland Hill, one of the highest peaks in north-west Trinidad, 2020

4.2 Baseline Emissions and Projections

For effective mitigation planning, a future projection of the emissions profile is necessary. Accordingly, business-as-usual (BaU) scenarios are constructed using relevant and appropriate models and methodologies as described below.

4.3 Model and Methodology

GHG emission projections

GHG emissions in Trinidad and Tobago for the industry, power generation, transport, waste and wastewater, and AFOLU sectors are projected to the year 2050.

A simplified version of the BIOS model was used for consistency as this model was the basis of the projection model used in the development of the "Carbon Reduction Strategy of Trinidad and Tobago" that led to the development of the NDC.

Different scenarios are used to project future emissions. These scenarios summarise families of assumptions about the most relevant variables affecting GHG emissions. Two different scenarios are included, based on two different economic perspectives.

It is important to highlight that the projections are not predictions and may change as circumstances change, and would therefore be periodically revisited and revised accordingly. The projections arising from the modeling conducted are therefore only indicative of the existing circumstances and assumptions.

In this regard, the outputs generated by the model are derived from hypotheses of certain statistically relevant variables. As with simulation models, the objective is to cover a wide range of probable events and assess their impact in terms of climate change mitigation policies, using reliable baseline data and information in order to instill confidence in the emissions

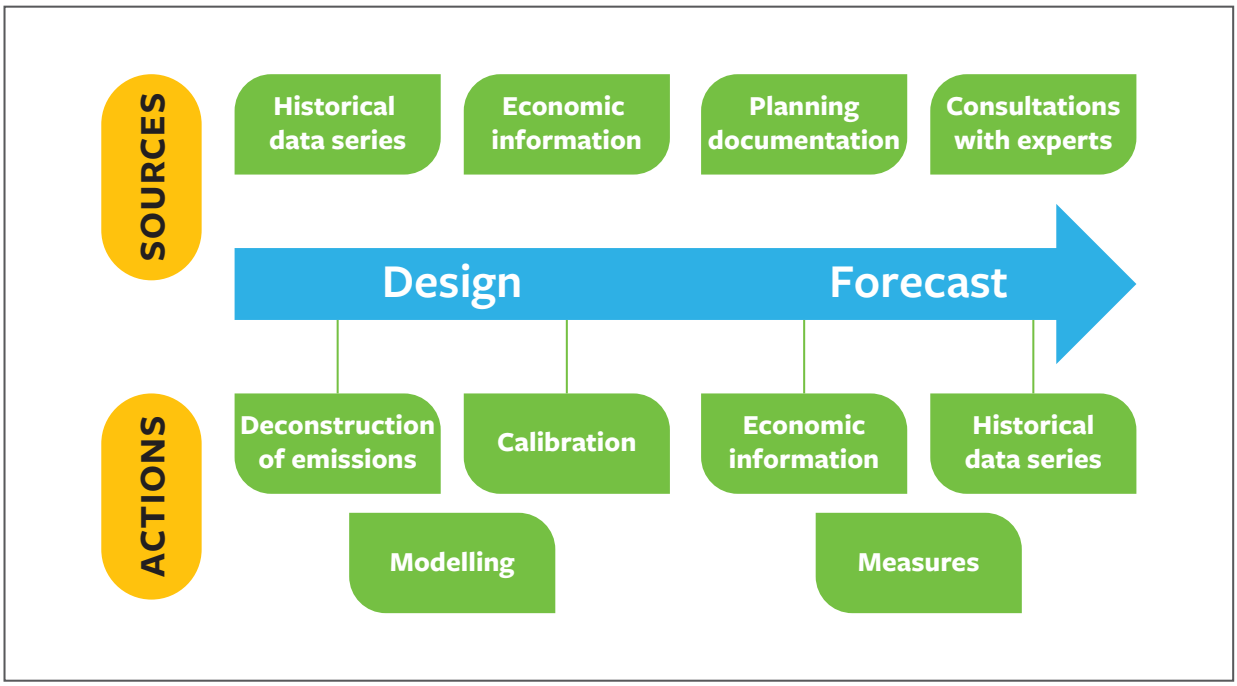


FIGURE 4.1 Framework for GHG emission modelling

projection. As such, the projections are generated using Trinidad and Tobago's GHG Inventory as baseline data, and using the same emission and conversion factors.

In addition, other relevant information sources were used as secondary data, including, among others, information on electricity demand extracted from the "BP Statistical Review of World Energy" (BP plc, 2019), the installed electricity generation capacity from the Energy Dossier TT (Espinasa & Humptert, 2016) or information on production outputs provided by the Central Bank of Trinidad and Tobago[1].

Model

BIOS® is an input–output-based emissions projection model that was first developed in 2010. Its core is a macroeconomic simulation model based on economic connections among economic sectors. It analyses how sectors are connected and how they supply goods and services to the final demand (input–output engine). The goal is to ascertain how much a sector needs from itself and from others in order to keep a certain level of production and to link all this to the value-added through Leontief coefficients[2]. Once those relationships are defined, based on a set of final demand scenarios, the model estimates the production levels of different sectors, the associated energy consumption, and the linked GHG emissions. To do so, energy consumption for each sector is used as an input for the production process, by using a satellite approach. Emissions are the output, along with the production of goods and services.

Specifically, each sector has an output level (both in terms of economic output, and GHG emissions) based on its specific inputs (both economic and energy-related). The BIOS® model therefore uses a holistic approach methodology that interrelates different economic sectors and is adjusted to variable economic scenarios over time. The GHG emission modelling framework is shown in **FIGURE 4.1**.

The main features of the model are:

- The **socio-economic module** which forecasts the general economic growth and population

1 Central Bank of Trinidad and Tobago: https://www.central-bank.org.tt/

2 Leontief coefficients (economic multipliers) are a measure of the successive effects on the economy as a result of an initial increase in production of an economic activity branch.

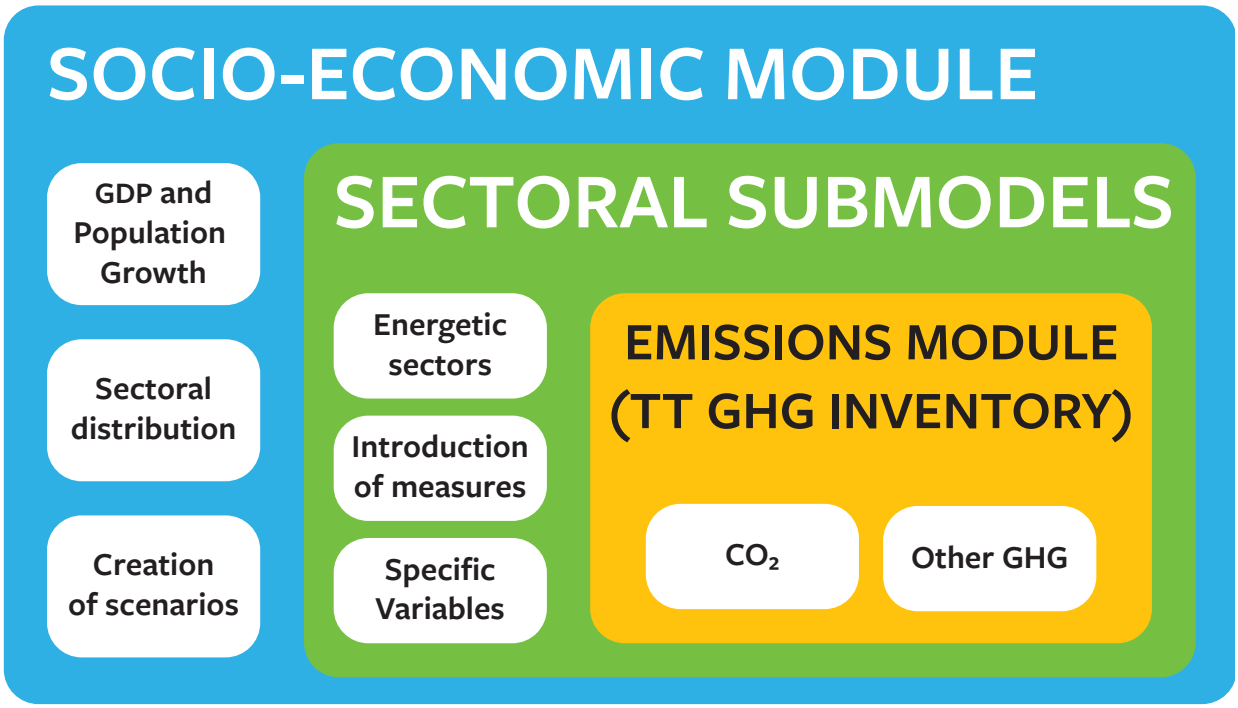


FIGURE 4.2 Structure of the emissions module for Trinidad and Tobago

growth of Trinidad and Tobago and that of the sectors (% GDP by sector), according to some assumptions and scenarios generated

- The **sectoral sub-models** which develop the technical specificities of each sector considered, according to the forecasts of the socio-economic module and specific variables for each sector. In addition, a sub-module is introduced where the identified mitigation measures can be introduced. The inputs needed to complete this module are the tCO_2e reduced annually in each scenario due to the measure, the year of implementation and the sector of application. As an output, the model discounts these emissions from the total emissions of the sector since the year of implementation of the measure.
- The **emissions module** which converts the activity data into GHG emissions. This module is generated from the activity data and uses the same emission and conversion factors as in the Trinidad and Tobago GHG Inventory.

The general structure of the tool is shown in **FIGURE 4.2**.

The integration of an Efficiency module within the model allows the energy needs per production unit to be adjusted over time. Therefore, the model allows for the introduction of efficiency improvements that show the potential decoupling between production and energy consumption or emissions.

It should be noted that only some of the modules of the BIOS® were used. The use of the BIOS® tool in its original format and structure was not possible due to the data gaps that were encountered in obtaining the information for the development of the projections. Specifically, the absence of input–output tables for Trinidad and Tobago made it impossible to use the tool as originally designed.

In its absence, a simplified socio-economic module was generated, where value-added per sector is connected to historical consumption and emissions. Expected evolution of GDP and value-added per sector, as well as population are the main variables for the socio-economic calculations.

Historical emission trends obtained from the GHG Inventory of Trinidad and Tobago were the first step for the development of the GHG emissions projections. Furthermore, it was necessary to combine this

Electric bus at UTT ► Campus, Trinidad, 2016

Photo Credit: Sindy Singh

with the information obtained from different country-level sources in order to reconstruct the historical patterns. This was a crucial step because the results of the historical reconstruction have a broad influence on the results of the emissions projections.

In addition, for every sector, different sources of data were available and the variables on which the projections depend were different. Therefore, it was necessary to construct ad hoc individual sub-models for each sector. The sub-models are connected through the economic module of the model. As a result, a *bottom-up* simulation model combined with *top-down* macroeconomic projections was the basis for the projections.

Development of Scenarios: General Assumptions

Scenarios are a key element in emissions projections and are the conceptual element that provides unity to the hypotheses applied to the variables, showing a coherent set of future visions and its consequences in the activity sectors.

Scenarios were based on socio-economic variables, building a matrix which reflects two possible future perspectives, a conservative option and an optimistic option.

Since the socio-economic perspective was chosen for the development of the scenarios, they were categorised considering economic factors. Therefore, the optimistic scenario has higher values of GHG emissions projected, because in this scenario, economic growth is expected to be higher, which would also imply having higher GHG emissions.

TABLE 4.6 shows the matrix of the two scenarios.

Conservative scenario: lower economic growth, also leading to lower GHG emissions. This scenario keeps the current GDP rates for each sector. This means that services is the most important sector (largest share of GDP) followed by industry.

Optimistic scenario: higher economic growth, leading to higher GHG emissions. This scenario is based on the trends of the last historical years and provides a picture of 2050 dominated by the service sector, as most developed economies in the world. Other industry shows a declining trend, while manufacturing industry and agriculture basically keep their share.

TABLE 4.6 Socio-economic scenarios included in this report ▼

SOCIO-ECONOMIC SCENARIOS		
	Conservative	**Optimistic**
Business as Usual	Business as Usual Conservative (BaUC) with existing measures	Business as Usual Optimistic (BaUO) with existing measures

Photo Credit: Rahanna Juman, Institute of Marine Affairs

▲ Coastal erosion can be exacerbated by sea level rise and storm surge, Trinidad, 2013

The main hypotheses considered in each socio-economic scenario are presented in **TABLE 4.7**.

The historical period (2006–2018) has been used to analyse the socio-economic variables, as this is the same period for which the country's GHG emissions inventory is available, and oriented to analyse the synergies between emissions and economic and demographic growth during this historical period, in order to establish a consistent trend.

Sectoral distribution of projected GDP is based on some assumptions as well. Considering the variation in the historical period (2006–2018), the trend of each sector was analysed. It should be noted that industry appears to be losing strength while the

TABLE 4.7 Main socio-economic assumptions

Assumption		Sector	Scenario	Medium average annual growth
GDP	Annual growth of the GDP considering the historical average growth[1] (2006–2018) in Trinidad and Tobago (Source: World Bank[2])	General	Conservative	+0.22%
GDP	Annual growth of the GDP considering the growth projections estimated in "World Bank World Development Indicators, International Financial Statistics of the IMF, IHS Global Insight and Oxford" report[3]	General	Optimistic	+1.8%
Population	Annual population growth considering the linear trend of population growth in the period 2006–2018 in Trinidad and Tobago (Source: World Bank)	General	Conservative	+0.56%
Population	Population is expected to grow in line with the regional population. (Source: World Bank)	General	Optimistic	+1.2%

1 Growth between 2006 and 2007 is the first to be considered for the trend. The calculation has been made: ((GDP 2018-GDP 2006)/GDP 2006)/12 years of period analysed

2 World Bank indicators: https://data.worldbank.org/indicator

3 World Bank, World Development Indicators, International Financial Statistics of the IMF, IHS Global Insight and Oxford" (2018) Retrieved from https://www.ers.usda.gov › webdocs › DataFiles › ProjectedRealGDPValues

TABLE 4.8 Evolution of the sectoral distribution of GDP | *Source: World Bank Development Indicators*

Weight	2006	2018	Variation	2050 Conservative	2050 Optimistic
Services	38%	59%	21%	59%	68%
Agriculture	0.6%	0.5%	–0.09%	0.5%	0.5%
Manufacturing Industry	20%	16%	–4%	16%	7%
Other industry (mining, quarrying, construction, electricity, water and gas)	31%	24%	–7%	24%	24%
Industry (total)	51%	40%	–11%	40%	32%

service sector appears to be gaining significance. These trends are reflected in the projections as shown in **TABLE 4.8**.

In addition, the projections consider other specific variables for each sector, such as energy efficiency parameters, degree of decoupling between consumption/production and demand/GDP, production limits of different industries or transportation modes. These indicators are calculated based on historical data for the period 2006–2018. The hypothesis section describes in more detail these assumptions for each of the sectors.

Baseline emissions projection

The historical reconstruction of the GHG emissions of the sectors is a key step in the development of the emissions projections with the BIOS model. The application of the model, even if it is designed to cope with data gaps, relies to some extent on the availability of historical data, on which the future projections are constructed.

In this regard, the GHG Inventory of Trinidad and Tobago has been used as the basis for the projections.

GHG Inventory overview

As Trinidad and Tobago's GHG Inventory was compiled using the IPCC 2006 methodology, it was necessary to reorganise it according to the country's economic sectors in order to estimate the projections. Accordingly, the energy sector of the IPCC is divided into the sectors of Energy Generation, Energy Consumption in Industries, and Transport. The rest of the sectors show the same classification.

In this regard, before projecting emissions, a brief analysis of historical emissions was carried out in order to identify historical trends and the main sources for all sectors.

The emission sources within each of the sectors are the following:

- **Power generation sector:** It includes emissions associated with the consumption of natural gas for electricity generation (98%) and a minor consumption of diesel for auto-generation (2%).
- **Industry sector:** This sector considers three main emission sources:
  - *Energy consumption* (natural gas and diesel) for energy industries.
  - Emissions associated with *industrial processes and product use* (*IPPU*), mainly minerals, chemicals and metals.
  - *Fugitive, venting and flaring emissions* released into the atmosphere due to the production of natural gas and oil.
- **Transport sector:** This sector includes emissions associated with the consumption of fuels: diesel, gasoline, CNG for road mobility; kerosene and avgas for aviation, and diesel for navigation at national level.
- **Waste and wastewater sector:** It includes two main emissions sources:
  - *Solid Waste Disposal*: It considers methane emissions generated in landfills from municipal and industrial solid waste discharges. It should be noted that during the development of the GHG inventory, the existence of incinerators has also been detected. However, no data was received to quantify the associated emissions for this inventory, albeit it is known that their contribution is small.

TABLE 4.9 Total emissions variation Historic Period

Total emissions (tCO_2e)	2006	2018	Δ 2006–2018
Electricity Generation	5,856,200	5,741,518	–2%
Industry	34,003,654	32,899,574	–3%
Transport	2,560,357	2,687,832	5%
Waste	1,649,023	2,460,045	49%
AFOLU	–2,303,432	–2,158,521	6%
Total	**41,765,801**	**41,630,448**	**–0.32%**

  - + *Wastewater*: This category considers emissions generated as a result of wastewater, both domestic and industrial. It also considers indirect N_2O emissions from effluents.
- AFOLU sector: This category considers the following emission sources.
  - + *Enteric Fermentation*: Associated with the methane emitted by animals.
  - + *Manure*: Associated with CH_4 and N_2O that is generated due to manure management.
  - + *Burnt area*: CO_2 emissions related to hectares burned due to forest and grassland fires.
  - + *Urea application*: CO_2 emissions from the use of urea as a fertiliser.
  - + *Land use and land use change*: Absorption and emissions of CO_2 from varying carbon stocks in forests, grasslands, and cropland.
  - + *Rice cultivation and harvest*: CH_4 emissions from the rice cultivation and harvest.

TABLE 4.9 and **FIGURE 4.3** show GHG emissions and removals evolution thorough the period 2006–2018 extracted from the GHG emissions inventory of Trinidad and Tobago.

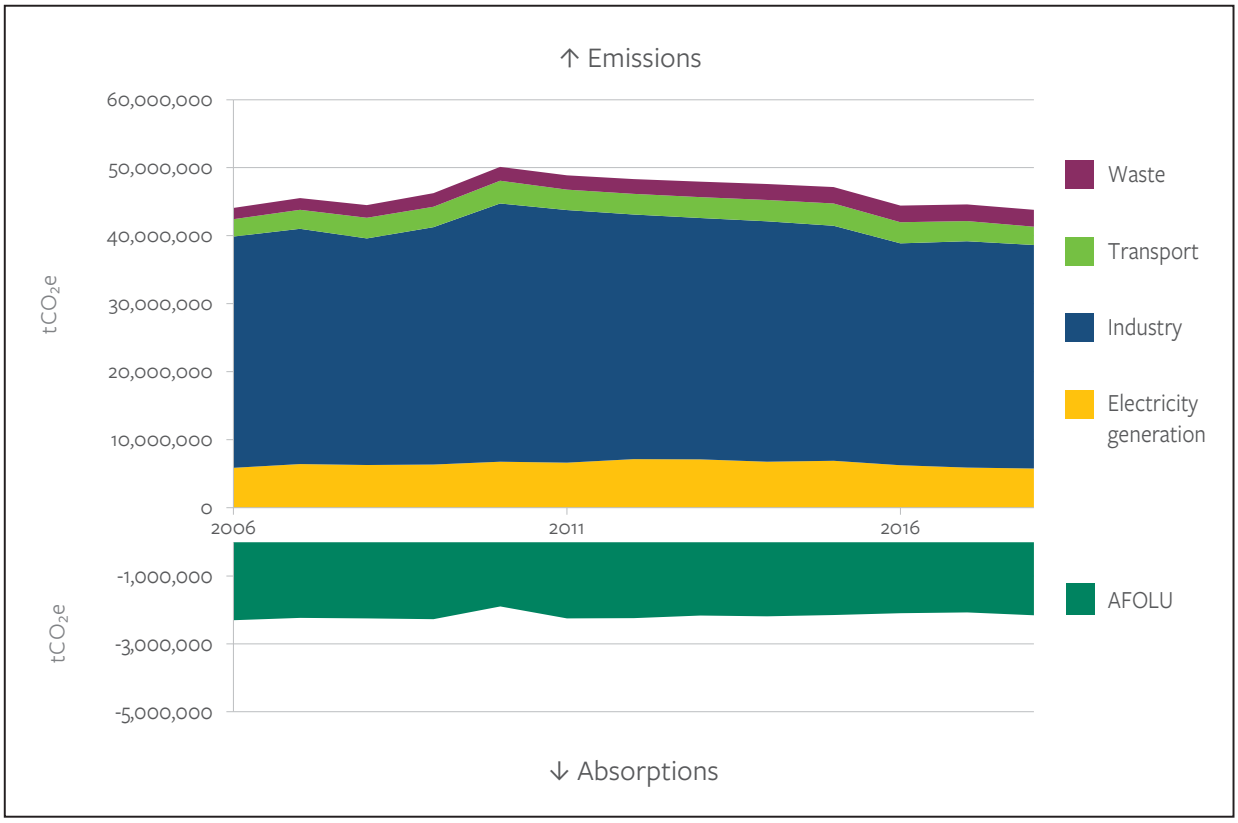


FIGURE 4.3 Historical GHG emissions and removals evolution

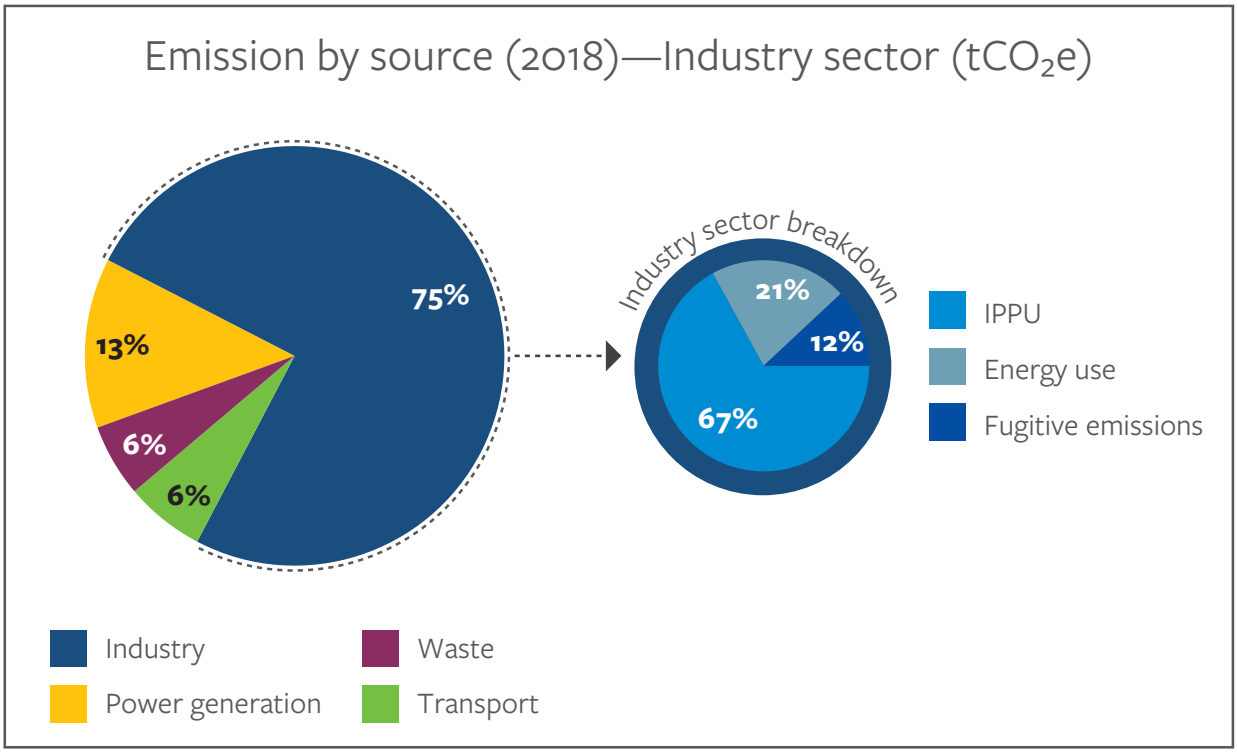


FIGURE 4.4 **Emission by source (2018): Industry sector**

Emissions are surprisingly stable over time and have decreased by a mere 0.32 percent from 2006 to 2018. It should be pointed out that there was a notable upward trend with an increase of 15 percent between 2006 and 2010, and that since then, emissions have decreased slightly.

The sector with the greatest influence is the industry sector which contributed to more than 70 percent of total emissions during the entire period.

This is mainly because of the importance of oil and natural gas industries, including petrochemical industries, in the country. Trinidad and Tobago has slightly different characteristics from other SIDS, mainly because of its rich energy resources which make it a leading resource-exporting country. This also affects Trinidad and Tobago's industrial development compared to that of other SIDS, giving the industry an important role in the country's economy. Apart from the extraction and processing of oil and natural gas, there are other industries that have a significant effect on the country's economy, such as methanol production, steel production (with lower contribution since the closure of the Arcelor Mittal plant in March 2016), and ammonia production.

Within the industrial sector, the main sources of emissions are those associated with industrial processes and product use (IPPU), followed by energy consumption within the sector. It should be noted that the energy consumption here refers only to energy industries. The existence of natural gas consumption in manufacturing industries is well-known, as it is used for energy purposes. However, there is not enough information to separate it from feedstock for the process. Given the impossibility of breaking it down, all-natural gas is considered a feedstock and is reported in the IPPU category, process emissions and product use. These results are shown in **FIGURE 4.4**.

However, it is worth noting the downward trend of the industrial sector in line with the sector's declining added value. **FIGURE 4.5** shows that most industrial sub-sectors have reduced their production or their production has been stabilised during the historical period, without reaching again the production peaks of decades ago. (Espinasa & Humptert, 2016; BP plc, 2019).

The evolution of electricity demand is highly correlated with GDP (86%) during the period analysed (2006–2018). As shown in **FIGURE 4.6**,

FIGURE 4.5 **Production in the industry sector**

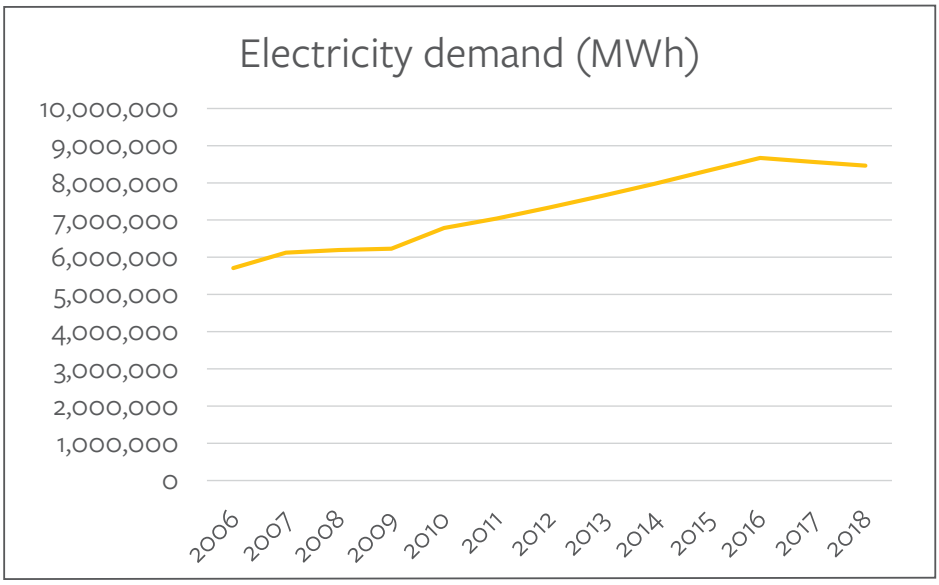


FIGURE 4.6 **Evolution of the electricity demand** *Information provided by the Ministry of Public Utilities*

electricity demand reached a peak in 2016 and thereafter decreased. Due to the correlation between both variables a regression analysis was chosen as the main method for the projection.

The historical trend shows clearly that emissions from the transport sector follow a fairly constant path where there is almost no variation in the shares of energy consumed by the road transport, aviation and navigation sub-sectors in the selected years. In absolute figures, there is an increase in energy consumption until 2016, when a peak is reached; the trend then slows down, even reversing the growth. Within the sector, road transport is the largest contributor to overall emissions, as shown in **FIGURE 4.7**.

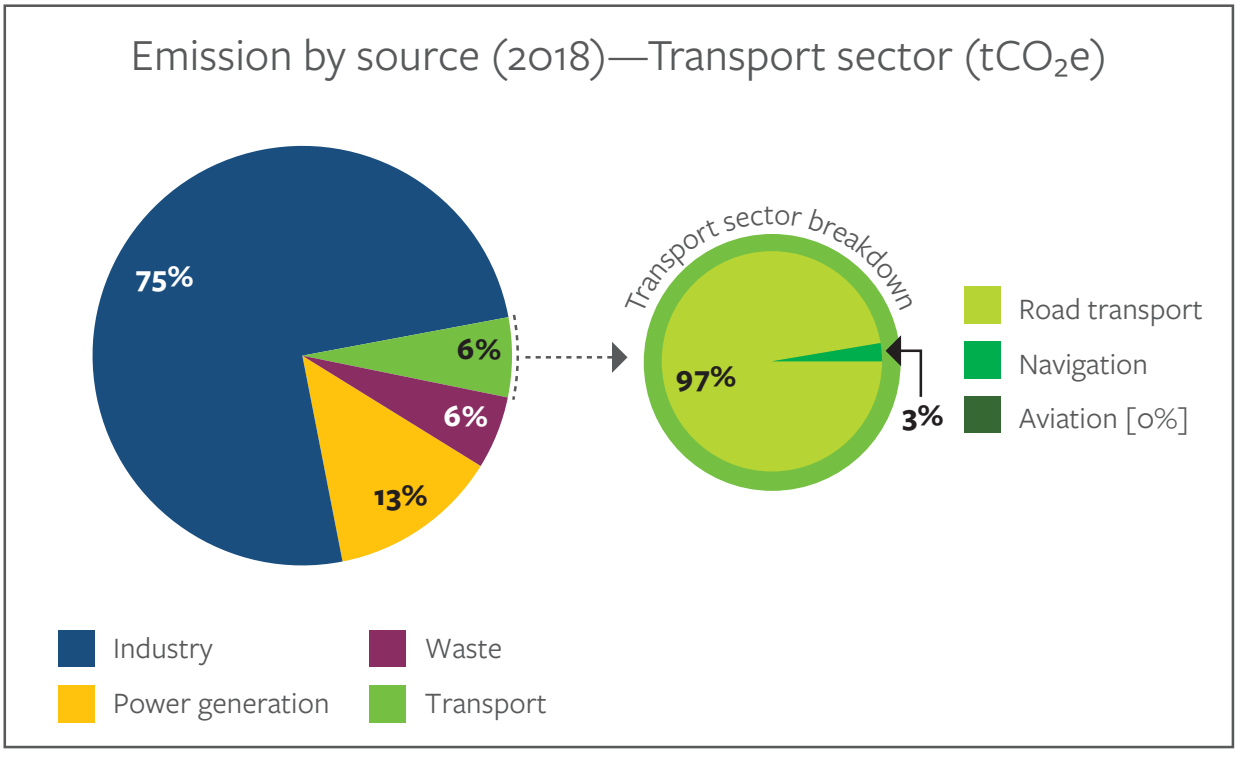


FIGURE 4.7 **Emission by source (2018): Transport sector**

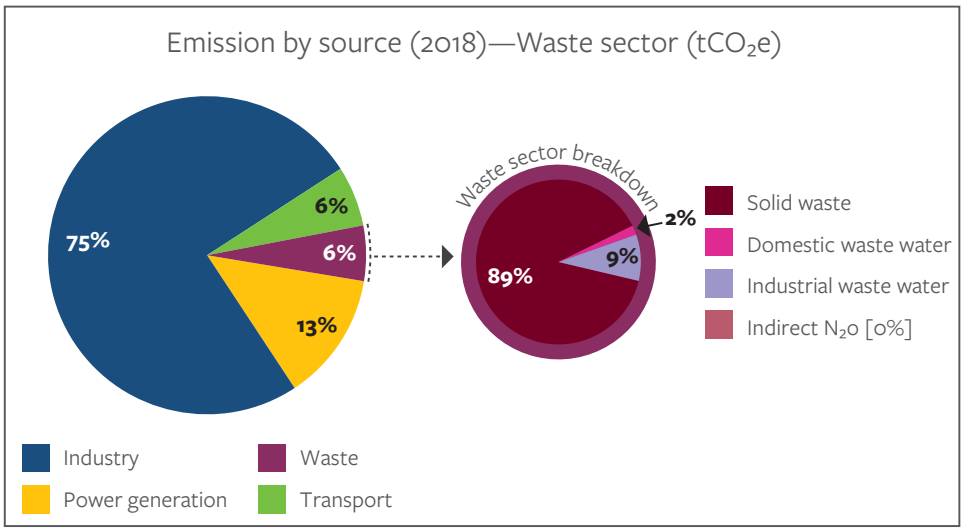


FIGURE 4.8 Emission by source (2018): Waste Sector

Regarding the waste sector, its contribution has increased during the historical period (2006–2018), likely as a result of population growth. The increase in population increases the amount of municipal waste and domestic wastewater generated.

On the other hand, as previously stated, the industrial sector maintained an important weight during the period analysed (2006–2018). Industrial wastewater is directly linked to industrial waste generated. It is therefore consistent that this stream of waste has increased and, consequently, emissions from the waste sector as a whole.

As shown in **FIGURE 4.8**, within the waste sector the contribution of emissions associated with solid waste stands out. These emissions are related to the methane that is emitted from decomposing waste materials deposited in landfills.

The AFOLU sector is handled differently from the other sectors as it is the only sector that has both emissions (associated with livestock farming,

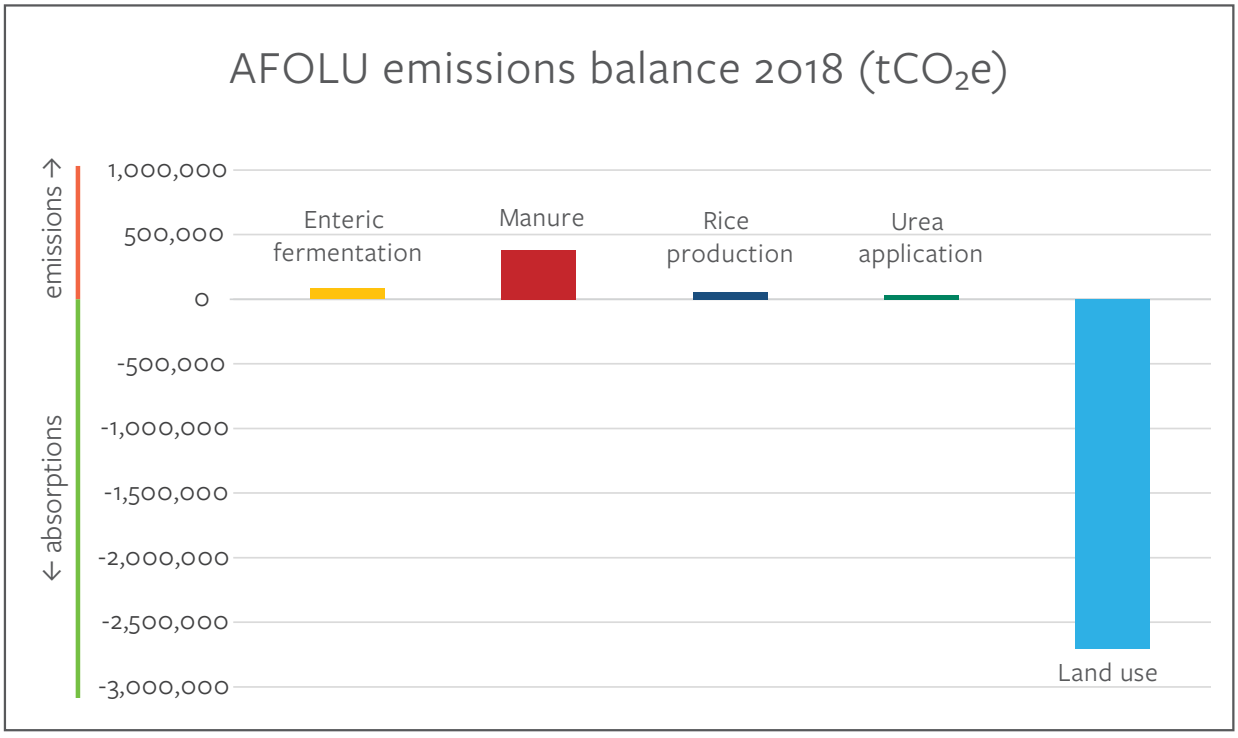


FIGURE 4.9 Emission by source (2018): AFOLU Sector

fertilisers and forest fires), and GHG removals (from the available forest area that act as a CO_2 sink). As a result, the balance of emissions is negative since more CO_2 is absorbed than is emitted.

As far as emissions from the sector are concerned, all emission sources show an upward trend in the historical period analysed. In terms of absorption, these show a downward trend, indicating a decrease in the forest area. However, in the balance between removal and emission, removal is much higher throughout the historical period analysed. These results can be seen in **FIGURE 4.9**.

Sectoral hypotheses and primary data

This section elaborates on the hypotheses which defined the results obtained in the model for the projection period in each sector. All the scenarios share some of the hypotheses since the evolution of all is affected to a certain extent by GDP and population growth. However, there are some particularities for each sector that are worth mentioning.

In addition to the sectoral characteristics, it should be noted that the scenarios also share several mitigation measures that are currently being implemented. Therefore, the BaU scenarios included these measures to the extent that they could be quantified.

The measures were assessed through a participatory process with stakeholders, quantified, and used in the model, as appropriate.

Below, the details of the hypotheses included in the model for every sector are explained. Additionally, the last section is devoted to the additional hypotheses used in the Mitigation scenarios.

Power Generation

The evolution of electricity generation and demand is usually closely linked to the economic evolution of a country. Trinidad and Tobago is no exception to this. Based on the data from the historical period, a clear link can be seen between the evolution of electrical energy demand and economic growth.

Therefore, in making a projection for electricity demand, the evolution of the economy was used as the base in the scenarios.

A very high correlation between GDP and electricity demand was observed (86%) and no signs of decoupling between both variables have yet been discerned. However, some energy efficiency measures have been implemented which may yield benefits in the medium term. As a result, the GDP has been considered as the main variable in order to project demand along with some decoupling factor.

Moreover, other variables need to be defined in the model to obtain the whole picture. To do so, using the demand as a basis, the total production output was projected and then distributed among the different technologies. Likewise, the projected installed capacity for each technology was contemplated considering

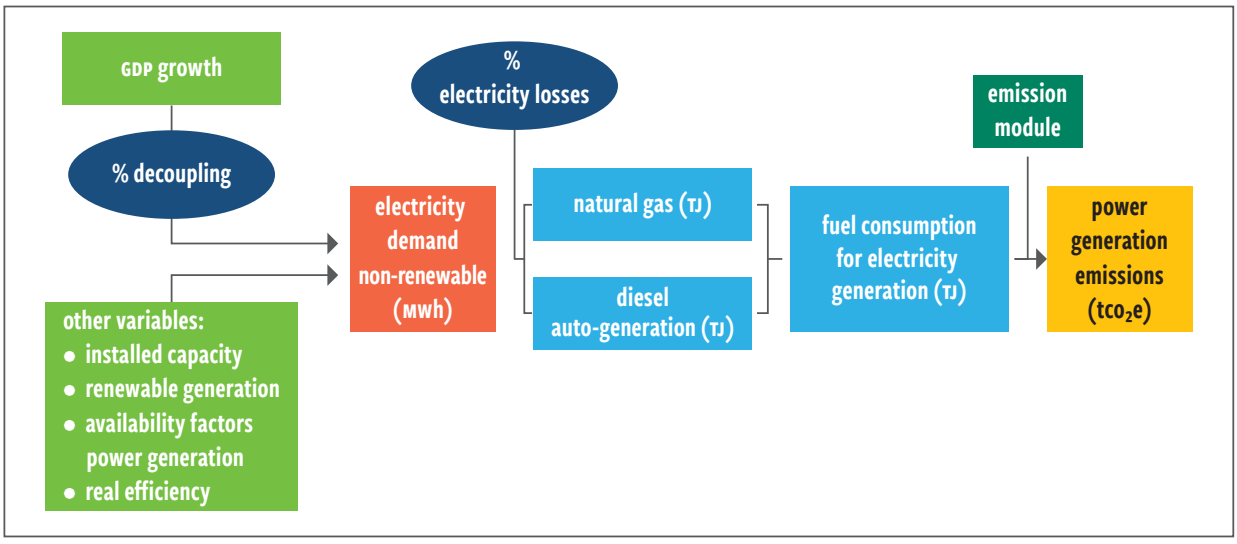


FIGURE 4.10 Relationship between variables for the power generation sector

TABLE 4.10 Assumption and variables for power generation sector

Assumption and variables for power generation sector		Scenario	Average annual growth
Non Renewable Fuels for Electricity Generation	98% natural gas and 2% diesel. These are the percentages that will be maintained during the projected period, being the average of the last 5 years.	All	–
Decoupling	A very clear correlation has been observed between GDP and Demand, so in BaU scenarios there is no decoupling factor, or, alternatively, there is a decoupling factor of 1.[1]	Conservative	1
		Optimistic	1
Availability Factor	Availability for each technology according to the Energy Information Administration (EIA).[2]	All	–
Installed Capacity	Evolution of installed MW according to TT's Energy Dossier	All	–
Real Efficiency	Average real efficiency of 36.3%. This is obtained from the ratio between the real and theoretical efficiency in the historical data multiplied by the theoretical efficiency of each technology for the projected years.	All	–

1 Historical data has been analysed where GDP has had a similar growth to that projected in the scenarios. In this sense, decoupling values have been chosen according to these observed data.
2 EIA: https://www.eia.gov/

the current plans for openings and closures of electricity generation plants.

Along the same lines, the penetration of renewable energy for electricity generation was taken into account given that the share of renewable generation will be at least 10 percent by 2050, according to the established policy goal of achieving 10 percent Renewable Energies (RE) by 2021 under a BaU Scenario and 30 percent by 2050 in the Mitigation scenarios. **FIGURE 4.10** and **TABLE 4.10** show the relation between variables and main assumptions for the sector.

Industry

The cause–effect relationship between economic growth and production is not so straightforward when it comes to industry. Each specific variable must be addressed carefully, as the interdependence between them is often not linear, according to historical data.

Bearing in mind this complexity, a more sophisticated approach was used, combining a multiple-regression scheme for the projection of the variables with the establishment of limits based on the maximum capacity of the industrial sites of Trinidad and

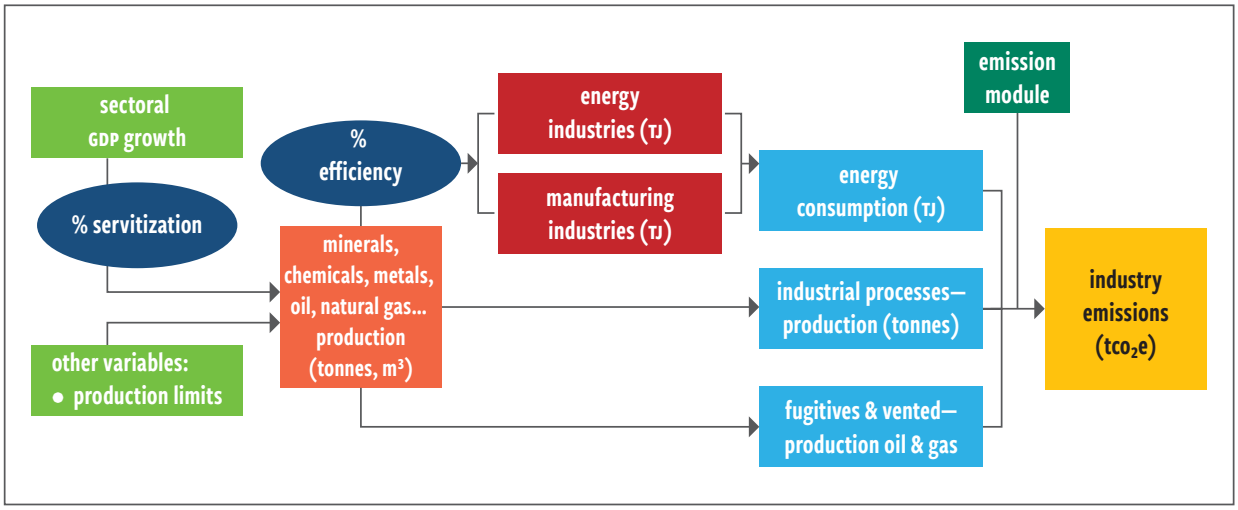


FIGURE 4.11 Relationship between variables for the industry sector

TABLE 4.11 Assumption and variables for industry sector

Assumption and variables for Industry sector		Scenario	Average annual growth[1]
% Servitization	% servitization between GDP and Natural Gas and Oil production. The production grows this percentage above the growth of the GDP. Source: Historic data[2]	All	+0.5%
	% servitization between GDP and Other products production. Production reduces this percentage above the growth of the GDP.	All	–0.4%
% Efficiency	Relationship between consumption and production in natural gas industries. Consumption reduces this percentage over production.	All	–0.1%
		All	+1%
	Relationship between consumption and production in oil industries. Consumption increases this percentage over production.	All	–0.4%
Production limits	The production limits are determined by the country-level bibliographic sources. The same limits that were considered in the development of the CRS have been considered.	All	–

1 Note that these are average values, but that each production considers its exact variation.
2 Historical data has been analysed where GDP has had a similar growth to that projected in the scenarios. Servitization values have been chosen according to these observed data.

Tobago. Furthermore, a different approach was used for process-based emissions, combustion emissions and fugitive emissions.

In both the conservative and the optimistic scenarios, the industrial processes were projected based on the expected evolution of the sectoral value-added. The production of gas and oil is linked to the value-added of the "Other industry" sector, while the industries producing other materials (chemicals, metals, etc.) and the treatment of gas and oil (refining, etc.) are linked to the manufacturing industry. However, a hard cap was established in both cases, considering that growth in capacity would take place during the projection period, but having the current maximum capacity as the baseline for the growth, which is lower than the expected economic growth. Additionally, industry-specific servitization parameters between GDP and production were included, considering historical ratios.

In the case of the activity data for the fuels consumed in the industry sector, the approach was more complex than for the process-based emissions. In this case, for the projection, in addition to the evolution of the economy, an efficiency parameter between historical consumption and production was considered.

Finally, the process was taken one step further, because in a similar manner as explained before for the industry production, capacity limits were also set for energy consumption. To do so, for every subsector, a limit was established considering its features and the historical data.

In the case of fugitive, vented and flaring emissions, a direct correlation was established between the production of natural gas and oil, and the emissions released into the atmosphere as a result of extraction and production activities. **FIGURE 4.11** and **TABLE 4.11** show the relation between variables and main assumptions for the sector.

Transport

The evolution of the fuel consumption and, therefore, the GHG emissions of the transport sector, are closely tied to the economic evolution of the country. Thus, for the transport sector, the projections for both the conservative and optimistic scenarios were based on the projected evolution of the economy for Trinidad and Tobago, including the evolution of the kilometres travelled and considering the degree of decoupling between GDP growth and fuel consumption/kilometres travelled.

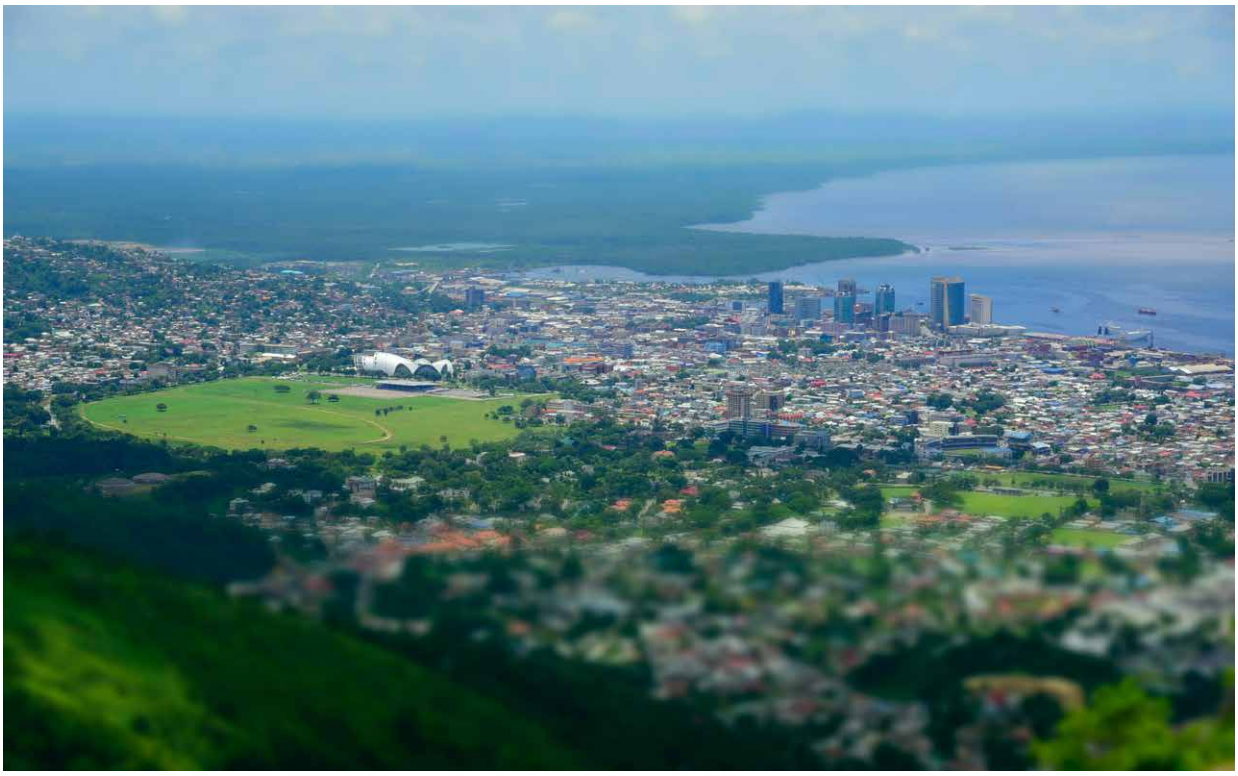


Photo Credit: Ministry of Planning and Development

▲ View of the capital Port of Spain, Trinidad, 2017

▼ View of Man of War Bay with Charlotteville, 2019

Photo Credit: Tobago House of Assembly

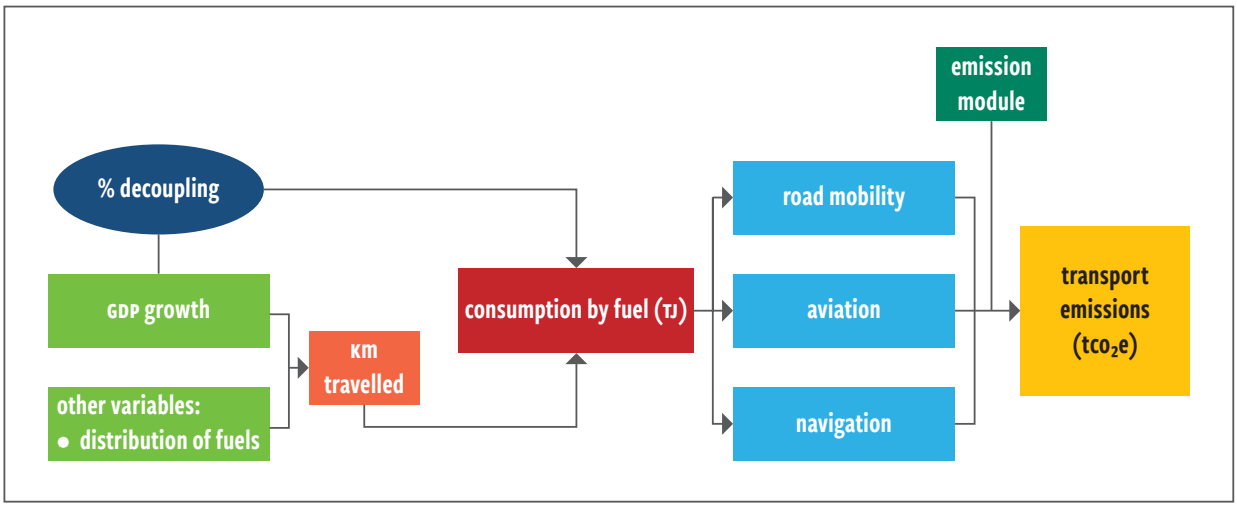


FIGURE 4.12 Relationship between variables for the transport sector

The GHG Inventory lacks high resolution data for a detailed analysis of the sector. Therefore, scenarios are solely based on economic projections in terms of different fuel consumption, not modes of transport. For a more accurate projection for the sector, other sources of data such as the number of vehicles in the country by type or the passengers/ kilometre for every vehicle would be necessary.

The link between the economic growth and the number of kilometres travelled in the country was defined. The distribution of the kilometres travelled among the different fuels was based on the historical evolution of fuel consumption, maintaining the current distribution. **FIGURE 4.12** and **TABLE 4.12** show the relationship between variables and main assumptions for the sector.

Waste and Wastewater

The cause–effect relationship between economic and population growth and waste generated seems clear in Trinidad and Tobago. Emissions from the sector are divided into emissions associated with solid waste and emissions generated as a result of wastewater, in both cases making a distinction between industrial and domestic waste.

It should be noted that the socio-economic projections used in this sector were also presented in the previous section and are common to all sectors. Furthermore, regarding emission factors, the same factors were used in developing the national GHG Inventory which, in the absence of country-specific data, uses the default data provided by the IPCC guidelines specifically for the Caribbean region.

TABLE 4.12 Assumption and variables for transport sector

Assumption and variables for transport sector		Scenario	Average annual growth
% Decoupling	% decoupling between GDP and fuel consumption in aviation and navigation. The consumption reduces this percentage above the growth of the GDP. Source: Historic data[1]. This decrease is due to the use of more efficient vehicles.	Both	–0.8%
Distribution of fuels	The distribution of fuels is estimated to be the same as at present: 0% electric mobility and biofuels, 0.1% CNG, 60% Gasoline, 39.9% Diesel.	Both	-

1 Historical data has been analysed where GDP has had a similar growth to that projected in the scenarios. In this sense, decoupling values have been chosen according to these observed data.

TABLE 4.13 Assumption and variables for the waste sector

Assumption and variables for waste		Scenario	Medium annual growth
Municipal Solid Waste Generation Rate (kg/cap/year)	Historical period: 550. This ratio could be further reduced with circular economy measures.	All	–
% SWDS (Solid Waste Disposal Sites)	Historical period: 83% → Projected BaU period: annual reduction of –0.01%, This means that in 2050, 80% of the waste generated will arrive at landfills. Projected Mitigation period: annual reduction of –0.3%. This means that in 2050, 60% of the waste generated will arrive at landfills. Related to Measures 1 and 3, reduce the volume of waste reaching the landfill by 50% by 2050 and recycle more materials. Influence on the % of waste going to landfill.	BaU	–0.01%
		Mitigation	–0.3%
Industrial Waste Generation Rate (Gg/$m GDP/yr)	Historical period: 5 → Projected period: 4.5. Assuming same reduction proportion as in Municipal solid waste.	All	–
% Industrial Waste	Historical period: 5% → Projected period: annual reduction of –0.032%. This means that in 2050, 4% of the waste generated in industries will arrive at landfills. Related to Measures: Reduction of industrial waste.	All	–0.032%
Methane Recovery	Historical period: 10 Gg → Projected period: 10.92 Gg: Cross-sectional measure: possible waste-to-energy plant, how much methane will be recovered. With the current waste composition, it has been calculated that the recovery of 750 tonnes of waste per day will mean the recovery of 916 tons of methane in one year. Calculated with the IPCC tool.	All	–
MCF Rate	Historical period MSW: 0.71, Industrial: 0.72 → Projected period: annual increase of 0.19%, This means that in 2050 the MCF value will be MSW: 0.77. Industrial: 0.78. Related to Measure: Sustainable disposal infrastructure: more managed sites. Improvement of facilities is linked to MCF ratio.	All	+0.19%
Wastewater	For domestic wastewater: the same fraction of population distribution is assumed as at present, (GHG Inventory), (urban high income, urban low income and rural, and the same degree of utilisation. For industrial wastewater: the GHG Inventory assumes constant production over the historical period for Beer and Malt, Pulp and Paper and Organic Chemicals industries. Thus, the same production values are considered, until these values are updated. The treatment method is Anaerobic Shallow in all cases. For indirect N_2O Emissions: linked to per capita protein consumption. Assumed to be constant.	All	Constant

Bearing these general assumptions in mind, a different approach has been used for each source of emission.

Regarding solid waste, methane emissions in landfills have been projected using the IPCC Waste Model which is the same used in the GHG Inventory. This tool uses the IPCC's First Order Decay (FOD) methodology[3] in order to estimate the methane that is being generated, depending on the composition of the waste dumped over time and on the climatic conditions as well as those of the landfill itself.

The characterisation of the waste arriving at the landfill, both municipal and industrial, has been assumed to be the same as in the historical period.

3 The CH_4 generation potential of the waste that is disposed in a certain year will decrease gradually throughout the following decades. In this process, the release of CH_4 from this specific amount of waste decreases gradually. The FOD model is built on an exponential factor that describes the fraction of degradable material which each year is degraded into CH_4 and CO_2 (Pipatti et al., 2006).

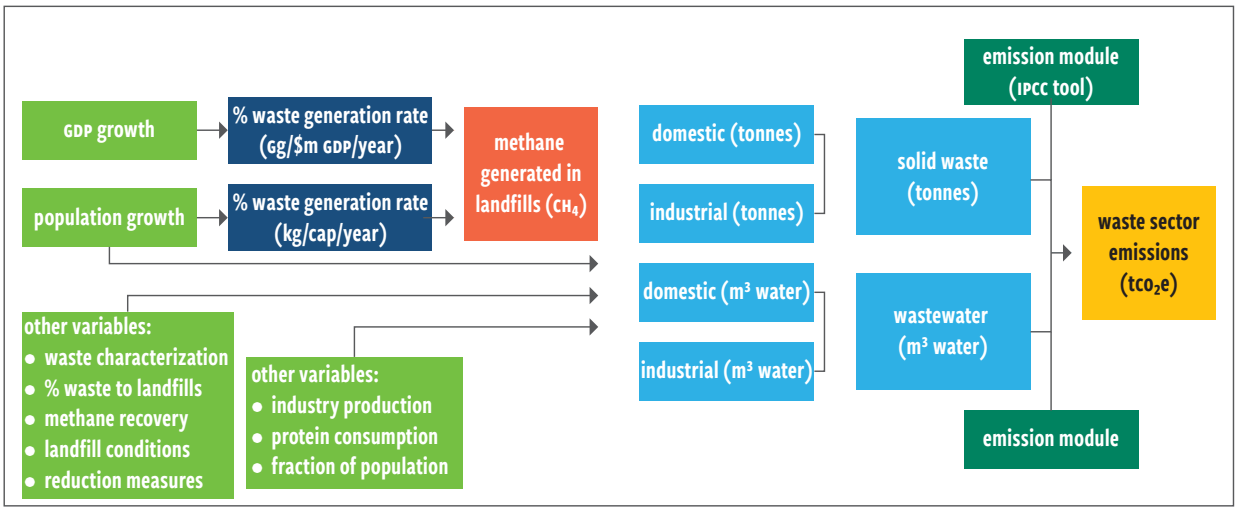


FIGURE 4.13 Relationship between variables for the waste sector

In this regard, it is assumed that current conditions of the landfills remain constant.

In the case of domestic wastewater, a direct link has been established between the wastewater generated and the population. For industrial wastewater, the evolution of the production of each of the industries has been considered, as well as the different rates of wastewater generation of each industry.

FIGURE 4.13 and **TABLE 4.13** show the relationship between variables and main assumptions for the sector.

AFOLU

The AFOLU sector is one of the most difficult sectors to project due to its intrinsic complexity. The correlation between socioeconomic variables and sectoral emissions is not as straightforward as in other sectors. Therefore, each specific variable must be addressed carefully, since the interdependence between them is often not linear according to historical data.

Bearing in mind this complexity, a different approach was used for each source of emissions and absorptions/sequestration, in both the conservative and the optimistic scenarios. It should be noted that this is the only sector where carbon sinks are projected, associated with the CO_2 absorbed by lands.

The considerations for each emission source are described below.

Enteric fermentation (CH_4) and manure (CH_4 and N_2O) emissions depend on the number of livestock, so the projection of the evolution of the livestock is linked to the evolution of the sectoral GDP. According to the historical data, a strong positive correlation can be observed between the two. If the GDP of the sector increases, the number of livestock increases.

The fraction of each group of livestock over the current total has been maintained in the projections, as the evolution in the historical period has not changed. It is expected that 99 percent of the livestock are poultry.

Emissions from forest and grassland fires are independent of socio-economic variables and can only be reduced by fire prevention measures.

Regarding the use of fertilisers, the associated emissions will also depend on consumption trends and not on socio-economic variables. For the moment, the GHG Inventory has not collected information about the use of nitrogenous fertilisers, so these have not been projected. In relation to the use of urea as a fertiliser, the average historical consumption has been maintained. In the case of rice production, it has also been considered a trend consumption based on the historical average.

Finally, in terms of land use, emissions do have a clear socio-economic influence, given that population growth could mean fewer green areas due to new urban settlements, and therefore fewer carbon sinks. However, it is also necessary to consider conservation and reforestation measures to ensure the conservation of this area of land over time.

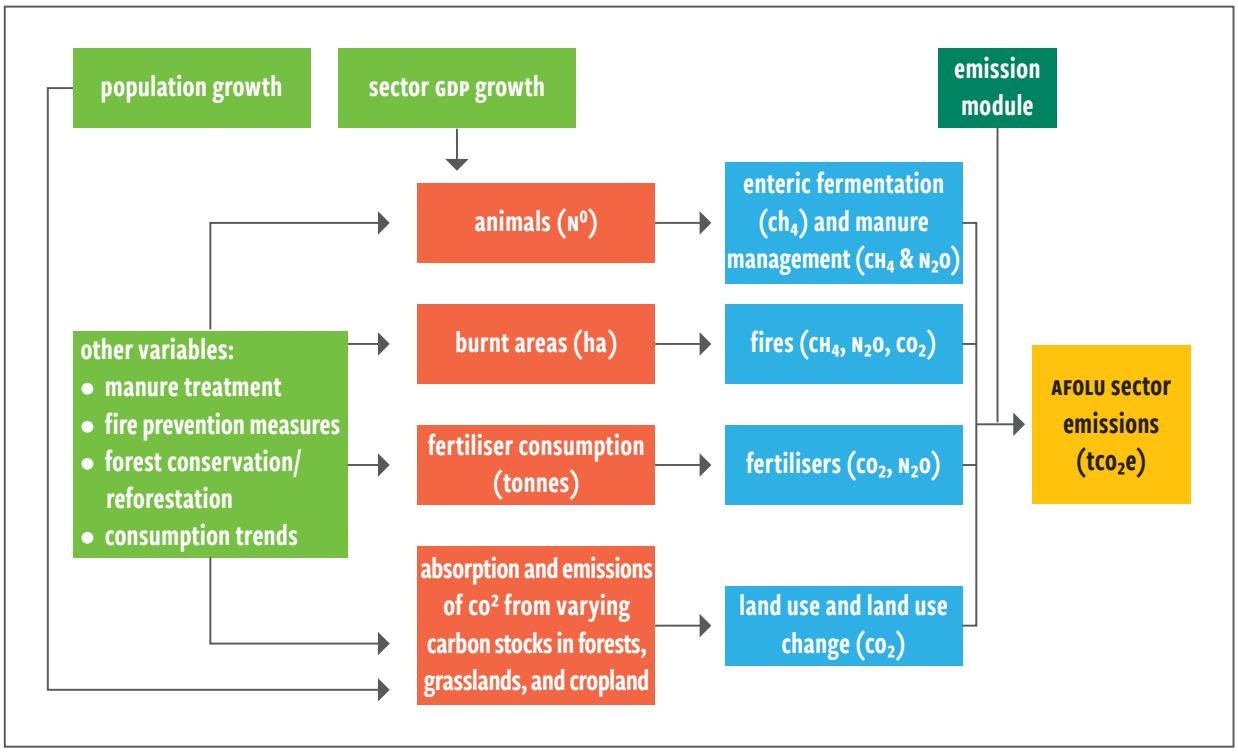


FIGURE 4.14 Relationship between variables for the AFOLU sector

TABLE 4.14 Assumption and variables for AFOLU sector

Assumption and variables for the AFOLU sector		Scenario	Medium annual growth
Livestock evolution	Growth proportional to the sector's GDP growth. Relationship extracted from historical data.	All	+0.3%
Fire prevention	Growth proportional to the sector's GDP growth. Relationship extracted from historical data.	Conservative	–0.6%
		Optimistic	–0.94%
Land use and land use change	Reforestation (absorptions—"minus" CO_2): there are several measures oriented to "Forest Conservation/Reducing deforestation/ reforestation". In the long term, by 2050, the forest area could increase by 10% Conservative; 12% Optimistic.[1]	Conservative	+0.31%
		Optimistic	+0.38%
	The areas of plantations are inversely proportional to population growth.	Conservative	–1.5%
		Optimistic	–2.5%
Fertilisers	No data is available for nitrogenous fertilisers. Urea usage remains constant during the projected period: 30,202 tonnes of urea per year.	All	Constant
Rice Cultivation and Harvest	Growth proportional to the sector's GDP growth. Relationship extracted from historical data.	All	+0.17%

1 Food and Agriculture Organization of the United Nations (2015b)

FIGURE 4.14 and **TABLE 4.14** show the relationship between variables used in the modelling.

Results of the projected scenarios

Once the historical GHG baseline, the economic scenarios and the hypotheses were established, the main outputs of the model for the Business as Usual and Mitigation scenarios were analysed. In order to do that, an initial comparative analysis between the different scenarios was performed. A detailed analysis for each sector was conducted comparing the results obtained in the different scenarios.

Total emissions

When comparing the projected scenarios, the influence of the variables on the results can be observed. An overview of the total emissions of each scenario is displayed in **TABLE 4.15**, including the emissions evolution for each scenario in the period 2018–2030 and 2018–2050.

The Conservative Scenario shows a fairly gradual variation in growth, in line with what was observed during the historical period. In the case of the Optimistic scenario the growth is higher, since according to the hypotheses considered, in this scenario there would be strong economic and demographic growth—variables to which emissions are closely linked.

Conservative BaU Scenario (BaUC)

After comparing the results obtained for both scenarios, a detailed analysis of the results obtained for the conservative BaU scenario is shown in **TABLE 4.16**.

As shown in **TABLE 4.16**, the greatest increase by 2050 in relative terms is projected to occur in the AFOLU sector with an increase of 22 percent, bearing in mind that emissions from the sector are not increasing but rather decreasing with GHG removals. In terms of emissions, the sector which is expected to increase the most is the transport sector, followed by the industrial and waste sectors. Emissions associated with electricity generation are projected to decrease.

Likewise, in absolute terms, the industry sector will see high growth in emissions. In fact, industry is now and, according to the projection results, will be the most emitting sector in Trinidad and Tobago in 2050, given the assumption that it will remain a key part of the country's economy. Its weight in total emissions remains constant over the period, while the evolution of the other sectors is not enough for them to reach the emissions level of the industrial sector.

After examining the total emissions results for the Conservative BaU scenario, a breakdown of the main inputs and outputs of the model by sector was undertaken.

TABLE 4.15 Comparison of total emissions by scenario

Total (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Conservative BaU (BaUC)	41,630,448	41,963,134	42,383,528	42,888,311	1%	3%
Optimistic BaU (BaUO)	41,630,448	47,912,904	50,357,039	52,271,832	15%	26%

TABLE 4.16 Total emissions in the Conservative BaU scenario

Total (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Power Generation	5,741,518	5,418,601	5,362,107	5,417,696	–6%	–6%
Industry	32,899,574	33,123,125	33,351,404	33,598,190	1%	2%
Transport	2,687,832	2,891,386	2,944,446	2,998,930	8%	12%
Waste	2,460,045	2,453,448	2,511,858	2,567,020	0%	4%
AFOLU	–2,158,521	–1,923,426	–1,786,287	–1,693,524	11%	22%
TOTALS	**41,630,448**	**41,963,134**	**42,383,528**	**42,888,311**	**1%**	**3%**

TABLE 4.17 Emission evolution by category: Power generation Sector—BaUC

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Natural Gas	5,612,635	5,271,671	5,213,669	5,267,718	–6%	–6%
Diesel	128,884	146,930	148,438	149,977	14%	16%
TOTAL	**5,741,518**	**5,418,601**	**5,362,107**	**5,417,696**	**–6%**	**–6%**

Electrical Power Generation

Emissions from the electricity generation sector are linked to the use of fossil fuels in the electricity generation matrix. **TABLE 4.17** shows the emissions assigned to electricity generation, divided by fuel. In absolute terms, the emissions from natural gas would be almost 5.2 million tCO_2e, while the emissions from diesel are 150 tCO_2e because they refer only to a small percentage of self-generation.

As can be seen in the table, the most important variable in this sector is the consumption of natural gas, which is the largest source of emissions in the sector. However, overall emissions are falling, due to the decrease in consumption of this fuel which is being replaced by renewable energies (10% in 2050). Despite the fact that energy demand is increasing, as it is correlated with GDP growth, it is moving towards a clean matrix, hence the reduction in emissions.

As previously noted, the emissions associated with the power generation sector depend on the evolution of demand. **FIGURE 4.15** shows this evolution and how the weight of generation is changing depending on the introduction of renewable energies.

Total demand is projected to increase by six percent. However, it is noted that the non-renewable generation will be replaced by renewable generation. Non-renewable demand is projected to decrease by five percent, thus reducing the sector's emissions.

Regarding generation by non-renewable technologies, this is produced in thermal and CCPG plants. It should be noted that based on the historical data, installed CCPG capacity has been growing over time,

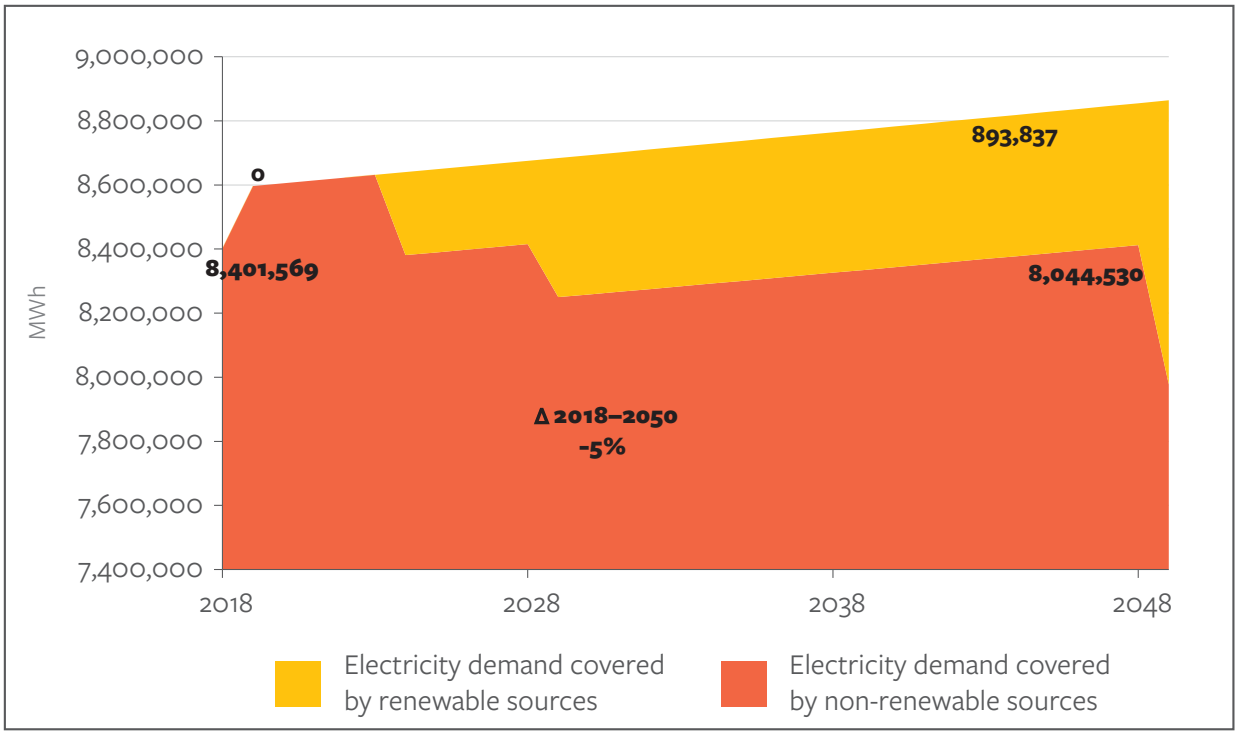


FIGURE 4.15 Evolution of electricity demand— BaUC

but without surpassing thermal installed capacity (2018 956MW CCPG and 1,140MW Thermal). This means that electricity generation has been transitioning to cleaner options over the last few years.

However, since there appear to be no plans for future plant closures or openings, it has been decided to maintain non-renewable generation at 50 percent. It should be highlighted that since non-renewable demand will decline, the installed capacity will cover energy needs without reaching maximum peaks, which also means that power generation plants are projected to operate below their maximum capacity.

Regarding renewable generation, it has been assumed that the share of renewable generation will be at least 10 percent by 2050, given the established policy goal of achieving 10 percent RE by 2021. It should be noted that this is a conservative estimate since an increase in the penetration of RE between 2021 and 2050 is also possible. In this regard, the installed capacity necessary to supply that demand has been projected, as shown in **TABLE 4.18**.

It should be noted that the renewable generation sources with the highest degree of development at present have been considered in order to make an initial estimate, although these may vary. The distribution within renewable sources does not affect projected emissions.

After considering the installed capacity of renewables projected in this scenario, the fossil fuels which will be the sources of emissions must be analysed. As shown in **TABLE 4.19**, the fuel which is most widely consumed in the power generation sites of Trinidad and Tobago will still be natural gas, since the current fuel consumption ratios have been maintained (98% natural gas and a minor 2 percent diesel for self-consumption). According to the outputs of the model, the decrease of natural gas consumption would be six percent by 2050.

Lastly, the trend seen for energy consumption shows no variation for GHG emissions. As can be seen, natural gas has the highest contribution, which is much larger than the contribution of diesel and is also proportional to the GHG emissions generated.

TABLE 4.18 Installed Capacity: Renewable—BaUC ▼

Installed Capacity (MWh)	2018	2030	2040	2050
Wind Power	0	66	67	125
Solar PV	0	130	114	221

Industry

As explained in previous sections, the emissions of the industry sector are divided into different sources. On the one hand, the process-based emissions need to be considered and, on the other hand, the emissions caused by the use of fuels in the industry sector and from fugitive emissions, particularly in the oil and natural gas production and transformation processes of Trinidad and Tobago, also need to be accounted for.

TABLE 4.20 summarises the results of the industry sector in the conservative scenario. Both at the

TABLE 4.19 Fuel consumption evolution—BaUC

Fuel Consumption (TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Natural Gas	99,950	93,878	92,940	93,808	–6%	–6%
Diesel	1,734	1,976.38	1,998.72	2,017.37	14%	16%

TABLE 4.20 Total emissions of the industrial sector in the BaUC scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
IPPU	22,043,786	22,496,271	22,913,852	23,343,613	2%	6%
Energy Use	6,920,947	6,788,964	6,678,601	6,572,919	–2%	–5%
Fugitive emissions	3,934,841	3,837,890	3,758,951	3,681,658	–2%	–6%
TOTALS	**32,899,574**	**33,123,125**	**33,351,404**	**33,598,190**	**1%**	**2%**

beginning and the end of the period, process-based emissions would be the highest contributor followed by the combustion of fuels. With a smaller contribution and on a downward trend would be fugitive emissions.

There are very small variations in the projected contributions of each category. In fact, the total emissions of the industry sector would not vary much in the projected period for the Conservative BaU scenario due to the hypotheses regarding the maximum capacity of the production plants and servitization parameters, which decouple production from GDP growth.

Process-based emissions would remain fairly constant over the period analysed with a small increase observed. These emissions are mainly linked to the ammonia industry which accounts for 73 percent of total emissions in this category over the projection period. Energy consumption is linked to the energy industries which would vary very slightly in its contribution based on historical trends. Finally, fugitive emissions are reduced due to the fact that natural gas and oil production are reduced under this scenario.

The first variable to be projected is production in the different manufacturing industries, since it is the key variable on which emissions will depend.

TABLE 4.21 shows the projected production of the industrial processes causing process-based emissions. Due to the hypotheses applied in the model, the production of those processes does not grow in line with the national economy because it is limited by the production capacity of the existing plants. This is so even if the growth rate and new plant projects are considered and the servitization parameter is analysed in the historical period to indicate production growth against the growth of the GDP.

These hypotheses project low growth in production for the industrial sector. As established in the economic module, the conservative scenario would maintain the current weight of industry, although it is not totally proportional since it also considers decoupling factors. The effect of this decoupling factor can be seen mainly in the metal industry, where it can be seen that GDP is growing while production is declining, due to the cessation of activity in this sector over the last few years.

Moreover, the hypotheses applied in the model show that projections from those processes are also limited by the production capacity of existing plants, even if a growth rate is considered.

If **TABLE 4.22** is compared to the production patterns seen above, it could be observed that there is no correlation between the production and the emissions. The reason for this is that the emissions factors vary for every process. Some processes are more emitting than others per unit of production.

TABLE 4.21 Production patterns of different industries—BaUC

Production Patterns manufacturing industries	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Ammonia (t)	4,433,408	4,538,491	4,627,768	4,718,800	2%	6%
Methanol (t)	5,081,500	5,201,684	5,304,007	5,408,342	2%	6%
Nitric Acid (t)	774,066	766,440	781,517	796,890	–1%	3%
Iron and Steel (t)	790,134	732,378	687,487	645,347	–7%	–18%
Minerals (t)	656,441	940,889	1,005,126	1,073,983	43%	64%

TABLE 4.22 Emissions of of the industrial processes—BaUC

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018-2030	Δ 2018-2050
Ammonia	16,382,812	16,771,126	17,101,031	17,437,425	2%	6%
Methanol	3,731,854	3,820,117	3,895,263	3,971,886	2%	6%
Nitric Acid	1,025,637	1,015,533	1,035,510	1,055,879	–1%	3%
Iron and Steel	575,218	533,171	500,490	469,813	–7%	–18%
Minerals	328,266	356,323	381,558	408,609	43%	64%

Photo Credit: National Energy [facebook.com/nationalenergytt]

Port of Brighton, La Brea. Jointly owned and managed by National Energy and La Brea Industrial Development Company (LABIDCO) ►

In general, it can be affirmed that emissions follow the trends set by the production. In fact, there is almost no variation in the emissions if the beginning and the end of the period are compared. The process with the highest contribution is the production of ammonia, followed by those of methanol, nitric acid, and metals and minerals.

It should be noted that these industries do not have associated natural gas energy consumption, as natural gas is considered a feedstock and is accounted for under the IPPU category.

In this case, Energy Use category refers to the energy industries. This consumption is limited by production and the degree of efficiency between consumption and production in the historical period. These figures are shown in **TABLE 4.23**.

In general, energy consumption would be gradually decreasing, except for the refineries where there would be an increase in consumption, as evidenced by the historical period analysed. However, it is not very pronounced, since it is also related to oil production, which decreases in the projected period. Among the subsectors, LNG industries would have the highest energy consumption during the entire period, even though it shows a downward trend linked to the decline in natural gas production, as shown in **TABLE 4.24**.

The projection is based on the economic data and the forecast for worldwide consumption of oil and natural gas. It should be noted that the modelling was done before the outbreak of the Covid-19 pandemic in December 2019. The analysis therefore does not

TABLE 4.23 Fuel input in Energy Industries—BaUC

Natural Gas Consumption (TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
LNG	84,347	81,806	79,653	77,557	–3%	–8%
PPGLP	9,525	9,060	8,680	8,316	–5%	–13%
Refineries	26,195	26,785	27,288	27,799	2%	6%

TABLE 4.24 Production Patterns Oil and Gas—BaUC

Production Patterns	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Natural Gas ($x10^6$ m^3)	37,032	36,404	35,681	34,972	–2%	–6%
Oil ($x10^3$ m^3)	3,685	3,579	3,473	3,370	–3%	–9%

TABLE 4.25 Emissions Natural gas consumption Energy Industries—BaUC

Natural Gas Consumption (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
LNG	4,736,459	4,593,787	4,472,890	4,355,174	–3%	–8%
PPGLP	534,889	508,787	487,434	466,977	–5%	–13%
Refineries	1,470,946	1,503,403	1,531,597	1,560,321	2%	6%

TABLE 4.26 Emission Fugitive and vented—BaUC

Fugitive and vented emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Natural gas	3,663,146	3,575,847	3,504,690	3,434,948	–2%	–6%
Oil	271,695	262,042	254,261	246,710	–4%	–9%

take into account the impact of the economic disruption of the pandemic. According to the projection model, there will be a small decrease in natural gas production in this scenario. Oil production also declines more moderately.

In general, the same trends seen in the consumption of energy appear in the emissions. There is no variation in the contribution of the categories because all categories consume natural gas.

Finally, fugitive and vented emissions would depend directly on the production of natural gas and oil which can be seen in **TABLE 4.25**.

Natural gas activity is much higher than that of oil, and accordingly, 93 percent of the emissions are associated with natural gas production (**TABLE 4.26**).

Transport

TABLE 4.27 describes both the activity data and GHG emissions projected for the transport sector of Trinidad and Tobago. Three main emission sources are distinguished: road transport, which accounts for 85–90 percent of total emissions during the period analysed, as well as navigation (3%) and aviation (< 1%)

Of the variations in every category, navigation and aviation show the highest decrease in emissions by 2050 at 18 percent. However, when looked at globally this decrease seems almost irrelevant compared to the increase in emissions from road transport which is projected to increase by 12 percent by 2050.

Emissions from road transport will account for the majority of the emissions from the transport sector over the entire period, which accounts for almost 250 tCO_2e increase in emission in 2050 compared to 2018.

A more detailed analysis is presented below.

In the case of road transport, the evolution of consumption has been determined by the evolution of kilometres travelled (**FIGURE 4.16**).

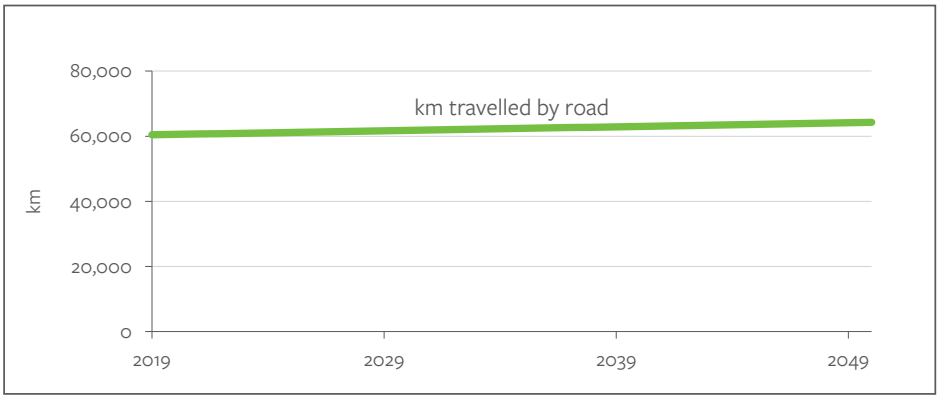
GDP growth may produce an increase in kilometres travelled. For a scenario with additional measures, the optimisation of transport routes would have to be considered as a variable in the reduction of kilometres travelled. However, in a Business as Usual scenario, this improvement has not been considered. Thus, kilometres covered vary from 60,000 to 64,170 in 2050.

Gasoline is the most widely consumed fuel in Trinidad and Tobago followed by diesel. Since the

TABLE 4.27 Total emissions of the transport sector in the BaUC scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Road Transport	2,616,234	2,824,806	2,881,768	2,939,924	8%	12%
Aviation	384	357	336	317	–7%	–17%
Navigation	71,234	66,259	62,379	58,726	–7%	–18%
TOTALS	**2,687,832**	**2,891,386**	**2,944,446**	**2,998,930**	**8%**	**12%**

FIGURE 4.16 Evolution of km travelled by road mobility—BaUC



average share of fuel distribution of the last three years of the GHG Inventory has been maintained throughout the projection period, these two fuels would account for approximately 99 percent of the total energy consumption in the transport sector. The distribution of energy consumption by fuel is shown in **TABLE 4.28**.

The table shows an increase in the consumption of gasoline, while the consumption of diesel is expected to decline compared with 2018. An increase in the consumption of CNG is also expected, but it will not affect the distribution of energy consumption among the different fuels.

In terms of emissions, the consumption of each would be almost proportional, with gasoline being the largest source of emissions, followed by diesel and kerosene, in that order. It should be noted that CNG has lower associated emissions, as its emission factor is lower than that of oil derivatives.

Navigation and aviation would vary less than road transport. These consumptions have been determined by considering GDP growth and a degree of decoupling between both. **TABLE 4.29** shows the variation in consumption for these sub-sectors.

Waste and Wastewater

Within the waste and wastewater sector, the contribution of solid waste, in its final disposal in the landfill site, stands out. This is the largest source of emissions in the sector with a contribution of almost 90 percent throughout the period projected.

Emissions associated with solid waste would decrease in the short term due to the measures implemented to improve the management of waste in landfills and methane recovery projects. However, these measures would be mitigated by the increase in economic and demographic activity.

Domestic wastewater and the indirect N_2O generated by the excrements, show an increase linked to the population increase. However, in absolute terms they would not appear to be significant. Finally,

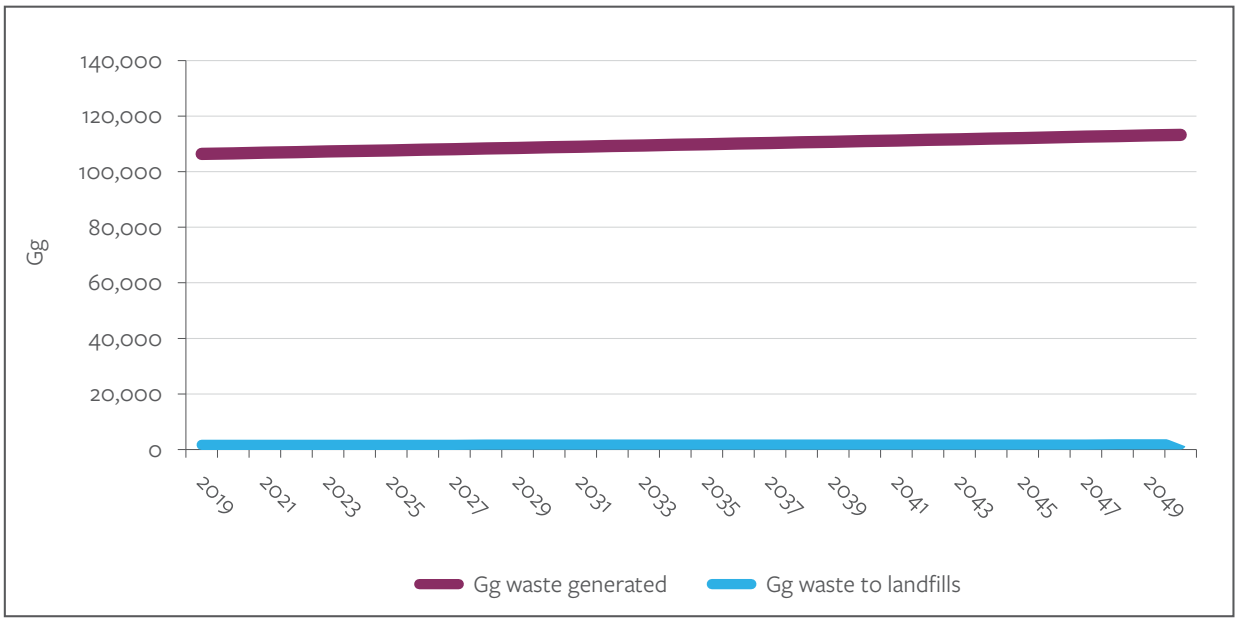
TABLE 4.28 Fuel Consumption Road Transport—BaUC

Consumption (TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Motor Gasoline	19,046	22,734	23,192	23,660	19%	24%
Diesel	16,626	15,813	16,132	16,457	–5%	–1%
Kerosene-Diesel	21	21	22	22	0%	5%
CNG	143	250	257	260	75%	82%

TABLE 4.29 Fuel Consumption Navigation and Aviation—BaUC

Consumption (TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Navigation (Diesel)	952	886	834	785	–7%	–18%
Aviation (Kerosene)	5	5	4.7	4.5	–7%	–18%

FIGURE 4.17 Gg of waste generated and arriving at landfills—BaUC



industrial wastewaters would remain constant due to the production ratios of these industries, which have remained relatively constant throughout the historical period.

As shown in **FIGURE 4.17**, the generation of waste increases over time, due to the fact that the rate of waste generation per capita is estimated to be the same as in the historical period. Nevertheless, it should be noted that in this scenario the population increase is gradual, which means that the total amount of waste generated will not increase very sharply. It should be noted that the generation of municipal waste is affected by two variables: 1) population: the more population the more waste; and 2) the rate of waste generation (kg/cap/yr): the higher the rate, the more waste generated. The total waste generated is therefore a combination of these two variables.

In this case, with the same generation rate and a slowly growing population, the projected results indicate that the tonnes of waste arriving at the landfill site are increasing.

The same phenomenon can be observed in the case of industrial waste which has been estimated to have the same rate of waste generation per unit of GDP as in the historical period, with the growth of GDP being gradual.

Each category of waste has a different amount of degradable organic carbon and its potential to generate methane is different. Depending on the amount of waste in each category, different amounts of associated emissions will be generated. **TABLE 4.30** presents waste characterisation for Trinidad and Tobago in 2018.

These values are assumed to be constant over the projected period. In the case of industrial waste, only one category is presented. Considering the evolution of the waste and its composition over time, **TABLE 4.31** shows the methane emissions generated by each category in landfills.

TABLE 4.30 Waste characterisation (amount of waste arriving at landfills) ▼

	SWDS (100%)	Industrial (100%)
Food	27%	
Garden	0%	
Paper	19%	
Wood	4%	
Textile	8%	
Nappies	0%	
Plastic, other inert	42%	
Industry		100%

TABLE 4.31 Methane generation in landfills

Emissions (Gg CH_4)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Food	13.4	14.1	14.6	15.0	5%	12%
Garden	0.0	0.0	0.0	0.0		
Paper	11.9	12.7	13.4	13.9	7%	17%
Wood	1.3	1.4	1.5	1.6	8%	23%
Textile	2.1	2.2	2.4	2.4	5%	14%
Industry	49.6	48.4	48.9	49.8	–2%	0%
Methane recovery	0.00	–0.9	–0.9	–0.9	100%	100%
TOTALS	**78.3**	**77.9**	**79.9**	**81.8**	**–1%**	**4%**

As seen in **TABLE 4.31**, industrial waste figures in Trinidad are relatively high. Estimates were calculated using expert judgement on the percentage of industrial waste that goes to landfill with a waste generation rate assumed to be 5Gg/$mGDP/yr. These figures would be estimated in future inventories using actual data as far it may be available. Regarding Municipal Solid Waste, the categories with the highest emissions are food and paper waste.

The category "methane recovery" projects the emissions that are potentially avoided by the recovery of methane, either through the implementation of measures for flaring or by being used for energy generation, and therefore also indicates mitigation potential through these measures. Hence, there is a short-term decrease in emissions at the landfill, despite the increase in waste arriving at the site.

Another variable that has been introduced in the solid waste model is the improvement towards developing sustainable facilities to promote the preservation of the environment and mitigate adverse health and socio-economic impacts of inadequate landfill security systems. The improvement influences the correction factor of the methane[4] (MCF), reducing the associated emissions.

Finally, the last emissions to be projected are those generated by wastewater and nitrogen effluents. To this end, population growth for urban water and production rates for industrial water have been considered. Assuming constant production and constant population fraction values, only population growth would influence the results. These results are shown in **TABLE 4.32**.

TABLE 4.32 Total emissions of Waste and Wastewater sector in the BaUC scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Solid Waste	2,191,545	2,182,265	2,238,208	2,290,903	0%	5%
Domestic Waste Water	45,225	47,905	50,369	52,834	6%	17%
Industrial Waste Water	223,245	223,245	223,245	223,245	0%	0%
Indirect N_2O	30	34	36	38	13%	27%
TOTALS	**2,460,045**	**2,453,448**	**2,511,858**	**2,567,020**	**0%**	**4%**

4 Waste disposal practices vary in the control, placement of waste and management of the site. The CH_4 correction factor (MCF) accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS. In unmanaged SWDS, a larger fraction of waste decomposes aerobically in the top layer. In unmanaged SWDS with deep disposal and/or with high water table, the fraction of waste that degrades aerobically should be smaller than in shallow SWDS. Semi-aerobic managed SWDS are managed passively to introduce air to the waste layer to create a semi-aerobic environment within the SWDS. The MCF in relation to solid waste management is specific to that area and should be interpreted as the waste management correction factor that reflects the management aspect it encompasses (Pipatti et al., 2006).

TABLE 4.33 Total emissions of AFOLU sector in the BaUC scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Enteric Fermentation	80,694	83,054	84,730	86,440	3%	7%
Manure Management	381,684	390,461	398,341	406,380	2%	6%
Emissions from biomass burning	53,317	49,294	45,964	42,633	–8%	–20%
Rice Cultivation and Harvest	201	205	209	212	2%	5%
Urea application	33,899	33,899	33,899	33,899	0%	0%
Land Use and Land Use Change	–2,708,314	–2,480,340	–2,349,430	–2,263,088	–15%	–5%
TOTALS	**–2,158,521**	**–1,923,426**	**–1,786,287**	**–1,693,524**	**11%**	**22%**

AFOLU

As mentioned above, in this sector there is no single socio-economic variable that influences all emissions and removals, thus the specific analysis for each emission source is presented.

In general terms, the main conclusion to be drawn is that during the projected period the sector will continue to act as a carbon sink, given that emissions are lower than absorptions, although this balance will be reduced by 11 percent in 2030 and 22 percent in 2050.

Enteric fermentation and manure management linked to livestock are increasing as a result of GDP growth. On the other hand, emissions associated with biomass burning and land use are reduced due to established conservation and prevention measures that mitigate the effects of the other variable affecting this source, population growth, which involves the occupation of forest land. Finally, the application of urea to rice cultivation shows the trend observed in the historical period.

Firstly, the emissions associated with enteric fermentation and manure management are presented. They account for approximately 84 percent of the total emissions. These emissions depend on the total number of livestock and their different categories. The evolution of the total number of livestock linked to the growth of the GDP of the AFOLU sector, has been projected. It should be noted that in this scenario the AFOLU sector maintains its relative weight over the GDP, so that growth is linear.

The total number of livestock in the year 2050 is projected to be 41,044,767. The fraction of each animal category has also remained constant over the period since it has not undergone any notable variation in the historical period (**TABLE 4.34**).

It can be observed that the category that generates the most emissions is poultry, as 99 percent of the animals belong to this category. It is followed by dairy cows and other livestock which generate the most methane per unit.

In relation to the area lost as a result of fires, this source is responsible for 10 percent of total emissions during the historical period. Projections have considered a reduction in the number of hectares burned due to the implementation of conservation measures related to fire preventions. **TABLE 4.35** shows this evolution in terms of area burnt (ha).

TABLE 4.34 Categories of livestock ▼

Total livestock			**100%**
Dairy Cows	0.05%	**Horses**	0.00%
Other Cattle	0.05%	**Mules and Asses**	0.01%
Buffalo	0.02%	**Swine**	0.08%
Sheep	0.04%	**Poultry**	99.69%
Goats	0.03%	**Other**	0.02%

TABLE 4.35 Fires—BaUC

Area burnt (ha)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Forest Fires	1,830	1,692	1,578	1,464	–8%	–20%
Grassland Fires	44	41	38	35	–7%	–20%

TABLE 4.36 Area of Forest Land Remaining Forest Land

Area of Forest Land Remaining Forest Land	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Plantation (ha)	12,600	9,922	8,185	6,815	–21%	–46%
Natural Conserved (ha)	175,762	185,907	194,808	204,134	6%	16%
Natural Private (ha)	51,200	40,317	33,258	27,691	–21%	–46%

As mentioned above, the application of urea as a fertiliser and the cultivation of rice maintain constant ratios. That is to say, a similar area is projected for rice cultivation and a similar degree of urea use as at present.

Finally, with regard to land use, the estimated carbon stocks depend on the evolution of the three forest areas categorised as plantations, natural conserved and natural private (see **TABLE 4.36**).

It can be seen that the area of plantations and private natural land is declining, linked to a growth that is inversely proportional to population growth. In contrast, conserved areas show a favourable evolution due to reforestation/forest conservation measures that are expected to increase over the projected period. The negative emission/absorption balance is therefore maintained.

Optimistic BaU Scenario (BaUO)

In this section, the results obtained for the Optimistic BaU scenario are detailed. In general, the emissions in the Optimistic BaU scenario are higher for every sector compared to the conservative scenario because the economic growth expected in this scenario is higher. Increased economic growth implies more production and higher consumption trends and, therefore, greater emissions.

More detailed information on the Optimistic BaU scenario is provided in this section, starting with an overview of the total emissions projected for the scenario. The section also includes a comprehensive assessment of the emissions.

Although the total emissions growth in 2050 compared to 2018 is higher in this scenario, the distribution of the emissions per sector does not vary significantly.

Similar to the conservative scenario, the industry sector would be the highest emitter throughout the whole period. Nevertheless, in the economic module it has been assumed that the industry would lose strength in this scenario. This is reflected in the evolution which, after reaching a maximum, stabilises, and even begins to decline.

TABLE 4.37 Total emissions in the Optimistic BaU scenario

Total (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Power generation	5,741,518	5,995,733	6,510,655	7,272,928	4%	27%
Industry	32,899,574	37,341,182	37,885,400	37,534,429	14%	14%
Transport	2,687,832	3,474,927	4,146,018	4,947,193	29%	84%
Waste	2,460,045	2,617,612	2,977,326	3,416,296	6%	39%
AFOLU	–2,158,521	–1,516,551	–1,162,360	–899,014	30%	58%
TOTALS	**41,630,448**	**47,912,904**	**50,357,039**	**52,271,832**	**15%**	**26%**

TABLE 4.38 Emission evolution by category: Power generation Sector—BaUO

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Natural Gas	5,612,635	5,833,154	6,330,421	7,071,593	4%	26%
Diesel	128,884	162,579	180,233	201,335	26%	56%
TOTAL	**5,741,518**	**5,995,733**	**6,510,655**	**7,272,928**	**4%**	**27%**

As for the rest of the sectors, the rapid growth can also be clearly observed with the transport and AFOLU sectors showing the largest increases. It is also noteworthy that in the case of electricity generation, it increases instead of decreasing, as in the conservative scenario, because the penetration of renewables is mitigated by the strong growth of GDP.

Electricity Power Generation

As mentioned above, the situation of the electrical energy generation sector in this scenario would be different from the situation observed in the conservative scenario. The main factor in this scenario is that the economic growth expected is higher, thus affecting the projected electricity demand—which depends directly on the economic growth. Furthermore, since Trinidad and Tobago cannot import or export electricity to or from other countries, the demand increase must be supplied by producing more electricity in the country, meaning higher electricity output.

TABLE 4.38 shows that emissions by fuel type would be higher than those of the conservative scenario, being proportional to fuel consumption. This scenario maintains the same natural gas and diesel consumption ratios. This is because, despite the fact that the same percentage of renewable generation on demand (10% by 2021) is considered, the proportional share of fossil fuels would also increase.

FIGURE 4.18 provides deeper insight on the evolution of the electricity demand, which corroborates the need for a greater input of fossil fuel consumption.

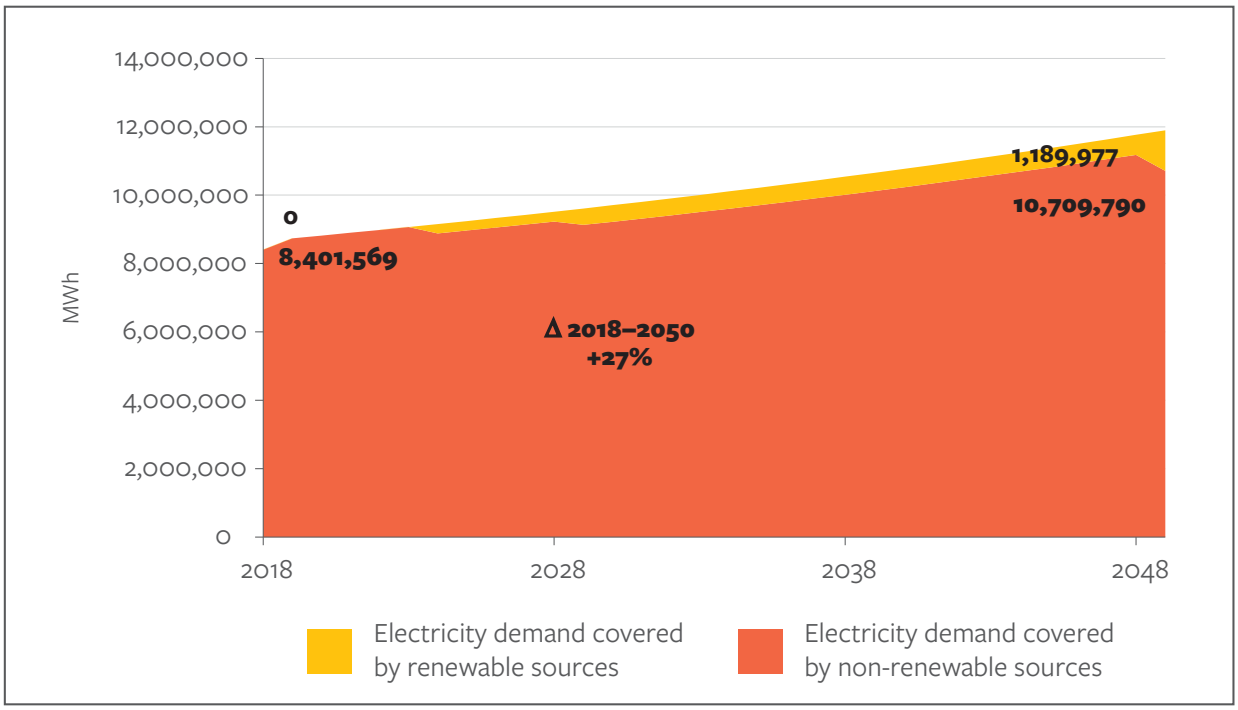


FIGURE 4.18 Evolution of electricity demand—BaUO

TABLE 4.39 Installed Capacity needed to Cover Electricity Demand— BaUO

Capacity needed to cover demand (MWh)	2018	2030	2040	2050
CCPG	551	599	664	703
Thermal	521	596	661	738
Wind Power	0	72	79	164
Solar PV	0	124	137	293

Installed capacity needed to cover the demand (**TABLE 4.39**) shows both the non-renewable and renewable sources.

As for the non-renewable demand, it is assumed that installed capacity will be maintained (956 MW CCPG and 1,140 Thermal) given no policy indication to either increase or reduce capacity over the projection period. Therefore, the installed capacity will cover energy needs without reaching maximum peaks, which also means that power generation plants are projected to operate below their maximum capacity.

In the case of renewables, given that there are currently no renewable plants in operation that generate electricity on a utility scale, **TABLE 4.39** shows the capacity required to meet projected demand.

It should be noted that the renewable generation sources with the highest degree of development at present have been considered in order to make an initial estimate, although these may vary. The distribution within renewable sources does not affect projected emissions.

Industry

Similar to the Conservative Scenario, the analysis of the GHG emissions of the industry sector in the Optimistic Scenario is divided into three sections: process emissions, combustion emissions, and venting & flaring emissions.

TABLE 4.40 summarises the results of the industry sector in the optimistic scenario, which projects process emissions to be the highest contributor, followed by the combustion of fuels and fugitive emissions, which show a downward trend.

From **TABLE 4.40** the following conclusions can be drawn. The IPPU sector shows an upward trend in the first period (2018–2030) and then stabilises. This is due to the maximum capacity factor that some industries reach. The energy consumption and fugitive emissions sector, both linked to gas and oil industries, shows that although they are on an upward trend, this is stabilising over the years. The reason is that in this scenario it is assumed that the "Other industries" sector is reducing its contribution.

Transport

The information below describes both the activity data and GHG emissions projected for the transport sector of Trinidad and Tobago. Three main emission sources are distinguished: road transport, which accounts for 85–90 percent of total emissions during the period analysed, as well as navigation (3%) and aviation (< 1%).

TABLE 4.40 Total emissions of the industrial sector in the BaUO scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
IPPU	22,043,786	26,112,028	26,668,382	26,585,361	18%	21%
Energy Use	6,920,947	7,173,743	7,177,353	7,018,070	4%	1%
Fugitive emissions	3,934,841	4,055,410	4,039,665	3,930,999	3%	0%
TOTALS	**32,899,574**	**34,687,789**	**37,885,400**	**37,534,429**	**5%**	**14%**

TABLE 4.41 Total emissions of the transport sector in the BaUO scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Road Transport	2,616,234	3,394,407	4,057,204	4,849,232	30%	85%
Aviation	384	432	476	526	12%	37%
Navigation	71,234	80,131	88,389	97,497	12%	37%
TOTALS	**2,687,832**	**3,474,927**	**4,146,018**	**4,947,193**	**27%**	**78%**

TABLE 4.42 Fuel Consumption Road Transport—BaUO

Consumption(TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Motor Gasoline	19,046	27,317	32,651	39,025	43%	105%
Diesel	16,626	19,001	22,711	27,144	14%	63%
Kerosene-Diesel	21	26	31	37	24%	76%
CNG	143	300	359	429	110%	200%

As in the conservative scenario, emissions from this sector mainly depend on road mobility, which is strongly related to GDP growth (**TABLE 4.41**). Although this sector shows a relatively large increase, its contribution to the total is not significant in comparison with other sectors.

The evolution of road mobility depends on the number of kilometres covered, as projected in **FIGURE 4.19**.

As in the conservative scenario, the kilometres travelled are proportional to the increase in GDP. For a scenario with additional measures, it would be necessary to consider the variable of optimisation of the transport routes that would reduce the kilometres made. However, in a Business as Usual scenario, this improvement has not been considered. In this sense, the kilometres covered vary from 60,000 to 106,752 in 2050, the curve being much sharper than in the conservative scenario.

As far as fuels consumption by road mobility is concerned, the same proportion is assumed as in a conservative scenario. Therefore, petrol continues to be the main fuel used followed by diesel. The distribution of the energy consumption by fuel is illustrated in **TABLE 4.42**, which shows an increase in all the fuels used.

Navigation and aviation would vary less than road transport. Consumption in these sectors has been determined by considering GDP growth and a degree

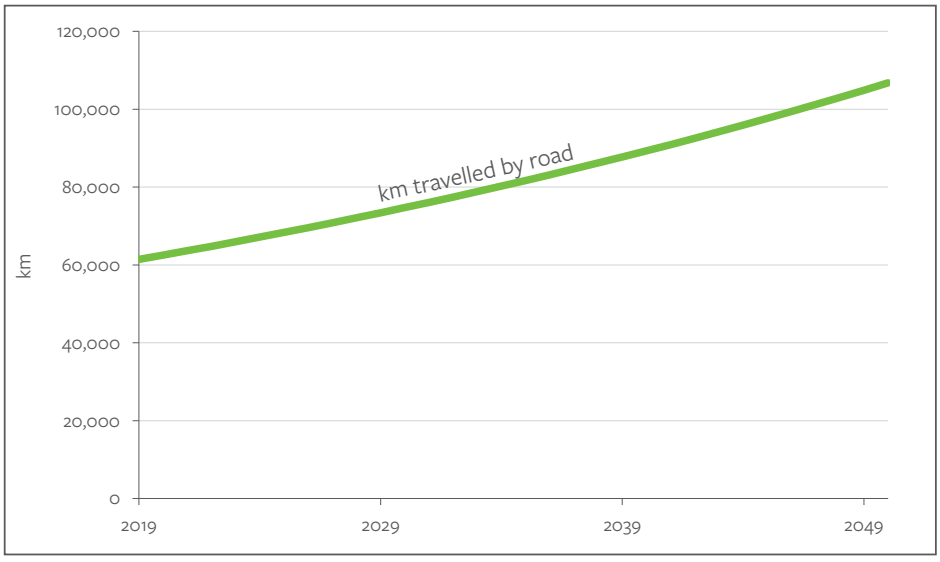


FIGURE 4.19 Evolution of km travelled by road mobility—BaUO

TABLE 4.43 Fuel Consumption Navigation and Aviation—BaUC

Consumption (TJ)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Navigation (Diesel)	952	1,071	1,181	1,303	12%	37%
Aviation (Kerosene)	5	6.1	6.7	7.4	13%	37%

TABLE 4.44 Total emissions of Waste and Wastewater sector in the BaUO scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Solid Waste	2,191,545	2,344,092	2,697,437	3,129,230	7%	43%
Domestic Wastewater	45,225	50,239	56,604	63,775	11%	41%
Industrial Wastewater	223,245	223,245	223,245	223,245	0%	0%
Indirect N_2O	30	36	40	45	20%	50%
TOTALS	**2,460,045**	**2,617,612**	**2,977,326**	**3,416,296**	**6%**	**39%**

of decoupling between them. **TABLE 4.43** shows the variation in consumption for these sub-sectors.

However, unlike the conservative scenario, the degree of decoupling between GDP and consumption (% improvement in vehicle efficiency) in this scenario has less weight than the increase in GDP. Therefore, consumption increases in the period analysed.

Waste and Wastewater

Within the waste and wastewater sector, the contribution of solid waste, in its final disposal in the landfill site, stands out. This is the largest source of emissions in the sector with a contribution of almost 90 percent throughout the projection period.

Unlike the previous scenario, in this case, even if measures to improve the management of waste in landfills and methane recovery projects are considered, population growth and GDP have a greater weight. As seen previously, these are the variables that influence the generation of total waste.

Domestic water and the indirect N_2O generated by the excrements, show an increase linked to the population increase. However, in absolute terms they are not significant.

Industrial wastewaters remain constant due to the production ratios of these industries, which have remained constant throughout the historical period, and are therefore assumed to be the same for the projection period.

Finally, the last emissions to be projected are those generated by wastewater and nitrogen effluents. To this end, population growth for urban water and

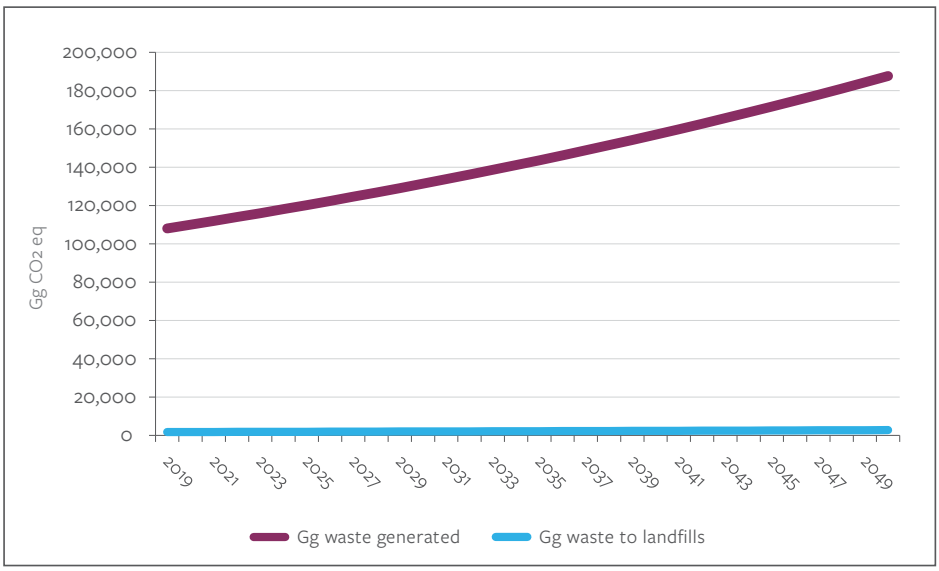


FIGURE 4.20 Gg of waste generated and arriving at landfills—BaUO

production rates for industrial water have been considered. Assuming constant production and constant population fraction values, only population growth has influenced the results. These results can be perceived in **TABLE 4.44**.

Solid waste

While the conservative scenario did not reach 120,000 Gg of waste generated, this scenario reaches almost 200,000.

Since the same rates of waste generation, same characterisation of waste and the same physical conditions of the landfills are maintained, emissions from this sector follow the same proportion shown in the conservative scenario.

AFOLU

As mentioned in the conservative scenario, this sector has emission sources that do not depend on socioeconomic trends, and therefore they show the same emissions as the conservative scenario. These emissions refer to the application of urea, rice cultivation and the emissions associated with the burning of biomass, only influenced by the conservation and prevention measures defined in the hypothesis section.

Emission from enteric fermentation and manure management are expected to continue being the main source of emission, with the increase being more pronounced than in the conservative sector, due to the increase of livestock. The total number of livestock in the year 2050 is projected to be 67,362,263. Likewise, the evolution of livestock and the main emitters in this category are proportional to the results shown in the conservative scenario.

Finally, with regard to land use, the estimated carbon stocks would depend on the evolution of the following three forest areas, as seen in conservative scenario (**TABLE 4.46**).

It can be seen that plantations and private natural land are projected to decline, and linked to a growth that is inversely proportional to population growth. In contrast, conserved areas show a favourable evolution due to reforestation/forest conservation measures, which are expected to increase over the projected period, in the same way as in the conservative scenario. The negative emission/absorption balance is therefore maintained.

TABLE 4.45 Total emissions of AFOLU sector in the BaUO scenario

Emissions (tCO_2e)	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Enteric Fermentation	80,694	100,674	121,711	147,125	25%	82%
Manure Management	381,684	473,295	572,196	691,676	24%	81%
Emissions from biomass burning	53,317	49,294	45,964	42,633	–8%	–20%
Rice Cultivation and Harvest	201	209	212	216	4%	7%
Urea application	33,899	33,899	33,899	33,899	0%	0%
Land Use and Land Use Change	–2,708,314	–2,173,922	–1,936,342	–1,814,563	20%	33%
TOTALS	**–2,158,521**	**–1,516,551**	**–1,162,360**	**–899,014**	**30%**	**58%**

TABLE 4.46 Area of Forest Land Remaining Forest Land BaUO

Area of Forest Land Remaining Forest Land	2018	2030	2040	2050	Δ 2018–2030	Δ 2018–2050
Plantation (ha)	12,600	7,207	4,524	2,840	–43%	–77%
Natural Conserved (ha)	175,762	185,907	194,808	204,134	6%	16%
Natural Private (ha)	51,200	29,284	18,384	11,541	–43%	–77%

CHAPTER FIVE
FINANCE, TECHNOLOGY AND CAPACITY BUILDING NEEDS AND SUPPORT RECEIVED

Photo Credit: Keegan Callender, Ministry of Planning and Development

▲ Mr. Kishan Kumarsingh delivers opening remarks at Inception Workshop for the Preparation of Trinidad and Tobago's Third National Communication and First Biennial Update Report, 2017

5.1 Support received for capacity-building

Steady progress is being made in advancing climate action in Trinidad and Tobago to achieve the objectives of the UNFCCC and implement country obligations, in spite of constraints and gaps. The availability of quality data and information continues to be a challenge and creation of the policy, legislative, institutional, and administrative enabling environment remains a priority. Support received was interpreted to mean funding and technical assistance. To this end the following activities have commenced:

National Climate Mitigation Monitoring, Reporting and Verification System

This system has been described in detail in Chapter 2. The system was developed with the support of multiple donors under the Low Emission Capacity Building Programme and the Nationally Determined Contribution (NDC) Support Progamme in collaboration with the UNDP. The National MRV System facilitates the collection, analysis and transparent reporting of accurate and reliable information and data on GHG emissions, efforts to mitigate them and resources/support devoted to enabling these efforts. The system is supported by templates that have been designed to systematically capture relevant information/data for easy retrieval and checking.

Trinidad and Tobago's National Climate Mitigation MRV System and its supporting Knowledge Management System (KMS) are designed to allow stakeholders (i.e. Executing Entities [EE]) to calculate their GHG emissions using the Intergovernmental Panel on Climate Change (IPCC) Guidelines and upload the information into the KMS. Since the KMS is operated by the EMA, its Air Unit will then perform the required quality control and assurance checks on the data before incorporating into the National Inventory.

A pilot project was designed and conducted (with the support of the NDC Support Programme and the Initiative for Climate Action Transparency [ICAT]) as an initial small-scale implementation of the Emissions Component of Trinidad and Tobago's National Climate Mitigation MRV System with the following objectives:

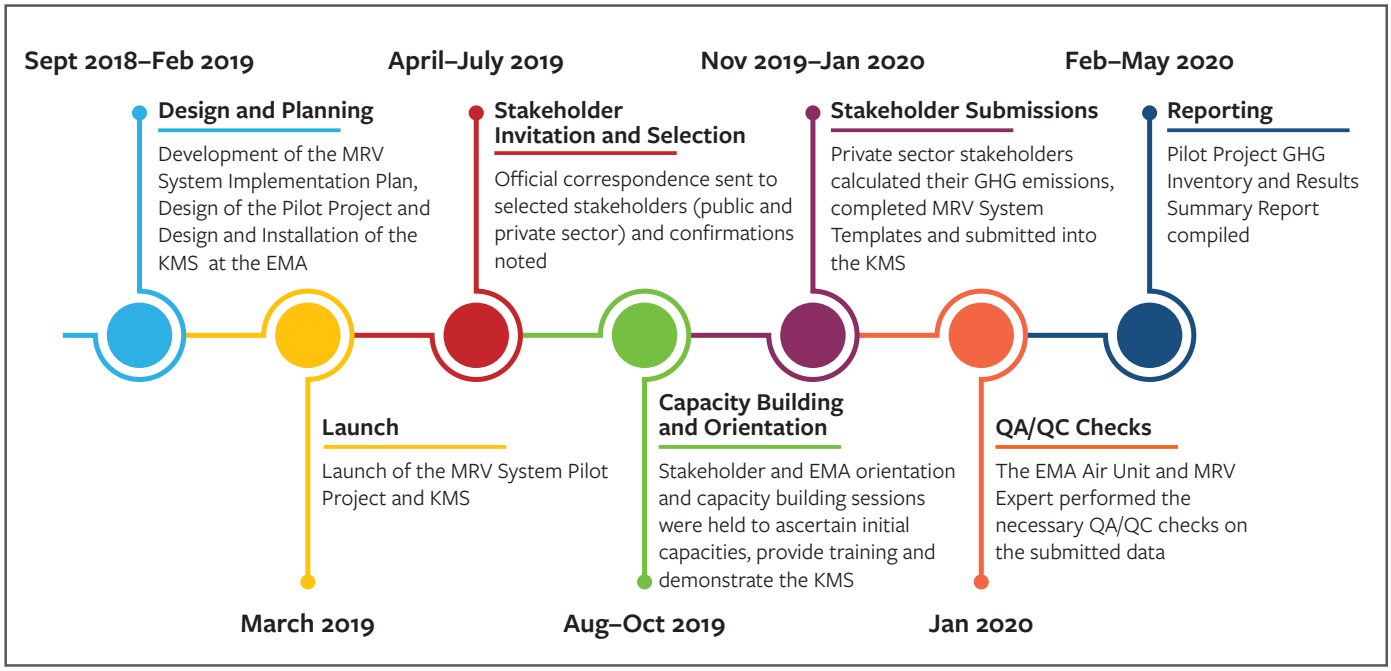


FIGURE 5.1 Pilot project timeline and activities

- Ensuring that Trinidad and Tobago's MRV of its GHG emissions is in accordance with applicable international standards, while taking national circumstances into account
- Coordinating and enhancing cooperation amongst the selected ministries and stakeholders in T&T's MRV System through their designated roles and responsibilities
- Testing the efficacy of the organisational structure of T&T's National MRV System
- Testing the operational procedures of data flow inputs/outputs to the KMS by identified institutional players
- Testing the ease of use of T&T's MRV System Templates by the relevant stakeholders and identifying any additional technical capacity necessary for their use
- Ensuring that stakeholders are adhering to the TACCC principles throughout their use of the MRV System Templates and Implementation Plan Action Tasks during the pilot project
- Supporting key institutional players with relevant technical information, knowledge and guidance to implement the National Climate Mitigation MRV System Pilot Project through the use of detailed tasks and templates
- Identifying obstacles and opportunities for the improvement of the National MRV System, highlighted action tasks for each stakeholder and the recommended templates.

The main activities of the pilot project, including stakeholder submissions into the KMS and the EMA conducting the necessary QA/QC checks, took place from November 2019–January 2020. Fifteen stakeholders from the public and private sectors participated voluntarily.

The Pilot Project Timeline and Activities are highlighted in **FIGURE 5.1.**

A number of capacity-building activities were facilitated under the pilot project.

- Stakeholders participated in an orientation session in October 2019, where they completed a capacity assessment survey and were introduced to the KMS. The results of the survey identified their initial individual technical capacities, organisational capacity and additional requirements for full participation in the National MRV System. Participants were also graded based on their GHG calculations, which were submitted into the KMS.

Photo Credit: Keegan Callender, Ministry of Planning and Development

▲ Participants at Inception Workshop for the Preparation of Trinidad and Tobago's Third National Communication and First Biennial Update Report, 2017

- Four members of the EMA Air Unit participated in this pilot project and completed a capacity assessment survey, practical exercises and the QA/QC checks on the stakeholder submissions of GHG calculations. These participants were also assessed based on a multi-criteria analysis.
- The KMS has two interfaces, one for the stakeholders (submitters of data/information) and the other for the EMA (receivers and holders of data/information). After being introduced to the KMS at the orientation session, stakeholders were provided with secure login credentials which granted them individual access to the KMS, along with the capability to upload their submissions.
- Regular capacity-building sessions and one-on-one tutorials were also held with the EMA Air Unit and the MRV and KMS Experts on the features of the system.
- The utilisation of the system by the stakeholders and EMA personnel allowed for the identification of various avenues for improvements and greater functionality of the KMS.
- A QA/QC Guidance document was developed to facilitate the process and to ensure consistency and sustainability of the system.

The following challenges were encountered on the stakeholder side:

- Limited technical capacity with respect to calculating GHG emissions using the IPCC Guidelines and Software
- Limited accessibility and availability of data required to conduct emissions calculations
- Institutional overlaps that may require clarification in processes related to emissions calculations
- Constrained human resources and inadequate time for carrying out the additional task of calculating and submitting emissions information into the KMS

The EMA also experienced some challenges:

- The need to improve working knowledge of sector specific GHG methodologies, 2006 IPCC Guidelines and QC checks
- The need to improve working knowledge of National MRV System Templates and KMS
- Limited human resources and time necessary for carrying out the additional tasks associated with the MRV System
- Lack of a comprehensive communication plan for formalised interactions with assigned stakeholders and the Coordinating Entity

The pilot project resulted in a number of recommendations which are already under development and/or implementation. These are:

- Development of a suite of MRV tutorial videos for convenient and step-by-step guidance for the users of the KMS and expected participants of the National MRV System
- Development of GHG Inventorying Certification Programme. This activity was supported by the NDC Support Programme which is detailed below:

Greenhouse Gas Inventorying Certification Programme

The Ministry of Planning and Development, through the NDC Support Programme and in collaboration with the UNDP and the Greenhouse Gas Management Institute (GHGMI), has developed a formal programme for Trinidad and Tobago to train, mentor, test, and certify experts with specific capabilities in:

- proper collection of input data and estimation of GHG emissions according to designated emission or removal categories;
- compliance with GHG reporting programmes rules and requirements;
- rigorous implementation of quality control (QC) procedures;
- application of international good practice for GHG estimation (i.e. IPCC guidelines).

The GHG Certification Programme aims to ensure that Trinidad and Tobago has access to qualified experts and supports the submission of high-quality data for its international climate change reporting and domestic policy implementation. The rollout of the Certification Programme is underway in collaboration with The University of the West Indies (UWI) and the GHGMI, to deliver the programme via a virtual learning platform with guided learning by experts. The instructors are also expected to benefit from training to ensure its continuity in the system through the building of national capacity.

Quality Control and Assurance Activities

Under the project to prepare the Third National Communication and First Biennial Update Report the support of an expert was engaged to conduct quality assurance of the draft inventory, through which a number of key recommendations were made for improvement. More importantly, this activity sought to build capacity with the EMA's Air Unit through practical exercises in inventory quality assurance. QA guidance which was developed and recommended under the MRV Pilot Project was further refined. The expert conducted QA/QC training in the application of the Transparency, Accuracy, Completeness, Consistency and Comparability (TACCC) principles for the development and review of GHG Inventories for relevant staff members of the Environmental Management Authority (EMA).

Technical Support for Quality Assurance

The UNFCCC Secretariat through its activities to strengthen the capacity of developing countries to prepare and manage National Greenhouse Gas (GHG) Inventories as a basis for the Enhanced Transparency Framework (ETF) under the Paris Agreement, provided technical assistance to Trinidad and Tobago for quality control and quality assurance, as the country developed its TNC and FBUR, and institutionalisation of GHG inventory and MRV processes. A GHG Inventorying Quality Assurance Training programme by the UNFCCC Secretariat was convened in February 11–15, 2019 in Port of Spain, Trinidad with stakeholders from all key

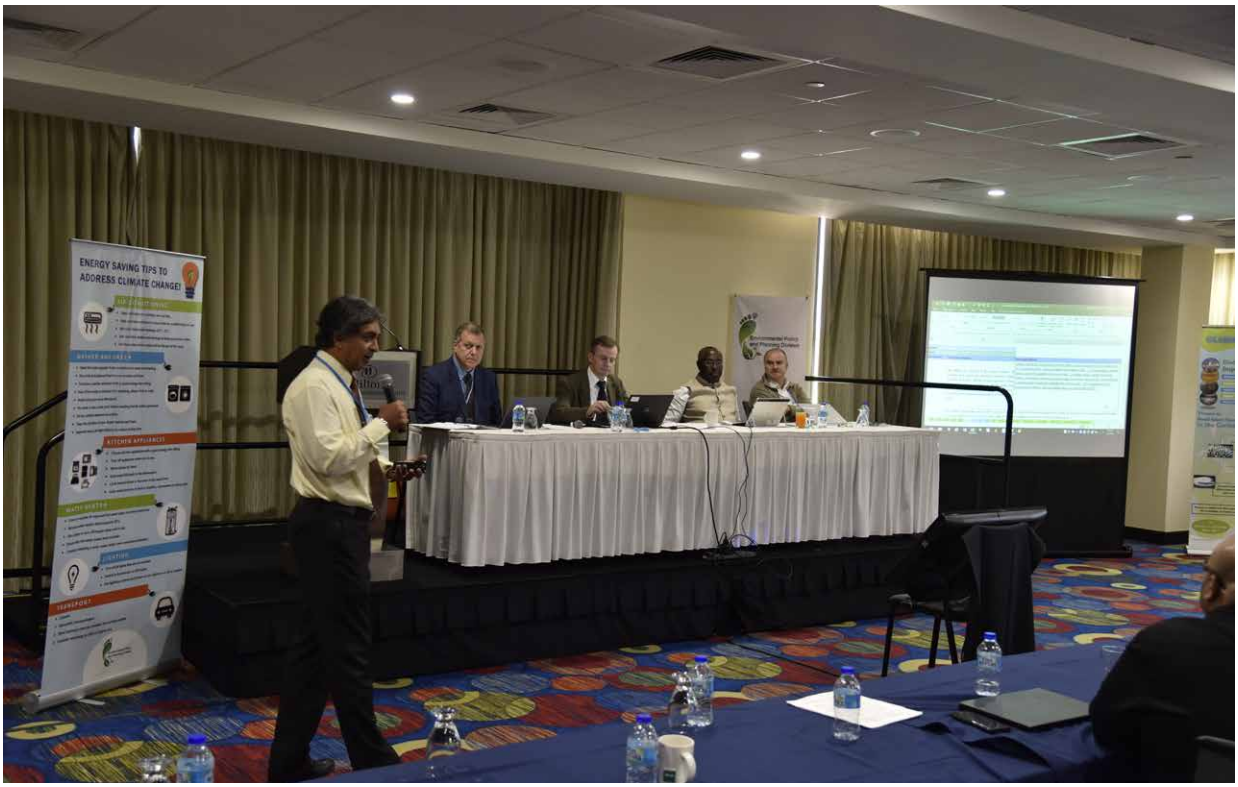


Photo Credit: Ministry of Planning and Development

▲ Panellists at the Greenhouse Gas Inventorying Quality Assurance and Control Training Workshop—United Nations Framework Convention on Climate Change (UNFCCC), Trinidad, February 11–15, 2019

sectors in attendance. The recommendations from the exercise are summarised below. It is important to note that some recommendations were taken on board to improve the inventory submitted with this report.

- Many participants were still unfamiliar or uncomfortable with the IPCC 2006 Guidelines. Capacity building in this area was recommended.
- There is currently no institutionalised relationship with the inventory compiler, Ministry of Planning and Development, and the suppliers of activity data. The National MRV System is recommended to routinise the institutional framework.
- No regular meetings of the inventory compiler, data suppliers and QA/QC personnel. These were conducted on an as-needed basis. It is recommended that all parties meet regularly to assess data quality and data needs (expected to increase as the inventory completeness and complexity increase).
- T&T should apply an archiving system to assure the availability of the inventory data including IPCC worksheets and activity data. The KMS will assist in this process.
- Routine inventory cycles are recommended with the aim of moving towards higher tiers with each progressive cycle (as data become available).
- Ensure that activity data, emission factors and global warming potentials are all consistent for the categories covered by the greenhouse gas inventory currently being prepared;
- An MoU or similar formal type of agreement should be established with all data providers when required to ensure quality and timeliness of data provision.
- Clarification of roles and responsibilities as well as coordination and data-sharing between government agencies and between public and private experts can and should be enhanced and strengthened.

Photo Credit: Ministry of Planning and Development

▲ Participants in attendance at the Greenhouse Gas Inventorying Quality Assurance and Control Training Workshop—United Nations Framework Convention on Climate Change (UNFCCC), Trinidad, February 11–15, 2019

Climate Promise

The Ministry of Planning and Development of Trinidad and Tobago is participating in the UNDP's Climate Promise initiative. The Climate Promise is UNDP's programme to support countries to increase the ambition of their national climate pledge (i.e. NDCs). Climate Promise activities in Trinidad and Tobago build upon its work for the preparation of greenhouse gas inventories. The preparation of the most recent national greenhouse gas (GHG) inventory for Trinidad and Tobago (included in this report) which included a comprehensive data collection exercise, highlighted certain weaknesses and gaps in the data collection process in various ministries and agencies, including in the agriculture, forestry and land use (AFOLU) and waste sectors. The Climate Promise work supported the execution of in-depth training workshops on data collection and management to improve the GHG Inventory compilation in the agriculture, forestry and land use (AFOLU) and waste sectors with a view to addressing the gaps and weaknesses identified. This would support a trajectory towards including all sectors in future NDCs as the country strives to develop economy-wide targets consistent with the objectives of the Paris Agreement.

5.2 Technology and capacity building support received

Trinidad and Tobago participated in a multi-country project titled "Technology Needs Assessment (TNA) - Phase III" in collaboration with the United Nations Environment Programme and Danish Technical University (UNEP/DTU) Partnership with funding from the Global Environment Facility (GEF). The TNA process undertaken built on the results of climate risk assessments and the NDC implementation plan for adaptation and mitigation respectively.

Photo Credit: Tobago House of Assembly

▲ Aqueduct ruins, Louis d'Or, Tobago, 2020

▼ Relaxing in the Matura National Park, Trinidad. 2010

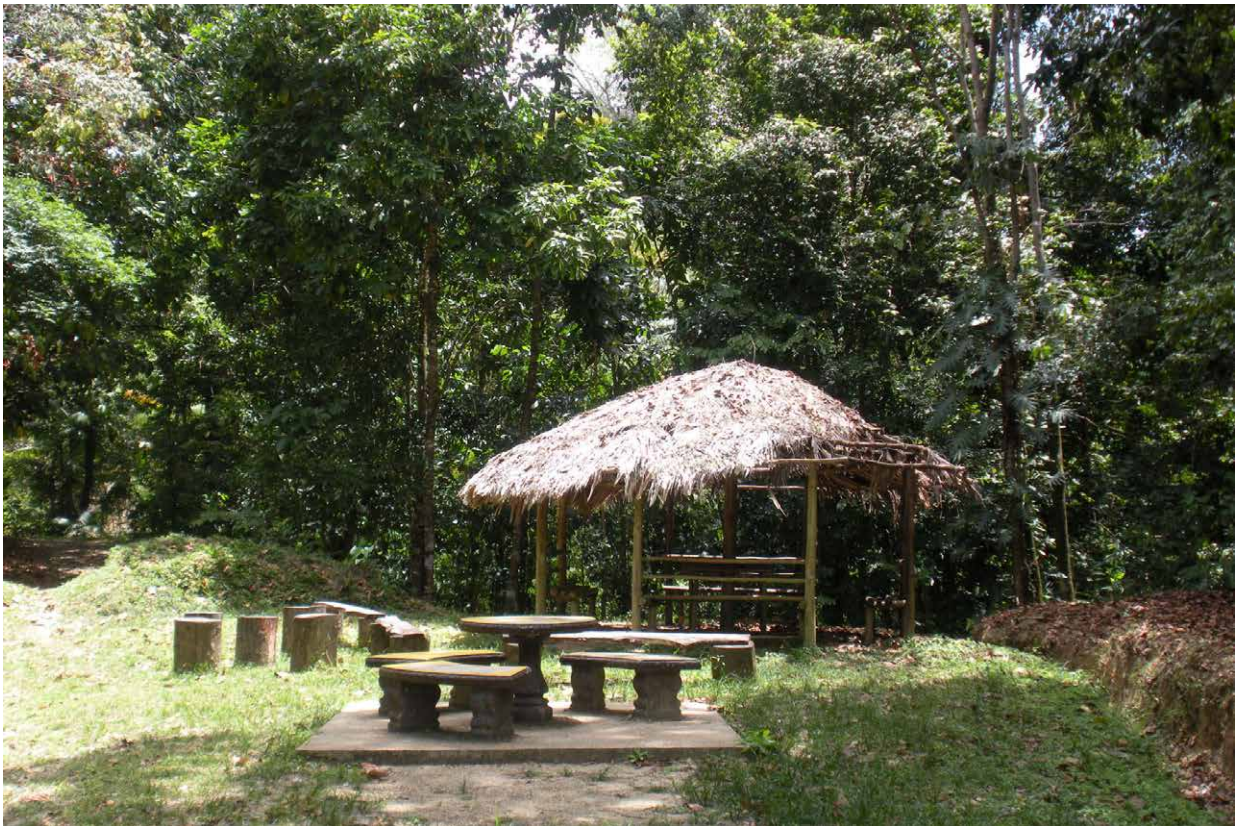


Photo Credit: Environmental Management Authority

TABLE 5.1 List of support needs

Need identified	Support needed	Specific type of support requested	When and for how long is support needed?	Where financial support is needed, please indicate	
				National budget available in USD	Financial support needed in USD
Country-wide wind atlas to assess wind RE feasibility	Wind measurements to inform and develop the wind atlas.	Technology transfer and Capacity building	As soon as possible for about 18 months		2,000,000.00
Institutional capacity for sustainable collection of GHG data in relevant sectoral institutions	Financial support for the establish-ment and staffing of specialised units in identified institutions	Financial support	2022 as seed start-up for five years		930,000.00
Identification of feasible sites for carbon capture and storage	Financial support for collecting and analysing data	Financial support and technology transfer	2022		500,000.00
A fully functional MRV/ETF unit	Financial support for the establishment and staffing of specialised MRV/ETF unit at the country's regulatory agency	Financial support	2022 as seed start-up for three years		450,000.00
Infrastructure requirements for sustainable transport	Financial support for assessing requirements for RE charging stations to transition to electric vehicles charged with RE	Financial support	2022		20,000.00

5.3 Gaps, Constraints and Support Needed

In the context of mitigation, the challenges have been identified in Chapter 6 under the section titled Gaps, Constraints and Capacity Building Needs for Convention Implementation.

However, full implementation of the foregoing activities would require additional support in the form of finance, capacity building and technology transfer. Support in this context refers to finance, capacity building activities, including technical training, provided through multilateral or bilateral donors specifically for climate related actions that are in alignment with the National Climate Change Policy. **TABLE 5.1** provides further details. The estimates are derived in consultation with experts in the respective fields identified as needing support. Projects that have been developed and executed have incorporated a post-project sustainability component aimed at integrating the outputs and outcomes into the policy, legislative, institutional and administrative framework. In some instances, additional funding may be required to create this framework where it is not already established. Therefore, the support needs identified in **TABLE 5.1** will be similarly structured to ensure sustainability.

5.4 Financial support received

TABLE 5.2, TABLE 5.3, and **TABLE 5.4** provide an overview of financial support received from the Global Environment Facility, bilateral sources, multilateral sources (including the Green Climate Fund).

TABLE 5.2 Climate-specific financial support received by origin

	Reporting period (timeframe covered)					
	2010–2020					
	Climate-specific amount					
Finance mobilised	**Domestic currency**	**USD equivalent**	**Status** (Committed/ Disbursed)	**Funding sources** (ODA, OOF, etc.)	**Financial instrument** (Grant, Concessional loan, Non-concessional loan, Equity, Other)	
Public finance support—bilateral	TTD 1 million		Disbursed	European Union Environment Programme—Trinidad and Tobago	Grant	
Public finance support—bilateral	TTD 900,000		Disbursed	European Union Environment Programme—Trinidad and Tobago	Grant	
Public finance support—bilateral	TTD 3.5 million	$600,000 (approx.)	Disbursed	European Union Environment Programme—Trinidad and Tobago	Technical Assistance—Grant	
Public finance support—Global Environment Facility	TTD 6.4 million (approx.)	$952,000	Disbursed	Global Environment Facility	Grant	
Public finance support—Global Environment Facility	TTD 8.2 million	$1,207,800	Disbursed	Global Environment Facility	Grant	
Public finance support—Global Environment Facility	TTD 897,600	$132,000	Disbursed	Global Environment Facility—UNEP DTU	Grant	
Public finance support—Green Climate Fund	TTD 1.7 million	$260,000	Disbursed	Green Climate Fund	Grant-Readiness Programme	
Public finance support—Green Climate Fund	TTD 3.9 million	$662,306	Disbursed	Green Climate Fund	Grant-Readiness Programme	
Public finance support—Green Climate Fund	TTD 2.8 million (approx.)	$425,420	Committed	Green Climate Fund	Grant-Readiness Programme	
Public finance support—Green Climate Fund	TTD 2.5 million (approx.)	$375,986	Committed	Green Climate Fund	Grant-Readiness Programme	

TABLE 5.2 (CONTINUED) Climate-specific financial support received by origin

Reporting period (timeframe covered)			
2010–2020			
	Focus of support (Mitigation, Adaptation, Cross-cutting, Other)	**Sector**	**Additional information**
	Mitigation of emissions in the transport sector. The objective of the initiative was to pilot the use of a fully electric vehicle in Trinidad and Tobago to demonstrate the applicability and use of the technology.	Electric Bus purchased in collaboration with the University of Trinidad and Tobago (UTT)	The project was completed and the bus is used as a campus shuttle by the UTT.
	Mitigation and Adaptation. The project aimed to conduct infrastructural upgrades/retrofit of the Toco Health Centre to increase climate resilience in the event of a climate related disaster.	Health Sector	The project is 66% complete.
	Adaptation. Vulnerability, Risk and Capacity Assessments were completed for the following sectors: Agriculture and food security, Water resources, Human health, Coastal resources and fisheries, Human settlements and infrastructure, Biodiversity, Finance Sector (including insurance), Tobago. The project also supported the demarcation of the Main Ridge Forest Reserve.	All sectors	Project was completed
	Mitigation and Adaptation, Cross-cutting. Preparation of Trinidad and Tobago's Third National Communication and First Biennial Update Report to the UNFCCC.	All sectors	Project was completed
	Mitigation and Adaptation. The project's objective is to implement capacity development activities in Trinidad and Tobago to improve the synergistic implementation of MEAs and contribute to increased national and global environmental benefits.	All sectors	Project is ongoing with expected completion by the end of 2021
	Adaptation and Mitigation. Cross-cutting. Support to Trinidad and Tobago to conduct a technology needs assessment and to prepare a Technology Action Plan.	All Sectors	Project is ongoing with expected completion by June 2021
	Adaptation. Cross-cutting. Improving the monitoring system for climate change impacts on the agriculture sector in Trinidad and Tobago.	Agriculture	Project is ongoing
	Cross-cutting. This project aims to develop the NDA's systems in addition to developing a national country programming including a pipeline of priority projects. The current readiness proposal complements this project by enabling the NDA to further identify and enhance areas of Climate change adaptation nationally and in so doing would help identify potential areas which allow for more efficient utilisation of GCF resources in synchronisation with the national climate change agenda.	Cross-cutting	Project is ongoing
	Cross-cutting—Accreditation of the Environmental Management Authority by the Green Climate Fund.	Cross-cutting	Project is ongoing
	Adaptation. Building climate resilience into Trinidad and Tobago's Healthcare System through creating an enabling environment for Climate SMART facilities and improved domestic incident management systems.	Health	Project is ongoing

TABLE 5.2 (CONTINUED) Climate-specific financial support received by origin

	Reporting period (timeframe covered)					
	2010–2020					
	Climate-specific amount					
Finance mobilised	**Domestic currency**	**USD equivalent**	**Status** (Committed/ Disbursed)	**Funding sources** (ODA, OOF, etc.)	**Financial instrument** (Grant, Concessional loan, Non-concessional loan, Equity, Other)	
Public finance support—Green Climate Fund	TTD 680,000	$100,000	Committed	Green Climate Fund	Grant-Readiness Programme	
Public finance support—Green Climate Fund	TTD 680,000	$100,000	Committed	Green Climate Fund	Grant-Readiness Programme	
Public finance support—other multilateral	TTD 625,000	$92,000	Disbursed	UNEP DTU/ European Commission	Grant	
Public finance support—other multilateral	TTD 2 million	$307,500	Disbursed	Inter-American Development Bank	Technical Assistance Grant	
Public finance support—other multilateral	TTD 5 million	$742,000	Disbursed	European Commission, UNDP and others	Grant	
Public finance support—other multilateral	TTD 3.9 million	$587,795	Disbursed	European Commission, UNDP and others	Grant	
Public finance support—other multilateral	TTD 850,000	$125,000	Disbursed	Initiative for Climate Action Transparency	Grant	
Public finance support—other multilateral	TTD 32 million	$4,800,000	Disbursed	European Union–Global Climate Change Alliance	Grant	

TABLE 5.2 (CONTINUED) Climate-specific financial support received by origin

	Reporting period (timeframe covered)		
	2010–2020		
	Focus of support (Mitigation Adaptation Cross-cutting, Other)	**Sector**	**Additional information**
	Cross-cutting. World Health Organization (WHO)/Pan American Health Organization (PAHO) readiness seeks to support The Caribbean Community and Common Market (CARICOM) member states in implementing the Caribbean Action Plan on health and climate change which ensures that the region is fully engaged in global climate change processes and agreements, that benefit Caribbean countries and territories by strengthening their technical cooperation methods, and facilitate the access to human, technical and financial resources necessary to address the effects of climate change on health. This readiness project is aligned with regional efforts to build climate resilience in the heath sector.	Health	Project is ongoing
	Cross-cutting. The aim of this project is to strengthen the foundation on which the region's agriculture sector prioritises investments for resilience and enhance conditions for improved reporting on greenhouse gas emissions in specified agricultural value chains. The project will help to compile and assess existing legal, market, financial, and data gaps and barriers, and define measures to address them.	Agriculture	Project is ongoing
	Mitigation. Capacity building for participation in carbon markets under the Clean Development Mechanism.	All mitigation sectors	Project completed
	Cross-cutting. The project focused on policy and legislative review and made recommendation for mainstreaming climate change into national development.	All sectors	Project completed
	Mitigation. Trinidad and Tobago participated in the Low Emission Capacity-Building Programme. Nationally Appropriate Mitigation Actions were designed, MRV System designed. NDC Implementation Plan developed.	Industry, power generation, transportation	Project has been completed
	Mitigation. Trinidad and Tobago participated in the NDC Support Programme. MRV System operationalised. NDC Financial Investment Plan developed. Gender Action Plan developed.	Industry, power generation, transportation	Project Completed
	Mitigation. Project supported the MRV Pilot Project, and is supporting the development of a policy framework for e-mobility.	Industry, power generation, transportation	Project is ongoing
	Mitigation. The project supports Trinidad Tobago in meeting its commitments to the global community under the UNFCCC/Paris Agreement as laid down in its Nationally Determined Contribution (NDC) as well as in the achievement of its national policy target of 10% of total electricity generated from renewable energy sources by 2021. Specifically, the action aims at an increased availability and use of energy from renewable sources and at increased efficiency levels in the consumption of energy.	Power Generation	Project is ongoing

TABLE 5.2 (CONTINUED) Climate-specific financial support received by origin

	Reporting period (timeframe covered)					
	2010–2020					
	Climate-specific amount					
Finance mobilised	**Domestic currency**	**USD equivalent**	**Status** (Committed/ Disbursed)	**Funding sources** (ODA, OOF, etc.)	**Financial instrument** (Grant, Concessional loan, Non-concessional loan, Equity, Other)	
Public finance support—national (optional)	TTD 500 million	$72 million (approx.)	Committed	National Budget	Budget Disbursements to the CNG National Gas Company	
Public finance support—national (optional)	TTD 3.1 million	$479,984	Disbursed	National Budget	Budget Disbursement to UNDP as the Implementing Agency	
SUBTOTAL Public finance support						
Private finance mobilised (optional, only if available)						
TOTAL						

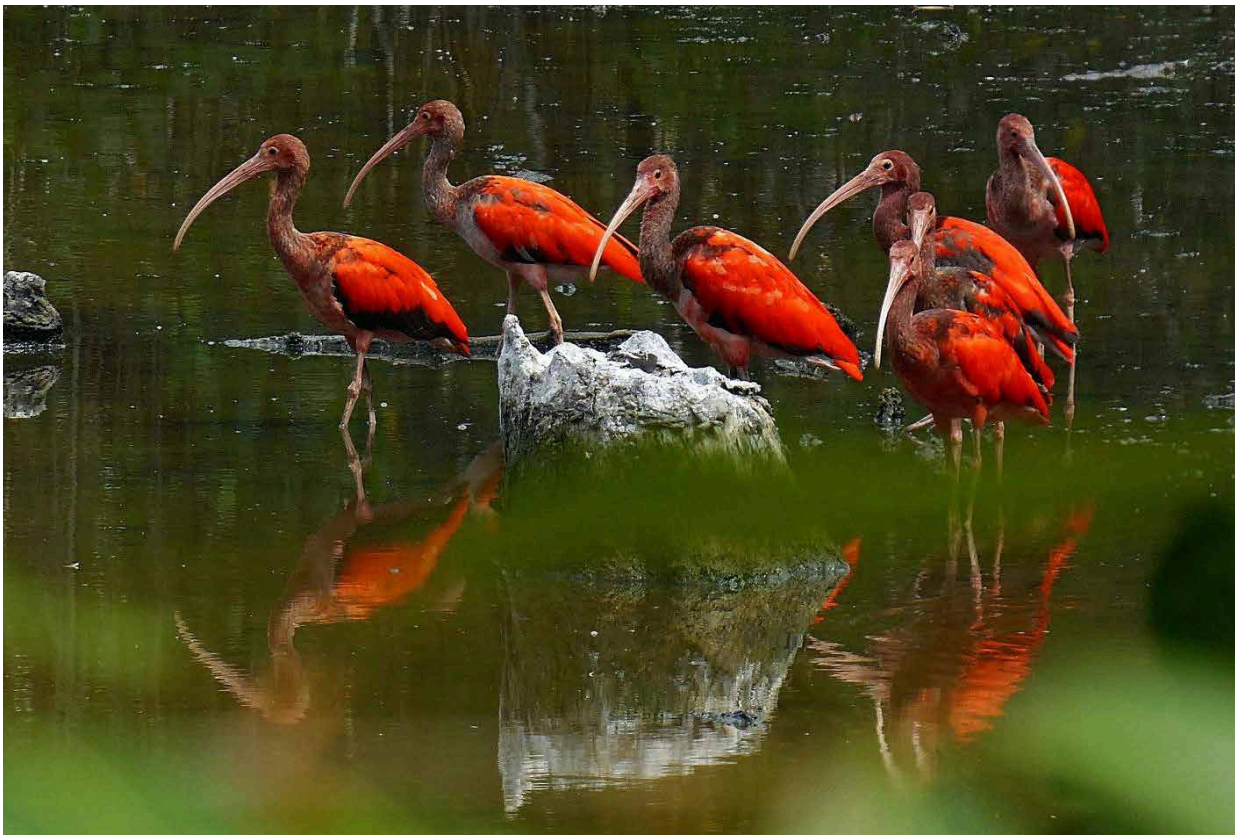


Photo Credit: Environmental Management Authority

▲ Scarlet Ibis searching for small fish, crustaceans and insects, Trinidad, 2018

TABLE 5.2 (CONTINUED) Climate-specific financial support received by origin

Reporting period (timeframe covered)			
2010–2020			
	Focus of support (Mitigation Adaptation Cross-cutting, Other)	**Sector**	**Additional information**
	Mitigation. Mitigation of emissions through the CNG programme.	Public Transportation	219 million TTD spent at the end of 2020. Programme is ongoing.
	Mitigation. Elaboration of a Strategy for the reduction of Carbon Emissions in Trinidad and Tobago.	Industry, Transportation, Power Generation	Project completed in 2015 with the publication of the *Carbon Reduction Strategy*

TABLE 5.3 Support pledged for the future, by origin

	Commitments/disbursements related to timeframes not covered by the reporting period[1]	
	Timeframe covered	
	2020–2024	
	Total USD	**Sources of funding**
Public finance support—bilateral		
Public finance support—Global Environment Facility	$1,060,400	Global Environment Facility—Capacity Building Initiative for Transparency (CBIT)
Public finance support—Green Climate Fund	$300,000	GCF—Readiness Programme Green Ports
Public finance support—other multilateral	$800,000	GCF Readiness—Advancing E-mobility in the Caribbean Region
Public finance support—national (optional)		
SUBTOTAL Public finance support		
Private finance mobilised (optional, only if available)		
TOTAL	**$1,664,000**	

1 This relates to pledges which are made for a point of time in later than the reporting period, e.g. for 2017 if the reporting period is 2014–2016.

TABLE 5.4 Capacity-building support received in the reporting timeframe

Reporting period (timeframe covered)		
2010–2020[1]		
Type of support [capacity building]	**Support activity**	
Technology Needs Assessment	Conduct a technology needs assessment	
Capacity Development for improved management of Multilateral Environmental Agreements for Global Environmental Benefits	The project's objective is to implement capacity-development activities in Trinidad and Tobago to improve the synergistic implementation of MEAs and contribute to increased national and global environmental benefits.	
Preparation of Trinidad and Tobago's Third National Communication and First Biennial Update Report to the UNFCCC	GHG Inventorying Training (Sectoral Training Workshop for Greenhouse Gas Inventorying Using IPCC 2006 Guidelines.) QA/QC Review of GHG Inventory Training (EMA QA/QC training was designed to simulate their identified QA/QC action tasks in a typical GHG inventory cycle.) Mitigation Analysis Technical Training. (Train-the-trainer in constructing BAU baselines for emissions profiling and projections within the main GHG-emitting sectors of Trinidad and Tobago.) Vulnerability and Adaptation Workshop. (This workshop disseminated information on: • vulnerability assessment methodologies. • identification and prioritisation of adaptation measures in the coastal zone.) Development of a Just Transition Policy to facilitate just transition of the workforce Development of MRV Informational Videos Public Awareness activities undertaken such as TV Programmes	
Pilot testing MRV system	Pilot testing the MRV system in the power generation sector, industry, transportation and waste sectors. Testing the efficacy of the MRV System, specifically the reporting of GHG emissions.	
Private Investment Mobilization Training	Private Investment Mobilisation Training Course including stakeholders from NDC sectors. The objective is to build capacity to implement low carbon strategies and programmes through leveraging private finance.	
E-mobility policy	Development of an e-mobility policy—Development of a framework for an E-mobility Policy for Trinidad and Tobago using the ICAT's Transformational Change Guidance.	
Development of carbon pricing recommendations	Development of carbon pricing recommendations for Trinidad and Tobago	

1 This period covers the timeframe for which the Ministry of Planning and Development can provide data

5.5 Data/information gaps

There are no formal arrangements for collecting information or data on financial, technology and capacity building needs. However, this was assessed through project-based activities as illustrated in **TABLE 5.4**.

The establishment of the MRV system is expected to gather information on support received as well as support needs for the future.

TABLE 5.4 (CONTINUED) Capacity-building support received in the reporting timeframe

Reporting period (timeframe covered)				
2010–2020				
	Year(s) received	**Status [ongoing, finalised]**	**Focus [mitigation, adaptation, unspecified]**	**Source of support**
	2018–2021	Completion in June 2021	For NDC implementation and addressing climate risks.	UNEP/DTU
	2017–2021	Completion in December 2021	The project's objective is to implement capacity-development activities in Trinidad and Tobago to improve the synergistic implementation of MEAs and contribute to increased national and global environmental benefits.	GEF/ UNDP
	2017–2021	Completion in May 2021	Mitigation and Adaptation. All sectors.	GEF/UNDP
	2019–2020	Completed	Mitigation.	ICAT (UNEP-DTU) and NDC Support Programme
	2020–2021	Ongoing	Mitigation.	UNDP, The Centre for Climate Strategies
	2020–present	Ongoing	Mitigation.	ICAT (UNEP-DTU)
	2020–2021	Completed	Mitigation.	UNFCCC

CHAPTER SIX
ADDITIONAL OBSERVATIONS

Photo Credit: Cindy Chandool

▲ National Climate Change Policy Consultation held in September 2019, Trinidad

The following information is relevant to Trinidad and Tobago's quest to meet its commitment to the Paris Agreement and expands on the Mitigations Actions covered in Chapter 4.

Emission reduction targets

Trinidad and Tobago has set a cumulative emissions reduction target in the power generation, transportation and industrial sectors under the Paris Agreement through its Nationally Determined Contribution (NDC) amounting to 15 percent from a business-as-usual baseline to 2030, amounting to 103,000,000 metric tonnes of carbon dioxide equivalent. Of this, an unconditional component equivalent to 1,700,000 metric tonnes of carbon dioxide equivalent is targeted to be reduced in the public transportation sector by 2030 relative to 2013. The gases covered are carbon dioxide, methane and nitrous oxide.

Progress in achievement of such emission reduction targets

To date, the country has invested approximately 32 million USD in a fuel switching programme in the transportation sector (See Case Study 1.1, page 58), and has realised the avoidance of 31,509 metric tonnes of carbon dioxide equivalent. Plans are also underway to construct a 112.5 MW capacity solar power generation plant that will introduce the equivalent of 10 percent renewable energy in the power generation mix targeted for 2022. Additionally, with the support of the European Union, a solar park is to be constructed by 2022 at the Piarco International Airport with an annual generation capacity of 1,443,830 kWh which is equivalent to an avoidance of 1,010 metric tonnes of carbon dioxide, and represents approximately 7 percent of power consumption at the airport. Also with the support of the EU, roof top solar is being installed

at 12 sites around the country that would realise the generation of 98kW.

Projects are being formulated for funding under the GCF to implement other activities identified in the NDC Implementation Plan in order to achieve its targets.

Integration of adaptation measures and mitigation activities

Trinidad and Tobago views climate change as a national development issue and has adopted a Pathways Approach to adaptation through the building of climate resilience and integration of climate change into the national development process by assessing climate risk vulnerability in the short to medium term while aiming at long term adaptation. Accordingly, a vulnerability capacity assessment study was conducted which identifies the sectors and geographical areas, and a financial investment plan for implementing the recommendations of the study has been completed. The integration of the recommendations, including the potential financing of activities, into sectoral strategies will be pursued. To this end, training on conducting vulnerability and climate risk assessments will be done within various sectors.

Trinidad and Tobago has developed an operational monitoring, reporting and verification (MRV) system for greenhouse gas emissions and mitigation actions (*See Chapter 3*). The system was tested through a pilot programme, gaps identified and addressed. The MRV system is being incorporated into law to make GHG emissions reporting mandatory as well as designed to report, monitor and evaluate mitigation actions taken or contemplated by emitting entities. The MRV system is currently being upgraded to allow for the reporting of data and information related to climate resilience and adaptation to facilitate reporting under the Paris Agreement as well as tracking of the integration of climate resiliency into the national development process, and the implementation of the National Climate Change Policy. It is expected that such reporting will further allow for the collection of data and information to facilitate relevant reports as required, such as the Biennial Transparency Reports (BTRs) under the Paris Agreement, and create a sustainable and institutionalised mechanism for compiling reports such as national communications and BTRs.

Gaps, Constraints and Capacity Building Needs for Convention Implementation

This section outlines the main barriers and opportunities for the sectors. First, the information needs are identified, followed by the main barriers to the development of the sectors, and the potential strengths and opportunities.

Power Generation

Information needed

- Behavioural models for energy usage
- Data on school sizes and available areas for RE installations
- System Parameterisation (e.g., Generator Models) for optimisation studies
- Site identification for community RE
- Comprehensive system studies for increasing penetration of RE
- Wind and Solar (and other RE) resource assessments for feasibility studies
- Enhanced knowledge about customers for providing comparison information in billing
- Site identification for Utility Scale RE

Main barriers

1. Inadequate legislation and policy frameworks to create an enabling environment for facilitating energy efficiency and renewable energy
2. Subsidised electricity costs contribute to low adoption of energy efficient and RE technologies
3. Insufficient system information to do proper optimisation studies

Potential Strengths and Opportunities

1. School curriculum changes can create meaningful long-term behavioural change
2. Good levels of internet penetration to improve customer engagement in electricity sector

3. High level of existing industrialisation and industrial service sector to support ramp-up of new industries if feasible
4. Job creation from new green economy
5. Creation of an enabling environment through legislative and policy reform
6. Incentivisation for commercial RE investments to encourage job creation

Industry

Information needed

- Feasibility studies for developing captured carbon industries
- Feasibility studies for implementing renewable fuels
- Feasibility studies for developing hydrogen industries

Main barriers

1. Highly competitive international markets make it difficult for companies to adopt best available technologies that do not improve their market position in addition to reducing GHG emissions
2. Ready supply of fossil fuel natural gas makes alternative fuel supplies uneconomical

Potential Strengths and Opportunities

1. High level of existing industrialisation and industrial service sector to support ramp up of new industries if feasible
2. Job creation from new green economy

Transport

Main barriers

1. Policy challenges to revitalise urban centres and to decentralise public services, and PAYD
2. Inadequate know-how and experience by decision-makers in public–private financing of urban development
3. Cultural acceptance of park and ride systems and arrangements
4. Free and abundant parking
5. Cultural acceptance of public transport largely based on an inefficient system

Potential Strengths and opportunities

1. The transport impacts of Comprehensive Smart Growth programmes are the reduction of resident and employee vehicle travel by 10–30%, or even more, compared with automobile-oriented development (Litman, 2003)
2. PAYD insurance applied to private automobile travel, and PAYD registration fees and taxes applied to all vehicles. PAYD pricing typically reduces affected vehicles' average annual mileage 10–15%, depending on how fees are structured (Litman, 2003)
3. Off-site or urban fringe parking facilities can provide a typical reduction of vehicle trips by 10–30% (Litman, 2003)
4. Parking management strategies to reduce vehicle travel directly, and support more compact, multi-modal development. Parking management programmes typically reduce vehicle trips 5–15% if financial incentives (such as pricing) are excluded, and 10–30% if included (Litman, 2003)
5. Transit improvements for urban travel
6. Switching from internal combustive engines to electric vehicles charged with RE

Waste and Wastewater

Information needed

- Capacity needs for specific training for the sectors
- Specific surveys such as knowledge, attitudes and practices (KAP) on reuse, recycling, and composting
- Feasibility studies for plants and technologies. for wastewater treatment plants and waste-to-energy plants

Main barriers

1. Capital cost for new projects and funding for capacity building and research

2. Capacity issues

Potential Strengths and Opportunities

1. Community programmes such as community composting programmes
2. Innovative reuse of plastic products such as tile stones, furniture, etc.
3. Incentivising investment for waste reduction, reuse and recycling
4. Centralised wastewater treatment plants

AFOLU

Information needed

- Quality activity data for estimating greenhouse gas emissions

Main barriers

1. Change in cultural and traditional practices
2. Resource constraints for effective forest management
3. Reluctance of private land owners to maintain forest stock

Potential Strengths and Opportunities

1. The sequestration potential of the forest stock is significant and can be increased through reforestation, rehabilitation of degraded land, and agroforestry, which will further increase the negative emissions of the country as well as create sustainable jobs
2. Vertical Farming practices to maximise nutrient and fertiliser application and use

Steps taken to integrate climate change considerations into national development and policy formulation

Trinidad and Tobago is currently updating its National Climate Change Policy (NCCP) to incorporate the provisions of the Paris Agreement and decisions taken under the Paris Agreement. The National Environmental Policy was updated and approved in 2018, and expressly incorporates issues relevant to climate change into the national development framework. The provisions of these policies are being integrated into sectoral development plans and strategies, including through the work of the National Sustainable Development Council established in 2020.

Notably, as a small island developing state where there are, invariably and inevitably, overlaps in land use, a major challenge is distilling the development impact signal from the climate change impact signal, particularly in respect of slow-onset impacts. This in turn provides a challenge to formulating approaches to mitigating impacts. To this end, climate change impact assessments are being incorporated into the environmental impact assessment process and procedures to ensure climate change considerations are taken into account in the development process. Such considerations will include socio-economic implications arising from climate change impacts such as those on amenities, communities and livelihoods.

Linkages between the national communication process and national development priorities

Actions being undertaken to mainstream the compilation of information through administrative, institutional, policy and legislative frameworks not only aim to facilitate reporting requirements of the UNFCCC and the Paris Agreement, but to provide updated data and information to inform the national development process, and build climate resiliency by taking into account climate risks, sectoral vulnerability, their interlinkages and long-term adaptation.

Activities related to transfer of environmentally sustainable technologies

A technology needs assessment (TNA) has been conducted in collaboration with the Technical University of Denmark (DTU). The approach taken by Trinidad and Tobago recognises that the TNA process is not a stand-alone process but an opportunity to identify, assess, adapt, adopt, synergise, and implement relevant technologies within the national development process, to address climate change through low carbon development pathways to build climate resilience, in keeping with the foundation already laid

Photo Credit: Sindy Singh

◀ Vulnerability and Adaptation Training Workshop, Tobago, 2019. Participants were introduced to some of the key methodological components used to conduct a vulnerability assessment of Trinidad and Tobago's coastal zone, namely, how to select the most suitable climate model projections for your needs; how to deal with uncertainty; vulnerability assessment methodologies; identification and prioritisation of adaptation measures in the coastal zone.

in the form of the National Climate Change Policy, the Carbon Reduction Strategy, the Vulnerability Capacity Analysis (VCA) and the NDC (and its Implementation and Financial Investment Plans) under the Paris Agreement. The TNA was therefore focused on the NDC Implementation Plan and the climate risks identified in the sectors covered in the VCA. The TNA and the TNA process delves into more detail about the specific technological applications and technologies that could be employed using further multi-criteria analysis. The prioritised technologies will fast-track and facilitate decision-making at the policy and practical levels, and implementation at the ground level. The TNA forms the basis of project proposals for funding and therefore facilitates the transfer of environmentally sustainable technologies.

Activities related to participation in global research and observation systems

The Government of the Republic of Trinidad and Tobago (GoRTT), through the Trinidad and Tobago Meteorological Service (TTMS), has continued to promote and collaborate in research and systematic observations related to climate change. Meteorological observations have been made in Trinidad and Tobago for more than 70 years. In 2021, the observation network of the TTMS comprised two meteorological synoptic observation stations, one upper air observation station, eight Automatic Weather Stations, and one automated weather observation station. Enhancement of this network is ongoing. Both synoptic weather stations disseminate synoptic weather messages every three hours, internationally. The data exchanged internationally by the TTMS is provided consistently with WMO Resolution 40 (Cg-XII) on policy and practice for the exchange of meteorological and related data and products. The TTMS has one Doppler radar which was installed in 2009 and one satellite receiver system installed in 2020, which replaced a 20-year-old system. The routine surface and upper air weather observations made by the TTMS continue to be the principal source of atmospheric observations relevant to climate change from Trinidad and Tobago. The radar data are used to serve T&T society and sectors, from applications in aviation weather service to flood protection and disaster reduction.

Under the World Meteorological Organization (WMO), Trinidad and Tobago through the TTMS continues to participate in several observation programmes such as the WMO's Global Climate Observing System (GCOS) programmes. The TTMS' two reference climatological stations at Piarco and Crown Point are part of the GCOS. The purpose of the GCOS is to ensure that climate data needed to address climate-related issues are obtained and made available to all potential users. Within the GCOS, the TTMS' climate stations are also part of the Regional Basic Synoptic Networks (RBSNs) engaged in surface and upper-air observing stations and part of the Regional Basic Climatological Networks (RBCNs). Data from these stations are exchanged globally in real time and the TTMS maintains a climatological

database of its hourly and daily synoptic climate data. The long climatological time series of the TTMS forms the basis of climate research and estimating climate change impacts at the national level. The upper air observations provide important information which is vital for both the forecast models and meteorologists.

The TTMS climate observations are also being included in the WMO's World Weather Records programme. The Purpose of the WWR is to ensure that the world records of weather and climate extremes are complete, accurate and up to date. Similarly, the TTMS participates in the World Weather Watch Programme (WWWP). The WWWP facilitates the monitoring and exchange of meteorological observations to ensure that countries have access to the required information that enables them to provide weather data, prediction and information services, and products to users. In addition to these, the TTMS climate data also form part of the World Data Center for Meteorology database in the USA, the National Climate Data Center in the USA, while its solar radiation data are included in the World Radiation Data Centre in Russia. The TTMS also provides its daily climate data to the Caribbean Institute of Meteorology and Hydrology, the WMO's Caribbean Regional Climate Centre. These datasets are used by regional and international scientists and research groups to contribute to the World Climate Research Programme. The TTMS climate data continues to contribute to national and regional research work which are used within the framework of the IPCC to determine climate change-relevant policy positions for national and regional policy makers.

Within the framework of the WMO's World Climate Programme, the TTMS contributes to its publications by providing an overview of the climate conditions over Trinidad and Tobago in the past year, along with information on observed extreme weather and climate events. The TTMS continues to participate actively in the publication of the Caribbean Climate Outlook Forum's (CariCOF) Caribbean Climate Outlook Newsletter, a monthly print and web-publication which provides updates of current climate conditions with 3 to 6-month outlooks for the coming seasons to help the region and individual countries adapt to climate variability and change.

Annually since 2015, the TTMS has participated in the international research effort of the peer-reviewed State of the Climate Report, an annual supplement to the Bulletin of the American Meteorological Society (BAMS). The TTMS contributes to the regional climate section of the preceding calendar year by assessing the local climate and placing it into a historical context. The TTMS participated significantly in the recently published *State of the Caribbean Climate* (2020), produced for the Caribbean Development Bank. Additionally, the TTMS participates in joint activities on climate variability and climate change with the Caribbean Institute of Meteorology and Hydrology, within the framework of the Caribbean Climate Outlook Forum.

As it relates to coastal zone management and monitoring, Trinidad and Tobago through its Institute of Marine Affairs (IMA) participates in:

1. a new lower maintenance Coral Reef Early Warning System (CREWS) buoy to be moored at Buccoo Reef, Tobago. CREWS buoys were originally procured and installed in Speyside and Buccoo in 2013 as part of a regional CREWS network developed by the Caribbean Community Climate Change Centre and National Oceanic and Atmospheric Administration (NOAA);
2. SEABED 2030 project, a Meso-American Caribbean Hydrographic Commission (MACHC) initiative to map the entire seabed by the year 2030, with a focus on data-sharing for the common good;
3. the provision of a national report at the Data Buoy Conservancy Panel (DBCP) in 2020 and attended the DBCP-36. The DBCP is a component of the Global Ocean Observing Systems (GOOS) under the Intergovernmental Oceanographic Commission IOC sub-commission for the Caribbean and adjacent regions IOCARIBE.
4. Sandy Shorelines Project funded by Korea International Cooperation Agency (KOICA) which is a regional beach monitoring network with nine other Caribbean island states.

Identification of needs and priorities for climate change research and systematic observations

Trinidad and Tobago has a unique climate vulnerability profile among the Eastern Caribbean islands due to its complex terrestrial terrain and its proximity to the equatorial belt. This has caused it to straddle multiple potential hazardous climatic threats, including being located within the southern fringe of the hurricane belt, the migration path of the tropical rain belt known as the Intertropical Convergence Zone (ITCZ) and the belt traversed by tropical waves. There is a clear need for research which distils climate variability impacts from those of climate change. This is important to show the scale of the climate change problem. There is also a clear need for research which addresses the understanding of ongoing climate change and research on climate change projections based on the most up to date greenhouse gas concentration trajectories (not emission scenarios), but which are appropriately scaled to the individual needs of each island. With regard to the country's emissions profile, there is a clear need for cross-sectoral climate change programmes aimed at increasing understanding of the scientific basis of climate change, sectoral impacts of climate changes, and available or emerging options for mitigation and adaptation.

There are a number of significant challenges in meeting the country's climate change research needs. These challenges are driven primarily by an insufficient climate monitoring network to adequately represent the high temporal and spatial variability of the country's rainfall and an inadequate organisational structure and human resource capacity for conducting targeted and innovative climate change research. In addition, the TTMS lacks the legal framework for a mandate making it accountable for specific areas of research. There is a need for funding to support a climate change research programme and to build capacity for climate modelling. The TTMS lacks appropriate modelling output and data which will enable it to undertake research to understand climate change impacts and adaptation impacts for energy production, generation, supply and distribution.

Ongoing and future impacts of climate change on the development of Trinidad and Tobago depend on four main, inter-linked physical factors: the extent of the warming; the changes in amount and variability of rainfall; the increase in extreme events; and the extent of sea-level rise. Both local private and public sector decision-makers need accessible, credible and relevant climate data and information to increase the country's resilience to more intense and frequent weather extremes. Experience has shown that when these decision-makers request data, they typically want climate data that cover their local area, to as fine a scale as possible, in formats that they can easily understand and incorporate into existing decision-making frameworks. In most cases, there is a gap between what is currently available at the TTMS and what is needed by decision-makers. To be effective and contribute optimally to the national climate research and climate actions, there is a need to proactively observe and collect appropriate climate datasets, necessary for preparing for current and future likely changes. This data need to be at a high enough spatial resolution to satisfy the needs of users in the private and public sectors. With ongoing climate change and an increase in the occurrence of weather and climate extremes, there is a great need for an improved hydro-meteorological surface observation network in Trinidad and Tobago. This will entail upgrading and rehabilitation of the observing network of the TTMS, including real time collection of data from the network, which is important for effective early warning systems (EWS) and disaster risk reduction (DRR) management decisions.

The Automatic Weather Stations (AWSs) component of the TTMS network is playing an increasing role in the observation networks and offers numerous advantages in weather and climate applications. Notwithstanding this, there are many current and anticipated challenges facing the AWS network. The current AWS network has irregular spacing, is inadequate and limited in geographical coverage with the result of large data-sparse areas. In addition, it lacks completeness in climate data records and does not meet the spatial resolution required for key climate elements needed to effectively monitor and

represent the local climate. Furthermore, the actual density of the AWS network is significantly poorer than that recommended by the WMO for rainfall and temperature parameters. Apart from these, there is a demand for increasing the resolution of the TTMS's surface Automatic Weather Stations observation network. There is a critical need to improve the number of monitoring stations and grow the capacity of the TTMS to manage and analyse data that are collected.

Given the diverse nature of its rainfall climatology, it means that any TTMS research programme will need to address climate change projections and the likely effects of climate change on a wide range of ecosystems (both natural and human). At the same time, the country's mitigation and adaptation priority research has to cover a wide range of issues including marine and land transport; agricultural and forestry activities; coastal zone management including coral reefs, energy demand and supply; and sustainable development of urban settlement and infrastructures, including proximity to coastal areas. Given Trinidad and Tobago's economic dependence on fossil fuel and international trade, the country's climate change mitigation research options need to be in line with the commercial needs and technology standards of the international market.

Given the existing national gaps, there is need to strengthen cooperation with international institutions for research programmes/projects and to grow local research programmes. While advancing this, there is also a need to improve collaboration among researchers and government, and for government agencies to share climatic and other data, openly. At the same time there is a need to better articulate the specific climate change research needed for integrating climate-related information into sectoral policy development.

A key barrier is inadequate research funding. There is a need to build capacity to secure research funding. This will enable the government's efforts towards working with the disaster risk management community and the local climate change communities in terms of research efforts.

Measures and recommendations to improve national programmes for climate change research and systematic observations

- Over the next one to five years, there is a need to augment the TTMS Automatic Weather Stations network to meet the required needs, as part of an overall programme to attain an optimal surface observation weather stations network. Initially, the target should include at least a network of 35 AWS, which is half of the 70 surface observation stations required by the country.
- The country seeks to acquire five radar-based non-contact river stage/gauge monitoring stations with a telemetry system to measure water levels at key points along the main flood-causing rivers. These stations should also have the ability to measure rainfall. The river stages will aid effective flood forecasting and warnings, and flood frequency studies.
- In addition, the need for at least five radar-based tide gauge stations with the capacity to measure weather elements is regarded as critical to building the requisite database at a minimum. The tide gauges will assist with providing flood and hazardous seas warnings, tides for port operations, fisherfolk operations, tourism recreation and leisure activities, tsunami and general sea level monitoring and, eventually, research into sea-level change. This could engender the establishment for a national Sea Level Monitoring System with a joint maintenance effort among government agencies.
- There is a need to develop a centralised coastal information management system as a data repository with the attendant data-sharing agreement protocols established.
- The meteorological network needs to be expanded by establishing observation alliances with the agriculture, water resource, energy, forestry and volunteer weather observers.
- Trinidad and Tobago may benefit from a programme of data rescue to unearth data held in historical documents, locally and internationally.

- As part of ongoing public education and awareness, climate change symposia or workshops which target young climate change scientists and students and highlight climate change research lessons learnt and their usage for policy development are seen as a critical part of the capacity-building agenda.
- There is a need for alignment of local climate research and information with regional and international research programmes. The ability of Trinidad and Tobago to engage in rapid uptake of emerging new global technologies, including finely detailed down-scaled climate modelling to appropriate levels for both islands, which are sufficient to unearth near real state of local climate change, is also a recognised capacity need.
- Participation in regional and international research programmes of the World Meteorological Organization, such as the World Climate Research Programme, as well as continued and increased participation in WMO observations programmes, such as the Global Climate Observing System (GCOS), are also seen as essential components for fully assessing climate change impacts.
- Apart from existing times slices over which climate change research are carried out, there is need for the country to refine the study of climate change modelling and greenhouse gas concentrations on shorter timescales (5–20 years) than is often presented in climate change studies and Summaries for Policy-Makers, in order to ensure their consistency with the country's development priorities and investments.
- There is need to expand the current climate change research areas in order to understand the sector-specific nature of vulnerability and adaptation, of socio-economic circumstances and other prevailing conditions. This could complement the development of a national climate change research agenda.
- Appropriate educational content on climate change (measuring, detecting, and assessing the impacts of climate change on natural and human systems and effective adaptation strategies) should be promoted at all levels of the education system.

Information on climate change education, training, and public awareness

Trinidad and Tobago has established a Multilateral Environmental Agreement/Climate Change Focal Point Network with representatives from government ministries and agencies, non-governmental organisations, civil society organisations and private sector entities including industry, trade unions, fiduciary organisations and academia. The network aims to facilitate an exchange of information, disseminate educational and awareness material on MEA and climate change, and solicit views to inform policy, projects and activities related to implementing MEAs and climate change. Such activities are frequently complemented by press releases, media interviews, social media content and public lectures. In particular, specific effort has been expended on training media personnel on climate change and MEAs regarding the relevant science and the engendering of understanding to foster informed, accurate and responsible reporting on climate change. Additionally, undergraduate modules on climate change are being taught at The University of the West Indies involving climate science, greenhouse gas inventorying, vulnerability assessments, climate change technology and needs assessments, and climate diplomacy and the international policy response to climate change.

Information on capacity-building activities, options and priorities

As the government moves to institutionalise and legislate its mitigation MRV system, capacity gaps have been primarily identified in greenhouse gas inventorying and quality assurance/control within state institutions. To redress this, training for government agencies and stakeholders in the private sector has been conducted and facilitated through the UNFCCC and the Greenhouse Gas Management Institute, with the aim of building capability for developing

Photo Credit: Ministry of Planning and Development

▲ "Training of Trainers": Multilateral Environmental Agreements Capacity Development for Improved Management of Multilateral Environmental Agreements for Global Environmental Benefits project, July 2020

greenhouse gas inventories for submission to the MRV system. In order to sustain the training on an on-demand basis, a certification programme has been developed and will be administered through local universities. This programme also aims to satisfy certification requirements for the regulatory authority.

Promotion of synergy in implementation of the Rio Conventions

The Ministry of Planning and Development is collaborating with the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) to implement a project titled "Capacity Development for improved management of Multilateral Environmental Agreements for Global Environmental Benefits." This project takes an incremental approach towards strengthening the capacity of the country's public sector staff; raising public awareness about global environmental issues and the related international conventions; strengthening the links between sectors, including the mainstreaming of environmental concerns in development policies and projects; contributing to an ecologically safe and sound environment; and meeting the objectives of the Rio Convention.

This project is implementing a number of activities to strengthen the ability of the Government of Trinidad and Tobago to create, leverage and maintain synergies for the national implementation of MEAs and to strengthen integrated approaches to environmental management, including the meeting of MEAs guidance and national reporting requirements. A number of key activities have been completed, including policy and legislative mapping, mapping of civil society organisations, mapping of MEA reporting requirements, and capacity-building as it relates to MEA obligations, all of which have been undertaken across all sectors.

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TECHNICAL ANNEX

Inventory Year: 2018

TECHNICAL ANNEX TABLE 1 GHG Inventory IPCC Short Summary Table (2018)

	Emissions (Gg)			Emissions CO_2 Equivalents (Gg)			Emissions (Gg)			
Categories	**Net CO_2 (1)(2)**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
Total National Emissions and Removals	35051.53363	183.9537715	4.069461548	NE	NE	NE	0.351895791	22.78739219	0	0
1—Energy	17057.17585	78.08901308	0.155149766	NE	NE	NE	0	0	0	0
1.A—Fuel Combustion Activities	15283.84219	0.930382261	0.15112716				NE	NE	NE	NE
1.B—Fugitive emissions from fuels	1773.333665	77.15863082	0.004022606				NE	NE	NE	NE
1.C—Carbon dioxide Transport and Storage	NO						NO	NO	NO	NO
2—Industrial Processes and Product Use	20668.77599	12.477584	3.87033	0	0	0	0	0	0	0
2.A—Mineral Industry	328.2656703	NE	NE				NE	NE	NE	NE
2.B—Chemical Industry	19787.41652	11.68745	3.87033	NE	NE	NE	NE	NE	NE	NE
2.C—Metal Industry	553.0938	0.790134	NE	NE	NE	NE	NE	NE	NE	NE
2.D—Non-Energy Products from Fuels and Solvent Use	NE	NE	NE				NE	NE	NE	NE
2.E—Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F—Product Uses as Substitutes for Ozone Depleting Substances				NE	NE		NE	NE	NE	NE
2.G—Other Product Manufacture and Use	NO	NO	NO	0	0	0	NO	NO	NO	NO
2.H—Other	NO	NO	NO				NO	NO	NO	NO
3—Agriculture, Forestry, and Other Land Use	–2674.41821	5.255619233	0.043860613	0	0	0	0.351895791	22.78739219	0	0
3.A—Livestock		3.7658447	NE				NE	NE	NE	NE
3.B—Land	–2708.317277		NE				NE	NE	NE	NE
3.C—Aggregate sources and non-CO_2 emissions sources on land	33.89906667	1.489774533	0.043860613				0.351895791	22.78739219	NE	NE
3.D—Other	NO	NO	NO				NO	NO	NO	NO

TECHNICAL ANNEX TABLE 1 (CONTINUED) GHG Inventory IPCC Short Summary Table (2018)

Inventory Year: 2018

	Emissions (Gg)			Emissions CO_2 Equivalents (Gg)			Emissions (Gg)			
Categories	**Net CO_2 (1)(2)**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NO_x**	**CO**	**NMVOCs**	**SO_2**
4—Waste	0	88.13155521	0.000121169	0	0	0	0	0	0	0
4.A—Solid Waste Disposal		78.54335058					NE	NE	NE	NE
4.B—Biological Treatment of Solid Waste		NE	NE				NE	NE	NE	NE
4.C—Incineration and Open Burning of Waste	NE	NE	NE				NE	NE	NE	NE
4.D—Wastewater Treatment and Discharge		9.58820463	0.000121169				NE	NE	NE	NE
4.E—Other (please specify)	NO	NO	NO				NO	NO	NO	NO
5—Other	0	0	0	0	0	0	0	0	0	0
5.A—Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH_3			NE				NE	NE	NE	NE
5.B—Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items (5)										
International Bunkers	384.7439613	0.003921943	0.010748252	0	0	0	0	0	0	0
1.A.3.a.i—International Aviation (International Bunkers)	370.6663335	0.002592072	0.010368289				NE	NE	NE	NE
1.A.3.d.i—International water-borne navigation (International bunkers)	14.07762782	0.00132987	0.000379963				NE	NE	NE	NE
1.A.5.c—Multilateral Operations	0	0	0	0	0	0	0	0	0	0

TECHNICAL ANNEX TABLE 2 Summary Detail of GHG in CO_2-eq (2006–2018)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2—CO_2**												
Energy	17303.20	18459.38	18618.10	18947.42	19545.65	19006.84	19288.93	19595.22	19191.77	19333.88	17796.42	17383.36	17057.18
IPPU	22579.38	22734.9	21310.06	22458.31	24689.56	23969.24	23174.43	22613.85	22412.82	21661.66	20764.48	21269.10	20668.78
AFOLU	–2719.08	–2713.95	–2708.83	–2703.71	–2698.58	–2699.80	–2701.02	–2702.23	–2703.45	–2704.67	–2705.88	–2707.10	–2708.31
WASTE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**37163.50**	**38480.32**	**37219.34**	**38702.01**	**41536.63**	**40276.28**	**39762.34**	**39506.84**	**38901.15**	**38290.87**	**35855.02**	**35945.37**	**35017.64**

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2e—CH_4**												
Energy	2474.07	2559.54	2530.15	2597.38	2669.96	2554.27	2525.40	2538.64	2497.62	2358	2054.21	2070.88	2186.85
IPPU	440.76	440.06	411.83	427.24	431.09	427.99	400.77	411.76	398.73	380.45	341.75	364.96	349.37
AFOLU	122.47	171.42	127.57	108.65	381.11	99.15	104.43	167.39	155.23	179.89	198.03	213.83	147.37
WASTE	1647.09	1736.98	1836.13	2007.89	2045.05	2111.77	2184.93	2274.72	2351.96	2427.95	2430.49	2450.13	2462.29
Total	**4684.38**	**4907.99**	**4905.68**	**5141.15**	**5527.22**	**5193.18**	**5215.53**	**5392.51**	**5403.54**	**5346.29**	**5024.48**	**5099.8**	**5145.88**

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2e—N_2O**												
Energy	39.95	43.13	46.47	45.68	50.34	45.81	46.22	47.16	47.22	49.02	46.22	44.20	41.13
IPPU	0.00	0.00	0.00	0.00	1024.63	1120.67	1070.90	787.27	976.45	1077.02	971.36	1007.08	1025.64
AFOLU	292.48	304.92	304.64	316.22	399.49	328.48	334.53	357.29	350.65	363.62	379.72	386.93	368.52
WASTE	0.02447524	0.02447524	0.02458591	0.0246985	0.02670824	0.02780325	0.02795301	0.03005577	0.03104804	0.03124625	0.03142934	0.03159522	0.03174427
Total	**332.46**	**348.07**	**351.13**	**361.93**	**1474.49**	**1494.98**	**1451.68**	**1191.76**	**1374.35**	**1489.69**	**1397.33**	**1438.24**	**1435.33**

TECHNICAL ANNEX TABLE 2 (CONTINUED) Summary Detail of GHG in CO_2-eq (2006–2018)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2e—HFCs**												
Energy	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
IPPU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
AFOLU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
WASTE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2e—PFCs**												
Energy	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
IPPU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
AFOLU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
WASTE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sectors	**Gg CO_2e—SF_6**												
Energy	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
IPPU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
AFOLU	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
WASTE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**