The Government of
ST. KITTS and NEVIS

St. Kitts and Nevis
Third National Communication (TNC)

To the United Nations Framework Convention on Climate Change (UNFCCC)

November 2024

Acknowledgements

The Third National Communication was prepared for:

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Foreword

Like other Small Island Developing States (SIDS), St. Kitts and Nevis considers climate change to be a significant threat to its growth and prosperity. For this reason, the Government of St. Kitts and Nevis remains committed to its national reporting requirements to the United Nations Framework Convention on Climate Change (UNFCCC). This was evidenced in our updated Nationally Determined Contribution (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and by our ratification of the Paris Agreement on April 22, 2016, along with many other Parties to the Convention.

St. Kitts and Nevis hereby presents its Third National Communication (TNC) to the United Nations Framework Convention on Climate Change. The TNC contains information relating to our national Greenhouse Gas (GHG) inventories, measures to mitigate and to facilitate adequate adaptation to climate change as well as any other relevant information that allows the Government deems relevant to the achievement of the objective of the Convention. The TNC will include core elements such as national circumstances, GHG inventories, a vulnerability and adaptation assessment, mitigation assessment, financial resources and technology transfer as well as information related to education, training and public awareness.

Although when compared to global GHG emissions, our contributions are negligible, St. Kitts and Nevis is committed to doing its part. Climate change is a challenge that will likely affect both the natural environment as well as the social and economic stability of the country. As such, St. Kitts and Nevis is endeavoring to become a low carbon economy, which will also provide ancillary benefits for sustainable energy usage and developments, as well as reducing the cost of adaptation. Mitigation strategies will also result in regional and global benefits, whose evidence will be witnessed in future decades.

In 2022, the Government has committed to sustainable measures for effective emissions reduction, energy conservation and renewable energy supply. a clear agenda has been adopted to transform St. Kitts and Nevis into a sustainable island state, founded on seven (7) key pillars, namely, food 4 security, green energy transition, economic diversification, sustainable industries, the Creative Economy, COVID-19 recovery and social protection. Improving on dataset accuracy and availability will be critical to support the Government's agenda.

The preparation of St. Kitts and Nevis Third National Communication Report was made possible through the financial support of the Global Environmental Facility (GEF) through the United Nations Environment Programme (UNEP). The report compilation was the result of the combined input and participation of a wide range of stakeholders across the various sectors of the economy, including government agencies, statutory bodies, non-governmental organizations and civil society and was led by the Ministry of Environment. The Government of St. Kitts and Nevis wishes to use this opportunity to express appreciation to all stakeholders involved in the process and wishes to re-iterate that a whole of society approach, working together nationally, regionally and internationally will be paramount to improve resilience, sustainability as well as achieving the goal of the Paris Agreement.

Hon Dr Joyelle Clarke
Minister of Sustainable Development, Environment, Climate Action and Constituency Empowerment

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Abbreviations

AMCS	Applied Meteorology and Climatology Section
4NR	Fourth National Report on The Implementation of the Cartagena Protocol on Biosafety
5AR	IPCC Fifth Assessment Report
6NR	Sixth National Report for The Convention on Biological Diversity
AD	Activity Data
ADP	Durban Platform for Enhanced Action
AFOLU	Agriculture, Forestry and Other Land Use
AWS	Automatic Weather Systems
BAU	Business-as-usual
BTR	Biennial Transparency Report
BUR	Biennial Update Report
BUR1	1st or Initial Biennial Update Report
BY	Base year (2014)
CAPI	Computer Assisted Personal Interview
CARICOF	Caribbean Climate Outlook Forum
CARICOM	Caribbean Community
CBI	Citizenship-by-Investment
CCCCC	Caribbean Community Climate Change Centre
CCM	Concerned Citizens Movement
CCMRVH	Caribbean Cooperative Measurement Reporting and Verification Hub
CCORAL	Climate Change Online Risk Management Tool
CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
CDKN	Climate and Development Knowledge Network
CFRNP	Central Forest Reserve National Park
CIIMS	Centralized Integrated Information Management Systems
CIIMS	Centralized Integrated Information Management Systems
CIMH	Caribbean Institute for Meteorology & Hydrology
CMO	Caribbean Meteorological Organization
COP	Conference of the Parties
COVID-19	Coronavirus
CREEBC	CARICOM Regional Energy Efficiency Building Code
CREWS	Climate Risk and Early Warning System
CRF	Common Reporting Format
CRF	Central Forest Reserve
CRT	Common Reporting Tables
CTF	Common Tabular format
DCPA	Development Control and Planning Act
DCPB	Development Control and Planning Board
DMR	Department of Marine Resources
DOA	Department of Agriculture
DOE	Department of the Environment
DPPE	Department of Physical Planning, and Environment
DRR	disaster risk reduction
ECCB	Eastern Caribbean Central Bank
EF	Emission Factor
EST	environmentally sustainable technology
ETF	Enhanced Transparency Framework

EU	European Union
EVCA	Enhanced Vulnerability Assessment
EVs	Electric Vehicles
EWS	Early Warning Systems
FAO	Food and Agriculture Organization
FOLU	Forestry and Other Land Use
FTC	Finance, Technology and Capacity-Building
FY	First year of the data-series (2008)
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Inventory
GHGMI	Greenhouse Gas Management Institute
GIS	Geographic Information System
GMO	Genetically Modified Organism
GPRS	General Packet Radio Service
GSKN	Government of St. Kitts and Nevis
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
HPS	High-Pressure Sodium
IE	Included elsewhere
IICA	Inter-American Institute of Cooperation on Agriculture
INC	Initial National Communication
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate change
IPPU	Industrial Processes and Product Use
IRP	Integrated Resource Plan
IRRP	Integrated Resource and Resilience Plan
IWCAM	Integrating Watershed and Coastal Area Management
IWECO	Integrated Water, Land and Ecosystem Project
LDC	Least Developed Country
LEAP	Low Emissions Analysis Platform
LULUCF	Land Use, Land Use Change and Forestry
MEA	Multilateral Environment Agreements
MPGs	Modalities, Procedures, and Guidelines
MRV	Measurement, Reporting & Verification
MRV Hub	Caribbean Cooperative Measuring Reporting and Verification Hub
NA	Not Applicable
NBSAP	St. Kitts and Nevis National Biodiversity Strategy Action Plan
NC	National Communication
NCCC	National Climate Change Committee
NCEPA	National Conservation and Environmental Protection Act
NCV	Net Calorific Value
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NDMD	Nevis Disaster Management Department
NE	Not Estimated
NEMA	National Emergency Management Authority
NEVLEC	Nevis Electricity Company
NGO	Nongovernmental organization

NHC	National Housing Corporation
NHCS	Nevis Histrorical and Conservation Society
NHLDC	Nevis Housing and Land Development Corporation
NIA	Nevis Island Assembly
NIR	National GHG Emission Inventory Report
NO	Not occurring
NOAA	National Oceanic and Atmospheric Administration
NPDP	Nationl Physical Development Plan
NPL	Nonperforming loans
NTG	Nevis Turtle Group
OAS	Organization of American States
OECS	Organisation of Eastern Caribbean States
OLADE	Organización Latinoamericana de Energía
PAM	People's Action Movement
PAP	Poverty Alleviation Programme
PLP	People's Labour Party
PPA	Power Purchase Agreement
PSIP	Public Sector Investment Programme
PSMA	Port State Measures Agreement
PWD	Public Works Department
PY	Previous year
QA	Quality Assurance
QC	Quality Control
RAC	Refrigeration and Air Conditioning
RFI	Request for Information
RFP	Request for Proposal
RSS	Refrigerations Services Sector
SCASPA	St. Christopher Air and Seaport Authority
SCNT	Saint Christopher National Trust
SDG	Sustainable Development Goal
SEI	Stockholm Environment Institute
SIDS	Small Island Developing States
SKELEC	St. Kitts Electricity Company
SKN	St. Kitts and Nevis
SKNLP	The St. Kitts & Nevis Labour Party
SKNMS	St. Kitts and Nevis Meteorological Services Office
SKSTMN	St. Kitts Sea Turtle Monitoring Network
SLM	Sustainable Land Management
SLMP	Sustainable Land Management Plan
SNAPPER	St. Kitts Nevis Aquaculture Pilot Project and Environment Research
SNC	Second National Communication
STEP	Skills Training and Empowerment Programme
SUV	Sports Utility Vehicle
SWMC	Solid Waste Management Corporation
TACCC	Transparency, Accuracy, Completeness, Comparability, and Consistency
TNA	Technology Needs Assessment
TNC	Third National Communication
ToR	Terms of Reference
UNCBD	United Nations Convention of Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-added Tax
WIDECAST	Wider Caribbean Sea Turtle Conservation Network
WMO	World Meteorological Organisation
WSD	Water Services Department

1. National Circumstances

Geography and History

The Federation of Saint Christopher (hereafter, St. Kitts and Nevis) with a combined area of 104 square miles (269 square kilometres, is a twin island state located in the Lesser Antilles of the Eastern Caribbean Sea. St. Kitts, the larger of the two, is located at latitude 17015' north and longitude 62045' west and Nevis is located two miles (3 km) to the south-east, at 17010' north and longitude 62035' west.

With a two-mile channel separating the land masses, St. Kitts and Nevis are located at the northern part of the Leeward chain of islands; approximately two hundred fifty miles (402 kilometers) southeast of Puerto Rico. St. Kitts is twenty-three miles (thirty-seven kilometers) at its greatest length, with an approximate area of sixty-eight square miles (176.8 square kilometers). Nevis is thirty-six square miles (93.6 square kilometers) and is almost circular in its configuration. Figure 1.1 shows a location map of St. Kitts and Nevis.

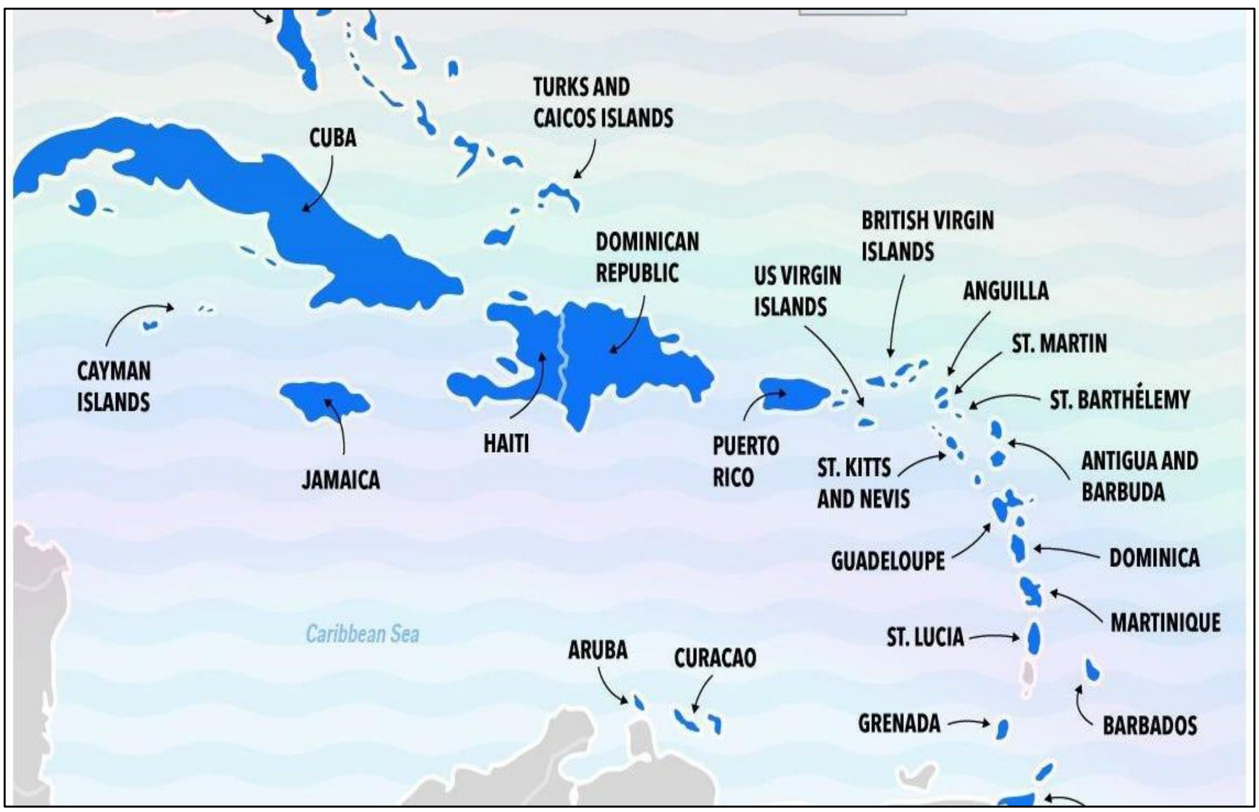


Figure 1.1. Location of St. Kitts and Nevis

The islands are the summits of a submerged mountain range that forms the eastern boundary of the Caribbean Tectonic Plate (MOE, 2001). The physical landscape of St. Kitts is characterized by three volcanic centres and ranges as shown in Figure 1.2. The first is the central northwest range, dominated by Mt. Liamuiga, which rises with a pronounced crater to 1,156 meters (3,792 ft.). It is the highest peak in St. Kitts and Nevis. The middle range is dominated by Verchild's mountain at 975 m, but otherwise consists of a number of irregular peaks. The southeast range has a number of irregular peaks with the highest at 900 m. The slopes of the latter two ranges are steeper and shorter on the leeward coast and the land near the coast is typically flat or moderately sloped; and hence the site of most development (MOSD, 2007).

Nevis Peak is the highest point on Nevis rising to about 985 meters (3,232 ft.) Round Hill is the second highest point on the island with an elevation of approximately 303 meters (990 ft.)

The slopes are cut by deep gullies or ghauts that act as the primary drainage channels (MOE, 2001), but they are almost entirely dry for most of the year. Only the relatively large Wingfield and Cayon rivers flow to the sea for much of the wettest part of the year (DOE, 2001).

Figure 1.2. Saint Kitts and Nevis

St. Kitts was inhabited by the Amerindian people called Arawaks. The Arawaks entered the Caribbean from South America about two thousand years ago and by AD 1500 had occupied all of the islands of the Caribbean as far north as The Bahamas and as far west a Cuba. They were followed at a much later date by a more war like people called the Caribs (Dyde 2008).

The Carib Indians called the island of St. Kitts "Liamuiga" which means fertile land. Christopher Columbus sailed past St. Kitts on his second voyage on 13th November 1493. St. Kitts was named San Jorge and Nevis was named St. Martin. The names were later changed by Spanish sailors to what they are today and by the early sixteenth century the names San

Cristobal, St. Christopher and Nevis, remained Spanish colonies for over a century; however, they were never really settled by the Spanish colonizers, as they were more interested in the Greater Antilles of the Caribbean and Central America. St. Christopher and Nevis also had a sizeable Carib population. During the late sixteenth century St. Christopher and Nevis became extremely popular with English, Dutch and French born sea raiders. Table 1.1 provides a chronology of key historical events.

Table 1.1. Chronology of significant historical and political events

Year	Event
1493	Christopher Columbus lands on the islands and names St. Kitts after his patron saint, Christopher
1623	The British establish their first Caribbean colony on St. Kitts
1626	The British massacre 2,000 indigenous Caribs
1628	The British establish a colony on Nevis
1783	France relinquishes claims on St. Kitts in the Treaty of Versailles
1871	St. Kitts, Nevis and Anguilla united as a British dependency
1980	Anguilla granted a constitution and its union with St. Kitts and Nevis formally revoked
1983	St. Kitts and Nevis jointly attain independence within the British Commonwealth with Kennedy Simmonds as prime minister.
1994	A state of emergency is declared after anti-government riots by Labour Party supporters in the capital, Basseterre.
1995	Prime Minister Kennedy Simmonds loses in a general election which he had called following a scandal involving allegations of drug smuggling; Labour Party leader Denzil Douglas becomes prime minister.
1997	Nevis legislators authorise a referendum on the issue of whether the island should secede from St. Kitts.
1998	August - Referendum on Nevis independence fails to achieve the two-thirds majority required for the island to secede.
1998	September - Hurricane George strikes
2000	Denzil Douglas begins a second term as prime minister after his Labour Party wins a majority of seats in a general election.
2003	March - Largest hotel complex in the eastern Caribbean opens on Frigate Bay, St. Kitts.
2004	October - Denzil Douglas begins a third consecutive term as prime minister.
2005	March - Government decides to close the 300-year-old, loss-making sugar industry after the 2005 harvest.
2015	February - The Team Unity coalition wins elections, ending the former ruling Saint Kitts and Nevis Labour Party's 20-year reign
2020	June – The Team Unity coalition wins elections to a second five-year term.

Government System and Political Structure

St. Kitts and Nevis is a federal state that is patterned after the British Westminster-style parliamentary system of government. The distinctiveness of its 1983 Constitution provides for the autonomy of Nevis with regard to certain "specified matters" and the establishment of a separate Nevis Island Assembly (legislature) to govern local concerns. As a constitutional monarchy within the Commonwealth of Nations, St. Kitts and Nevis recognizes Queen Elizabeth II or her successor as the symbolic head of government with the Governor General as her resident representative. Although legally responsible for the government of both islands, the Governor General appoints a deputy to represent him or her on Nevis.

As the highest executive authority on the islands, the Governor General appoints the Prime Minister, the deputy Prime Minister, other ministers of the government, the leader of the opposition in Parliament, and members of the Public Service Commission and Police Service Commission (Table 1.2**)**. The Governor General has the authority to and may prorogue or dissolve Parliament at any time. However, as is the case in most Commonwealth countries, the nature/scope of the Governor General's powers is restricted by the requirement that he or she acts only in accordance with the advice of the Prime Minister.

The federal government of St. Kitts and Nevis is directed by a unicameral parliament known as the National Assembly; established by the 1983 Constitution to replace the House of Assembly. Presently the assembly consists of eleven elected members, or representatives, and three appointed members, or senators. Two of the senators are appointed by the governor general on the advice of the prime minister. The other is named on the advice of the leader of the opposition. Both representatives and senators serve five-year terms.

The focus of effective power in the federal government is the Cabinet of Ministers, which is chaired by the Prime Minister and consists of other ministers drawn from the membership of the Assembly (either representatives or senators). The Cabinet determines the business and policies of government. According to the Constitution, the Cabinet is "collectively responsible to the National Assembly," but because its members are drawn from that body, there is little likelihood of serious disagreement between the two.

Electoral districts, or constituencies, are delimited by the Constituencies Boundaries Commission. A minimum of eight constituencies on St. Kitts and three on Nevis is mandated by the Constitution. Boundaries are not established solely on the basis of population; the commission is charged to consider other factors, such as population density, fair representation for rural areas, communication differences, geographical features, and existing administrative boundaries.

The island of Nevis elects representatives both to the National Assembly and to its own Nevis Island Assembly (NIA); a separate eight-member body elected, three appointed) charged with regulating local affairs. The NIA is subordinate to the National Assembly with regard to external affairs and defense and in cases where similar but not identical legislation is passed by both bodies. The guidelines for legislative autonomy in Nevis are contained in the "specified matters"- areas of local administration for which the Nevisian legislature (five may amend or revoke provisions passed by the National Assembly. There are twenty-three specified matters, including agricultural regulations, the borrowing of monies or procurement of grants for use on Nevis, water conservation and supply, Nevisian economic planning and development, housing, utilities, and roads and highways. Nevis’s secession from the Federation requires a two-thirds vote in the NIA and the approval of two-thirds of the voters in a referendum. St. Kitts has no corresponding right of secession.

The Nevis Island Administration closely parallels the structure of the Federal government and has a Premier, an Assembly incorporating both elected and appointed members, and a body functioning as a local Cabinet. The Cabinet is chaired by the Premier and includes two or more members of the NIA. Disputes between the Nevis Island Administration and the federal government must be decided by the High Court.

The High Court sits in Basseterre and is the final Court of Appeal in the Federation. Appeals beyond the High Court are heard by the Court of Appeal of the Eastern Caribbean States Supreme Court. Further appeals beyond that level may be taken to the Judicial Committee of the Privy Council in London; but only if they conform to certain prescribed conditions, such as issues that require constitutional interpretation or are decisions of "great general or public importance." Local Magistrate's Courts provide summary jurisdiction.

Traditionally, parishes provided administrative boundaries; nine (9) on St. Kitts and five (5) on Nevis. Today the significance of parishes has been eroded through the increased reliance on constituency boundaries as a factor in the appropriation of public sector investments. Figure 1.3 below shows the parish boundaries for St. Kitts and Nevis.

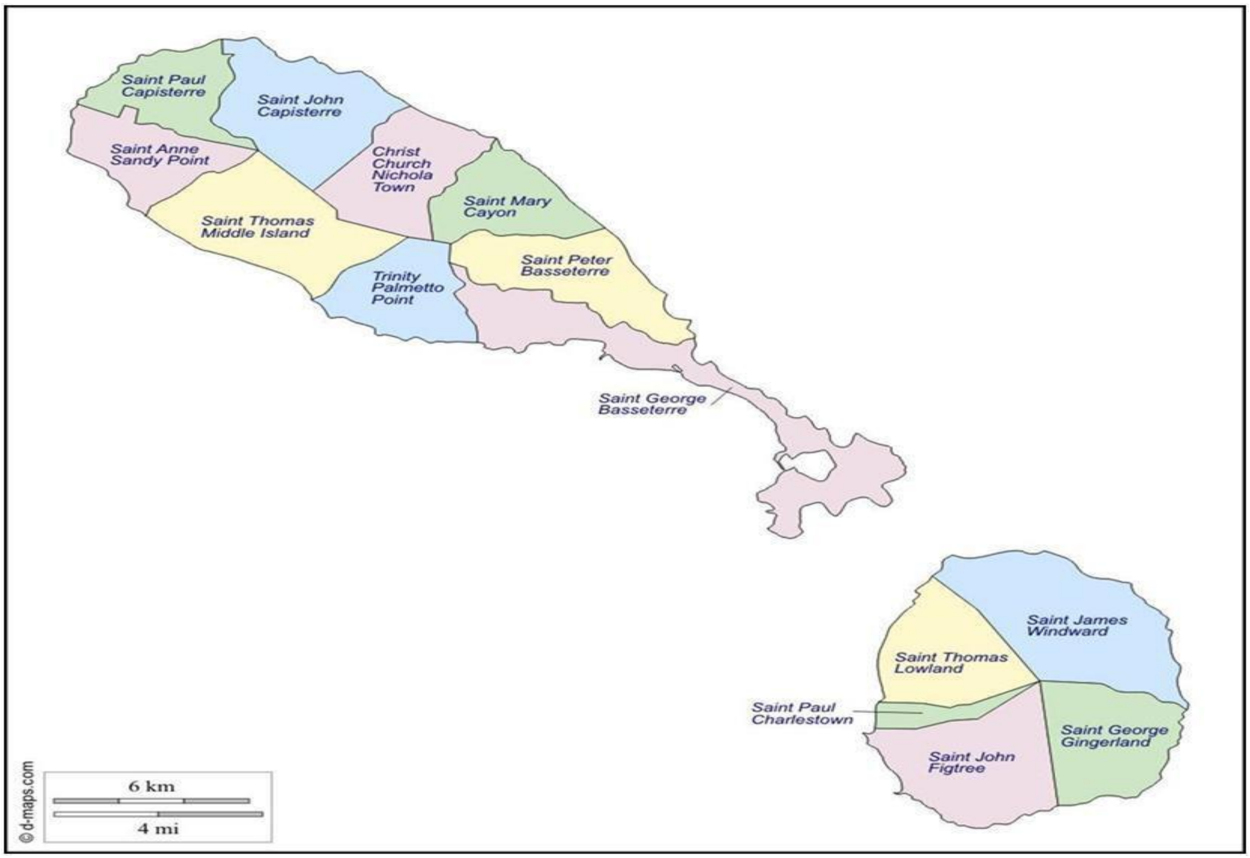


Figure 1.3. Map showing parish boundaries for St. Kitts and Nevis

Table 1.2. Chief Minister, Premiers and Prime Ministers of St. Kitts and Nevis

	Time in Office	Political Party
Chief Ministers of St. Kitts and Nevis (1960–67)		
Honourable Paul Southwell	January 1960-July 1966	St. Kitts and Nevis Labour Party
Right Honourable Robert Bradshaw	July 1966-February 1967	St. Kitts and Nevis Labour Party
Premiers of St. Kitts and Nevis (1967–83)		
Right Honourable Robert Bradshaw	February 1967-May 1978	St. Kitts and Nevis Labour Party

Paul Southwell	May 1978-May 1979	St. Kitts and Nevis Labour Party
Lee Moore	May 1979-February 1980	St. Kitts and Nevis Labour Party
Right Honourable Dr. Kennedy Simmonds	February 1980-September 1983	People's Action Movement
Prime Ministers of St. Kitts and Nevis (1983–present)		
Right Honourable Dr. Kennedy Simmonds	September 1983-July 1995	People's Action Movement
Right Honourable Dr. Denzil Douglas	July 1995-February 2015	St. Kitts and Nevis Labour Party
Dr. The Honourable Timothy Harris	February 2015-present	People's Labour Party

Climate

St. Kitts and Nevis's climate is generally classified as tropical marine, and for the most part is influenced by the northeast trade winds and tropical oceanic cyclonic movements. Atmospheric conditions are pleasant as warm temperatures are modified by constant sea breezes. Variations in seasonal temperatures are insignificant with a mean annual temperature of approximately 27ºC (80.6ºF). The average temperature at Basseterre and at Charlestown is 27.8ºC (81.7ºF). Only at higher elevations do temperatures drop below 17ºC (62.6ºF). Lower temperatures are usually recorded in winter months (January to April).

The rainfall type is mainly relief/orographic and increases in amount and frequency with altitude. The central mountain range uplift effect produces an annual average of 64 inches (1,625 mm). Mean annual rainfall ranges from about 40 inches (1,016mm) in the coastal areas, to about 150 inches (3,810mm) in the mountain interior. The relative humidity level is usually low in the dry season and high in the wet season. The mean value is 76 percent but ranges from 70% in March to around 78% in September, October and November.

There is an observed uneven monthly and annual distribution with a generally reliable wet period between August and September. The driest months are from January to April. The very low rainfall together with high evapo-transpiration rate contributes to the overall dry conditions as is evidenced annually by the desiccation and shrinking of terrestrial water bodies.

The prevailing wind is the north-east trade with mean speeds ranging from 10-20 miles per hour (mph). The periods of seasonal low-pressure July - September have higher wind speeds of 20-30 mph. The regional pattern is locally modified by land and sea breezes. The hurricane season extends from June to November, and there is a high annual frequency of tropical disturbances which generate squalls and high wind velocities. Some of the major hurricanes that have affected St. Kitts & Nevisare shown in Table 1.3 below.

The economic, social and environmental impacts of tropical storms and hurricanes in Small Island Developing States economies such as St. Kitts and Nevis can be devastating; especially given the dependence on tourism.

Table 1.4.

Table 1.3. Tropical storms and hurricanes impacting St. Kitts and Nevis 1950-2017

Year	Hurricane/ Tropical Storm		Year	Hurricane/ Tropical Storm
Aug 1950	Hurricane BAKER		Jul 1996	Hurricane BERTHA
Sept 1950	Hurricane DOG		Sept 1998	Hurricane GEORGES

Sept 1953	Tropical Storm EDNA		Oct 1999	Hurricane JOSE
Jan 1954	Hurricane ALICE		Nov 1999	Hurricane LENNY
Aug 1956	Hurricane BETSY		Aug 2000	Hurricane DEBBY
Aug 1959	Tropical Storm EDITH		Sept 2004	Tropical storm JEANNE
Sept 1960	Hurricane DONNA		Dec 2007	Hurricane OLGA
Oct 1963	Tropical Storm HELENA		Oct 2008	Hurricane OMAR
Jul 1979	Tropical Storm CLAUDETTE		Sept 2009	Hurricane ERIKA
Sept 1979	Tropical Storm FREDERIC		Aug 2010	Hurricane EARL
Sept 1981	Tropical Storm GERT		Sept 2010	Hurricane IGOR
Sept 1989	Hurricane HUGO		Aug 2011	Tropical Storm EMILY
Aug 1995	Tropical Storm IRIS		Oct 2012	Hurricane RAFAEL
Sept 1995	Hurricane LUIS		Oct 2014	Hurricane GONZOLO
Sept 1995	Hurricane MARILYN		Aug 2017	Hurricane IRMA
			Sept 2017	Hurricane MARIA

Table 1.4. Select hurricanes in St. Kitts and Nevis and economic impact

Date of Event	Number of People Affected	Deaths	Economic Impact (USD Millions)
September 1989- Hugo	1,300	1	46
September 1995- Luis	1,800	0	197
September 1998- Georges	10,000	5	400
November 1999-Lenny	1,180	0	41.4
August 2017- Irma	-Not Determined	0	19.6
September 2017-Maria	Not Determined	0	32.8

Ecology

St. Kitts and Nevis, like other islands in the Caribbean has had much of its virgin forest cleared mainly for agriculture. While the peaks are still covered with some forest, they do not show the typical virgin forest characteristics. Since the closure of the sugar industry on St. Kitts, it has been observed that vegetation succession has been taking place particularly on the lower slopes. The emergence of secondary vegetation on the former sugar lands represents an expansion in secondary forest cover.

The lowlands on both islands are intensely used for development or farming. In the past, the increasing demand for agricultural land resulted in the clearing and cultivation of the upper slopes, which in turn has led to soil erosion and sedimentation of rivers and the near shore coastal areas. The closure of the sugar industry and the subsequent availability of land at lower elevations for agricultural expansion have minimized the risk of land degradation on steep slopes. Vegetation on St. Kitts and Nevis can be classified into four distinct zones as shown in Table 1.5 below. Table 1.6 shows the vegetation types in St. Kitts and Nevis with common and scientific name.

Table 1.5. Vegetation/forest diversity of St. Kitts and Nevis

Vegetation Zone	Description	Vegetative Types

Halophytic	Coastal location Mangroves and wetlands	Coconut palms Sea grape Seaside mahoe Manchineel Indian almond Tamarind Sea lavender Mangrove trees Water lilies
Xerophytic	Dry woodland Grassland Cactus scrub	Button mangrove Braceletwood White cedar Fleshy herbaceous Aloes and herbs Wild frangipani Casha
Cultivated Belt		Fertile Native and introduced plants agriculture crops
Mesophytic	Mountain forest	Ferns Mountain cabbage palm Spiny palm Spanish ash Wild mango Orchids Bromliads

Table 1.6. Vegetation types in St. Kitts and Nevis

Vegetation Type	Common Name	Scientific Name
Shrubs	Sugar Apple Soursop Castor Oil Plant Indigo Barbados Cherry Barricada Bush	*Annona squamosa* *Anonas muricata* *Ricinus communis* *Indigofera suffruticosa* *Malpighia emarginata* *Jatropha gossypifolia*
Medicinal Herbs	White top Rabbit meat Donkey rub down Broom White lady Nutgrass	*Parthenium hysterophorous* *Leonotis nepetifolia* *Rhynchosia minima* *Sida spp* *Thunbergia fragans* *Cyperus rotendus*
Seasonal Herbs	Onion Chives Thyme	*Allium cepa* *A. Schoenoprasm L.* *Thymus vulgaris*
Root & Tuber Crops	Sweet potato Dasheen Yam Cassava Tannia Eddoe	*Ipomea batatas* *Colocasia esculenta* *Dioscorea alata* *Manihot esculenta* *Xanthosoma sagittifolium* *Colocasia sp.*

Legumes	Peanuts String beans Pigeon peas	*Arachis hypogaea* *Phaseolus vulgaris* *Cajanus cajan*
Trees	Flamboyant Frangipani plant Baobab tree Cashew Saman Pawpaw Hog plum Gliricidia Banana Mango Pineapple Avocado Grapefruit Orange Lime Breadfruit Wax apple Indian jujube	*Delonix regia* *Plumeria rubra* *Adasonia digitata* *Anacardium Occidentale* *Samanea saman* *Carica papaya* *Spondias mombin* *Gliricidia sepium* *Musa L.* *Mangifera indica cv Julie* *Ananas cmosus* *Persea Americana* *Citrus. sinesis* *Citrus paradist* *Citrus. aurantifolia* *Artocarpus altillis* *Syzgium samarangense* *Ziziphus mauritiana*

The Biodiversity Review of St. Kitts and Nevis "Report on Rapid Assessment of Causes and Consequences of Biodiversity Loss" was prepared as part of the revision of the 2004 National Biodiversity Strategy and Action Plan(NBSAP). This Report detailed the number of terrestrial, aquatic and marine faunal species recorded in St. Kitts and Nevis. These are summarized in the Table 1.7 below.

Table 1.7. Summary of St. Kitts and Nevis's faunal biodiversity

Species Type	**Number of Species**	**Examples**
Seabirds	9	Brown Pelican, Brown Booby, Frigate Bird, etc.
Shorebirds	24	Great Blue Heron, Cattle Egret, Spotted Sandpiper, etc.
Terrestrial birds	44	Rock Dove, Red-necked Pigeon, Ground Dove
Mammals	15	African Green Vervet Monkey, Cattle, Sperm whale, etc.
Reptiles & Amphibians	14	Green Turtle, Ground Lizard, Mountain Chicken, etc.
Invertebrates	17	Millepede, Red Dragon Fly, Caribbean Cray Fish
Marine & Aquatic		
Demersal	9	Doctor Fish, Grunts, Snapper, etc.
Coastal pelagic	3	Gars, Ballahoo, Jacks.
Ocean Pelagic	4	Dolphin, Tuna, Mackerel, Conch

Generally marine water quality conditions for St. Kitts and Nevis are acceptable with the near shore benthic conditions favouring the growth of pelagics. Seagrass communities are common along the Atlantic Coast of both islands (particularly at the Southe ast Peninsula).[1] In general, beach deposits indicate a littoral drift rather than direct beach deposits. Sea grass

[1] Island Planning Services, EIA Report Friar's Bay Development

communities perform several functions including the following:

- Stabilizing the sea floor
- Providing food and habitat near shore pelagics and for other marine organisms
- Maintaining water quality

Supporting local economies

Sea floor areas devoid of sea grass tend to be more vulnerable to intense wave action from currents and storms.[2] The extensive root system in sea grasses (which extends both vertically and horizontally) assists in stabilizing the substrate layer in a manner similar to the way land grasses prevent soil erosion on land. Without sea grasses to diminish the force of the currents the extent of beach and overall coastal erosion would be greater.

While some species, including the green sea turtle, graze directly on sea grass leaves, others use sea grasses indirectly to provide nutrients. Debris from bacterial decomposition of sea grass plants provides food for worms and crabs. Advanced decomposition releases nutrients such as nitrogen and phosphorus, which, when dissolved in water, are re-absorbed by sea grasses and phytoplankton.

Although sea grasses are ideal for juvenile and small adult fish for escape from larger predators, many infaunal organisms (animals living in soft sea bottom sediments) also live within sea grass areas. Species such as clams, worms, crabs, and echinoderms, like starfishes, sea cucumbers, and sea urchins, use the buffering capabilities of sea grasses to provide a refuge from strong currents. The dense network of roots established by sea grasses also helps deter predators from digging through the substratum to find faunal prey organisms. Sea grass leaves provide a place of anchor for seaweeds and for filter-feeding animals like sponges and foams.

As with seagrass communities, coral reefs are important to the overall health of the near-shore marine ecosystem in St. Kitts and Nevis. Coral reefs provide habitat for the vast majority of sea floor dwelling or demersal species in the Caribbean. The fringing reef system on the Atlantic coast of St. Kitts and Nevis is relatively shallow compared to the deeper barrier reef system on the Caribbean coasts. Wilcox (1989) indicated that the fore-reef and the reef flat/crest of the Atlantic coast fringing reef system consisted mainly of rubble, with less than 5% living coral.

Common fish species found within the waters of the Federation include hind (Serranidae), parrotfish (Scardae), grunt (Pamadosydae), surgeonfish (Acunthuridae), sharks (Elasmabranchii), swordfish (Xiphias gladius), snappers (Lutjandae), groupers (Serranidae), and the Caribbean spiny lobster (Panulirus argus).

The importance of the marine ecology to St. Kitts and Nevis is further highlighted as several beaches provide habitat for turtle nesting. There are three main species of turtles that nest and or feed on the beaches and in the waters around the islands. These are the Hawksbill (Eretmochelys imbricate), Green (Chelonia mydas) and Leatherback turtles (Dermochelys coriacea). The Hawksbills and Greens feed primarily in the coastal areas of the Southeast Peninsula and are generally found in these waters year-round. Greens feed primarily in sea

[2] Island Planning Services "Report on Rapid Assessment of Causes and Consequences of Biodiversity Loss"

grass beds while Hawksbills feed primarily on coral reefs. Leatherbacks activity is restricted to the laying of eggs by adult females on the beaches.

Eckert (1989) identified several beaches on St. Kitts where turtle nesting took place but noted that only a few were significant habitats. This observation is supported by the St. Kitts Sea Turtle Monitoring Network (SKSTMN). The SKSTMN and the Nevis Turtle Group (NTG) are community based non-profit organizations that were founded in 2003. Both organizations monitor nesting sea turtle populations and act as an advocate for the strengthening of sea turtle protection laws. The organizations work in conjunction with several local, regional and international agencies including the St. Kitts Fisheries Department, St. Christopher Heritage Society, The Wider Caribbean Sea Turtle Conservation Network (WIDECAST), United Nations Educational, Scientific and Cultural Organization (UNESCO) Small Islands Voice, Ross University School of Veterinary Medicine, the Georgia Sea Turtle Center, St. Catherine's Island Center, University of Illinois School of Veterinary Medicine & local citizens to develop a long term sea turtle monitoring & protection program.

The main threats to turtles throughout St. Kitts include predation of eggs and hatchlings from mongoose, human poaching of eggs, over catch of turtles during the harvesting season for meat, habitat degradation through development activity, and coastal and sea borne pollution. The objectives of the SKSTMN are to implement, under the direction of the St. Kitts Department of Marine Resources, a long-standing sea turtle conservation management program, and to promote community awareness of the plight of sea turtles.

Consequences of Biodiversity Changes

Diversity at all organizational levels, ranging from genetic diversity within populations to the diversity of ecosystems in landscapes, contributes to global biodiversity. However, for the purposes of this report the discussion here is focused on species diversity, because the causes, patterns and consequences of changes in diversity at this level are relatively easily observed and documented. Species diversity has functional consequences because the number and kinds of species present determine the organism traits that influence ecosystem processes.

The quality and character of species traits may mediate energy and material fluxes directly or may alter abiotic conditions within an ecosystem. Limiting resources, habitat disturbance and microclimate changes regulate process and production rates that are vital for ecosystem functioning. The universal aspects of species diversity that determine specie characteristics include the following:

- Number of species present (species richness)
- Relative abundances (species evenness)
- Particular species present (species composition)
- Interactions among species (non-additive effects)
- Temporal and spatial variations in these properties

Changes in biodiversity alter the functional traits of species in an ecosystem in ways that directly influence ecosystem goods and services. Influences might be positive (for example, increased agricultural, fisheries or forestry production) or negative (for example, loss of harvestable species or species with strong aesthetic and cultural values). Variations in species traits affect ecosystem processes directly through changes in biotic controls and indirectly through changes in abiotic controls, such as availability of limiting resources, disturbance regime, or micro/macroclimate variables.

Changes in the profile of biodiversity of St. Kitts and Nevis may alter ecosystem processes and adversely impact the resilience of ecosystems to environmental change. This has profound consequences for the goods and services that residents of and visitors to St. Kitts and Nevis derive from the environment. The wider ecological and societal consequences of a changing biodiversity should be minimized to preserve options for future solutions to local, regional and global environmental problems.

The following effects and relationships that impact biodiversity have been observed in St. Kitts and Nevis, more visible since the closure of the sugar industry.

Vegetation succession (from sugar cane to guinea grass and shrubbery mainly) is causing a retreat of the forest line in some areas because of grass fires. Grass fires also adversely impact arboreal species (habitat loss and disturbance) and soil organisms.

Observed increases in the mongoose population, particularly on the South East Peninsula have resulted in an observed decline in birdlife in that landscape as the mongoose eats the bird eggs.

Dramatic increases in the monkey population throughout St. Kitts and Nevis severely impacts agricultural output and profitability as they destroy crops. Like the mongoose, monkeys also disturb breeding and nesting sites for birds; a factor that affect pollination.

Land allocation, mainly for resort development throughout St. Kitts and Nevis has resulted in changes in several sensitive ecosystems. Land preparation activities including but not limited to dredging, infilling, excavation and grading have led to the removal of plants and habitat disturbance (both aquatic and terrestrial).

Land based sources of pollution carried by storm water runoff into the near shore marine environment affects water quality and the health of coral reefs. The net result has been an observed reduction in near shore pelagic.

Population

St. Kitts and Nevis is scheduled to conduct its population census in September 2021. It will be the first time that the census will be administered using the Computer Assisted Personal Interview (CAPI) platform.

Based on the latest United Nations estimates, the current population of St. Kitts and Nevis is approximately 53,082 or 0.00068% of the total World's population.[3] The population density in St. Kitts and Nevis is 205 per square kilometre or 530 persons per square mile. Table 1.8 and

Table 1.9 below show the estimated and projected population dynamics for the period 2015 to

[3] Extract from World Population Prospects (2019 Revision)

2020 and 2020-2050, respectively.

Table 1.8. Population projections of St. Kitts and Nevis (2015-2020). Source: United Nations, Department of Economic and Social Affairs, Population Division

Year	Pop	Yearly % Change	Yearly Change	Density (P/Km²)	Urban Pop (%)	Urban Population
2020	53,199	0.77 %	399	205	32.9 %	17,523
2019	52,823	0.73 %	382	203	32.9 %	17,354
2018	52,441	0.76 %	396	202	32.8 %	17,188
2017	52,045	0.81 %	420	200	32.7 %	17,031
2016	51,625	0.82 %	422	199	32.7 %	16,879
2015	51,203	0.88 %	437	197	32.7 %	16,736

Table 1.9. Projected population increase for St. Kits and Nevis (2025-2050). Source: United Nations, Department of Economic and Social Affairs, Population Division

Year	Pop	Yearly % Change	Yearly Change	Density (P/Km²)	Urban Pop (%)	Urban Population
2025	54,741	0.57%	308	211	33.80%	18,481
2030	55,832	0.40%	218	215	35.20%	19,645
2035	56,490	0.23%	132	217	37.20%	21,042
2040	56,730	0.08%	48	218	39.90%	22,617
2045	56,610	-0.04%	-24	218	42.60%	24,135
2050	56,161	-0.16%	-90	216	45.50%	25,561

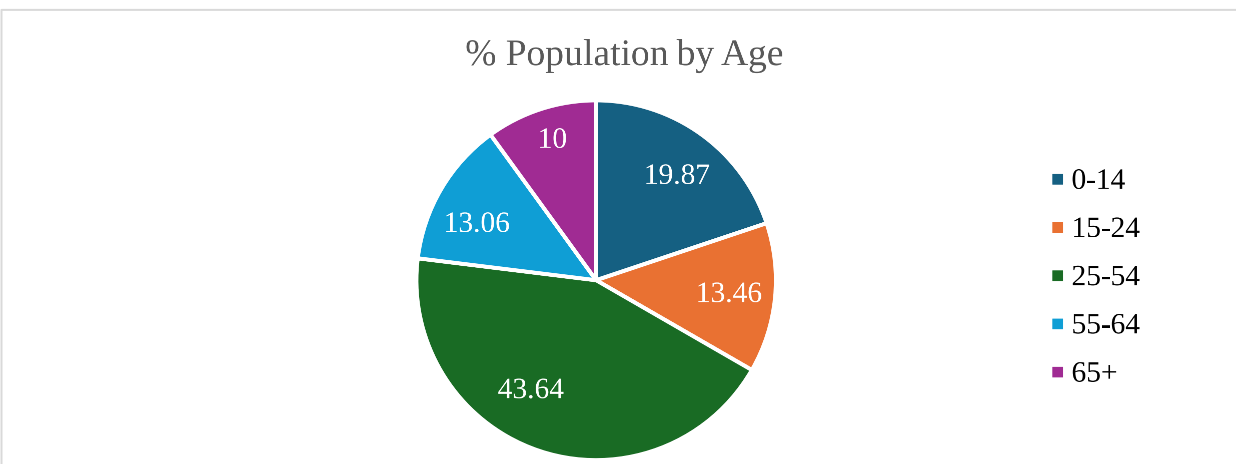


Figure 1.4 below provide an overview of some demographic features of the population. Key observations include:

- There is no significant difference in the gender distribution
- Almost 50% of the population falls within the age cohort (25-54), with another 13.46% within the age range of 15-24

- There is a relatively low dependency

Table 1.10. Age structure of St. Kitts and Nevis population

Age Cohort	% of Population	Males	Females	Total
0-14	19.87%	5,357	5,336	10,693
15-24	13.46%	3,504	3,741	7,245
25-54	43.64%	12,010	11,477	23,487
55-64	13.06%	3,527	3,485	7,012
65+	10%	2,540	2,844	5,384
Total		**26,938**	**26,883**	**53,821**

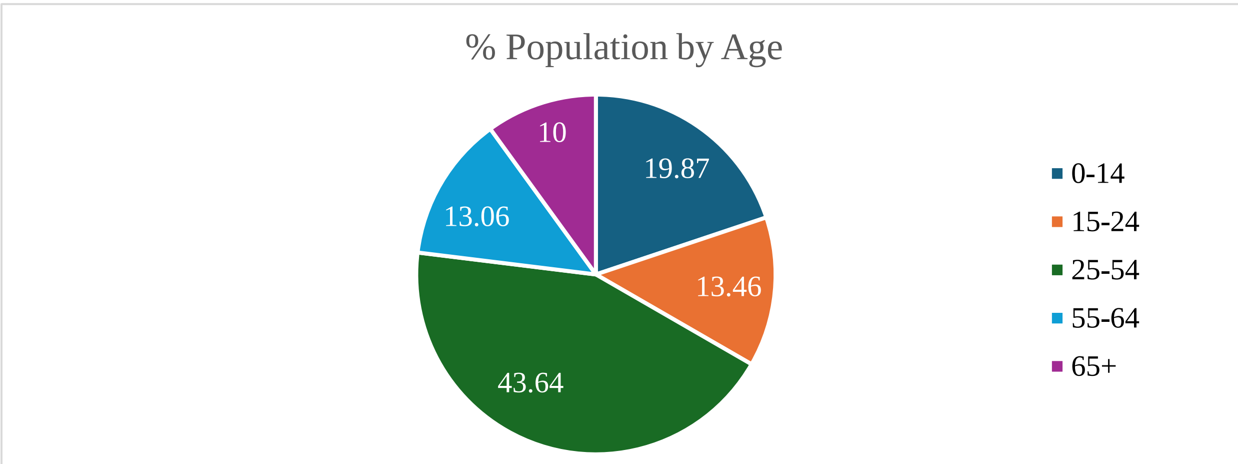


Figure 1.4. Population distribution by age cohort

The population pyramid for St. Kitts and Nevis (Figure 1.5) illustrates the age and sex structure of the population and provides some insights about economic, social and political stability of the country. The shape of the population pyramid gradually evolves over time based on fertility, mortality, and international migration trends.

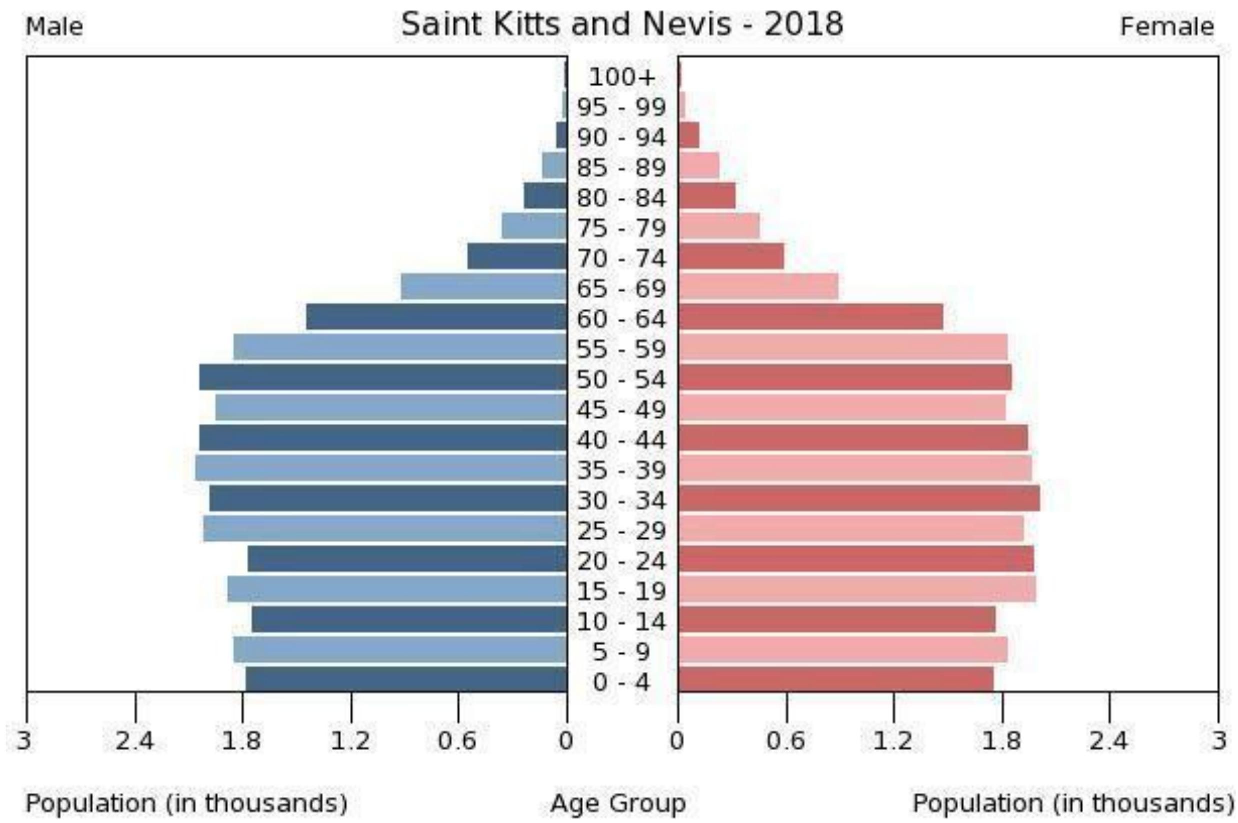


Figure 1.5. Population pyramid for St. Kitts and Nevis (2018)

The population of St. Kitts and Nevis is approximately made up of 92.5% of African descent, 3% mixed, 2.1% Caucasians, 1.5% East Indian 6% other and 0.3% unspecified.[4]

The religious profile is summarized as follows based on 2001 estimates:

- Protestant 74.4% (includes Anglican 20.6%, Methodist 19.1%, Pentecostal 8.2%, Church of God 6.8%, Moravian 5.5%, Baptist 4.8%, Seventh Day Adventist 4.7%, Evangelical 2.6%, Bretheren 1.8%, other .3%)
- Roman Catholic 6.7%
- Rastafarian 1.7%
- Jehovah's Witness 1.3%
- Other 7.6%
- None 5.2%
- Unspecified 3.2%

The major urban areas are Basseterre and Charlestown. In St. Kitts, while the population

[4] Department of Statistics, Ministry of Sustainable Development

is concentrated in the capital and surrounding suburban areas, a considerable portion of the population is located in coastal areas, with many villages located along coastal roads. Nevis follows a similar pattern to St. Kitts with the population being concentrated in and around Charlestown. Many of the villages in Nevis are located along the island's main road. The location of the population centres on the coast enhances the vulnerability of St. Kitts and Nevis to the impacts of climate change.

Economy

St. Kitts and Nevis is heavily dependent on revenues from the tourism industry and remains one of the fastest growing economies in the Eastern Caribbean; offering investment opportunities within the priority sectors as identified under the National Adaptation Strategy. These include financial services, tourism, real estate, agriculture, information technology, education services and limited light manufacturing. Table 1.11 provides a summary of key economic parameters.

Table 1.11. St. Kitts and Nevis economy at a glance. Sources: ECCB, CDB, IMF, GSKN

	2015	2016	2017	2018	2019	2020
Real GDP Growth (%)	2.1	3.7	1.6	2.1	1.8	12.5
Average Inflation (%)	-2.6	1.5	1.5	-1.1	0.5	-2.0
Unemployment (%)	NA	NA	NA	NA	NA	NA
Primary Balance (% of GDP)	7.7	9.6	3.4	7.1		
Public Sector Debt (% GDP)	66.1	61.5	58.4	58.2	57.4	NA

It is estimated that economic growth in 2018 increased to 2.5% from 1.2% in the previous year.[5] Tourism was the main contributor, with the hotel and restaurants sector performing very well, followed by the transport, storage and communications sectors. Overnight arrivals increased by 4.2% year-on-year; helped by additional direct flights from Atlanta, New York and Miami. Cruise ship arrivals were also up. The room stock was enhanced by the first full year of operation of a new luxury Park Hyatt hotel.

Growth in the construction sector fell following the completion of this hotel in 2017. Major public investments included the construction of the East Line Bus Terminal, ongoing rehabilitation of the island main road, and the completion of construction of the second cruise ship berth (all in St. Kitts). The real estate and business activities sectors added very little to economic growth, as did the financial sector, which was burdened by high levels of nonperforming loans (NPLs).

According to the Eastern Caribbean Central Bank (ECCB), St. Kitts and Nevis had an estimated Gross Domestic Product of USD $787.8 million in 2016, with forecasted growth of 3.1 percent in 2017. The introduction of the People Employment Programme in 2012 (two years ago renamed and reorganised as the Skills Training and Empowerment Programme (STEP), has lowered unemployment significantly. No official unemployment data have been published since 2009, but according to the government of St. Kitts and Nevis (GSKN) the STEP still employed 2,000 persons as of February 2018, giving major relief to the labour market.

[5] Eastern Caribbean Central Bank County Review

Central Government's fiscal position improved following the introduction of a new Citizenship-by-Investment (CBI) option. The 2018 launch of the Sustainable Growth Fund led to a strong rise in CBI revenue flowing directly to the Consolidated Fund. The government of St. Kitts and Nevis achieved a primary surplus of $195 million (mn) – or 7.1% of gross domestic product (GDP) – and an overall surplus equivalent to 5.6% of GDP. While full-year data are not yet available for CBI receipts, inflows reached $287M – or 39% of total of St. Kitts and Nevis revenue – between January and September 2018. Total revenue rose 23.5%, mainly due to the CBI-driven 84.0% increase in nontax revenue, while tax revenue was just 8.0% higher. Total expenditure rose by 11.4%, as capital expenditure and net lending increased by 29.3%.

Total public sector debt as a percentage of GDP remained stable in 2018. The ratio of debt to GDP fell marginally from 58.4% to 58.2%. This partly reflected restructuring of a portion of the Nevis Island Administration's debt. Domestic debt represented 75.0% of total debt and the remaining 25.0% was foreign debt. New debt included the financing of the second cruise ship berth, as well as loans for the National Housing Corporation and a water-drilling project in Nevis.

The capital account surplus increased from $91.8M to $140.2M, mainly because of stronger CBI inflows. These inflows also contributed to a $78.3M rise in international reserves.

The Caribbean Development Bank (CDB) projected an increase in growth to 3.0% in 2019, mainly on the back of expanding construction and tourism activities. Construction activity is expected to accelerate with ongoing public infrastructure investments at the St. Kitts airport and seaport, and on each of the islands' main roads. The strong 2018 CBI inflows and resulting construction activity in hotel and condominium projects, was expected to add to sector growth tin 2019.

St. Kitts and Nevis targeted a lower primary surplus for 2019. Total revenue was expected to decline by 8.1% and total expenditure likely to grow by 5.7%, the primary surplus was projected to fall to 2.1% of GDP. The projected decline in revenue was due to a projected 29.1% drop in nontax revenue – mainly CBI receipts – although this will remain the main revenue category. On the expenditure side, capital expenditure was expected to increase by 21.8%, with one third of the funds being earmarked for improving the public infrastructure. Major proposed investments included the rehabilitation of the main roads on both islands, the upgrade to the airport on St. Kitts and the construction of the second cruise ship berth in St. Kitts, and the expansion of the hospital in Nevis.

The main risks to the macroeconomic and the fiscal outlook stemmed from external factors. The COVID-19 global pandemic has severely impacted growth across the economy of St. Kitts and Nevis; with the impact being most severe in the tourism industry. The pandemic has shifted the developmental agenda in St. Kitts and Nevis and has changed the timelines for the delivery of important capital projects. Nonetheless, St. Kitts and Nevis has engineered a framework which is helping to build economic resilience.

Some of the economic relief and stimulus measures implemented by the government to date includes[6]:

[6] Ministry of Finance

- Provision of additional funds to support the Poverty Alleviation Programme (PAP)
- Provision of additional resources to capitalize the Severance Payment Fund
- Provision of $30 million in funding through the Development Bank of St. Kitts and Nevis for mortgage loans to citizens of St. Kitts and Nevis
- Moratorium on mortgages held with the National Housing Corporation (NHC) and the Development Bank of St. Kitts and Nevis
- Moratorium on payments for electricity services for April to June 2020 by the St. Kitts Electricity Company (SKELEC) and the Nevis Electricity Company (NEVLEC)
- Postponement of the payment of Property Tax from June to September 2020
- Reduction of the Corporate Income Tax rate from 33 percent to 25 percent for the period April to December 2020 for businesses that retain at least 75 percent of their employees
- Reduction of the Unincorporated Business Tax rate by 50 percent (from 4 percent to 2 percent) for the period April to December 2020
- Waiver of payments for consumption of water for April to December 2020 for individuals affected by COVID-19
- Waiver of payments for the consumption of water by farmers for nine months (April to December 2020)
- Removal of the value-added tax (VAT) and Import Duty on additional hygiene items such as hand sanitizers, disinfectant sprays, rubbing alcohol and latex gloves, and removal of Import Duty and Customs Service Charge on selected food items for nine months
- Continuation of the Fresh Start Programme with an injection of $5 million to provide access to capital to fund small and medium sized business projects
- Provision of additional financial resources to the Ministry of Health
- Provision of additional financial resources to the Ministry of Education

As of November 2020, the Social Security Board had provided income support to displaced individuals in the amount of $22.6 million.[7] The government has also provided direct income support to thousands of recipients under the Poverty Alleviation Programme (PAP). The number of recipients peaked in May 2020 totalling of 4,873. Of this number, 940 households were added as a direct result of the impact of COVID-19 on their livelihoods. The government of St. Kitts and Nevis expended $28.4 million on the PAP up to the end of November 2020. Other significant spend included $14 million on Health, Education and National Security and $6.5 million in the agriculture Sector.

It is estimated further that taxes waived, and the impact of deferred taxes would be in excess of $26 million. The National Housing Corporation provided breathing space for some 171 homeowners for three months to the tune of $452,682 and the Development Bank of St. Kitts

[7] Extracted from the St. Christopher and Nevis Budget Address 2021

and Nevis assisted 351 of its clients at approximately $3.8 million.

According to the Eastern Caribbean Central Bank (ECCB) 1,717 loan recipients have accessed the moratorium facilities extended by commercial banks operating in the Federation during 2020. The value of the deferred loan facilities with commercial banks is in the region of $511 million. The economic outlook for the period 2021 to 2023 has projected the recurrent revenue to be approximately $724.2 million per annum while the average annual amount for recurrent expenditure would likely be in the region of $642.3 million.

Additionally, the medium-term Capital Expenditure projections are expected to average about

$122.3 million per annum. It is anticipated that the fiscal operations of the government would result, on average, in a recurrent account surplus of $81.9 million, an overall deficit of $25.4 million and a primary deficit of $8.6 million. Based on these projections, it is likely that the potential impact of the pandemic would require the government to borrow in order to achieve its development objectives for 2021 and the medium term.

Institutional and Legislative Framework

St. Kitts and Nevis has a long history of addressing various aspects of sustainable development, particularly soil and water conservation. For the most part this history has been associated with the sugar industry; given that land management including conservation activities were integrated into the management of overall operations of the sugar estates. Today, the Ministry of Sustainable Development is primarily responsible for the sustainable land management in St. Kitts and Nevis.

The Ministry of Sustainable of Development was established in 2005 and became responsible the lands and surveys functions of the Ministry of Agriculture and Housing and the environment management portfolio from the Ministry of Health. As of 2015, the Ministry of Sustainable Development was restructured; the main change being the removal of the environment portfolio from the Department of Physical Planning and Environment to the Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlement.

A new Ministry of Environment and Cooperatives was created following the June 2020 General Elections. Its mission is to provide a framework to identify, consult, network, evaluate and build resilience to support sustainable livelihoods and the natural, built and cultural environments. The Ministry is committed to pursuing strategic and innovative partnerships locally, regionally and internationally with the view to create a roadmap for a safer and sustainable future.

This Ministry provides strategic advice on and implements environment and relevant interrelated policies to achieve a safer and sustainable future.[8] The key priority is to create an enabling environment in support of this vision. Coordinated and constructive collaborated partnerships are at the core of achieving inclusive, sustainable and resilient measures. The Ministry has embraced several cross- cutting issues in the face of changing climate patterns, the life changing impacts of natural phenomena particularly on the economic livelihood of vulnerable groups. This ministry has a significant role to perform in contributing to the

[8] Extracted from the Report on Plans and Priorities for the Year 2021 as part of the Budget Estimates

achievement of the 2030 Sustainable Development Goals (SDGs). Eight (8) SDGs fall within the remit of the Ministry. These include:

- Goal 6: Clean Water
- Goal 7: Affordable and Clean Energy
- Goal 9: Industry, Innovation and Infrastructure
- Goal 11: Sustainable Cities and Communities
- Goal 12: Responsible consumption and production
- Goal 13: Climate Action
- Goal 14: Life Below Water
- Goal 15: Life on Land

The Ministry intends to place greater emphasis on heightened meaningful collaboration, national park development, exploring sustainable financing, strengthening the regulatory framework, policy development, risk management and sharpening digitally enabling skills.

Table 1.12. History of the DOE

Year	Line Ministry	Core Responsibilities
1996	Health & Environment	To meet its international obligations to various bi-lateral and multilateral economic and environmental agreements. Lead agency for environmental management.
2005	Sustainable Development	Focal point in St. Kitts and Nevis for the United Nations Framework on Climate Change (UNFCCC), the United Nations Convention of Biological Diversity (UNCBD) and the United Nations Convention to Combat Desertification UNCCD
2015 to 2020	Agriculture, Marine Resources, Cooperatives, Environment & Human Settlement	United Nations Framework on Climate Change (UNFCCC), the United Nations Convention of Biological Diversity (UNCBD), Montreal Protocol, Cartegena Protocol on Biosafety, Nagoya Protocol
2020 to Present	Ministry of Environment & Cooperatives	United Nations Framework on Climate Change (UNFCCC), the United Nations Convention of Biological Diversity (UNCBD), Montreal Protocol, Cartegena Protocol on Biosafety, Nagoya Protocol

The Ministry of Sustainable Development mandate is to provide sound, economic advice and related pertinent information that pave the way for the advancement of the government's economic, social and physical agenda. This is achieved by compiling, assessing and disseminating the requisite information that will allow government and the private sector to develop, plan and carefully implement policies that will stimulate our economic growth and foster proper planning.

During 2021, the Ministry will undertake new initiatives in: Improving Environmental Management through Sustainable Land Management (SLM), identifying, assessing and developing the various communities island-wide in an effort to increase their sustainability in accordance with the UN Sustainable Development Goals and the mandatory St. Kitts and Nevis Population and Housing Census 2021.[9] Ongoing projects through government's revenue, New Land Distribution Programme, Commercial Infrastructure Development Project, National Museum Restoration Project, Construction of a Sustainable Development Building.

Presently, the Ministry of Sustainable Development includes the following departmental components:

- Administration
- Economic Affairs and Public Sector Investment Programme
- Physical Planning
- Lands and Surveys
- Statistics

The Development Control and Planning Board (DCPB) is responsible for the review and determination of all building and development planning applications in St. Kitts. Additionally, the DCPB is responsible for land use zoning, review of environmental impact assessments and the design and implementation of development plans and broader national policy instruments such as the National Physical Development Plan (NPDP).

The NPDP provides the general framework for sustainable development in the context of land use planning. The purpose of the NPDP is to identify appropriate physical planning and land use strategies that allow for sustainable exploitation of the natural resource base and to direct the use of public sector and private industry resources for planned and orderly development. The DCPB addresses the broad sustainable development areas of:

- Agriculture and rural development
- Environmental protection
- Water resource management
- Land use planning
- Climate change adaptation
- Biological diversity conservation

The Department of Economic Affairs and Public Sector Investment Programme is the main contact and coordinating office in the Ministry of Sustainable Development for local, regional and international projects, and for lending and donor agencies such as the Caribbean Development Bank (CDB); Organization of American States (OAS); United Nations Development Programme (UNDP); United Nations Environment Programme (UNEP); the Global Environmental Fund (GEF); World Bank; and the European Union (EU).

This department prepares and manages the government's Public Sector Investment Programme

[9] Extracted from the Report on Plan and Priorities for the Year 2021 as part of the Budget Estimates

(PSIP) through close collaboration with line ministries and statutory corporations. The PSIP directs the preparation of the capital budget and assists in ensuring a holistic approach to inter-ministerial and inter-departmental programming, so as to avoid duplicity.

Nevis has its own Department of Physical Planning, and Environment (DPPE) and it is responsible for land use planning, land conservation, and environmental management. In 2005 a draft Physical Development Plan was prepared for the island, which proposed land to be earmarked for various land use types including environmental conservation areas. Generally, the DPPE on Nevis works closely with the Department of Environment (DOE) on St. Kitts with regard to the meeting country obligations under the key MEAs and other physical planning, development and environmental initiatives.

The Water Services Departments (WSDs) for both islands are responsible for the identification, upkeep and protection of water supply sources on St. Kitts and Nevis. The WSDs work in close collaboration with the DOE, DPP and DPPE.

The Departments of Agriculture (DOAs) for both islands develop policies and programmes related to agriculture. The DOAs are responsible for a range of services related to agriculture and rural development. Some of these include soil sampling and analysis, soil conservation, forestry, water conservation and integrated pest management.

The Public Works Departments (PWDs) oversee the design and project management functions for new and maintenance of existing public infrastructure, including buildings, roads, drainage, bridges, and culverts.

The Saint Christopher National Trust (SCNT) and the Nevis Historical and Conservation Society (NHCS) are civil society organizations that are involved in sustainable development decisions and matters affecting built heritage and conservation in St. Kitts and Nevis. The SCNT was founded in 2009 with the goal of preserving the national heritage of St. Kitts. The Trust evolved from the St. Christopher Heritage Society which was incorporated as a private company in 1994. The main objective of the SCNT is to promote the protection, conservation, interpretation and enhancement of the natural environment of St. Kitts, including its animals and plant life.

The NHCS was established in 1980 to conserve the natural, cultural, and historic resources of the island and adjacent marine areas. The society is a non-profit organization managed by an executive board. Since its inception the NHCS has instituted projects and policies designed not only to preserve Nevis' unique history and environment, but also to make that heritage accessible and intelligible to locals and visitors

The National Housing Corporation (NHC) and the Nevis Housing and Land Development Corporation (NHLDC) and the Solid Waste Management Corporation (SWMC) play a role in sustainable development in St. Kitts and Nevis. The NHC on St. Kitts and the NHLDC on Nevis are responsible for the public supply of affordable shelter accommodation and related infrastructure. The SWMC is a statutory authority with the responsibility of developing solid waste management facilities for storage, collection, treatment and disposal of solid waste.

Legislative and Regulatory Framework

St. Kitts and Nevis ratified the Paris Agreement under the UNFCCC on 22nd April 2016 and thus has the responsibility of meeting the climate change reporting requirements of the Paris Agreement, including the Enhanced Transparency Framework (ETF). At present, St. Kitts and Nevis currently lacks a comprehensive, detailed, and unambiguous legal framework for a national climate Measurement, Reporting, and Verification (MRV) system.

However, there does exist a legal context that has relevance to components of climate MRV. St. Kitts and Nevis has several pieces of legislation that address environmental protection, natural resource management and data collection that serve as a baseline for integration into a future legal framework for climate change reporting and activities. A list of existing laws and policy frameworks for elements of integration are listed below:

- National Conservation and Environmental Protection Act, 1987
- Development Control and Planning Act, 2000.
- Nevis Development Control and Planning Ordinance 2005
- Solid Waste Management Corporation Act
- National Housing Corporation Act
- Whitegate Development Corporation Act, No. 15 of 1999
- Forestry Ordinance 1904
- Water Courses Ordinance 41/56
- Public Health Act No. 22 of 1969
- Pesticide and Toxic Chemicals Control Act 1999
- Agricultural Development Act 1973
- St. Kitts-Nevis Building Regulations, Code and Guidelines (No.7 of 2000) and
- Substances that Deplete the Ozone Layer (Control) Regulations (No. 06 of 2004)
- Fisheries Aquaculture and Marine Resources Act, 2016
- Biosafety Act No. 14 of 2012

The National Conservation and Environmental Protection Act (NCEPA) provides the legislative authority for the management and development of natural and historic resources in St. Kitts and Nevis. The NCEPA outlines a framework for the declaration of sensitive ecological and historic sites as protected areas.

Areas chosen as protected areas under this piece of legislation must have the following purposes and objectives:

- Preserve the biological diversity of wild flora and fauna that may be endemic, threatened or of special concern, and the land and marine habitats upon which the survival of these species depends;

- Protect selected examples of representative or unique biological communities, both on land and on marine areas;

- Sustain natural areas important for the protection and maintenance of life support systems, and basic ecological processes including water recharge and soil regeneration; and

- Protect selected natural sites and scenic beauty of special scientific, ecological, historical or educational value, including sites that are already degraded and need protection for restoration or sites that may become degraded if not protected.

The purposes and objectives of NCEPA have linkages to climate change adaptation and other aspects of sustainable development.

The Development Control and Planning Act, No. 14 of 2000 (DCPA) provides for the orderly and progressive development of land in both urban and rural areas of St. Kitts. It complements the NCEPA in that it provides for the protection of the environment and improvement of associated amenities. With regard to land use planning and management, the Act sets out the framework for the grant of development permission and for the design and implementation of a National Physical Development Plan (NPDP) to direct spatial development through time. Planning and development control functions include but are not limited to the following:

- Review of building and development applications;

- Zoning;

- Review of EIAs; and

- Design and implementation of development plans.

Similar to the NCEPA, the DCPA contains provisions that establish linkages to climate change adaptation.

On Nevis the Development Control and Planning Ordinance 2005 provides the legislative framework for the Nevis Island Administration to prepare physical development plans that would guide the development and management of land use on the island. It provides also for the exercise of development control, including building activities. The Ordinance has a similar scope to the DCPA on St. Kitts as it makes provisions also for the following:

- Review of building and development applications;

- Land use zoning;

- Review of EIAs;

- Design and implementation of development plans; and

- Natural and heritage preservation.

The Water Courses and Water Works Ordinance (Cap 185 of 1956) establishes legislative and regulatory powers for the WSD on both islands to regulate the supply of water to consumers, prevent waste, misuse and pollution of water and control sanitation of watersheds. It addresses issues of water supply and protection of watercourses. The management of watersheds in St. Kitts and Nevis is intricately linked with climate change mitigation and adaption strategies. Watershed management functions are shared between several agencies including the Water Services Departments; the Department of Physical Planning, Department of Environment; the Department of Physical Planning and Environment (Nevis); and the Departments of Agriculture.

The St. Kitts-Nevis Building Regulations, Code and Guidelines (No.7 of 2000) (often referred to as the Building Code) provides the regulatory framework for the management of construction and built developments. The scope of the Code applies to the construction of new buildings and structures, alterations, renovations, remodelling, demolitions, removal, relocation, maintenance and occupancy of existing buildings. The DCPA and the Nevis Development Control and Planning Ordinance are the main legislative instruments that guide the implementation of the Code. The Building Code has linkages to climate change adaptation and resilience.

The Substances that Deplete the Ozone Layer (Control) Regulations (No. 06 of 2004) shows the commitment of St. Kitts and Nevis to meet its requirements under the Montreal Protocol. The Montreal Protocol is an international agreement that seeks to control the production and consumption of certain ozone-depleting substances. This regulation has linkages to climate change mitigation.

The International Trade in Wild Fauna and Flora Act, 2009 was passed to facilitate St. Kitts and Nevis's compliance with the obligations under the Convention on International Trade in Wild Flora and Fauna or CITES. This Act also has the objective of conserving and managing the wild flora and fauna of St. Kitts and Nevis.

The Biosafety Act was enacted in 2012 and addresses the movement, transit, handling and use of all genetically modified organisms that may have adverse effects on the conservation and sustainable use of biological diversity. St. Kitts and Nevis has also undertaken an Assessment of Capacity Building Needs and Country Specific Priorities in biodiversity management in 2010 as an enabling activity for the CBD. The main objective of this project was to examine *ex situ* and *in situ* conservation strategies for national biodiversity resources. The main outputs from this project were:

- Management Frameworks for Biodiversity Threat Mitigation in St. Kitts and Nevis
- Incentive Measures for the Promotion of Biodiversity Conservation in St. Kitts and Nevis.
- Implementation of General Measures for the Conservation and Sustainable Use of Biodiversity in St. Kitts and Nevis.
- St. Kitts and Nevis Second National Report on Biodiversity to the Convention on Biodiversity.

- A Compilation of Traditional Knowledge for the Protection and Conservation of Biodiversity in St. Kitts and Nevis.

A **draft Biosafety (Amendment) Bill 2016** to amend the Biosafety Act, No. 14 of 2012 has been prepared and is awaiting passage in the National Assembly. Draft accompanying Biosafety Regulations have been prepared also to accompany the amended legislation. **Fisheries Aquaculture and Marine Resources Act, 2016** provides for the conservation, management, development and sustainable use of fisheries, aquaculture and marine resources of St. Christopher and Nevis. It also provides for the monitoring and control of fishing vessels within and beyond the country's territorial waters. It has repealed the Fisheries Act, 1984.

Under this legislation, it is intended that all functions, duties and responsibilities will be exercised in a manner that is aligned with several principles including but not limited to the following:

- All natural living resources including the host environment are assets of the people and should be developed and managed for the benefit of present and future generations.
- Fisheries resources are to be used sustainably toward achieving socio-economic benefits.
- Fisheries conservation and management measures should be based on best practices.
- The ecosystem approach to the management and development of fisheries and the general marine environment shall be applied.
- Marine biodiversity shall be maintained and enhanced

The general principles outlined in Section 5 of the Act are consistent with the Guidelines for Mainstreaming Biodiversity Conservation into National Development.

1.1.1. Policies and Plans

Sustainable development initiatives in St. Kitts and Nevis have been supported by primarily by financing provided by the Global Environment Facility (GEF) through the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Convention on Biological Diversity (UNCBD).

As is the case with many Caribbean territories, the risk of accelerated land degradation as an environmental problem has become more apparent in St. Kitts and Nevis following the 2005 closure of the sugar industry. This has led to the implementation of the Sustainable Land Management Plan (SLMP). The SLMP developed a set of draft sustainable land management strategies that are linked to climate change adaptation.

Several policy instruments and plans have been approved by the government of St. Kitts and Nevis. These include the following:

- National Climate Change Policy (2017)
- National Climate Change Adaptation Strategy – 2018

- Sixth National Report for The Convention on Biological Diversity (6NR)
- Fourth National Report on The Implementation of the Cartagena Protocol on Biosafety (4NR)
- Kitts and Nevis National Biodiversity Strategy and Action Plan (NBSAP) 2014-2020
- Centralized Integrated Information Management Systems (CIIMS)
- National Bio safety and Biotechnology Policy (Revised 2016)
- Climate Change Online Risk Assessment Tool (CCORAL)
- National Energy Policy and Energy Action Plan (2011)
- Integrated Resource Plan (2017)
- Caricom Regional Energy Efficiency Building Code (Adopted 2019)

The National Climate Change Policy 2017 provides the legal mandate and policy framework for development of the National Climate Change Adaptation Strategy for St. Kitts and Nevis.[10] It provides overarching guidance for the creation of institutional mechanisms to enable low carbon and climate resilient development, in harmony with other sectoral policies, and for the implementation of adaptation and mitigation measures. The policy focuses on mainstreaming of climate change considerations into the national development agenda through:

- Strengthening existing institutional arrangements for systematic observations, research and climate change modeling including through cooperation with academia, nongovernmental organizations (NGOs)and the private sector;
- Assessing sectoral vulnerability to climate change by conducting vulnerability analyses and formulating adaptation options, including technological application, in biophysical and socio-economic systems;
- Revising sectoral policies to include consideration of climate change impacts derived from vulnerability analyses;
- Revising national development plans to incorporate climate change vulnerability, impacts and adaptation options with a view to climate proofing new developments and retrofitting existing infrastructure, and strengthening climate resilience, particularly to extreme weather events and slow-onset adverse climate impacts; and
- Enhancing the resilience of natural biophysical systems to maximize ecosystem services such as the natural coastal defense.

National Climate Change Adaptation Strategy (2018) provides guidance on priorities and appropriate measures for adaptation to reduce vulnerability to the impacts from climate

[10] Adopted from the National Climate Change Policy (2017)

change and build long term resilience in St. Kitts and Nevis.[11] It emphasizes the need for an integrated approach that addresses the economic, environmental and social dimensions of climate change and identifies specific adaptation objectives and measures to address sectoral and cross-sectoral vulnerabilities at the macro level. The Strategy also provide mitigation co-benefits where possible, through prioritizing adaptation measures that minimize greenhouse gas emissions and enhance natural ecosystems functioning as carbon sinks.

The Strategy covers the period 2018-2030 and aims at operationalizing the policy directives outlined in the National Climate Change Policy of 2017. The strategy covers the period 2018- 2030.

Sixth National Report for the Convention on Biological Diversity was submitted May 2019. The Report suggests that generally the country has been contributing to the achievement of the Aichi Biodiversity Targets (ABT). The national targets for St. Kitts and Nevis have been influenced and directed by the global "Aichi Targets", which were adopted in 2010 under the Convention on CBD's 2011-2020 Strategic Plan.[12] The National Biodiversity Targets for St. Kitts and Nevis

were developed through a process of consultation with relevant stakeholders. In developing the National Targets, the elements of related targets were merged into one, thus reducing the total number of targets to twelve. The selected targets were then finalized by a multi-sectoral National Biodiversity Steering Committee. A number of indicators were also developed which allow for assessing the level of achievement of each target during the implementation of the 2014-2020 NBSAP.

Fourth National Report on the Implementation of the Cartagena Protocol on Biosafety (4NR). The government of St. Kitts and Nevis submitted its Fourth National Report in December 2019. The Report suggests that national measures for the implementation of the Protocol are partially in place. Although the government of St. Kitts and Nevis has implemented several national bio safety measures including the drafting of regulations and guidelines; there remains the need to undertake initiatives that target the mainstreaming of bio safety into national biodiversity strategies and action plans and other policies.[13] Additionally, while there is permanent staff in place at the DOE to administer functions directly related to bio safety, there is no established mechanism for budget allocations for the operationalizing national bio safety measures.

National Bio safety and Biotechnology Policy (Revised 2016) provides the framework to protect the natural biological resources and the health of the people of the Federation of St. Kitts and Nevis from the adverse effects that may arise from the development and application of biotechnology and its derived products, but not including pharmaceuticals.[14] This will be achieved by:

- Regulating and monitoring the development and use of Genetically Modified

[11] Adopted from the National Climate Change Adaptation Strategy (2017)
[12] Extracted from the Revision of the National Biodiversity Strategy and Action Plan for St. Kitts and Nevis Under the United Nations Convention on Biodiversity (National Biodiversity Targets 2014).
[13] Extracted from the Fourth National Report on the Implementation of the Cartegena Protocol on Biosafety
[14] Adopted from the National Bio safety and Biotechnology Policy

Organisms (GMOs) in St. Kitts and Nevis

- Establishing criteria for assessing the risks associated with GMO use
- Developing the capacity in St. Kitts and Nevis to effectively manage such risks
- Promoting the establishment of collaborative links with regional countries and institutions on bio safety
- Establishing mechanisms for assessing the benefits to be derived from GMO use
- Ensuring that public education, participation and consultation are part of the implementation of this policy

The goal of the bio safety policy is to ensure an appropriate level of protection for the conservation of biological diversity and human health and wellbeing, in the development and application of modern biotechnology in the Federation of St. Kitts and Nevis.

St. Kitts and Nevis National Biodiversity Strategy and Action Plan (NBSAP) 2014-2020.[15] [15] The NBSAP (2014-2020) provided an opportunity for the government of St. Kitts and Nevis to mainstream biodiversity in the overall development process by setting new national targets, principles and priorities which are in line with the Aichi Targets on Biodiversity and the Strategic Plan on Biodiversity, 2011 – 2020. The NBSAP also focused on stronger institutional integration. It identified and examined how various provisions of key legislative, regulatory and policy instruments can better influence biodiversity management in St. Kitts and Nevis.

The Guidelines on Mainstreaming Biodiversity Conservation into National Development were developed as part of the 2014-2020 NBSAP preparatory process. They aim at providing direction to users (Development Regulators and Practitioners) to help them mainstream biodiversity conservation in development policies, plans, projects and activities. The Guidelines contain direction on mainstreaming biodiversity conservation in selected development themes and sectors. Strategies designed to give direction to biodiversity management at the national level in order to achieve the local and international targets and ultimately achieve the national goals have been included under each of the following themes/sectors:

- Poverty reduction
- Agriculture and rural development
- Environmental protection
- Land degradation
- Water resource management
- Marine resources management
- Land use planning, and infrastructure

[15] Adopted from the National Biodiversity Strategy and Action Plan (2014-2020)

Caribbean Climate Online Risk Assessment Tool (CCORAL) has been designed as an online support system to support climate resilient decision making.[16] Among other things the CCORAL provides a platform for rapid screening, understanding climate influence and inter alia apply climate risk management process. It has been designed to engender a programmatic risk management approach to decision making. The Public Sector Investment Programme has adopted CCORAL in the screening of all Public Sector Capital Projects.

Other Policy Based Initiatives

In 2008 the government of St. Kitts and Nevis established the Central Forest Reserve (CFR) as a protected area. The CFR covers an area of approximately 1250 acres and represents the last remaining stand of undisturbed tropical forest on the island of St. Kitts. Nevis Peak on the island of Nevis has been earmarked under administrative order to be declared a protected area. The objective of managing these protected areas is to protect and conserve important species of plants and animals which are endemic to St. Kitts and Nevis.

Under the (Integrating Watershed and Coastal Area Management) IWCAM project, the government of St. Kitts and Nevis has designated the lower coastal section of the Basseterre Valley as a protected area. The project sought to demonstrate the proper management and protection of a critical aquifer and well-field through a parallel process of mitigation of threats from contaminants, on-the-ground protection, and improved user-resource management.

Prior to the designation of the CFR and the lower coastal section of the Basseterre Valley as protected areas, Brimstone Hill National Park Fortress on St. Kitts and the Bath Hotel on Nevis were the only two effectively declared sites in the Federation. In 1999 the Brimstone Hill Fortress National Park was declared a World Heritage Site.

The St. Mary's Biosphere Reserve has been established under the Man and the Biosphere Project and is an important site in term of biological diversity.[17] St. Mary's is one of the first biosphere reserves of the Caribbean Island countries and serves as an example of village participation in efforts to preserve the outstanding mosaic of natural and cultural landscape values. It has a combined terrestrial and marine surface area 4,040.27 hectares.

Additionally, in July 2010 St. Kitts and Nevis through the Ministry of Sustainable Development formally commenced the implementation of the SLMP. The key project outputs included:

- Guidelines on Mainstreaming Sustainable Land Management into National Development
- The Strategic Framework for Investment Planning and Resource Mobilization for Sustainable Land Management Interventions
- Review of Legislation, Regulation, Policy & Institutional Framework for SLM
- Report on knowledge Management for SLM: Databases on Land Use, Land

[16] https://www.caribbeanclimate.bz/caribbean-climate-chage-tools/tools/

[17] www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/latin-america- and-the-caribbean/saint-kitts-and-nevis/st-marys

Tenure, Land Degradation and Land Zoning

- SLMP Geographic Information System (GIS) Training Needs Assessment
- Training Manual for Managing Land Resources in St. Kitts & Nevis

The Strategic Framework for Investment Planning and Resource Mobilization for Sustainable Land Management Interventions developed under the SLMP can be used to further sustainable development activities in St. Kitts and Nevis.

The major issues affecting the mainstreaming of climate change adaptation and broader sustainable development in St. Kitts and Nevis continue to be the following:

- There is no comprehensive national policy or plan that addresses sustainable development. The plans and policies are programme specific and need to better examine cross-cutting issues. Increased emphasis on sustainable development interventions to meet national development priorities should provide the supporting framework for the articulation of a national policy or plan.
- The Ministry of Sustainable Development provides a general institutional coordinating mechanism for sustainable development in St. Kitts and Nevis. However, there is need for greater inter agency cooperation and collaboration at the national level to make the model more effective.
- Data management systems for climate change, biological diversity and land degradation and other sustainable development indicators are inadequate. Additionally, insufficient research capacity affects the availability and quality of data that is relevant to sustainable development.
- Insufficient capacity for the design and management of sustainable development interventions.

Additionally, there is a large degree of public uncertainty on and understanding of climate change issues. Reducing the risk of disasters from climate change adaptation in St. Kitts and Nevis should involve the adaptation of a multi-hazard and iterative approach. Mainstreaming climate change adaptation will depend on the sector and the climate change impact of concern. Nonetheless, the following should assist in mainstreaming climate change interventions at the national level:

- Increasing the use of vulnerability and adaptation assessment in development activities
- Reducing vulnerability to sustain livelihoods
- Improving the management of climate-sensitive natural resources (water resources) and economic production systems
- Promoting economic diversification to reduce over reliance on climate-sensitive primary sectors
- Increasing the resilience of infrastructure and physical development

- Restructuring risk profile and sharing through improved financial intermediation and mechanisms
- Including climate change issues and adaptation into national policies, programmes and budgets
- Strengthening information and communication on climate change effects and adaptation options
- Enhancing inter-island cooperation to improve productivity and management of shared resources

Measurement, Reporting, and Verification (MRV) System

National Climate MRV systems are defined by the measurement, reporting and verification of a countries' climate actions under its main functional components: GHG emissions, mitigation, adaptation, policies, and support. Understanding the interaction of the system inputs and the defined outputs of these components is integral to choosing and implementing feasible strategies and policies, analysing emission trends and the prioritisation of a Parties' limited resources when addressing climate change. In 2002, the basis for non-annex I reporting to the United Nations Framework Convention on Climate Change (UNFCCC) was established and defined. Developing country parties have strived since then to implement these systems whilst balancing their national priorities and ensuring that the process takes into account their national circumstances.

Today, through the Paris Agreement, defined more recently in the Glasgow Pact, Parties are required to implement the Enhanced Transparency Framework (ETF) with common reporting tables and common tabular formats (with flexibility provisions embedded for developing parties) to build mutual trust and confidence and promote the effective implementation of actions.

The government of St. Kitts and Nevis has positioned itself on a path towards establishing an all-encompassing and comprehensive MRV system through its work during the current reporting cycle in preparation of the Third National Communication and 1st Biennial Update Report (TNC/BUR1) as well as previous climate change projects. Specific capacity building initiatives were prioritised and highlighted below:

- Capacity building of local experts to initiate the process of institutionalising memory and technical capacity in all reported sectors for the TNC/BUR1 to meet the demands of the new reporting requirements identified under the ETF. All selected regional/international consultants were required to provide training sessions in their reporting sector (Mitigation, GHG inventory, Adaptation, Gender, and Support) as part of their project output.
- Establishment of a National Climate Change Committee inclusive of the "set-up" of working groups in adaptation and mitigation.

Through the implementation of a National MRV system and continued prioritisation of capacity building actions for future reporting cycles, it is envisaged that this system will measure, report, and verify the following activities and actions in adherence with the Transparency, Accuracy, Completeness, Comparability, and Consistency (TACCC) principles that govern climate change reporting:

- Activities that cause climate change - Greenhouse Gas Inventory (GHGI)
- Mitigation policies and measures
- Actions taken that prevent climate change (mitigation actions and Nationally Determined Contributions (NDC) implementation and progress)
- Climate change impacts and adaptation
- Actions taken to adapt to climate change (adaptation actions and NDC implementation and progress)
- Financial, technology transfer and capacity building activities needed and received for undertaking the actions above

1.1.2. Institutional arrangements related to MRV

Small Island Developing States (SIDS) member countries are widely considered to be some of the first countries to experience the adverse effects of climate change though they are amongst the least responsible in terms of global GHG emissions. St. Kitts and Nevis is a SIDS member country but has prioritised the need to provide the domestic and international community with the required reports highlighted in the Paris Agreement that adhere to the TACCC principles in an effort to demonstrate commitment and leadership in the climate change negotiations and reporting process; whilst using the information to guide domestic policy.

Due to limited institutional, human and technical capacity within the identified domestic teams, St. Kitts and Nevis continues to face challenges in the reporting process as was previously identified during submission of their first and second national communications. To aid in the overcoming of these obstacles whilst prioritising continuous improvement, the government of St. Kitts and Nevis engaged regional and international consultants to conduct the relevant planning and preparation activities to meet its reporting obligations as well as to conduct sensitisation and capacity building training in all reporting sectors to begin the process of institutionalising memory and technical capacity.

Analysis of previously submitted climate change reports (1st and 2nd National Communications and NDC) revealed a substantial loss of historical information (chosen calculation methodologies, activity data, expert judgement, and background justification) that hindered opportunities to revise/recalculate previous emission estimates, to extend the reporting time series to include missing years as well as improve reporting through the latest BUR reporting cycle. Previous reports were conducted using a decentralised, project-based MRV system.

Cognisant of the issues faced during previous reporting cycles and an understanding of the necessary improvements to previous institutional arrangements (inclusive of data flows and communication channels), St. Kitts and Nevis used the opportunity of the BUR1 reporting cycle to begin the process of moving from a decentralised project-based system to a centralised project-based system. As highlighted earlier in the chapter and in an effort to achieve this goal, St. Kitts and Nevis prioritised the enhancement of technical and institutional capacity of the domestic team; through capacity building activities conducted by the different consultant teams during their identified action tasks required for the relevant reporting activities.

An example of this approach can be seen through the Greenhouse Gas Inventory (GHGI) and Mitigation Assessment/Chapter compilation process where regional consultants leading the technical aspects of the relevant reports worked in a collaborative manner with national experts; to undertake targeted training and provide guidance whilst gaining knowledge from the domestic team on available activity data, input parameters for calculations and relevant national circumstances. Activities included GHGI compilation training, hands-on participation in data collection activities, and a UNFCCC quality assurance review during the GHGI compilation process. Mitigation activities included sensitisation and training on the development of the mitigation actions and the use of the Low Emissions Analysis Platform (LEAP) model. The mitigation actions also included a validation workshop where the results of the modelling and related actions were presented to all stakeholders to verify and accept the results.

Figure 1.6 below, represents the institutional arrangements for the development of St. Kitts and Nevis' 3rd National Communication (TNC) and 1st Biennial Update Report (BUR1) reporting process. The institutions and roles of the actors involved are described in

Table 1.13 below to highlight the interactions between regional/international consultants and the domestic team during the preparation of the St. Kitts and Nevis National Inventory Report (NIR) and mitigation chapters.

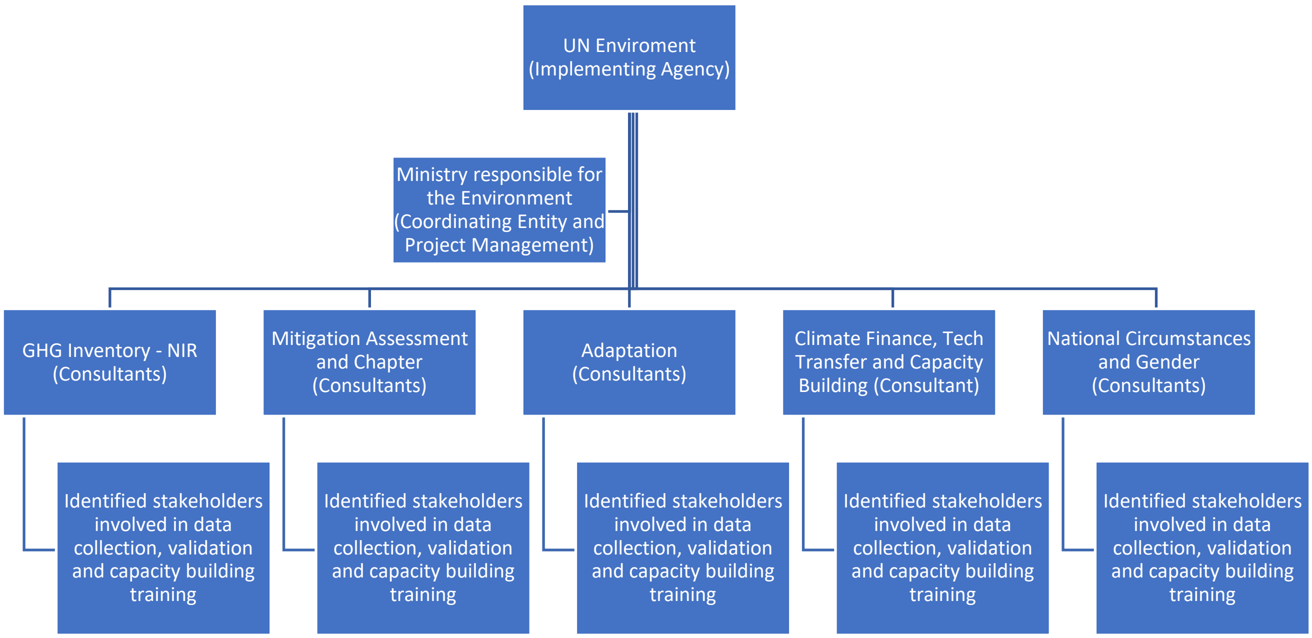


Figure 1.6. Institutional arrangements for the Third National Communication and First Biennial Update Report

Table 1.13. Institutions and roles of stakeholders involved in the preparation of St. Kitts and Nevis NIR and mitigation assessment

MRV Component	Sector	Responsible Entity	Role
Planning	Crosscutting	Ministry of Environment and Cooperatives	Coordinating and policymaking authority with respect to environment and climate change in St. Kitts and Nevis. Overseeing the entire national inventory process from the early stages of data collection through processing and reporting. This includes liaising with data providers, and identifying national sectoral experts, as well as coordinating their capacity building.
Data Collection	Energy	Ministry with responsibility for the Environment	Provides information related to GHG emissions associated

MRV Component	Sector	Responsible Entity	Role
		Department of Statistics Nevis Electricity Company (NEVLEC) Royal Utilities Marriot Frigate Bay St. Kitts Electricity Company Limited (SKELEC) Sol Petroleum Group Delta Petroleum PetroCaribe Custom and Excise Department Ministry with responsibility for Energy	with electricity generation, national fuel consumption data, energy balance, and vehicle registration data. Provides information on projects and future plans for the sector to inform potential mitigation actions.
	Agriculture	Ministry of Environment and Cooperatives Ministry of Agriculture, Fisheries and Marine Resources Department of Statistics Food and Agriculture Organisation (FAO)- Reports Department of Statistics	Provides data and technical support when compiling GHG emissions for agriculture. Provides information on projects and future plans for the sector to inform potential mitigation actions.
	Forestry	Ministry of Environment and Cooperatives Forestry Unit Lands and Survey Department Food and Agriculture Organization (FAO) (reports)	Provides technical support when compiling GHG emissions for land. Provides maps for the land sector. Provides information on projects and future plans for the sector to inform potential mitigation actions.
	Waste	Solid Waste Management Corporation (SWMC)	Provides information on the waste sector.

MRV Component	Sector	Responsible Entity	Role
		Department of Statistics Carib Brewery World Bank and UN Statistics (reports)	Provides statistical parameters that can be applied when estimating GHG emissions from the waste sector. Provides information on the country's wastewater treatment works (domestic and industrial). Provides information on projects and future plans for the sector to inform potential mitigation actions
	Industrial Processes and Product Use	Custom and Excise Department Department of Statistics Ozone Unit	Provides GHG information for the IPPU sector, particularly on refrigerants. Provides information on projects and future plans for the sector to inform potential mitigation actions.
Preparation	Sectors and Cross cutting	Caribbean Cooperative MRV Hub and Greenhouse Gas Management Institute Support of National Experts and Data Providers	Provides capacity to chosen national sectoral experts to take a hands-on role in preparation of National Greenhouse Gas Inventory. Provides capacity training to mitigation team in the development of the models and assessment for mitigation. Collecting and evaluating data. Selection of methodological approaches and use of expert judgement. Estimation of GHG emissions. Assessment of uncertainty and analysis of key categories. Preparation of inventory report.

MRV Component	Sector	Responsible Entity	Role
Quality Control	Cross cutting	External MRV Hub and GHGMI experts	Review of estimations and expert judgement by experts not involved in the compilation of greenhouse gases. Review of data and projections and expert judgement by mitigation team not involved in the modelling process.
Quality Assurance/ Review	All sectors	Sectoral experts, and data providers including: Ministry of the Environment and Cooperatives Department of Statistics Nevis Electricity Company Ltd Royal Utilities Marriot Frigate Bay St. Kitts Electricity Company Limited Sol Petroleum Group Delta Petroleum PetroCaribe Custom and Excise Department Ministry of Environment and Cooperatives Ministry of Agriculture, Fisheries and Marine Resources Forestry Unit Lands and Survey Department Solid Waste Management Corporation (SWMC) Carib Brewery Ozone Unit St. Kitts and Nevis Bureau of Standards St. Kitts and Nevis Met Office	Review National Circumstances of methods, approaches, and assumptions. Formal and informal technical reviews of National Inventory Report. Validation workshop for mitigation actions and modelling with stakeholders.
Validation	Sectors and Cross cutting	Identified St. Kitts and Nevis sectoral experts and relevant government officials as identified in the Institutional Arrangements Cabinet	Provide oversight on the compilation of the report, including reviewing and providing inputs on activity data, emission factors, relevant input parameters and expert judgement used, in order to ensure the reports and GHGI emission estimates reflect national circumstances. Validates the final NIR before

MRV Component	Sector	Responsible Entity	Role
			submission to the Cabinet. Provides final approval of NIR, BURs, etc. before submission to the UNFCCC.
Management	Cross cutting	Department of Environment, Ministry of Environment and Cooperatives	Data collection procedures, documentation, data archiving, reviewing, checking and evaluation of planned prioritised improvements, data collected and summarised data gaps list. Submission of final report to the UNFCCC. Review of necessary inventory improvements and data archiving procedures.

1.1.3. Overall coordination of MRV

The government structures relevant to climate MRV are led by the Department of the Environment (DOE) in the Ministry of Sustainable Development, Climate Action, Environment and Constituency Empowerment. The DOE has the role and responsibility of overseeing the implementation of procurement and deliverables produced from national, regional, and international project-based consultants. The DOE ultimately provides final validation and approval, prior to the submission of reports to the UNFCCC.

Though not fully implemented, the government of St. Kitts and Nevis has drafted Terms of Reference for the establishment of a National Climate Change Committee (NCCC) with the intended purpose of steering the national implementation of the National Climate Change Policy (2017) as well as other climate change related projects. The NCCC is intended to be a multi-disciplinary and multisectoral body with representative stakeholders selected from private and civil agencies as well as government entities.

Regionally, St. Kitts and Nevis has worked with other Caribbean Community (CARICOM) countries on climate MRV elements vis-a-vis an executed Memorandum of Understanding (MoU) with the Caribbean Cooperative MRV Hub (2019-2023), and through regional Green Climate Fund (GCF) projects such as capacity building to facilitate climate resilience in disaster risk management and private sector access to climate finance (2021) as well as capacity building to support planning, programming and implementation of GCF funded activities (2020). St. Kitts and Nevis has successfully engaged local and regional partners, namely the MRV Hub (GHGI, Mitigation, MRV and Finance, Technology and Capacity-Building (FTC)) and Relate Consultancy (Gender/Vulnerability).

Informal arrangements for domestic MRV

St. Kitts and Nevis has numerous departmental strategy and planning documents that are inclusive of climate MRV components. These strategy and planning documents serve as guiding documents, however, and are not necessarily indicative of formalised MRV roles or responsibilities.

Stakeholders involved in MRV

St. Kitts and Nevis has a strong set of stakeholders involved in climate MRV. Specific roles and responsibilities for each stakeholder have not yet been established. Many of the stakeholders listed in Table 1.14 carry out MRV activities across multiple climate pillars and/or multiple MRV components. It should be noted that even if not specifically indicated in Table 1.14, the St. Kitts and Nevis government operates using mirror ministries for both islands.

Table 1.14. MRV system stakeholder list, roughly allocated across the three climate pillars

Primary climate pillar within MRV system	Agency or Institution Agencies may serve in multiple areas and/or sector expertise	Sector/Expertise
Institutional Coordination & Leadership	Department of Environment (DOE)	Institutional
	Ministry of Sustainable Development, Climate Action, Environment and Constituency Empowerment	Institutional
Mitigation & GHG Inventory	Department of Environment (DOE)	Agriculture
	Ministry of Agriculture, Fisheries and Marine Resources	Agriculture
	Department of Statistics	Agriculture
	Food and Agriculture Organisation (FAO)	Agriculture
	Forestry Unit	FOLU
	Lands and Surveys Department	FOLU
	Ministry of Public Infrastructure and Utilities, Transport, Information, Communication and Technology and Post	Energy
	Ministry of Tourism, Civil Aviation and Urban Development	Energy
	Department of Statistics	Energy
	Nevis Electricity Company (NEVLEC)	Energy
	Royal Utilities Marriot Frigate Bay	Energy
	St. Kitts Electricity Company Limited (SKELEC)	Energy
	Sol Petroleum Group	Energy
	Delta Petroleum	Energy
	Petro Caribe	Energy
	Customs and Excise Department	Energy
	St. Christopher Air and Seaport Authority	Energy
	Solid Waste Management Corporation	Waste
	Department of Statistics	Waste
	Carib Brewery	Waste
Adaptation	Department of the Environment	Adaptation and Resilience
	Department of Economic Affairs and PSIP	Adaptation and Resilience

Primary climate pillar within MRV system	Agency or Institution Agencies may serve in multiple areas and/or sector expertise	Sector/Expertise
	Ministry of Tourism, Civil Aviation and Urban Development	Adaptation and Resilience
	Ministry of Sustainable Development, Climate Action, Environment and Constituency Empowerment	Adaptation and Resilience
	St. Kitts and Nevis Bureau of Standards	Data and Information
	St. Kitts and Nevis Chamber of Industry and Commerce	Data and Information
	Department of Physical Planning	Adaptation and Resilience
	IWRM Nevis	Water & Coastal Zone Resources
	Ministry of Finance, National Security, Citizenship and Immigration, Health, and Social Security	Adaptation and Resilience
	Department of Marine Resources and Nevis Turtle Group	Data and Information/ Adaptation and Resilience
	Department of Agriculture	Data and Information
	Water Resources - Nevis	Adaptation and Resilience
	Nevis Disaster Management	Adaptation and Resilience
	St. Kitts and Nevis Met Service	Data and Information
Support	Ministry of Finance, National Security, Citizenship and Immigration, Health, and Social Security	Finance & Economic Development
	Ministry of Sustainable Development, Climate Action, Environment and Constituency Empowerment	Finance & Economic Development/ Capacity Building
	Ministry of Foreign Affairs, Economic Development, International Trade, Information, Communication and Technology and Post	Finance & Economic Development
Crosscutting	Ministry of Education, Youth, Social Development and Gender Affairs	Education
	Ministry of Finance, National Security, Citizenship and Immigration, Health, and Social Security	Finance & Economic Development
	St. Kitts and Nevis Customs and Excise Division	Data and Information
	Department of Statistics	Data and Information
	St. Kitts and Nevis Chamber of Industry and Commerce	Finance & Economic

Primary climate pillar within MRV system	Agency or Institution Agencies may serve in multiple areas and/or sector expertise	Sector/Expertise
		Development
	Ministry of Justice and Legal Affairs	Legal Affairs

1.1.4. GHG inventory, mitigation, adaptation, and support MRV

St. Kitts and Nevis is working towards further developing MRV system components that move from a project-based (linear) system to an on-going, recurring system (cyclical). Until further development is completed, typical information management systems and cross-coordination of MRV work within each climate change pillar (mitigation, adaptation, support) will be limited. Identified MRV needs highlighted in Table 1.14 will support the further elaboration of explicit roles and responsibilities, information collection and management, quality assurance and quality control (QA/QC) procedures, continuous standard operating procedures, documentation and archiving of data, and preparation and improvement planning documents.

Data collection and management

In general, data collection agreements and enforcement are not standard amongst broader climate MRV stakeholders in St. Kitts and Nevis. However, there are isolated data collection mandates in the FOLU, agriculture, energy, and transportation sectors. In general, data collection and reporting are directly linked to Ministry objectives or project-based reporting cycles.

The primary data used in the most recent climate reporting, namely the GHG inventory, mitigation assessment, and vulnerability assessment, was accomplished through ad-hoc requests from identified stakeholders relevant to the reporting sector who may collect data sets through operation of agency-specific projects, research, or other mandates. These sources combined constitute a solid foundation of data suppliers. The Department of Statistics conducts labour and census surveys. These surveys are on a typical schedule, but challenges have been noted in recent years due to lack of timeliness of implementation and lack of resources.

Disaggregated datasets by standardised social, environmental, or economic indicators or parameters (example, gender-disaggregated climate data) are limited but have improved in recent years due to stakeholder participation and international conventions (e.g., climate change, biodiversity, and sustainable development goals).

Climate action development and implementation

Similar to data collection and management, mitigation and adaptation actions are developed and implemented by a range of stakeholders and government ministries. Measurement of actions from preparation, implementation, to on-going monitoring phases (inclusive of the choice of progress indicators). Currently, project-based measurement, reporting, and verification of mitigation and adaptation actions are implemented when climate finance is available and/or at the direction of climate action funding sources.

National Climate Change Committee (NCCC) - Purpose and Function

The government of St. Kitts and Nevis intends to establish and implement the procedural action tasks defined in its draft Terms of Reference for the NCCC before the Parties' next reporting cycle. The NCCC will act as an oversight body responsible for facilitating he implementation of St. Kitts and Nevis National Climate Change Policy and climate change related projects (inclusive of international reporting obligations). It is envisaged that through the implementation of its mapped-out functions, the process of climate change reporting and its related MRV components will become more informed, transparent, and streamlined. Identified functions include (as identified in draft ToR for NCCC):

- Develop and implement the incorporation of climate change considerations into national development planning across all sectors
- Develop and implement a public relations and awareness strategy
- Provide guidance on the selection and development of climate change related projects for submission to international funding agencies
- Advise on any other matters related to climate change and its impacts on St. Kitts and Nevis
- Be the focal points for climate change in their respective organisations and/or sectors
- Act as the main advisory body to the government of St. Kitts and Nevis on any matters related to climate change
- Guide the development and implementation of national adaptation and mitigation plans for St. Kitts and Nevis
- Advise on the incorporation of climate change considerations into relevant national development plans, budgets as well as sector plans ("Climate-proofing") and monitor implementation
- Monitor and provide guidance for the implementation of climate change projects and programmes in St. Kitts and Nevis to ensure coherence and effectiveness
- Consult on a regular basis with civil society, the private sector, academia, and relevant Ministries membership

Two working groups are planned under the climate change pillars of adaptation and mitigation to facilitate the implementation of the functions of the NCCC identified above. Table 1.15 below, identifies the various sectoral stakeholders that are envisaged to form the mitigation and adaptation working groups.

Table 1.15. Potential stakeholder list for mitigation and adaptation working groups

Mitigation Working Group	Adaptation Working Group
Energy Unit	Department of Physical Planning
SKELEC	Department responsible for Water Resources
NEVLEC	Department of Agriculture
Ministry responsible for Transport	Marine Resources
Forestry Division	Disaster Preparedness Representative
Department of Agriculture	Ministry responsible for Health
Solid Waste	Met Services
Economic Affairs	Department of the Environment

Department of the Environment	Gender Representative
Met Services	Youth Representative
Gender Representative	Farmer Representative
Youth Representative	Civil Society Representative
Private sector Representative	NHCS
Ministry responsible for Finance	National Trust
	Public Works and Infrastructure
	Ministry responsible for Finance

Support and climate finance MRV

The government of St. Kitts and Nevis has not developed a climate finance MRV methodology (example, use of Organization for Economic Cooperation and Development Rio Markers) or a tool for tracking climate support needed and received to integrate within the broader envisaged National MRV System. A feasibility study is planned to develop the tool and its required data inputs to facilitate reporting of support needed and received for the Parties' UNFCCC reporting cycles.

The tool will allow St. Kitts and Nevis to:

- Have a clear overview of Nationally Determined Contribution (NDC) related financial flows, sources, and purposes
- Have a clear overview of climate change projects related financial flows, sources, and purposes
- Indicate the recipients of capacity building and technology transfer support inclusive of financial flows, sources, and purposes
- Indicate the recipients of financial support and identify gaps in sectoral support
- Demonstrate accountability, transparency, and trust in future UNFCCC's negotiations
- The costs to implement the adaptation and mitigation actions that are outlined in the NDC
- The cost to implement adaptation and mitigation actions not included in its NDC
- The investments and finance needed to achieve St. Kitts and Nevis adaptation, and mitigation priorities as outlined in its NDC

1.1.5. Current progress towards establishment of a domestic MRV system

The government of St. Kitts and Nevis through the TNC/BUR1 project prioritised the need to sensitise local stakeholders through capacity building activities in the fields of climate change MRV in an effort to move from a decentralised project based on system and improve overall transparency in its reporting outputs. Activities included two training workshops to validate proposed institutional arrangements MRV framework through conducting a detailed mapping survey as well as sensitisation on the following topics below. All stakeholders involved in capacity building training under the climate pillars of mitigation and adaptation as well as those involved in coordination of climate change related activities in St. Kitts and Nevis were invited to attend.

Workshop topics covered:

- Reporting under the climate pillars of mitigation and adaptation
- Functional components of MRV systems
- Institutional arrangements and mapping of roles/responsibilities
- Initial institutional arrangement mapping based on stakeholder surveys collected and analysed
- Transition to the Enhanced Transparency Framework (ETF)
- Biennial Transparency Reporting outline and Common Reporting Tables (CRT)
- Sensitisation to common tabular format (CTF) reporting – tracking NDC implementation and progress

Initial analysis of information gathered during the St. Kitts and Nevis baseline MRV assessment identified the need to implement the proposed National MRV system (inclusive of the NCCC) as current decisions under the Paris Agreement require the documentation of institutional arrangement mapping of all reported sectors as well as increased scrutiny on the adherence to the TACCC principles of St. Kitts and Nevis international reporting outputs. To establish an implementation baseline, the following prioritised gaps and potential improvements were identified (see Table 1.16).

Table 1.16. Gaps and needs of improvement identified for St. Kitts and Nevis MRV system

Identified Gaps	Needs for Improvement
MRV system not yet formally established	Set up MRV system with explicit roles/responsibilities mapped for all envisaged stakeholders in the aforementioned system. Priority and focus to be placed on: • Ensuring that administrative capacity is sufficient for identified tasks • Capacity building training provided to activity data providers involved in multiple reporting sectors due to the current lack of technical/human capacity in country.
Data collection, processing and reporting efforts need to yield better data more efficiently	Establish and implement a sustainable MRV system with appropriate institutional, procedural, and legal arrangements with clear reporting and documentation requirements.
No official legislative or compliance mechanisms	Conduct analysis of current legislation and policies and used recommendations to revise and/or draft legislation/policies that mandate the execution and continuation of climate change related activities as well as data collection efforts that are internationally binding (example, UNFCCC reports under the Paris Agreement).
No established data sharing agreements amongst stakeholders	Implement standardised operating procedures and agreements for data sharing to regularly collect data and reporting across all economic sectors that adhere to the timelines proposed in the GHG reporting cycle. St. Kitts and Nevis as a starting point, needs to implement memoranda of understanding and confidentiality agreements to facilitate the process in the interim.
Need for greater public	Conduct education and awareness campaigns from primary

Identified Gaps	Needs for Improvement
awareness around climate change initiatives	education level to broader public awareness campaigns. Public buy-in will foster political buy-in, which will be necessary for government stakeholders to continue their commitment to climate MRV.
Lack of institutional and human capacity to operate envisaged MRV system	Increase in number of staff hires to meet the demands of new national commitments for enhancing national climate MRV systems, enhanced international reporting requirements (Enhanced Transparency Framework) and other related permanent functions such as participation in National GHG Inventory preparation, tracking of NDC actions (implementation and progress), gender experts, and climate support tracking (climate finance, technology transfer and capacity building).
No established MRV QA/QC procedures	Embed QC procedures throughout the MRV system and enact a set of QA procedures to assess the accuracy of final reports. Quality control procedures to be implemented at the data collection, calculation, and compilation phase with a QA/QC coordinator identified at the start of the next reporting cycle.
No established MRV data archiving procedures	Embed data archiving procedures throughout the MRV system to ensure no loss of institutionalised or historical data for future Party reporting cycles. Selection of a data archiving coordinator before the start of the next reporting cycle is recommended.
Lack of formal performance indicators to monitor mitigation and adaptation actions	Develop and track set of national MRV performance indicators to monitor the implementation and progress of mitigation and adaptation actions. Capacity building on the choice of progress indicators as well as sensitisation on use of the common tabular format reporting template is recommended.
Insufficient domestic allocation for funding MRV system	Increase domestic allocation of funding to implement climate goals and monitor execution in the medium to long term where feasible and based on prioritisation of national resources.

As St. Kitts and Nevis moves towards a centralised project-based system and eventually a centralised on-going system, the following list of prioritised activities have been included in its MRV system improvement plan:

- Drafting of legal mandate and/or policy defining data to be collected. Required data sources and data collection procedures to be identified in document
- Mapping of formalised institutional arrangements
- Documentation of domestic resource allocations for climate related agenda (financial and human)
- Inclusion and implementation of the use of data collection templates designed and presented during TNC/BUR1 action tasks
- Implementation of quality assurance/quality control procedural elements and action tasks inclusive of checklists and National QA/QC plan
- Design and implementation of a data management system inclusive of section dedicated to data archiving and institutionalisation of memory

- Integration of country specific planning and/or preparation documents to ensure conducted activities are in line with government priorities
- Sensitisation on the use of the Common Reporting Tables and Common Tabular Formats that are required for reporting under the Enhanced Transparency Framework
- Increased stakeholder engagement for continued buy-in to the process as current envisaged action tasks under the proposed MRV system fall outside the current mapped job responsibilities of stakeholders
- Documentation of current methodologies applied for estimations to ensure no loss of historical memory
- Setting up a proposed ministerial climate change committee to ensure consistency amongst ministries in the government and across national plans, to ensure high level political support from the government and to promote cross-sectoral coordination amongst all envisaged stakeholders
- The Ministerial Climate Change Committee should include all current ministries due to the cross sectoral nature of climate change reporting and are identified as follows:
    - Ministry of Finance, National Security, Citizenship and Immigration, Health and Social Security
    - Ministry of Education, Youth, Social Development and Gender Affairs
    - Ministry of Foreign Affairs, Economic Development, International Trade, Investment, Industry and Commerce
    - Ministry of Public Infrastructure and Utilities, Transport, Information, Communication and Technology and Post
    - Ministry of Agriculture, Fisheries, Marine Resources, Entrepreneurship, Cooperatives and Creative Economy
    - Ministry of Tourism, Civil Aviation and Urban Development
    - Ministry of Justice and Legal Affairs
    - Ministry of Sustainable Development, Climate Action, Environment and Constituency Empowerment

Furthermore, domestically, it is expected that this proposed MRV system will allow for the government of St. Kitts and Nevis to:

- Demonstrate transparency, accountability, and trust to the taxpayers of St. Kitts and Nevis
- Determine the impacts and costs of climate change actions
- Determine the investments needed to achieve adaptation and mitigation priorities highlighted in the St. Kitts and Nevis Nationally Determined Contributions
- Track progress of climate policies to improve implementation and ensure climate priorities

and outcomes are achieved

2. National GHG Inventory

Introduction

St. Kitts and Nevis GHG emissions estimates were prepared in line with 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines. The IPCC Guidelines for the implementation of the GHG inventory contain prescribed methods for the calculation of emissions, providing a unified framework for the reporting and documenting of all sources for all inventories. One of the main aims of this method is to ensure comparability of data gathered in individual states and that calls for a definition of at least a minimum scope of equal methods, criteria, and estimating procedures.

The conceptual approach towards the preparation of the GHG inventory for St. Kitts and Nevis allows for reporting of the results both using 2006 IPCC reporting tables or common reporting format (CRF) tables as used by Annex I countries, adjusted for the reporting elements which are not applicable for the non-Annex I countries. These can easily be adjusted to common reporting tables (CRT) needed for reporting under the PA ETF. Furthermore, increased transparency achieved through enhanced reporting information allows for the international review process to identify potential issues, recommendations, and encouragements for further improvement of the St. Kitts and Nevis GHG inventory estimates. The Scope of the GHG inventory represents the geographical coverage of the territory of St. Kitts and Nevis as internationally recognised.

2.1.1. Global Warming Potential

The global warming potential (GWP) of a greenhouse gas is defined as the ratio of the time-integrated radiative forcing from the instantaneous release of 1 kg of a trace substance relative to that of 1 kg of a reference gas. Direct radiative effects occur when the gas itself is a greenhouse gas. The reference gas used is CO_2, and GWP-weighted emissions are reported in kilotonnes of CO_2 equivalents (kt CO_2eq).

Table 2.1 lists the direct (except for CH_4) 100-year time horizon of GWPs relative to CO_2 for all GHGs included in the inventory of St. Kitts and Nevis. This table is adapted from Table 8.A.1 of the Appendix 8.A of the IPCC Fifth Assessment Report (5AR) which includes the most recent GWP values.

Table 2.1. Global warming potentials (100 Yr Time Horizon) from the IPCC Fifth Assessment Report

Gas – common name	Chemical formula	GWP from 5AR
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
HFC-32	CH_2F_2	677
HFC-125	CHF_2CF_3	3,170
HFC-134a	CH_2FCF_3	1,300
HFC-143a	CH_3CF_3	4,800

Gas – common name	Chemical formula	GWP from 5AR
HFC-227ea	CF_3CHFCF_3	2,640
PFC14	CF_4	6,630
PFC116	C_2F_6	11,100
Sulphur hexafluoride	SF_6	23,500

Global warming potentials are not provided for CO, NO_x, NMVOCs, SO_2 or aerosols because there is no agreed method to estimate the contribution of gases that are short-lived in the atmosphere, spatially variable, and have only indirect effects on radiative forcing.

Inventory preparation

The process of inventory preparation is designed according to the PDCA-cycle ("Plan – Do – Check – Act"). This is a generally accepted model for pursuing systematic quality work according to international standards, to ensure the maintenance and development of quality systems. This structure is in accordance with structures described in decision 19/CMP.1 and in the 2006 IPCC Guidelines. The process consists of inventory planning, inventory preparation, inventory quality checking and prioritised improvements based on national circumstance which are integrated into the annual GHG Inventory cycle.

All inventory data is stored in a structured folder and filing system made available on a cloud drive to the St Kitts Ministry of Environment and Cooperatives. Supporting data and references are stored and archived in electronic form and on various media (USB pen, hard copies). Access to files is limited in accordance with the security and confidentiality policy. Backup copies of the Dropbox folder are made on individual computers, MRV Hub folders are also backed-up and archived at regular intervals in accordance with the requirements of the information system.

Before the inventory is reported to the UNFCCC Secretariat, GHG emission estimates and the relevant chapter goes through an approval process. The institution designated for final approval is the Ministry of Environment and Cooperatives with inventory estimates sent to all other relevant Ministries and departments for comments and consent.

Once the planned MRV system becomes fully functional in St. Kitts and Nevis, the Party intends to make its GHG inventories publicly available on their website. Every submission is expected to be accompanied by a short description of the GHG emission trends. The GHG emission estimates will be presented in a more aggregated manner to better communicate the climate change related issues to the general public. GHG emissions will also be presented through indicators such as carbon intensity of the economy and carbon emissions per capita. Data used in the inventory preparation is listed in Table 2.2.

Table 2.2. Key data sources used in GHG inventory reporting cycle

Source	Activity data/Fuels	Years covered	Scope	Reference
Department of Customs	motor gasoline, aviation gasoline, kerosene, gas oil, diesel, lubricants and others	2008-2018	Total national consumption of each fuel	Department of customs database
Department of	Number of registered	2020	Vehicle fleet in St.	Vehicle fleet database

Source	Activity data/Fuels	Years covered	Scope	Reference
Tourism, Transport and ports	road vehicles in St. Kits and Nevis		Kitts and Nevis	2020 Nevis Statistical Digest 2019
Energy Balance	Firewood, LPG, gasoline alcohol, jet fuel kerosene, diesel oil, fuel oil, charcoal, non-energy	2010-2012	Total national consumption of each fuel	OLADE (Latin American Energy Organisation) (2015); The Bahamas. Energy Balances 2010-2012; file http://biblioteca.olade.org/opac-tmpl/Documentos/old0349.pdf.
Nevis electric Company	Gas/diesel oil	2011-2018	Consumption of fuels for power generation in Nevis.	Individual reporting to GHG inventory team
Royal Utilities Marriot Frigate Bay	Gas/diesel oil	2011-2018	Consumption of fuels for power generation in the St. Kitts	Individual reporting to GHG inventory team
St. Kitts Electricity Company Limited	Gas/diesel oil	2008-2018	Consumption of fuels for power generation in the St. Kitts	Individual reporting to GHG inventory team
Sol Petroleum group	Gasoline, diesel, LPG	2013-2018	Fuels delivered for retail, government, commercial and Power sector	Individual reporting to GHG inventory team
Delta Petroleum	High sulphur diesel, ultra-low sulphur diesel, LPG	2008-2018	Fuel delivered to the final consumers	Individual reporting to GHG inventory team
Petrocaribe	Diesel, gasoline	2008-2018	Fuel delivered to the market and by different suppliers to different clients	Individual reporting to GHG inventory team
World bank	Historical GDP growth, total primary consumption, total electricity production, population growth (rural/urban), revenues from tourism, tourist visits	2008-2018	Macroeconomic and social drivers	https://ourworldindata.org/energy/country/saint-kitts-and-nevis?country=~KNA https://data.worldbank.org/indicator/SP.POP.TOTL?locations=KN
Department of Statistics	Census data	1970, 1980, 1991, 2001, 2011	National water supply, toilet facilities and garbage disposal for St. Kitts and Nevis population.	Individual reporting to GHG inventory team
Department of Statistics	Population statistics	1871-2011 (10-year intervals)	Population growth and rates	Individual reporting to GHG inventory team
St. Kitts Solid Waste Management Corporation	Annual waste generation	2008-2018	Collected tonnage of waste at landfills in both St. Kitts and Nevis	Individual reporting to GHG Inventory team
World Bank	Population statistics	1960-2018	Annual population	https://data.worldbank

Source	Activity data/Fuels	Years covered	Scope	Reference
			values for the years 1960-2018.	.org/indicator/SP.POP.TOTL?locations=KN&year_high_desc=true
Carib Brewery	Wastewater (Beer and Malt)	2009-2018	Wastewater generated by local brewery	Individual Reporting to GHG Inventory Team
St. Kitts and Nevis (Department of Statistics and Ministry of Agriculture, Fisheries and Marine Resources)	Livestock	2014-2018	Annual livestock count for St. Kitts and Nevis	Individual Reporting to GHG Inventory Team
Ministry of Agriculture, Fisheries and Marine Resources	Manure Management System	2000-2018	Manure Management System allocation per livestock category	Individual Reporting to GHG Inventory Team
Ministry of Agriculture, Fisheries and Marine Resources (Sales- TDC)	Urea Purchases	2015, 2017 and 2018	Annual sales values from local distribution company	Individual Reporting to GHG Inventory Team
FAOSTAT	Livestock	2000-2018	Annual livestock count for St. Kitts and Nevis	https://www.fao.org/faostat/en/%3f%23data#country/188 (individual dataset archived)
FAOSTAT	Urea	2002-2017	Total import urea values in tonnes	https://www.fao.org/faostat/en/%3f%23data#country/188 (individual dataset archived)
FAOSTAT	Fertilizer Imports	2000- 2018	Total import fertilizer values in tonnes for St. Kitts and Nevis	https://www.fao.org/faostat/en/%3f%23data#country/188 (individual dataset archived)
GIS Department, St. Kitts	GIS Land Cover Map 2017- St. Kitts only	2017	Land cover map for St. Kitts generated from high resolution satellite imagery (~1m)	SKN GHGI:AFALU Methodology Report. Chezon Tuckett, Ronell Browne, 10/9/2020
ArcGIS Living Atlas	ESRI 2020 Land Cover Map- St. Kitts and Nevis	2020	A 10-meter resolution map of Earth's land surface from 2020.	https://livingatlas.arcgis.com/landcover/
USGS	Recalibrated surface reflectance images from Landsat 7 and 8	2000 -2020	Landsat satellite images covering both St. Kitts and Nevis.	https://www.usgs.gov/landsat-missions/landsat-surface-reflectance
Google Earth Engine	High resolution satellite image in the google earth engine	2020	Google Earth Engine high resolution maps for 2020 – 2021 covering both St.	https://code.earthengine.google.com/

Source	Activity data/Fuels	Years covered	Scope	Reference
			Kitts and Nevis was used for digital verification of classified land use maps.	

2.1.2. Institutional Arrangements for GHG inventory preparation

The Ministry of Environment and Cooperatives, apart from its role as the UNFCCC focal point, coordinates the preparation and presentation of all national reports submitted in adherence with the reporting requirements to the UNFCCC. At present, the technical aspects of the planning and preparation of the National Greenhouse Gas Inventory Report are led by regional/international consultants, working collaboratively with selected national experts to build national capacity and institutionalise the GHGI reporting process. This effort includes GHG inventory compilation training and hands-on participation in data collection, GHG inventory calculation training (inclusive of chosen methodologies, activity data and emission factors), and quality assurance activities during the inventory compilation process. The institutions and roles of these actors involved in the preparation of the St. Kitts and Nevis NIR are noted below in Figure 2.1 and Table 2.3

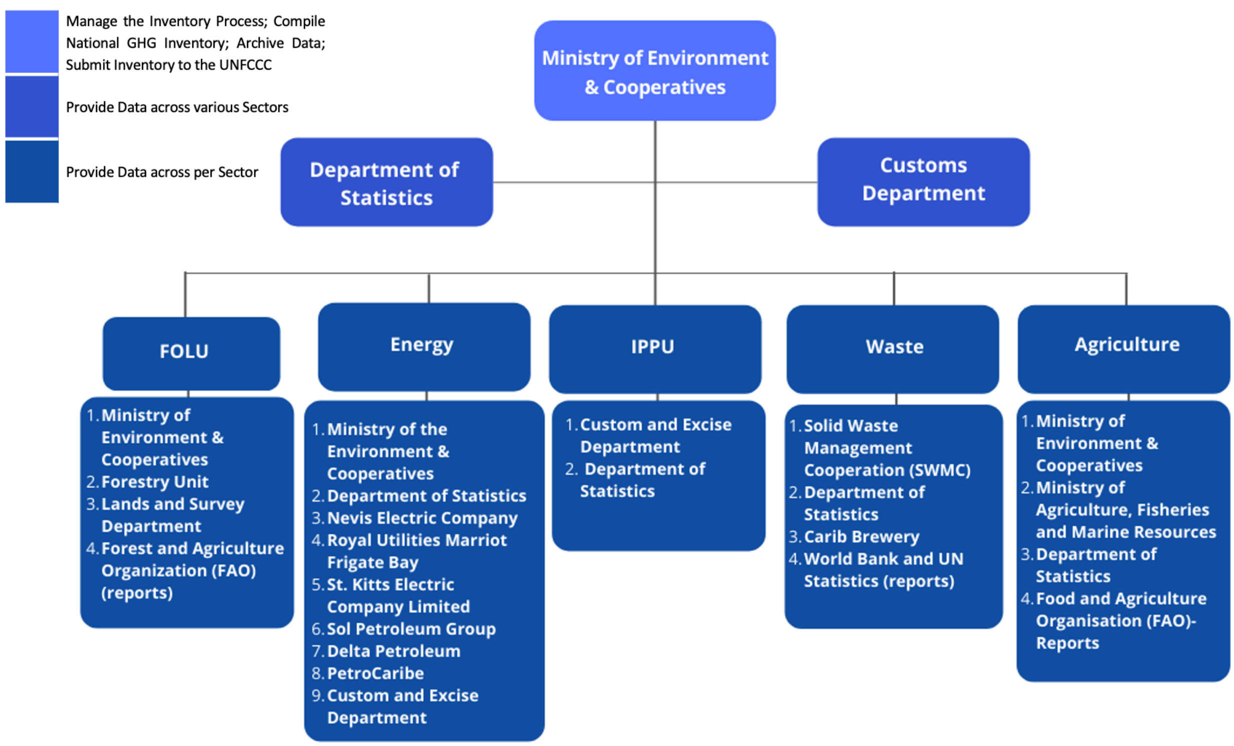


Figure 2.1. Institutional arrangements for the national GHG inventory preparation in St. Kitts and Nevis

Table 2.3. Institutional arrangements - roles & responsibilities

Inventory Phase	Sector	Institution and Contacts	Roles
Planning	Crosscutting	• Ministry of Environment and Cooperatives	• Coordinating and policymaking authority with respect to environment and climate change in the St. Kitts and Nevis. • Overseeing the entire national inventory process from the early stages of data collection through processing and reporting. This includes liaising with data providers, and identifying national sectoral experts- coordinating their capacity building
Data-Collection	Energy	• Ministry of the Environment and Cooperatives • Department of Statistics • Nevis Electric Company • Royal Utilities Marriot Frigate Bay • St. Kitts Electric Company Limited • Sol Petroleum Group • Delta Petroleum • PetroCaribe • Custom and Excise Department	Provides information on GHG emissions associated with electricity generation, national fuel consumption data, energy balance, and vehicle registration data.
	Agriculture	• Ministry of Environment and Cooperatives • Ministry of Agriculture, Fisheries and Marine Resources • Department of Statistics • Food and Agriculture Organisation (FAO) - Reports	Provides data and technical support when compiling GHG emissions for agriculture
	Forestry	• Ministry of Environment and Cooperatives • Forestry Unit • Lands and Survey Department • Food and Agriculture Organization (FAO) - Reports	Provides technical support when compiling GHG emissions for land Provides maps for the land sector

Inventory Phase	Sector	Institution and Contacts	Roles
	Waste	• Solid Waste Management Cooperation (SWMC) • Department of Statistics • Carib Brewery • World Bank and UN Statistics - Reports	Provides information on the waste sector Provides statistical parameters that can be applied when estimating GHG emissions from the waste sector Provides information on the country's wastewater treatment works (domestic and industrial).
	Industrial Processes and Product Use	• Custom and Excise Department • Department of Statistics	Provide GHG information for the IPPU sector, particularly on refrigerants
Preparation	Sectors and Crosscutting	• Caribbean Cooperative MRV Hub and Greenhouse Gas Management Institute • Support of National Experts and Data Providers	Provide Capacity to chosen National sectoral experts to take a hands-on role in preparation of National Greenhouse Gas Inventory Collecting and evaluating data Selection of methodological approaches and use of expert judgement. Estimation of GHG emissions Assessment of uncertainty and analysis of key categories Preparation of inventory report
Quality Control	Cross-cutting	• External MRV Hub and GHGMI experts	Review of estimations and expert judgement by experts not involved in the compilation of greenhouse gases
Quality Assurance/ Review	All Sectors	• Sectoral Experts, and Data Providers including • Ministry of the Environment and Cooperatives • Department of Statistics • Nevis Electric Company • Royal Utilities Marriot Frigate Bay • St. Kitts Electric Company Limited • Sol Petroleum Group • Delta Petroleum • PetroCaribe • Custom and Excise Department • Ministry of Environment and Cooperatives	Review National Circumstances of methods, approaches, and assumptions Formal and informal technical reviews of National Inventory Report

Inventory Phase	Sector	Institution and Contacts	Roles
		• Ministry of Agriculture, Fisheries and Marine Resources • Department of Statistics • Forestry Unit • Lands and Survey Department • Solid Waste Management Cooperation (SWMC) • Department of Statistics • Carib Brewery	
Validate	Sectors and Cross-cutting	• Identified St. Kitts and Nevis sectoral experts and relevant government officials as identified in the Institutional Arrangements • Cabinet	Provide oversight on the compilation of the report, including reviewing and providing inputs on activity data, emission factors, relevant input parameters and expert judgement used, in order to ensure the reports and GHGI emission estimates reflect national circumstances. Validates the final NIR before submission to the Cabinet Provides final approval of NIR, BURs, etc. before submission to the UNFCCC
Management	Cross-cutting	• Department of Environment, Ministry of Environment and Cooperatives	Data collection procedures, documentation, data archiving, reviewing, checking and evaluation of planned prioritised improvements, data collected and summarised data gaps list. Submission of final report to the UNFCCC Review of necessary inventory improvements and data archiving procedures.

General description of methodologies used and data sources

GHG emissions inventories were prepared in accordance with the IPCC methodology as presented in the 2006 IPCC Guidelines for all gases and sectors. Due to the importance of the source and accessibility of activity data, different methods and approaches (tiers) aligned with the IPCC methodology were used. Methods and emission factors used are summarized in Table 2.4 and Table 2.5.

Table 2.4. Summary report for methods and emission factors used from CRF Tables

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	EF	Method applied	EF	Method applied	EF
1. Energy	T1	D	T1	D	T1	D
A. Fuel combustion	T1	D	T1	D	T1	D
1. Energy industries	T1	D	T1	D	T1	D
2. Manufacturing ind. and	T1	D	T1	D	T1	D
3. Transport	T1	D	T1	D	T1	D
4. Other sectors	T1	D	T1	D	T1	D
5. Other	NO	NA	NO	NA	NO	NA
B. Fugitive emissions from	T1	D	T1	D	T1	D
1. Solid fuels	NO	NA	NO	NA	NO	NA
2. Oil and natural gas	T1	D	T1	D	T1	D
2. Industrial Processes	NO, NE	NA, NE	NO, NE	NA, NE	NO, NE	NA, NE
A. Mineral Products	NO	NO	NA	NA	NA	NA
B. Chemical Industry	NO	NO	NA	NA	NA	NA
C. Metal Production	NO	NO	NA	NA	NA	NA
D. Non-Energy Product	NO	NO				
F. Substitutes for ODS						
G. Other product man. and	NE	NE	NE	NE	NE	NE
3. Agriculture	T1	D	T1	D	T1	D
A. Enteric Fermentation			T1	D		
B. Manure Management			T1	D	T1	D
D. Agricultural Soils			NA	NA	T1	D
G. Liming	NE	NE	NA	NA	NA	NA
H. Urea application	T1	D	NA	NA	NA	NA
4. LULUCF	T1	D	T1	D	T1	D
A. Forest Land	T1	D	T1	D	T1	D
B. Cropland	T1	D	NA	NA	T1	D
C. Grassland	T1	D	NA	NA	T1	D
D. Wetlands	T1	D	NA	NA	NA	NA
E. Settlements	T1	D	NA	NA	D	D
F. Other Land	T1	D	NA	NA	D	D
G. HWP	NE	NE	NA	NA	NA	NA
5. Waste	T1	D	T1	CS, D	T1	D
A. Solid Waste Disposal	NA	NA	T1	D		
B. Biological Treatment			T1	D	T1	D
C. Incineration	T1	D	T1	D	T1	D
D. Waste-water Treatment	NA	NA	T1	D	T1	D

Table 2.5. Summary report for methods and emission factors used for F-gases from CRF Tables

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		SF6	
	Method applied	EF	Method applied	EF	Method applied	EF
2. Industrial Processes	NO, NE	NA, NE	NA, NO	NA	NA, NE	NA, NE
C. Metal Production	NA	NA	NO	NA	NA	NA
F. Substitutes for ODS	NE	NE	NA	NA	NA	NA
G. Other product man. and use	NA	NA	NA	NA	NE	NE

ENERGY SECTOR

In the Energy sector, default IPCC emission factors and net calorific values (NCV's) were used for all types of commercial fuels.

The approach taken to determine quantities of fuels consumed was a combination of the bottom up and the top-down approach. This approach was taken since a consistent time-series for the national fuels consumption for the period 2008-2018 was not available. Bottom-up data at the national level was received from SOL Group, Delta Petroleum, and PetroCaribe. These datasets were checked with top-down datasets received from St. Kitts and Nevis and after analysis were observed to have significant time-series consistency issues, largely due to the customs department being migrated to a newer data management platform. Furthermore, there is an inconsistency in allocation of fuels between gas oil and diesel oil (also if combined). Various inconsistencies were observed for LPG, where bottom-up data show significantly higher estimates, however, the gasoline time-series was consistent and used in the assessment of the total primary energy supply for that fuel.

Energy industries

The quantities of fuel consumed for electricity production was determined through bottom-up questionnaires submitted to Nevis Electricity Company Limited, Royal Utilities - Marriot Frigate Bay and to St. Kitts Electricity Company Limited. However, since the datasets were not complete (data for 2008-2010 was missing for some producers) the GHG emissions for 2008-2010 period were estimated through average efficiency of the electricity production at the producer's level, with missing data determined in the period 2011-2018 and the trend of overall electricity production in the period 2008-2010 as St. Kitts and Nevis reported to the World Bank.

Manufacturing industries and Construction

Fuels used in the manufacturing industry was determined using levels as determined by OLADE Energy Balance for St. Kitts and Nevis 2010-2012 and aligned with the overall trends of the St. Kitts and Nevis Primary Energy consumptions. Fuel used by construction was aligned with the evolution of trends for the number of heavy-duty vehicles and off-road machinery.

Transport sector

The quantities of gasoline consumed were taken from the customs database. Based on the vehicle fleet database for 2020 for St. Kitts and Nevis and historical evolution of the vehicle fleets licensed in Nevis (source: Nevis statistical digest); a bottom-up model for the fleet evolution for the period 2008-2018 and mileage driven for different types of road vehicles was developed and calibrated to the gasoline consumed in road transport. Once the model was calibrated to the gasoline consumption, the diesel consumptions for road transport was estimated using the same approach. Such an approach allows for better assumptions of N_2O and CH_4 emissions from the Transport sector and will also allow for future improvements and estimation of emissions from lubricants used in the transport sector.

Other (Commercial/Institutional sector and Households)

Emissions from households were estimated based on the consumption as identified in the OLADE Energy Balance for 2010-2012 scaled for the growth of the population in St. Kitts and Nevis, with exception of fuelwood and charcoal where consumption was scaled based on the growth of the rural population. To assess the top-down fuels available for both households and the commercial sector the data was collected from individual producers/importers of charcoal for the period 2008-2018.

Fugitive emissions

Fugitive emissions in St. Kitts and Nevis follow the changes in the LPG transported in the period 2008-2018.

INDUSTRIAL PROCESSES AND PRODUCT USE

Emissions in the IPPU sector have not been estimated. The estimation of IPPU GHG emissions for subsequent GHG inventory preparation is addressed in the improvement plan.

AGRICULTURE SECTOR

After analysis of the available datasets, GHG emissions in the agriculture sector were estimated by applying a Tier 1 IPCC approach and using default IPCC emission factors/inputs as highlighted in Table 2.4.

Enteric Fermentation

Livestock population datasets were provided by country experts for St. Kitts for the time series 2014-2019 with no available information for Nevis. After comparison with the data sourced from FAOSTAT for the time series 2008-2018, the latter was chosen as the input due to its longer time series and inclusion of Nevis estimates. Default IPCC emission factors were selected from Tables 10.10 and 10.11 (2006 IPCC Guidelines Vol 4) and are reflective of the LAC region.

Manure Management (CH_4)

As highlighted in the section above (enteric fermentation), FAOSTAT livestock values for the time series 2008-2018 were chosen by the GHGI compilation team. Default IPCC emission factors were selected from Tables 10.14 – 10.16 (2006 IPCC Guidelines Vol 4) and are reflective of the LAC region.

Manure Management (Direct N_2O)

Data on Manure Management Systems (MMS) allocations was provided based on the identified species/livestock categories present in-country. MMS in St. Kitts and Nevis were inclusive of solid storage, dry lot, liquid slurry and pasture/range/paddock (included under managed soils). For livestock categories with two MMS allocations, a 50-50 split was assumed. FAOSTAT livestock values and IPCC defaults (Table 10.19 and 10A-4 to 10A-9- 2006 IPCC Guidelines Vol4) were selected for GHG emission estimates.

Manure Management (Indirect N_2O)

The IPCC defaults for the following were chosen and applied to calculation methodologies:

- Fraction of managed livestock manure nitrogen that volatises (Table 10.22 Vol 4 2006 IPCC Guidelines)
- Emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (Table 11.3 Vol 4 2006 IPCC Guidelines)
- Amount of managed manure nitrogen for livestock category that is lost in the MMS (Table 10.23 Vol 4 2006 IPCC Guidelines)
- Emission factor for N_2O emissions from nitrogen-leaching/run-off

Managed Soils (Direct and Indirect N_2O)

Livestock counts and annual amounts of nitrogen applied in synthetic fertilisers were sourced from FAOSTAT and used for GHG emission estimates in the managed soils sub-categories. IPCC default values for Typical Animal Mass, annual average nitrogen excretion per head of species, annual nitrogen excretion rate and emission factors for leaching and run-off/volatilization were selected as inputs, as no country information was available. Defaults chosen were reflective of the LAC region.

Urea Fertilisation

The department of Agriculture provided the annual quantities of purchased urea for the time series 2015-2020 with 2016 data missing. Comparison to urea import data collected through FAOSTAT showed consistent values for the years 2015 and 2017, with the FAOSTAT dataset applied due to access of data over a longer time series. The default IPCC emission factor was selected as no country information was available.

WASTE SECTOR

After analysis of the available datasets, GHG emissions in the Waste sector were estimated by applying a Tier 1 IPCC approach and using default IPCC emission factors/inputs as highlighted in Table 2.4.

Solid Waste Disposal

Country experts provided population growth and rates that were collected approximately every ten years through the national census process. Comparisons with annual population data accessed from the World Bank were consistent with the submitted country data (10-year intervals) and selected as the input for the First Order Decay (FOD) Model.

Information on annual waste generation was provided for the time series 2009-2018 and compared to the reflective IPCC defaults of the Caribbean region. The default value showed a difference of approximately 290kg/waste/capita/year lower than in-country data; with the latter chosen as the required input. IPCC default waste composition categorisations were used, as country specific categorisations were not available in the relevant IPCC format (no Party categorisation definitions available for comparison). Sludge deposition values at MSW sites were obtained during the data collection process for the time series 2009-2018 and applied to the FOD model.

Due to the lack of collection/categorisation of information on industrial waste, St. Kitts and Nevis has included its Industrial estimates in its MSW GHG emission estimates. A Tier 1 approach using GDP per capita as the default input was applied and analysed by the Inventory team but was not deemed reflective of the Party as the GDP per capita values are heavily dependent on the Tourism Industry.

Open Burning

Population estimates and per capita waste generation were applied using the same dataset inputs gathered for municipal solid waste. In the absence of specific data on the fraction of the population that open burns, and following discussions with in-country experts, an estimated allocation of 2% (fraction of population that open burns) was assumed and applied.

Domestic Wastewater

For calculating GHG emission estimates for domestic wastewater, St. Kitts and Nevis used the dataset from the World Bank as well as the IPCC default for BOD reflective of the LAC region. No information was available on in-country BOD estimates. Information was provided on water supply and toilet facilities through the national census and was used to allocate the types of treatment or discharge. For the chosen treatment types (latrine, sewer, septic system, and sea/river/lake discharge), default values for MCF (specific to each treatment system) and Maximum Methane Producing Capacity (BOD) were used in the calculation of the applicable emission factor. Income group information in IPCC categorisations (rural, urban low-income, urban high-income) was not available. Urbanisation country estimates were sourced from the United Nations Population Division.

Industrial Wastewater

Wastewater generation values from the local brewery were provided for the time series 2009-2018 with default IPCC values for the MCF and B_0 used for the identified treatment or discharge.

2.1.3. Quality Assurance and Quality control

St. Kitts and Nevis is planning to develop and implement a new Quality Assurance and Quality Control (QA/QC) Plan as recommended by the IPCC Guidelines (IPCC 2006). This plan will identify the specific data quality objectives related to the principles of transparency, accuracy, consistency, completeness and comparability (TACCC) required for the St. Kitts and Nevis national inventory and provides specific guidance, documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting. The QA/QC plan will be a part of the Manual of Procedures which is to provide a general overview of the QA/QC system. In addition, the manual provides guidance and templates for appropriate quality checking, documentation, and transparency. The selection of source data, calculation methodologies, peer and expert review of inventory data, and the annual requirements for continuous improvement of the inventory are also to be outlined in the manual.

Quality Control (QC) in St. Kitts and Nevis

Quality Control is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- Provide routine and consistent checks to ensure data integrity, correctness, and completeness
- Identify and address errors and omissions
- Document and archive inventory material and record all QC activities.

As the majority of calculations are performed using Excel spreadsheets, no human errors are expected once the system is validated. The Excel spreadsheets use specific colour codes to ensure that the data is manipulated only in the cells dedicated for the data input and not in the other cells. Once the validation process is finalised, the calculation cells will be locked for editing.

During development of the Excel spreadsheets, the following QC steps were performed:

Checks of methodological and data changes resulting in recalculations

- Check for temporal consistency in time series input data for each source category.
- Check for consistency in the algorithm/method used for calculations throughout the time series.

Completeness checks

- Confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory.
- Check that known data gaps resulting in incomplete source category emissions estimates are documented.
- Compare estimates to previous estimates: for each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or deviations from expected trends, recheck estimates and explain any differences.

Check of activity data, emission factors and other parameters

- Cross-check all input data from each source category for transcription errors.
- Check that units are properly labelled in calculation sheets.
- Check that units are correctly carried through from beginning to end in calculations.
- Check that conversion factors are correct.
- Check that temporal and spatial adjustment factors are used correctly.

Check of emissions estimates

One of the elements of quality control of GHG emissions estimates is checking the general results through sets of regional indicators which allows for the assessment of the plausibility of the results, in particular when emission estimates are based on assumptions and expert judgement. Furthermore, the plausibility checks on the evolution of trends are implemented in the LULUCF sector, where a specific focus is given to a land use and change matrix. While sudden and significant land use changes from one land use to other (such as from forestry land use) are possible due to the extreme weather (e.g., hurricanes) events or natural disasters (e.g., volcano eruptions), other changes are much less likely to happen over a short period of time (e.g., rapid land change to forest land, or from settlements to forestland). In such cases those land changes are carefully examined and if QC checks show that emissions happen due to errors in the data interpretation, such estimates are not included in the national totals. The identified issues are then included in the improvement plan and will be addressed in the subsequent submission. The priority level (low, medium, high, very high) is assessed in accordance with the used criteria (see Section 2.1.7).

Check of Uncertainty assessment

The checks consisted of the following:

- Check that the qualifications of individuals providing expert judgement for uncertainty estimates are appropriate.
- Check that qualifications, assumptions and expert judgements are recorded or referenced.
- Check that calculated uncertainties are complete and calculated correctly.
- Check that there is detailed internal documentation to support the uncertainty estimates.

While the first three QC checks were performed, the last QC check shows that detailed documentation is not available for the most of uncertainty estimates. The inventory compilation team with the guidance of local experts decided to use expert judgement except for categories for which default uncertainty estimates are available in 2006 IPCC GL.

Preparation of NIR

- Check if the Excel spreadsheet archive for NIR preparation has been created.
- Check that all the relevant chapters are included in the NIR.
- Check that AD, EF and other numerical information mentioned in the text is correct.
- Check all AD data is presented in the tables in the NIR.
- Check all EF and other parameters used in the tables in the NIR.
- Check all graphs for accuracy and presence in the whole period.
- Check all titles for tables and pictures.
- Check that all Annexes to the NIR are included and updated.

Documentation and archiving

QA/QC checks of documentation and archiving procedures:

- Check that inventory data, supporting data and inventory records are archived and stored to facilitate detailed review.
- Check that all supporting documentation is archived.
- Check that results of the QC analysis and uncertainty estimates are archived.
- Check that there is detailed internal documentation to support the estimates and enable replication of emissions estimates.
- Check that bibliographical data references are properly cited in the internal documentation and archived under the specific "References folder".
- Check that inventory improvements plan is updated and archived.

Quality assurance (QA) in the St. Kitts and Nevis

QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC activities. It is planned that both local and MRV Hub experts coordinate peer reviews at regular intervals and carry out checks to verify the transparency, accuracy, consistency, comparability, and completeness of submitted inventories. The review findings will then be addressed by the inventory team as appropriate and based on prioritisation of activities.

2.1.4. Uncertainty assessment

The combined uncertainty was derived using a Tier 1 method (Table 2.6). The uncertainties of individual activity data and emission factors are based on expert judgment or IPCC 2006 Guidelines. Since expert judgments of individual experts are at variance, the highest individual uncertainties have been taken into account. The total uncertainties have been derived both for Level Uncertainty as well as for Trend Uncertainty.

Table 2.6. Uncertainty of GHG emission estimates in 2008 and 2018 by sectors

	2008	2018
1 Energy	6.90%	6.33%
2 IPPU	NO	NO
3 Agriculture	50.06%	64.49%
4 LULUCF	56,07%	28,73%
5 Waste	87.37%	79.87%
TOTAL COMBINED UNCERTAINTY	23,61%	24,14%
TOTAL COMBINED UNCERTAINTY (w/o LULUCF)	13.71%	14.03%

TOTAL trend uncertainty (2018/2008) is 15.03% (w/ LULUCF) and 6.94% (w/o LULUCF).

The primary factor contributing to the lower uncertainty values in 2018 was the energy sector. Mainly due to the improved AD in 2018 compared to 2008, when some activity data was missing and fall-back approaches were needed to estimate emissions. The higher uncertainty values in the agriculture sector are a result of a higher proportion of soil emissions, for which the same IPCC default EFs with significant uncertainty were used for both the base year and for 2018 estimates.

More detailed data regarding the uncertainty assessment are included in the Annex: Quantitative uncertainty analysis.

Uncertainty Assessment in LULUCF

Overall accuracy of classified land use maps increased from 56%-62% with Kappa value of 0.40 to 0.55 in Analysis 1 to 77%-90% and Kappa-values were between 0.72 and 0.88 in Analysis 2 (Table 2.7). In Analysis 2 axillary sugarcane field data, recalibrated Landsat surface reflectance images and NDVI band derived from the Landsat surface reflectance images were used to improve accuracy of classification.

Table 2.7. Improvement in overall accuracy of land use classification

	Analysis 1		Analysis 2	
Year	**Overall accuracy (%)**	**Kappa value**	**Overall accuracy (%)**	**Kappa value**
2000	56.09	0.43	84.04	0.81
2005	56.00	0.44	86.50	0.83
2008	56.59	0.41	87.20	0.84
2011	56.21	0.40	76.75	0.72
2014	65.90	0.55	90.60	0.88
2018	62.12	0.55	80.40	0.76

2.1.5. Brief description of Key source categories

The analysis of key source categories was performed on the basis of sectoral distribution and use of Approach 1. This approach was used both for the year 2008 and for the year 2018. A level assessment was undertaken for 2008 and 2018, and a trend assessment was performed for 2018. The analysis has been performed at a level of IPCC categories as suggested in Table 4.1 in Volume 1 of 2006 IPCC Guidelines. The results are presented in Table 2.8 and Table 2.9 below.

The analyses have been performed with and without LULUCF sector. On the basis of the KCA, including LULUCF, 9 categories were selected as key categories in 2018 according to the level assessment, and an additional 2 were chosen as key categories according to the trend assessment only. As many as 8 categories are key sources according to level and trend KC analysis (
Table 2.10).

Table 2.8. IPCC key source categories for 2018, Approach 1 – level only

IPCC Category code	IPCC Category		Greenhouse gas	Last Year emissions 2018 (kt CO_2eq)	Lx,t	Cumulative Total of Column G
1.A.1	Energy industries	Liquid fuels	CO_2	181,15	0,341	34,1%
3.B.1.b	Land converted to iorest land	-	CO_2	98,70	0,186	52,7%
1.A.3.b	Road transportation	-	CO_2	98,00	0,185	71,2%
4.A	Solid waste disposal	-	CH_4	45,90	0,086	79,8%
3.B.1.a	Forest land remaining forest land	-	CO_2	41,65	0,078	87,7%
3.B.3.b	Land converted to grassland	-	CO_2	13,73	0,026	90,3%
4.D	Wastewater treatment and discharge	-	CH_4	12,21	0,023	92,6%
3.B.2.b	Land converted to cropland	-	CO_2	10,33	0,019	94,5%
1.A.4	Other sectors	Liquid fuels	CO_2	7,04	0,013	95,8%

Table 2.9. IPCC Key source categories for 2018, Approach 1 – trend only

IPCC Category code	IPCC Category		Greenhouse gas	Base Year emissions 2008 (kt CO2eq)	Last Year emissions 2018 (kt CO2eq)	Base year Abs(Emission) kt CO2eq	Trend Assessment (Txt)	% Contribution to Trend	Cumulative Total of Column G
1.A.3.b	Road transportation	-	CO_2	68.92	98.00	68.92	0.05	17.1%	17.1%
3.B.6.b	Land converted to other land	-	CO_2	23.45	2.44	23.45	0.05	16.2%	33.3%
1.A.1	Energy industries	Liquid fuels	CO_2	149.48	181.15	149.48	0.04	14.7%	48.0%
3.B.1.b	Land converted to forest land	-	CO_2	-87.49	-98.70	87.49	0.04	12.5%	60.6%
3.A.1	Enteric fermentation	-	CH_4	14.95	5.17	14.95	0.02	7.7%	68.3%
3.B.3.b	Land converted to grassland	-	CO_2	20.84	13.73	20.84	0.02	6.2%	74.5%
4.A	Solid waste disposal	-	CH_4	35.85	45.90	35.85	0.02	5.3%	79.7%
3.B.2.b	Land converted to cropland	-	CO_2	16.49	10.33	16.49	0.01	5.2%	85.0%
4.D	Wastewater treatment and discharge	-	CH_4	4.96	12.21	4.96	0.01	4.9%	89.9%
1.A.4	Other sectors	Liquid fuels	CO_2	12.59	7.04	12.59	0.01	4.6%	94.5%
3.B.5.b	Land converted to settlements	-	CO_2	3.39	0.75	3.39	0.01	2.1%	96.5%

Table 2.10. IPCC key source categories for 2018, Approach 1

IPCC Category code	IPCC Category		Gas	Key categories L = level T = trend
1.A.1	Energy industries	Liquid fuels	CO_2	L,T
1.A.3.b	Road transportation	-	CO_2	L,T
1.A.4	Other sectors	Liquid fuels	CO_2	L,T
3.A.1	Enteric fermentation	-	CH_4	T
3.B.1.a	Forest land remaining forest land		CO_2	L
3.B.1.b	Land converted to forest land	-	CO_2	L,T
3.B.2.b	Land converted to cropland	-	CO_2	L,T
3.B.3.b	Land converted to grassland	-	CO_2	L,T
3.B.5.b	Land converted to settlements	-	CO_2	T
3.B.6.b	Land converted to other land	-	CO_2	T
4.A	Solid waste disposal	-	CH_4	L,T
4.D	Wastewater treatment and discharge	-	CH_4	L,T

Most of the 12 key categories are from the LULUCF sector (5): 3 categories are CO_2 emissions from fuel combustion which are both level ant trend, followed by 2 CH_4 level and trend key categories (4.D Wastewater treatment and discharge and 4.A solid waste disposal) and 1 CH_4 trend key categories from agriculture sector (3.A.1 Enteric fermentation).

Key category analysis as a base for prioritizing improvements in GHG inventory

Key source categories are to receive special considerations in terms of improvements and QA/QC. In Table 2.11, methodologies used to calculate emissions from the key categories are presented.

In principle the improvements for the Energy related categories are to focus on the robustness of the activity data and to replace some assumptions with statistical data gathered for that specific purpose. Improvements in the calculation factors such as NCV and EF are not to be foreseen since in the key source categories only commercial fuels are used which are standardised.

Waste related emissions could be improved through both activity data and emission factors, with the focus on the determination of the share of biodegradable waste in solid waste composition, and in-situ verification of the structure and nature of the landfill sites.

Subject to the available resources, emission estimates should also be improved in the agriculture sector, primarily through the improvement of the activity data since both manure management and enteric fermentation are only trend Key source categories.

Table 2.11. Methodologies used for key categories according to the level in 2018

IPCC Category code	IPCC Category		Gas	Methodology	EF and other parameters
1.A.1	Energy industries	Liquid fuels	CO_2	Tier 1	D
1.A.3.b	Road transportation	-	CO_2	Tier 1	D
4.A	Solid waste disposal	-	CH_4	Tier 1	D
4.D	Wastewater treatment and	-	CH_4	Tier 1	D

IPCC Category code	IPCC Category		Gas	Methodology	EF and other parameters
	discharge				
1.A.4	Other sectors	Liquid fuels	CO_2	Tier 1	D
1.A.2	Manufacturing industries and construction	Liquid fuels	CO_2	Tier 1	D
3.A.1	Enteric fermentation	-	CH_4	Tier 1	D
3.B.1.a	Forest land remaining forest land	-	CO_2	Tier 1	D
3.B.1.b	Land converted to forest land	-	CO_2	Tier 1	D
3.B.2.b	Land converted to cropland	-	CO_2	Tier 1	D
3.B.3.b	Land converted to grassland	-	CO_2	Tier 1	D
3.B.5.b	Land converted to settlements	-	CO_2	Tier 1	D

2.1.6. General Assessment of Completeness

Sources and sinks

All sources of direct GHG gases, included in the IPCC Guidelines, are covered by the inventory with exception to some sub-categories where emissions are currently not estimated and are included in the GHG Inventory Improvement plan.

Gases

All direct GHGs with exception of F-gases from sources subject to the implementation of the GHG Inventory Improvement plan.

Geographic coverage

The geographic coverage is complete. No territory in St. Kit and Nevis has been left uncovered by the inventory.

Notation keys

NO (not occurring)

This notation key is used for activities or processes in a particular source or sink category that do not occur within a country. The highest number of source categories marked with NO is found in the AFOLU sector, but there are some in industrial processes and energy industries as well.

NE (not estimated):

There are several sub-categories marked with NE such as:

- 1.A.1.c Manufacturing of Solid fuels and other energy industries
- 3.A Domestic Aviation
- 3.D Domestic Navigation
- Memo Item: International Aviation
- 2.D.1 Lubricant use

- 2.D.2 Paraffin Wax Use
- 2.D.3 Solvent Use
- 2.F.1a Refrigeration and stationary Air Conditioning
- 2.F.1.b Mobile Air Conditioning
- 2.G.1.b Use of Electrical Equipment
- 3.D Agriculture soils
- 3.G Liming
- 3.J Other
- 4.G Harvested wood products

None of the sub-categories noted as "NE" are expected to be a Key Source Category once GHG emissions are estimated.

IE (included elsewhere):

There are a few categories marked with IE because relevant data was not available on the reporting level, and emissions are therefore included in some other categories. These sources are:

- All consumption of diesel/ gasoline for domestic navigation and leisure boats are currently included under the road transport.

In addition, notation key IE is used also for some categories in the LULUCF sector, when IPCC methodology requires that emissions are reported in the agriculture sector. These sources are:

- Indirect N2O emissions from Managed soils (CRF table 4(IV)) are reported in the agriculture sector under agriculture soils – atmospheric deposition
- Direct N2O emissions from mineralization/immobilization from FL and GL converted to CL are reported under relevant category (3.D.1.5) under agriculture soils

NA (not applicable):

This notation key is used for activities in a given source/sink category that do not result in emissions or removals of a specific gas. Categories in the CRF for which "NA" is applicable are shaded so they do not need to be filled in.

C (confidential)

For the preparation of the GHG Inventory no data received were considered confidential for the purpose of the preparations of St. Kitts and Nevis GHG Inventory.

2.1.7. Improvement planning

Improvement planning is an essential element of the yearly reporting cycle contributing to the quality of the GHG inventory estimates. Improvements are initiated through the internal or external reviews of the GHG inventory. Since this is the first cycle of the GHG emission estimates for the period 2008-2018 for St. Kitts and Nevis, the improvements reflect the identified gaps or deficiencies identified by the inventory compilers.

Improvement planning is subject to assessment of the different priority levels:

LOW: emission estimates are not likely to present as a key source category and do not have effects on national total GHG emissions (e.g., better allocation of emissions among the different source categories)

MEDIUM: emission estimates are not likely to become a key source category and could have some limited effect on national total GHG emissions

HIGH: emission estimates have a potential to become a level key source category or could have more substantive effect on national total GHG emissions

VERY HIGH: emission estimates have a potential to become a level key source category or could have significant effect on national total GHG emission levels and could affect the trend of the evolution of national GHG emission.

Detailed table on the planned improvements is presented in the Improvement Plan section.

ENERGY SECTOR

Activity data improvements and full implementation of the top-down approach

During the preparation of the GHG inventory for the period 2008-2018 the time-series inconsistencies have been identified in the data received from St. Kitts and Nevis Custom Department. Those identified inconsistencies apply only to the imports of Diesel fuel, Gas oil and Liquefied Petroleum Gas, where fluctuations in the data present a time-series outlier. It also must be noted that Customs Department is in the process of implementing quality improvements and migration of data, which may also contribute to the inconsistencies in the period 2008-2018. It is expected that for future submissions, a consistent top-down time-series will be developed which will allow for the preparation of the comparison of GHG emissions from energy sector using a top-down approach and bottom-up approach.

Determination of the fuels used in international navigation and aviation

Fuels used for international navigation and international aviation are reported according to the IPCC methodology as memo items. Memo items shall not be included in the national totals, therefore it is important to have a quality data on those fuel consumptions. For the subsequent submission, and with full implementation of the MRV system in St. Kitts and Nevis it is expected that the quality of those data will improve significantly.

Better allocation of data in manufacturing industries and construction, road transport sector and Other

Once the MRV system is established and fully functional, the quality of sectoral data will improve, reducing the need to rely on results from past projects or GHG estimates that used fall-back approaches and assumptions based on sectoral drivers.

INDUSTRIAL PROCESSES AND PRODUCT USE

The main priority for future improvements is to prioritise efforts to estimate emissions from:

- 2F1a refrigeration and stationary air conditioning
- 2F1b mobile air conditioning

This is where the majority of the emissions from IPPU is expected to occur. This should take into account that the hospitality businesses and commercial sectors extensively use stationary air conditioning systems, and that air conditioning is also increasing in households. In addition to taking into account that passenger cars, vans, and busses are predominantly equipped with AC, it is also necessary to estimate leakages from the road transport sector and mobile air conditioning systems.

Once those emissions are estimated, the remaining categories where emissions are expected −such as 2D1 Lubricant use, 2D2 Paraffin Wax Use, 2D3 Solvent Use, and potentially 2G1b Use of Electrical Equipment − will be addressed.

AGRICULTURE, FORESTRY AND OTHER LAND USE

The main priority for future improvements in the agriculture sector is to prioritise in-country data collection efforts for the following inputs:

- Livestock count (2000-2018) for both St. Kitts and Nevis
- Fertilizer imports (2000-2018)
- Urea sales from sole distributor (2000-2018)

At present, emission estimates are primarily based on the use of international datasets for the time series 2000-2018. Improvement in data collection and country-specific datasets would allow for validation of the input parameters used during the GHG inventory process.

In the forestry and other land use (FOLU) sector, the main priority for future improvements builds upon initial ground truthing activities during the GHG inventory reporting cycle and the development of country specific emission factors and activity data. The following activities have been identified:

- Field survey and measurements to develop country specific emission factors
- Generating emission factors for forest, grasslands, and wetlands with woody vegetation
- Capacity building training on GIS

WASTE SECTOR

The main priority for future improvements in the waste sector is to prioritise in-country data collection efforts for the following input parameters:

- Waste tonnage values at solid waste disposal sites disaggregated into the appropriate IPCC categories
- Country specific waste composition percentages

- Urbanisation percentages for the population of St. Kitts and Nevis disaggregated into rural, urban high and urban low income
- Industrial solid waste values deposited at solid waste disposal sites

Overview of Trends in Greenhouse Gas Emissions

2.1.8. Description of Emission Trends for Aggregated GHG emissions

Total emissions (Figure 2.2) of GHG in 2018, sinks not included, amounted to 363.5 kt CO_2 eq., which represents a 15.5% increase in emissions compared to the year 2014, and a 21.2% increase compared to 2008. In the period 2008-2012, a slight reduction of emissions was recorded (-1.9%), due to the economic conditions at that time. However, since 2013, emissions have shown a stable increasing trend, attributed to heightened economic activity and a significant contribution from the tourism sector. The number of tourists visiting St. Kitts and Nevis has increased by 84.1% since 2013, while revenues from the tourism industry have nearly tripled. The positive macroeconomic trends are driving emissions in all sectors upwards, with the exception of agriculture emissions, where a slight decline in GHG emissions has been observed mainly due to reduced activities in this sector. Emission estimates for all categories and subcategories are provided in the Annex: GHG Emission Tables.

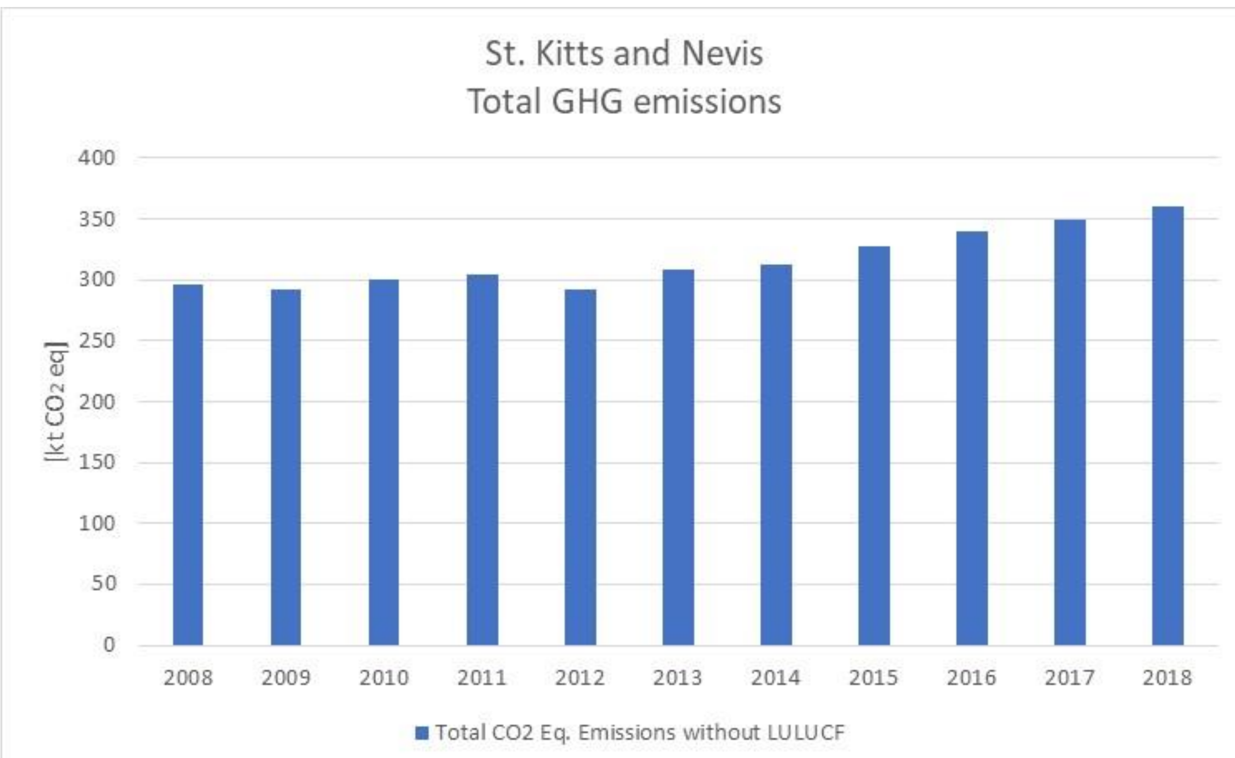


Figure 2.2. St. Kitts and Nevis - total GHG emissions (w/o LULUCF)

Note: LULUCF sector is currently not included in the emissions estimated due to significant variations in emissions/sinks due resulting from land use changes, which are driven by the uncertainties identified in the land use remote sensing approach.

2.1.9. Description of Emission Trends by Gas

CO_2 emissions in 2018 represented 80.4% of overall emissions of greenhouse gases (Figure 2.3, Figure 2.4). CO_2 emissions, excluding LULUCF, have followed energy consumption trends and have exerted a major impact on total emissions. Compared to 2014, CO_2 emissions increased by 17.3% in 2018. The share of CO_2 emissions in total GHG emissions has slightly increased, from 78.5% in 2008 and 79.1% 2014, indicating that emissions in the energy sector is growing faster than in other sectors, such as waste and agriculture).

In 2018, CH_4 emissions accounted for 12.8% of total emissions, which was 6.8% higher than in 2014 and 12.8% higher than 2008. N_2O emissions represented 1.9% of total emissions, showing an increase of 28.5% compared to 2014, but a decrease of 7.1% compared to 2008. Emissions from F-gases have not been estimated but are expected to be addressed through the implementation of the improvement plan.

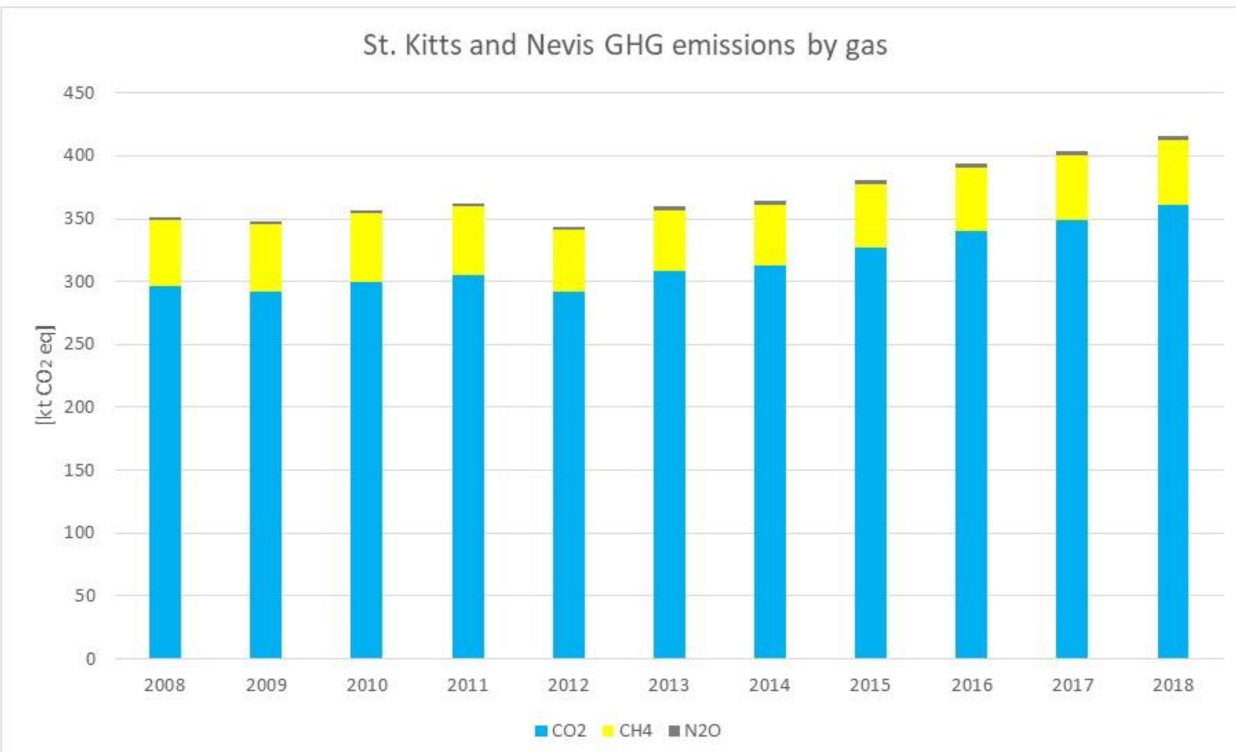


Figure 2.3. St. Kitts and Nevis GHG emissions by gas (w/o LULUCF)

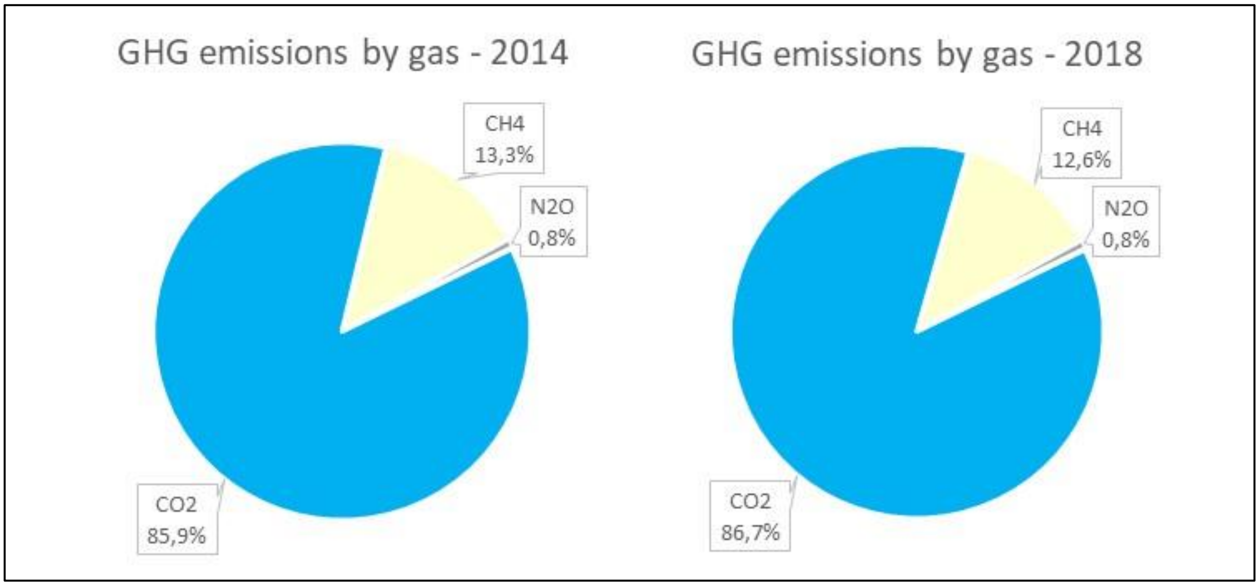


Figure 2.4. St. Kitts and Nevis GHG emissions by gas in 2014 and 2018 (w/o LULUCF)

2.1.10. Description of Emission Trends by Sector

According to the UNFCCC Reporting Guidelines, emissions estimates are grouped into five IPCC categories: Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land-Use Change and Forestry, and Waste (Figure 2.5, Table 2.12).

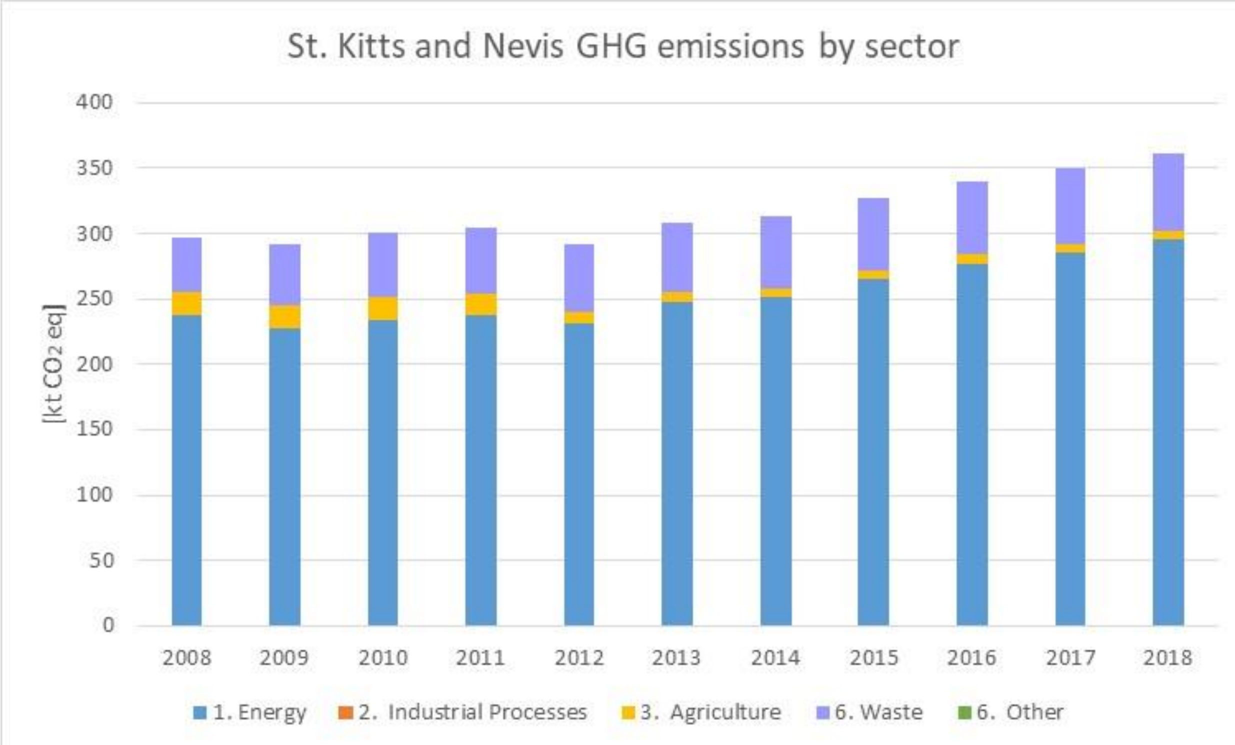


Figure 2.5. St. Kitts and Nevis GHG emissions by sector

By far the largest emitting sector is energy (Figure 2.6), which in 2018 accounted for 81.7% of total GHG emissions. In this sector emissions have increased by 17.3%, compared to estimates in 2014.

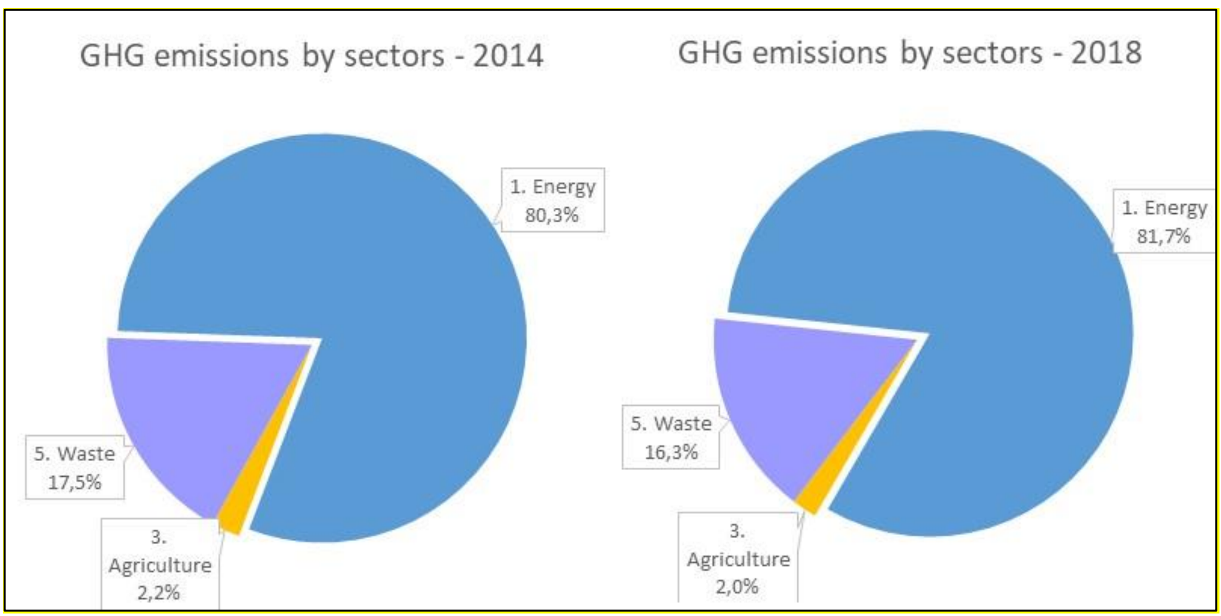


Figure 2.6. St. Kitts and Nevis GHG emissions by sector in 2014 and 2018 (w/o LULUCF)

From 2008–2018, GHG emissions from the energy industry are the biggest sub-sector, accounting for 61.6% of energy emissions, reflecting an increase of 21.2%. Between 2014 and 2018, a steep growth of +13.4% was recorded, primarily due to the increased consumption of electricity.

The greatest increase in GHG emissions was observed in the transport sector, which rose by 41.6% until 2008, primarily due to the growth in road transportation. Emissions from other forms of transport, such as rail, also significantly increased. However, in the period following 2008, GHG emissions from transport decreased reaching their lowest point in 2011, with a decline of - 24.4% compared to 2008. This decrease was attributed to the spill-over effects of the global financial crisis, which significantly impacted the tourism industry. Since 2011, GHG emissions from transport have shown a strong upward trend, doubling by 2018 with an increase of +87.1%.

Between 2008 and 2018, there was a modest increase in GHG emissions from the manufacturing industry and construction, rising +33.7%. The majority of these emissions, 97.4%, came from the construction sector. It is anticipated that after 2018, emissions from manufacturing industries will decrease due to the closure of the production of incandescent bulbs in St. Kitts and Nevis.

Emissions from the Other sectors, which includes households and other commercial uses, fluctuate significantly from year to year but generally exhibit a slightly decreasing trend, resulting in a 10.6% reduction in emissions from 2014-2018.

Fugitive emissions from fuel account for only 0.001% of emissions in the energy sector but have increased by 8.3% since 2014, primarily due to the growth in the transport and storage of LPG.

In most sub-sectors, emissions from industrial processes do not occur due to the absence of industrial installations in St. Kitts and Nevis. In the sub-sectors where GHG emissions are expected–such as 2D non-Energy Products from Fuels and Solvent use with 2D1 Lubricant Use and 2D2 Paraffin wax–GHG emissions have not yet been estimated. This also applies to 2F1a Refrigeration and Stationary Air conditioning and 2F1b Mobile Air conditioning. The estimation of GHG emissions from these currently unassessed sectors is included in the improvement plan and will be estimated in the subsequent GHG reporting cycle.

As the third most significant sector, agriculture emissions in 2018 amounted to 9.45 kt CO_2eq, representing 2.6% of total emissions. It is a relatively minor source of CH_4 but a major contributor of N_2O emissions. Withing the agriculture sector, CH_4 emissions made up 61.4% of total emissions, while N_2O emissions accounted for 38.5, and CO_2 contributed just 0.1%. Although the GHG emissions from agriculture show some oscillations from year to year, the general trend since 2008 has been a decrease, with the exception of 2018, when emissions were 13.5% above 2014 levels. The most significant sub-sector is enteric fermentation, which contributes 54.7% of all agriculture emissions, followed by emissions from agricultural soils at 44.4% and manure management at 20.9%. The remaining emissions (0.1%) are due to CO_2 emissions from urea application.

The total net removals/sinks of CO_2 from the LULUCF sector were not included in the national totals due significant variations in emissions, which can be attributed to uncertainties in the methodology applied during this initial stage of the emission estimates for LULUCF. Namely the quality control of the initial estimates show that the majority emissions/sinks arise from the land use and land use change matrix which is derived from satellite images. However, the data for the period 2005-2015 contains irregularities and reflections, making it unsuitable for accurate land use interpretation.

Methane emissions from the waste sector are the largest source of CH_4, representing 16.2% of total GHG emissions in St. Kitts and Nevis in 2018, and 90.3% of all CH_4 emissions. The portion of CH_4 emissions in this sector amounts to 98.8%, while N_2O is 1.2% and CO_2 emissions are 0.1%. Solid waste handling contributes 77.9% to the total emissions from this sector, while wastewater handling accounts for 21.9%, and waste incineration contributes 0.2%.

Emissions in 2018 were 7.4% higher than in 2014. Emissions from solid waste disposal have been steadily increasing since 2008, rising by +28.1% due to population growth and positive macroeconomic development. Meanwhile, emissions from wastewater treatment and discharge have more than doubled since 2008, primarily driven by trends in the tourism sector.

Table 2.12. GHG emissions and removals in St. Kitts and Nevis (in kt CO_2eq) by sectors and sub-sectors, 2008-2018.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change to BY	Change to PY
Total CO_2eq Emissions without LULUCF	299,99	295,77	303,63	308,22	294,24	309,77	314,74	329,21	341,95	350,84	363,54	15,5%	21,2%
Total CO2eq Emissions with LULUCF	234,14	229,92	237,78	217,73	203,75	219,29	201,65	216,12	228,86	237,74	250,44	24,2%	7,0%
1. Energy	238,00	227,79	234,39	238,03	231,81	247,49	251,58	264,71	277,03	284,88	295,17	17,3%	24,0%
A. Fuel Combustion	238,00	227,79	234,39	238,03	231,81	247,49	251,58	264,71	277,03	284,88	295,17	17,3%	24,0%
1. Energy Industries	149,97	162,74	167,95	171,24	163,15	159,91	160,31	167,61	176,47	175,51	181,74	13,4%	21,2%
2. Man. Ind. & Constr.	4,43	4,25	4,22	4,39	4,42	4,67	4,92	5,17	5,42	5,67	5,92	20,3%	33,7%
3. Transport	70,96	50,63	52,51	53,68	56,29	75,08	78,44	83,95	88,51	95,56	100,44	28,1%	41,6%
4. Other sectors	12,64	10,18	9,71	8,72	7,96	7,83	7,91	7,98	6,63	8,14	7,07	-10,7%	-44,1%
5. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-5,3%	-40,9%
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
2. Oil and Natural Gas and other	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	-5,3%	-40,9%
2. Industrial Processes	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	-	-
A. Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
C. Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
D. Non-energy products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
E. Electronics industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
F. Product uses as ODS substitutes	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
G. Other product manufacture and use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
3. Agriculture	20,44	20,39	20,39	19,48	10,62	9,68	8,33	8,69	8,26	8,20	9,45	13,5%	-53,8%
A. Enteric Fermentation	14,95	14,95	14,95	14,08	7,11	6,48	5,18	5,59	5,19	5,17	5,17	-0,2%	-65,4%
B. Manure Management	2,36	2,37	2,37	2,49	1,96	1,91	1,86	1,92	1,92	1,91	1,98	6,1%	-16,2%
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
D. Agricultural Soils	3,12	3,06	3,06	2,91	1,54	1,28	1,28	1,17	1,13	1,11	2,29	79,3%	-26,6%
E. Prescribed Burning of Savannahs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
F. Field Burning of	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change to BY	Change to PY
Agricultural Residues													
G. Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
H. Urea applications	0,01	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,00	0,01	250,0%	-6,7%
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
4. Land Use, Land-Use Change and Forestry	-65,84	-65,84	-65,84	-90,49	-90,49	-90,49	-113,10	-113,10	-113,10	-113,10	-113,10	0,0%	71,8%
A. Forest Land	-130,02	-130,02	-130,02	-151,65	-151,65	-151,65	-140,34	-140,34	-140,34	-140,34	-140,34	0,0%	7,9%
B. Cropland	16,49	16,49	16,49	22,58	22,58	22,58	10,33	10,33	10,33	10,33	10,33	0,0%	-37,4%
C. Grassland	20,84	20,84	20,84	30,75	30,75	30,75	13,73	13,73	13,73	13,73	13,73	0,0%	-34,1%
D. Wetlands	0,00	0,00	0,00	0,14	0,14	0,14	0,00	0,00	0,00	0,00	0,00	-	-
E. Settlements	3,39	3,39	3,39	3,13	3,13	3,13	0,75	0,75	0,75	0,75	0,75	0,0%	-77,8%
F. Other Land	23,45	23,45	23,45	4,55	4,55	4,55	2,44	2,44	2,44	2,44	2,44	0,0%	-89,6%
G. Harvested wood products	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
5. Waste	41,55	47,59	48,85	50,71	51,81	52,61	54,84	55,81	56,66	57,76	58,92	7,4%	41,8%
A. Solid Waste Disposal	35,85	36,97	38,18	39,31	40,35	41,09	42,04	42,96	43,76	44,80	45,90	9,2%	28,0%
B. Biological treatment of solid waste	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-
C. Incineration and open burning of waste	0,12	0,13	0,13	0,13	0,13	0,13	0,13	0,13	0,13	0,13	0,14	3,2%	8,7%
D. Waste water treatment and discharge	5,58	10,50	10,54	11,27	11,33	11,39	12,66	12,72	12,77	12,83	12,88	1,7%	131,0%
E. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-
6. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-
Memo Items													
International Bunkers													
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-	-
Navigation	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	-	-
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-
CO_2 Emissions from Biomass	0,14	0,14	0,14	0,14	0,14	0,16	0,16	0,16	0,17	0,17	0,17	12,2%	27,8%

2.1.11. Energy Sector

Overview over the sector

The energy sector is the primary source of GHG emissions in St. Kitts and Nevis, accounting for 81.8% of overall CO_2 eq. emissions in 2018 (excluding LULUCF). Emissions in this sector stem mainly from fuel combustion, which contributes 99.9% of the sector's emissions, with fugitive emissions from fuels making up less than 0.1% of emissions (Figure 2.7).

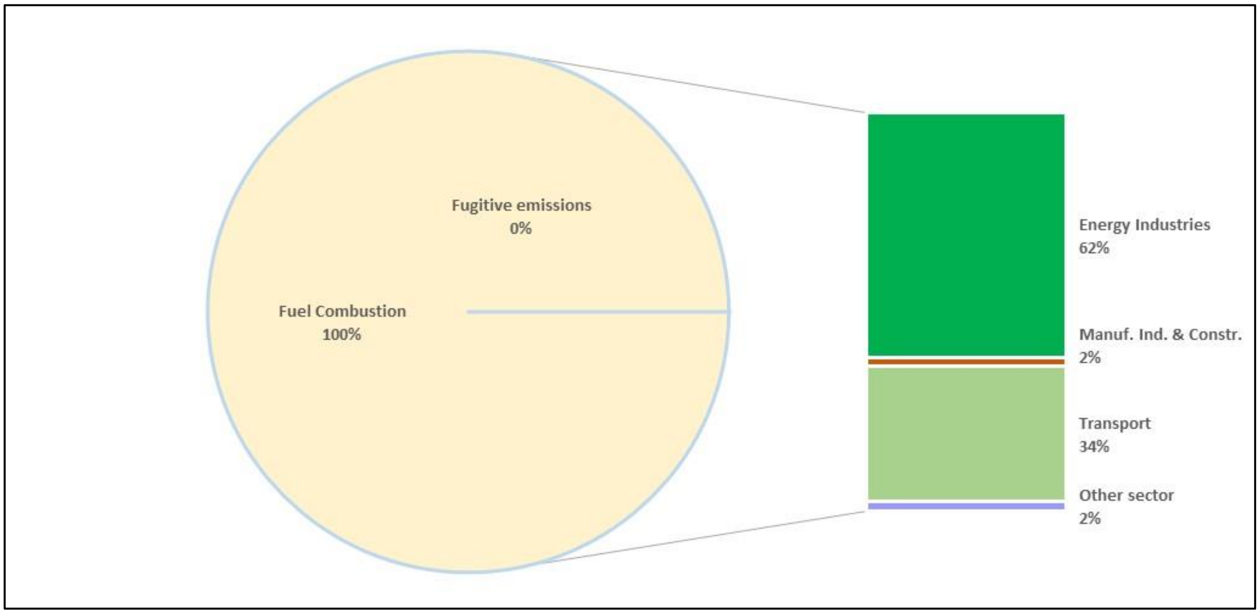


Figure 2.7. 2018 Emissions of GHG in energy sector by categories

Emissions from the energy sector are shown in Table 2.13 and Figure 2.8. Compared to 2017, GHG emissions increased by 3.6% in 2018, representing a 17.3% rise from 2014 levels and a 24% increase from 2008.

Table 2.13. Emissions from energy sector by sources in kt CO_2 eq

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. Energy	238,00	227,79	234,39	238,03	231,81	247,49	251,59	264,72	277,03	284,88	295,18
A. Fuel Combustion	238,00	227,79	234,39	238,03	231,81	247,49	251,58	264,71	277,03	284,88	295,17
1. Energy Industries	149,97	162,74	167,95	171,24	163,15	159,91	160,31	167,61	176,47	175,51	181,74
2. Man. Ind. & Constr.	4,43	4,25	4,22	4,39	4,42	4,67	4,92	5,17	5,42	5,67	5,92
3. Transport	70,96	50,63	52,51	53,68	56,29	75,08	78,44	83,95	88,51	95,56	100,44
4. Other sectors	12,64	10,18	9,71	8,72	7,96	7,83	7,91	7,98	6,63	8,14	7,07

5. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas and other	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002

The primary driver of the rising GHG emissions is the transport sector, where fuel consumptions in 2018 increased by 28.1% compared to 2014 and by 41.6% compared to 2008.

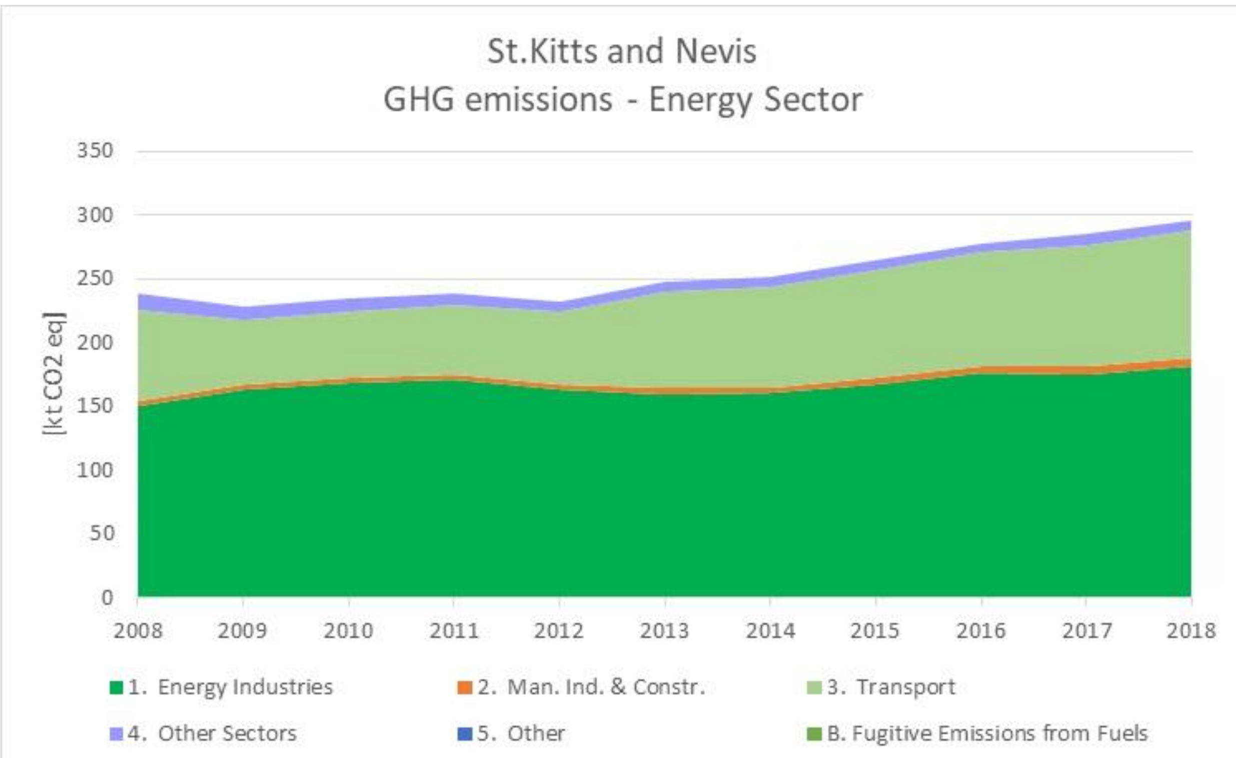


Figure 2.8. 2018 Emissions of GHG in energy sector by categories

Energy industries (electricity production) which are also contributing to the trend in 2018 increased emissions for 3.5% compared to previous year and 13.4% compared to 2014. The increase in emissions is a consequence of higher demand for electricity. The demand is driven by a positive macroeconomic environment mainly driven by the positive trends in the tourism sector. Lack of change in the trend for Manufacturing industries and Construction and 'Other sectors' with Households and Commercial and other energy use; are due to the relative small amount of emissions having a negligible effect on the overall developments of emissions in the energy sector.

Fuel combustion

Energy Industries

This category (Table 2.14, Figure 2.9) presents the consumption of fuels and emissions of greenhouse gases in:

- Public electricity and heat production (CRF 1.A.1.a)
- Petroleum refining (CRF 1.A.1.b)
- Manufacture of solid fuels and other energy industries (CRF 1.A.1.c)

Public electricity and heat production is the only relevant sub-category in the energy industries. Electricity in St. Kitts and Nevis is generated by diesel-powered generators operated by the two main public electricity producers, SKELEC and NEVLEC.

Table 2.14. Emissions from energy industries (in kt CO_2 eq)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A.1. Energy industries	149,97	162,74	167,95	171,24	163,15	159,91	160,31	167,61	176,47	175,51	181,74
a. Public electricity and heat production	149,97	162,74	167,95	171,24	163,15	159,91	160,31	167,61	176,47	175,51	181,74
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Minor emissions are also anticipated in the solid fuel manufacturing category due to limited charcoal production; however, these emissions have not yet been estimated.

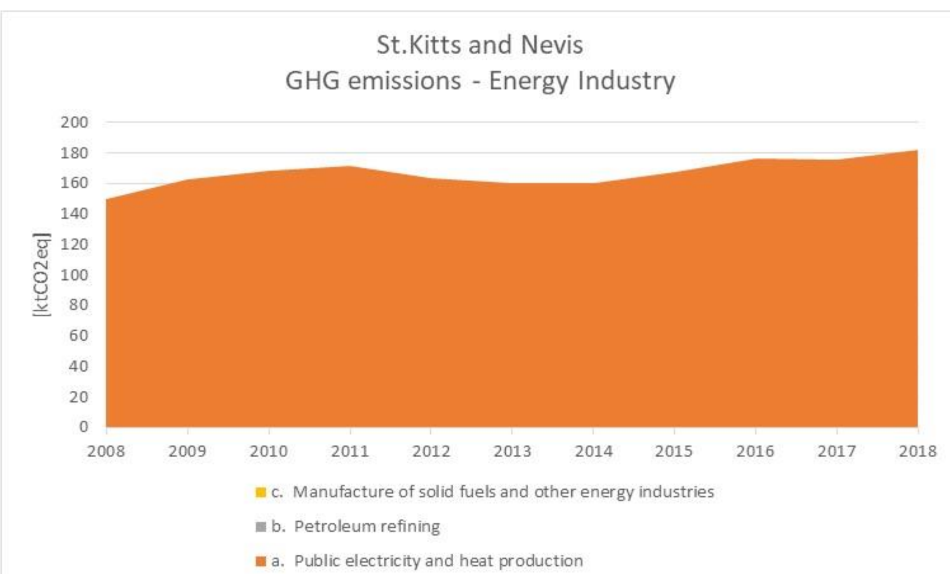


Figure 2.9. 2018 GHG emissions in energy industries

GHG emissions in 2018 reached 182 kt CO_2eq, reflecting an increase of 3.5% from the previous year and 13,4% from 2014. Over the period 2008−2018, no major disruptions in electricity production were observed in the GHG emission time-series due to extreme weather events. Electricity production id experience a slight decreased due to macroeconomic conditions. Notably, in 2010, the Windwatt company commissioned the Maddens Wind Farm on Nevis Island, adding eight wind turbines (each 275kW of installed capacity) for a total installed capacity of 2,2 MW. Additional investments in renewable energy sources, such as photovoltaics, have been announced, which are expected to contribute to future emission reductions in this sector.

Manufacturing industries and construction

This category, as outlined in CFR reporting, captures fuel consumption and greenhouse gas emissions across six specific industry types. All others industries, including the construction industry, are reported under Other industry. In contrast, the 2006 IPCC reporting table disaggregates this category further into thirteen distinct categories.

For St. Kitts and Nevis, GHG emissions are allocated into two categories: 1.A.2.e − Food Processing, Beverages, and Tobacco and 1.A.2.k – Construction. An overview of the emission trends in these categories are presented in Table 2.15 and Figure 2.10.

Table 2.15. Emissions from manufacturing industry and construction in kt CO_2eq

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A.2 - Manufacturing industries and construction	4,43	4,25	4,22	4,39	4,42	4,67	4,92	5,17	5,42	5,67	5,92
1.A.2.e - Food processing, beverages, and tobacco	0,15	0,15	0,15	0,14	0,15	0,15	0,15	0,15	0,15	0,15	0,15
1.A.2.k - Construction	4,27	4,10	4,08	4,25	4,27	4,52	4,77	5,02	5,27	5,52	5,77

GHG emissions in Manufacturing industries and construction in 2018 increased by 4.4% compared to previous year, 20,3% compared to 2014, and 33.7% compared to 2008. Within this category the vast majority (97,6%) of emissions is attributed to 1.A.2.k Construction, while the remaining 2,6% falls under 1.A.2.e Food Processing, Beverages, and Tobacco. The primary driver of these trends is the Construction sector, where emissions increased for 20.9% compared to 2014.

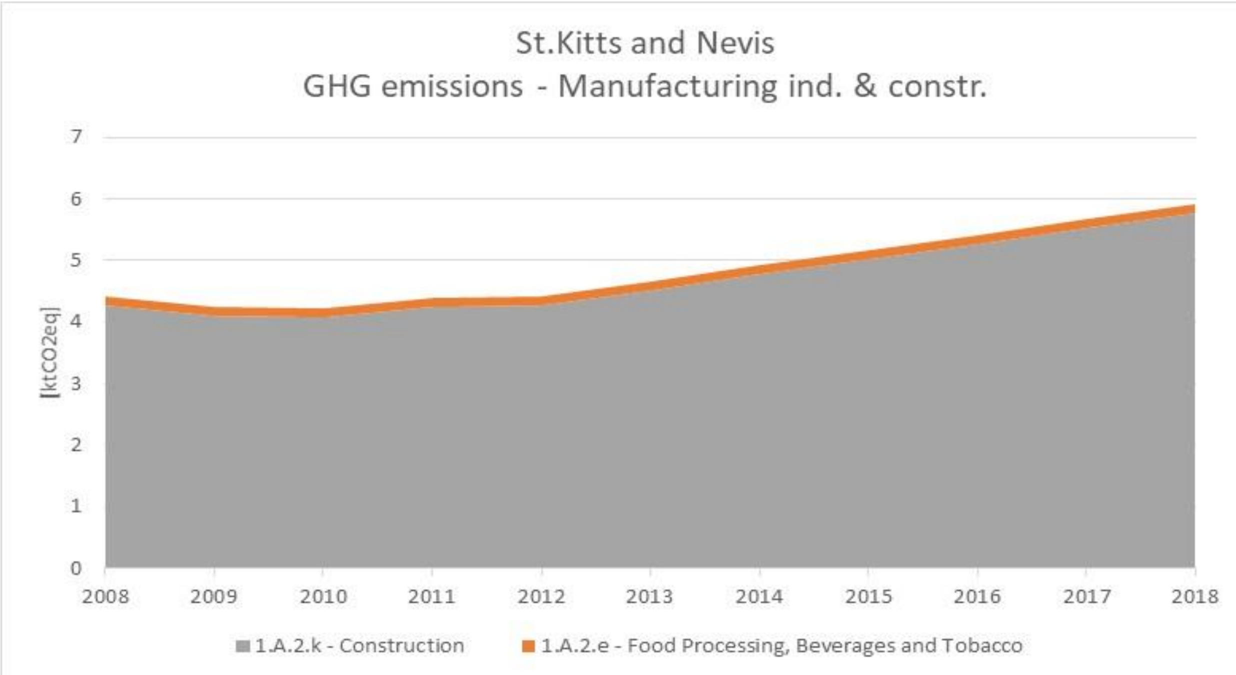


Figure 2.10. Emissions of GHG in manufacturing industries and construction

Transport sector

This category encompasses the consumption of fuels and associated greenhouse gases emissions in the following areas:

- Domestic aviation (CRF 1.A.3.a)
- Road transportation (CRF 1.A.3.b)
- Railways (CRF 1.A.3.c)
- National navigation (CRF 1.A.3.d)

It is important to note that, at this stage, emissions from domestic aviation (flights taking off and landing in St. Kitts and Nevis) and domestic navigation are not yet estimated. It is also anticipated that neither of these two sub-categories will emerge as key categories once emissions are assessed. The evolution of the emissions in this sector is presented in Table 2.16 and

Figure 2.11.

Table 2.16. Emissions from Transport in kt CO_2eq

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A.3 - Transport	70,96	50,63	52,51	53,68	56,29	75,08	78,44	83,95	88,51	95,56	100,44
1.A.3.b - road transportation	70,86	50,52	52,35	53,54	56,15	74,95	78,28	83,79	88,35	95,39	100,26
1.A.3.c - Railways	0,10	0,11	0,15	0,14	0,14	0,14	0,16	0,16	0,16	0,17	0,19

Almost all GHG emissions from the transport sector in St. Kitts and Nevis are from road transport. Emissions from railways are limited to St. Kitts Scenic Railway, a 29km long narrow-gauge railway that exclusively transports tourists along the coastline of St. Kitts. In 2018, GHG emissions from the road transport sector increased by 28.1% compared to 2014 and by 48.6% compared to 2008. Meanwhile, emissions from railways in 2018 have increase by 15.1% compared to 2014 and by 88.9% compared to 2008.

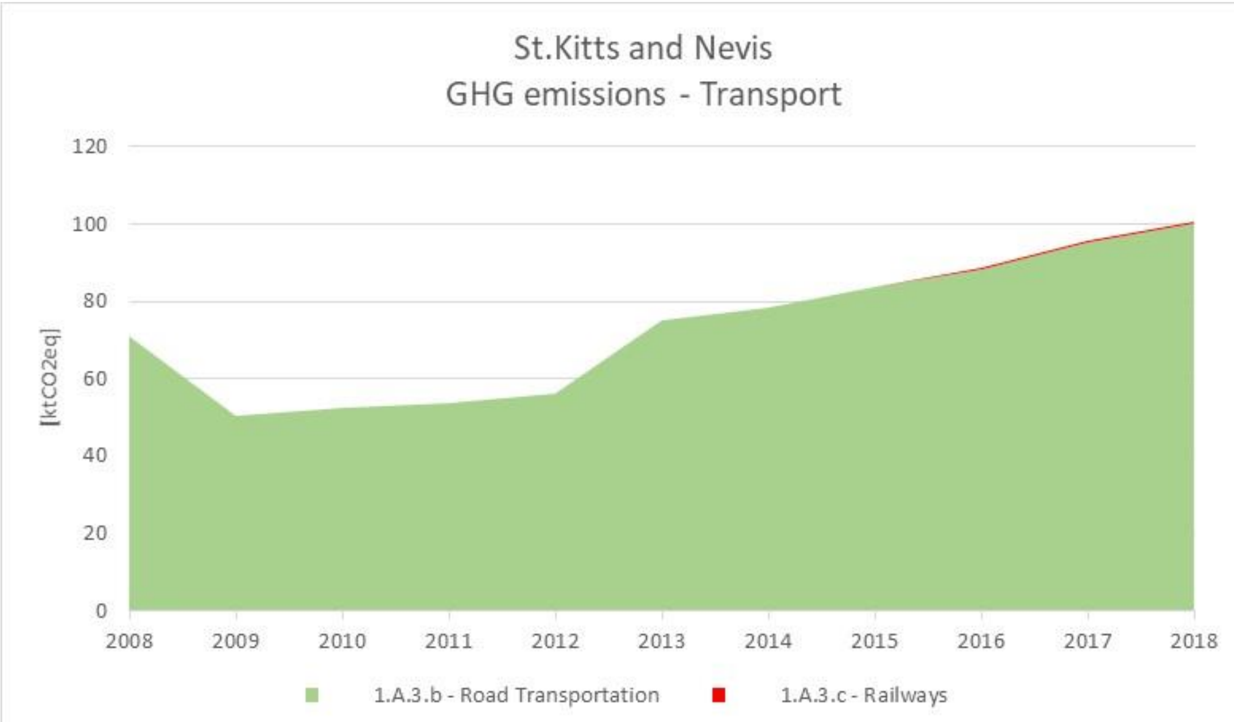


Figure 2.11. Emissions of GHG in transport sector

Within the Transport sector (Figure 2.12, Table 2.17), in 2018, emissions from cars represent 63.3% of the overall emissions in the sector which is 1.0% less than in 2018. The second largest share goes to heavy duty vehicles (HDV) and busses with 24.0% of emissions, down from 26.9% in 2008. The biggest increase in share is observed for light duty vehicles (LDV) where the share in emissions increased from 8.4% in 2008 to 12.6% in 2018.

The majority of vehicles imported into St. Kitts and Nevis are second-hand vehicles originally produced for the US or Japanese markets. As a result, the share of vehicles without three-way catalysts was already small in 2008, at 0.81%, and has further declined to 0.05% in 2018.

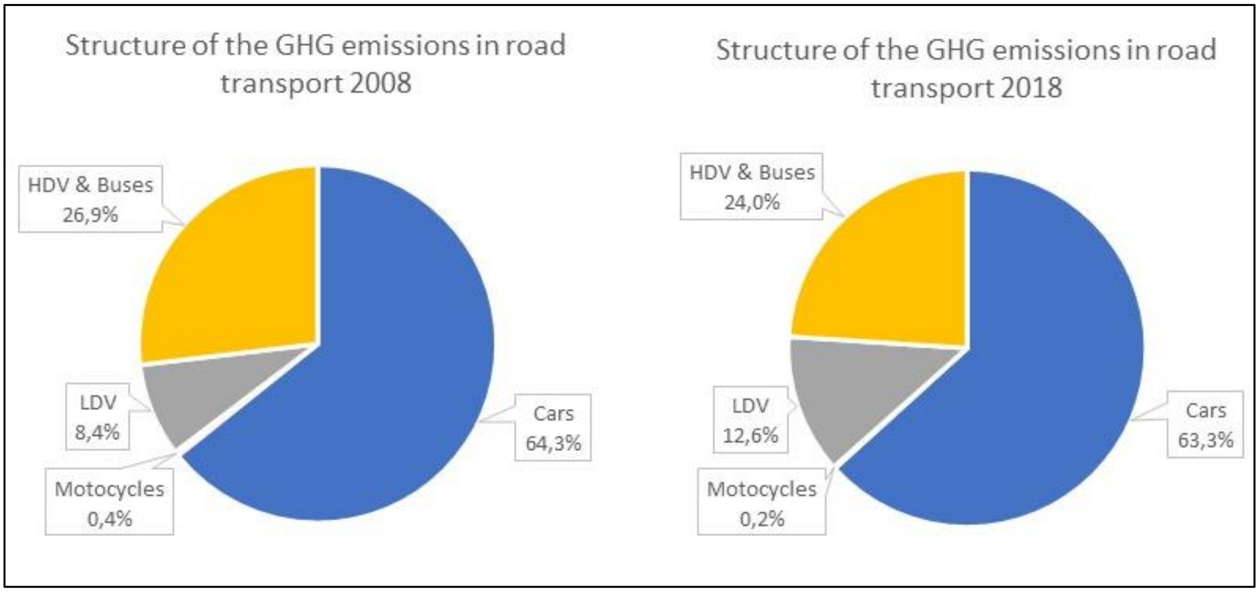


Figure 2.12. Structure of the GHG emissions from road transport in 2008 and 2018.

Table 2.17. Structure of the emissions from transport in kt CO_2eq

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A.3.b - road transportation	70,86	50,52	52,35	53,54	56,15	74,95	78,28	83,79	88,35	95,39	100,26
1.A.3.b.i - Cars	45,54	29,73	31,56	32,78	34,73	50,86	52,90	55,58	59,38	62,57	63,42
1.A.3.b.i.1 - Passenger cars with 3-way catalysts	44,72	29,38	31,32	32,62	34,61	50,74	52,80	55,50	59,32	62,51	63,37
1.A.3.b.i.2 - Passenger cars without 3-way catalysts	0,81	0,35	0,24	0,16	0,12	0,12	0,10	0,08	0,06	0,06	0,05
1.A.3.b.ii - Light-duty trucks	5,99	4,85	5,26	5,56	5,74	7,41	8,87	9,30	10,57	12,03	12,65
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts	5,32	4,31	4,70	4,97	5,13	6,64	7,96	8,34	9,49	10,79	11,34
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts	0,67	0,54	0,56	0,59	0,61	0,78	0,91	0,95	1,08	1,23	1,30
1.A.3.b.iii - Heavy-duty trucks and buses	19,04	15,73	15,33	15,00	15,52	16,53	16,35	18,76	18,24	20,64	24,03
1.A.3.b.iv - Motorcycles	0,29	0,22	0,20	0,19	0,16	0,15	0,15	0,15	0,16	0,16	0,17

GHG emission from cars in 2018 increased by 19.9% compared to 2014 and 39.3% compared to 2008. Meanwhile, emissions from LDVs, which include vans that operate on several bus routes, rose by 42.6% compared to 2014 and a staggering 111.3% compared to 2008 (Figure 2.13). Emissions from heavy duty vehicles and busses during the same period increased by 46.6% and 26.2%, respectively. While the HDVs emissions are primarily driven by the commerce and construction sectors, LDVs mainly serve tourism and domestic transport demands.

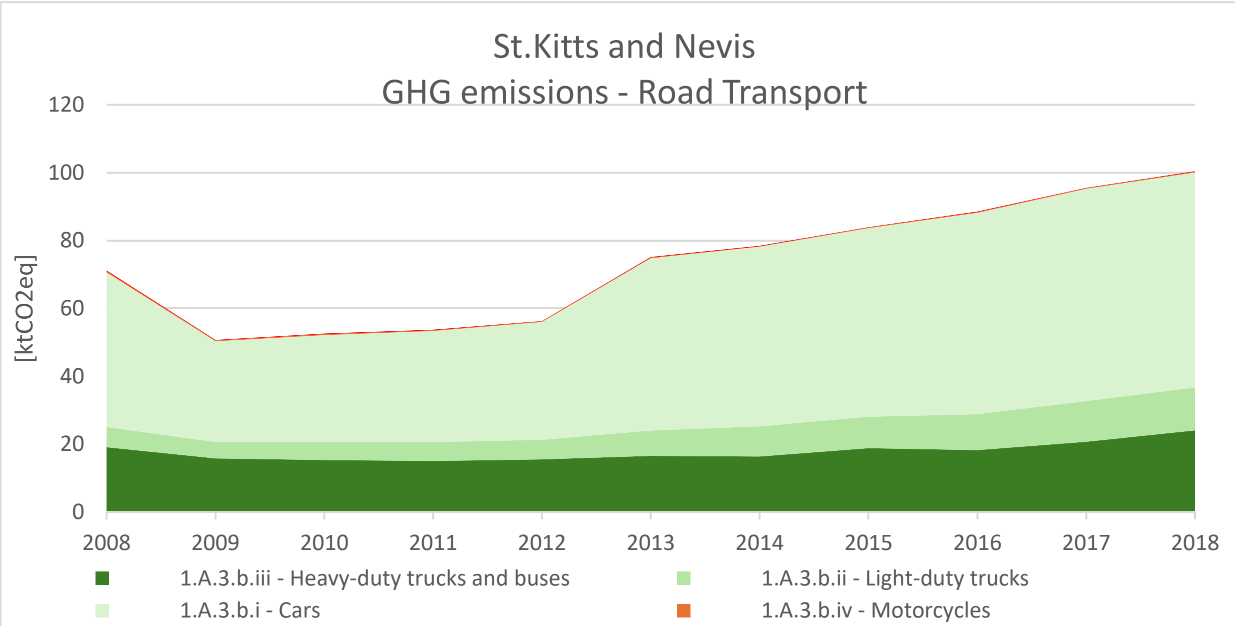


Figure 2.13. Structure of GHG emissions in road transportation

The evolution of emissions from passenger car transport is closely tied to macroeconomic environment, GDP growth, and the increased purchasing power of residents of St. Kitts and Nevis. During the observed period, (2008-2018) there was a decline in emissions from 2009–2012 due to the spillover effects of the global financial crises. However, the number of vehicles per capita increased from 365 cars per thousand inhabitants in 2008 to 404 cars per thousand inhabitants in 2018, indicating that, on average, each household had one car by 2018.

Other sector

This category encompasses the consumption of fuels and the associated greenhouse gas emissions in the following categories:

- Commercial /institutional sector (CRF 1.A.4.a)
- Residential sector (CRF 1.A.4.b)
- Agriculture /forestry / fishing (CRF 1.A.4.c)

GHG emissions from the other sector consists of two main sub-categories, commercial/institutional and residential sector, with the former accounting for 95.2% of emissions in 2018. The remaining 4.8% originated from agriculture/forestry/fishing. The predominant source of emissions in this category was liquid fuels (LPG) primarily used for food preparation both in the residential and commercial sectors (including services). In 2018, GHG emission from the other sector decreased by 10.7% compared to 2014, mainly due to emission reductions in the commercial and institutional sector. Conversely, emissions from households increased by 3.9% during the same period, driven primarily by population growth in St. Kitts and Nevis. The evolution of the emission is detailed in Table 2.18 and Figure 2.14.

Table 2.18. Structure of the emissions from the other sector in kt CO_2eq

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A.4 - Other sectors	12,64	10,18	9,71	8,72	7,96	7,83	7,91	7,98	6,63	8,14	7,07
1.A.4.a - Commercial/ Institutional	8,15	5,65	5,11	4,11	3,34	3,12	3,16	3,18	1,79	3,26	2,14
1.A.4.b - Residential	4,13	4,18	4,27	4,27	4,28	4,37	4,41	4,46	4,50	4,55	4,59
1.A.4.c - Agriculture/Forestry/ Fishing/Fish Farms	0,36	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34
1.A.4.c.i - Stationary	0,36	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34	0,34
1.A.4.c.ii - Off-road Vehicles and Other Machinery	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.A.4.c.iii - Fishing (mobile combustion)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

It is important to note that emissions from the sub-categories 1.A.4.c.ii − off-road vehicles and other machinery (which includes emissions from fuels combusted in traction vehicles on farmland and in forests) and 1.A.4.c.iii − fishing (which includes emissions from fuels combusted for inland, coastal and deep-sea fishing) have not yet been estimated. Plans to estimate these emissions are included in the improvement plan.

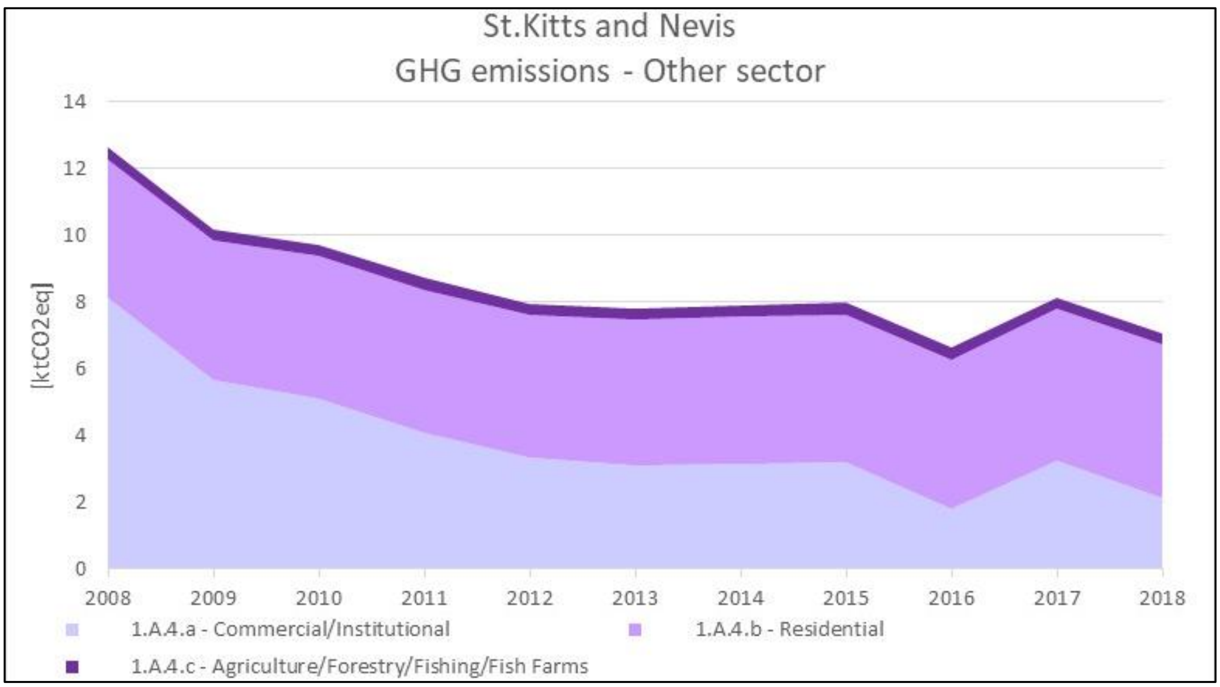


Figure 2.14. Structure of GHG Emissions in the other sector

Fugitive emissions from solid fuels, oil, natural gas and other emissions from energy production

This category encompasses the fugitive emissions of greenhouse gases from the following categories:

- Solid fuels (CRF 1.B.1)
- Oil and natural gas (CRF 1.B.2)

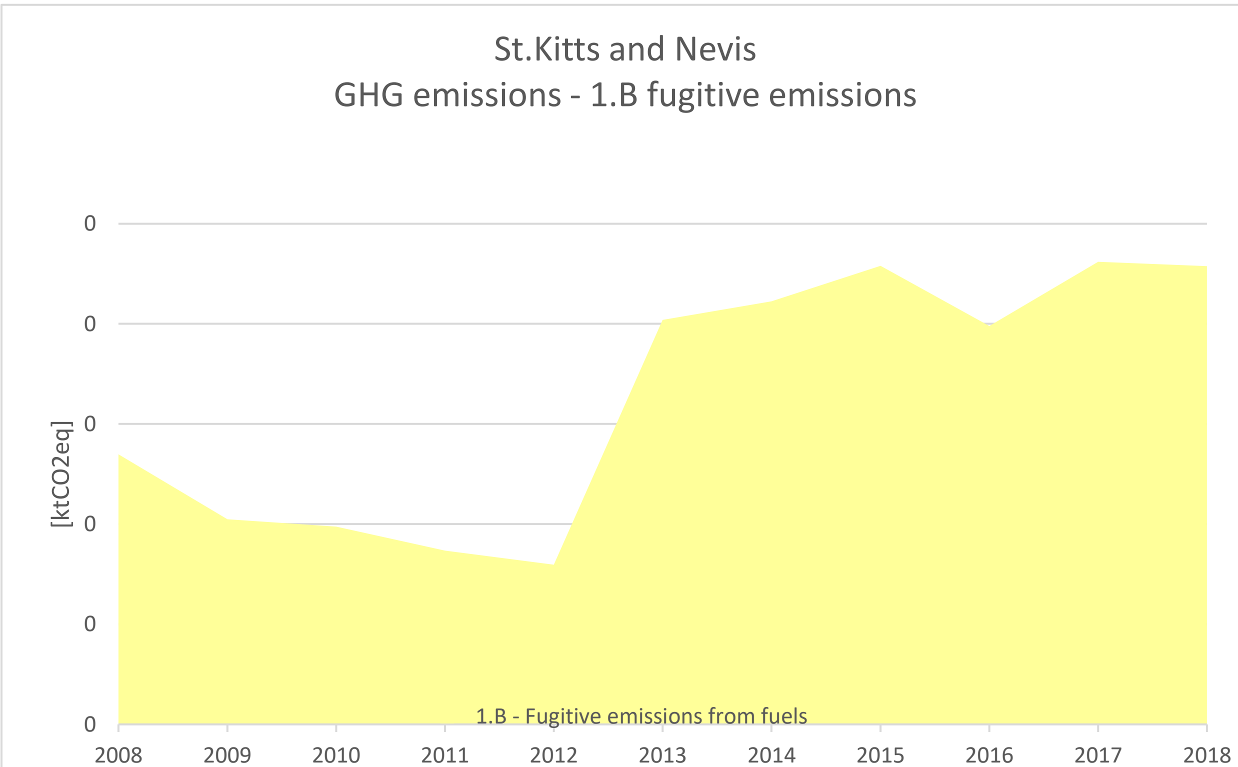
Fugitive emissions from solid fuels do not occur in St. Kitts and Nevis. In contrast, fugitive emissions for oil and natural gas, specifically from LPG are minimal, amounting to 0,002 kt CO2eq. This represents an 8.3% increase compared to 2018 see (Table 2.19, Figure 2.15). The emissions are driven by the amount of transported LPG.

Table 2.19. Trends of fugitive emissions from fuels (in kt CO_2eq)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.B - Fugitive emissions from fuels	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002
1.B.1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a - Coal mining and handling	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.i - Underground mines	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.i.1 - Mining	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.i.2 - Post-mining seam gas emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.i.3 - Abandoned underground mines	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.ii - Surface mines	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.ii.1 - Mining	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.a.ii.2 - Post-mining seam gas emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.b - Uncontrolled combustion and burning coal dumps	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c - Solid fuel transformation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 - Oil and Natural Gas	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002
1.B.2.a - Oil	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002
1.B.2.a.i - Venting	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.ii - Flaring	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii - All Other	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002
1.B.2.a.iii.1 - Exploration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.2 - Production and Upgrading	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.3 - Transport	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002	0,002	0,002	0,002
1.B.2.a.iii.4 - Refining	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.5 - Distribution of oil products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.6 - Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b - Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.i - Venting	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.ii - Flaring	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii - All Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.1 - Exploration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

1.B.2.b.iii.2 - Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.3 - Processing	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.4 - Transmission and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.5 - Distribution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.6 - Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.3 - Other emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Figure 2.15. Trends in GHG fugitive emissions



2.1.12. Industrial Processes and Product Use

Emissions from industrial processes are currently not included, and GHG emissions from product use have not yet been estimated. It is not anticipated that emissions from product use will reach a level or trend significant enough to be classified as a key category. The estimation of emissions from the following areas is included in the improvement plan, along with an assessment of their priority level:

- Lubricant use (2.D.1)
- Paraffin wax use (2.D.2)
- Solvent use (2.D.3)
- Refrigeration and stationary air conditioning (2.F.1.a)
- Mobile air conditioning (2.F.1.b)

- Use of electrical equipment (2.G.1.b)

2.1.13. Agriculture, Forestry and Other Land Use

Overview of the Agriculture Sector

The agriculture sector is the smallest contributor of overall GHG emissions for St. Kitts and Nevis (

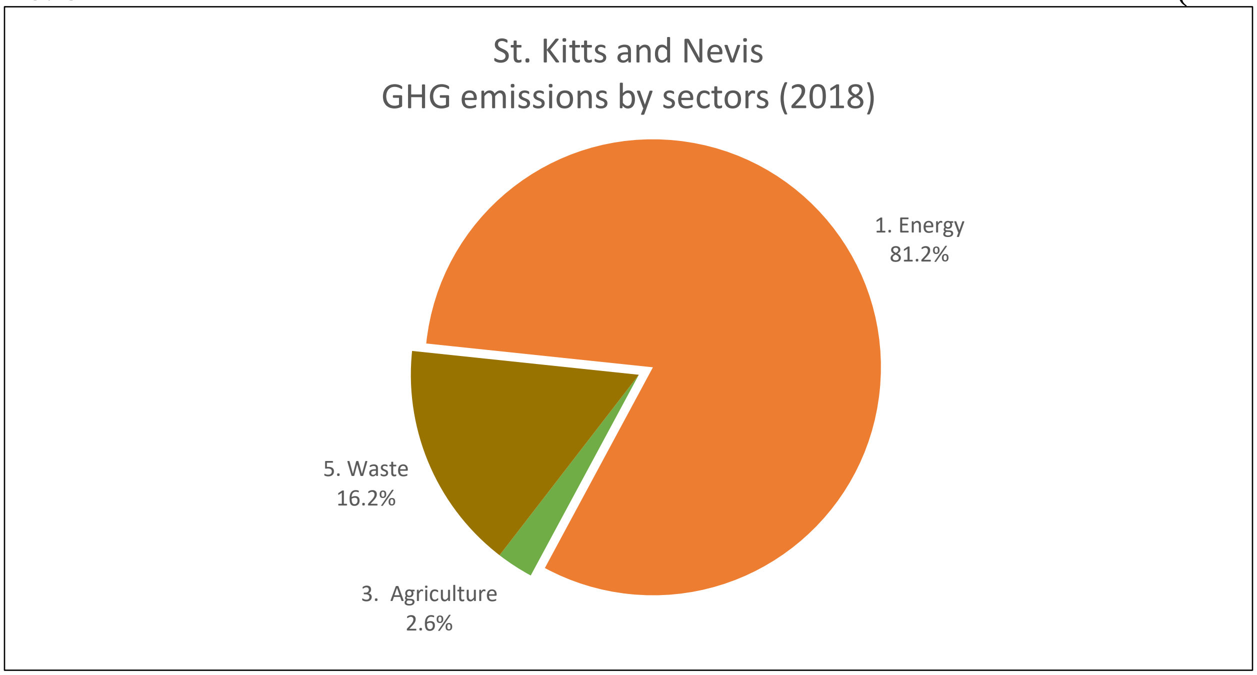


Figure 2.16). In 2018, GHG emission estimates accounted for approximately 2.6% of overall CO_2eq emissions (excluding LULUCF). Emissions from this sector primarily arise from enteric fermentation (approximately 55%), manure management (21%) and managed solid waste (24%). It is important to note that urea application was omitted from the 2018 estimates due to incomplete datasets; historical trends indicate that this omission accounts for less than 1% of the total GHG emissions from the agriculture sector.

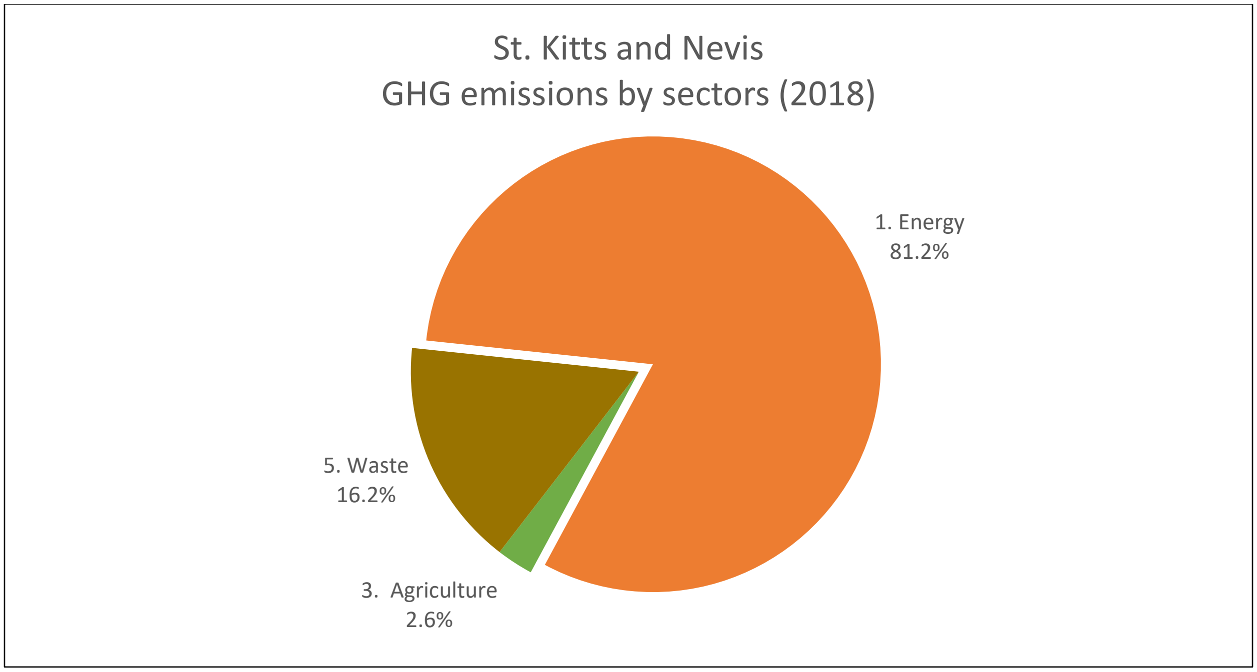


Figure 2.16. 2018 St. Kitts and Nevis GHG emissions by sector w/o LULUCF

GHG emissions in the agriculture sector typically come from sources related to livestock, crop production, soil management, and the application of fertilisers. In St. Kitts and Nevis, the agriculture sector accounted for 2.4% of GDP in 2010, with 19.2% of the islands' total land area dedicated to agriculture use. These practices include livestock production and soil enrichment from fertilisers. The Ministry of Agriculture indicated that no liming occurs in St. Kitts and Nevis, and urea amendments to soil are accounted for based on data provided by a local distributor. Additionally, biomass burning was not estimated as country specific data was not available.

Based on this information, GHG emission estimates for the gases CO_2, CH_4 and N_2O were compiled for the agriculture sector categories and are detailed in Table 2.20 and illustrated in Figure 2.17.

Table 2.20. Reported IPCC categories in the agriculture sector

IPCC Category	IPCC Category Name
3.A.1	Enteric fermentation (CH_4)
3.A.2	Manure management ($CH_4$and Direct N_2O)
3.C.3	Urea application (CO_2)
3.C.4	Managed soils (Direct N_2O)
3.C.5	Managed soils (Indirect N_2O)
3.C.6	Indirect N_2O emissions from manure management

St. Kitts and Nevis did not calculate emission estimates for enteric fermentation, manure management, and managed soils in the SNC submission due to lack of data and country specific information. To enhance the accuracy of previously submitted GHG emission estimates in the agriculture sector, GHG emission estimates were prepared for the time series from 2000 to 2018.

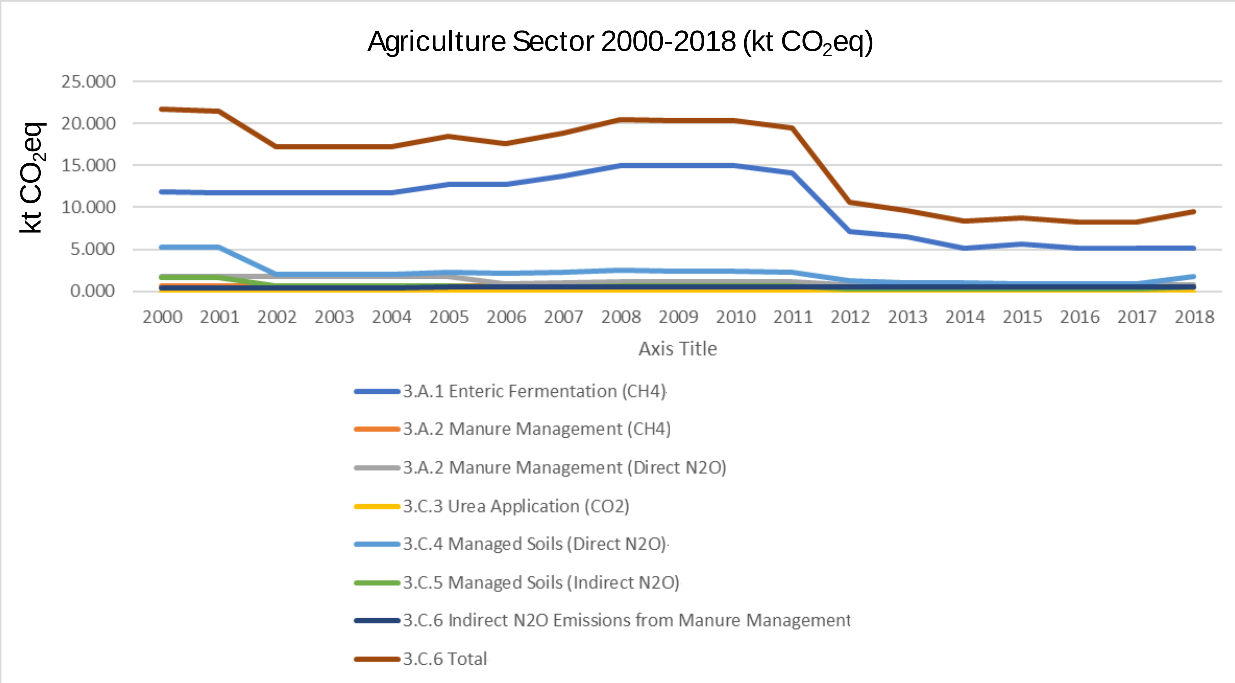


Figure 2.17. GHG Emissions trends 2000-2018 by IPCC sub-category

Total GHG emissions in the agriculture sector accounted for 21.657 kt CO_2eq in the year 2000 and 9.443 kt CO_2eq in the year 2018. This represents a decrease in overall sectoral emissions of approximately 56.4%.

It is important to note that emission estimates for sub-categories involving livestock used FAOSTAT datasets from 2000–2018 due to incomplete country datasets and IPCC defaults, with input parameters reflective of the LAC region. In-country experts provided information on manure management system usage by livestock category, allowing for accurate reporting of livestock associated with pasture/range/paddock allocation under managed soils.

For urea application, country-specific data was available for only two years of the 2002–2018 time series. Therefore, the compilation team opted to use FAOSTAT urea import data until the local dataset can be extended and validated. Due to lack of local data on fertilizer inputs or usage, FAOSTAT data for the years 2000–2018 was used to calculate emissions for indirect N_2O emissions from managed soils.

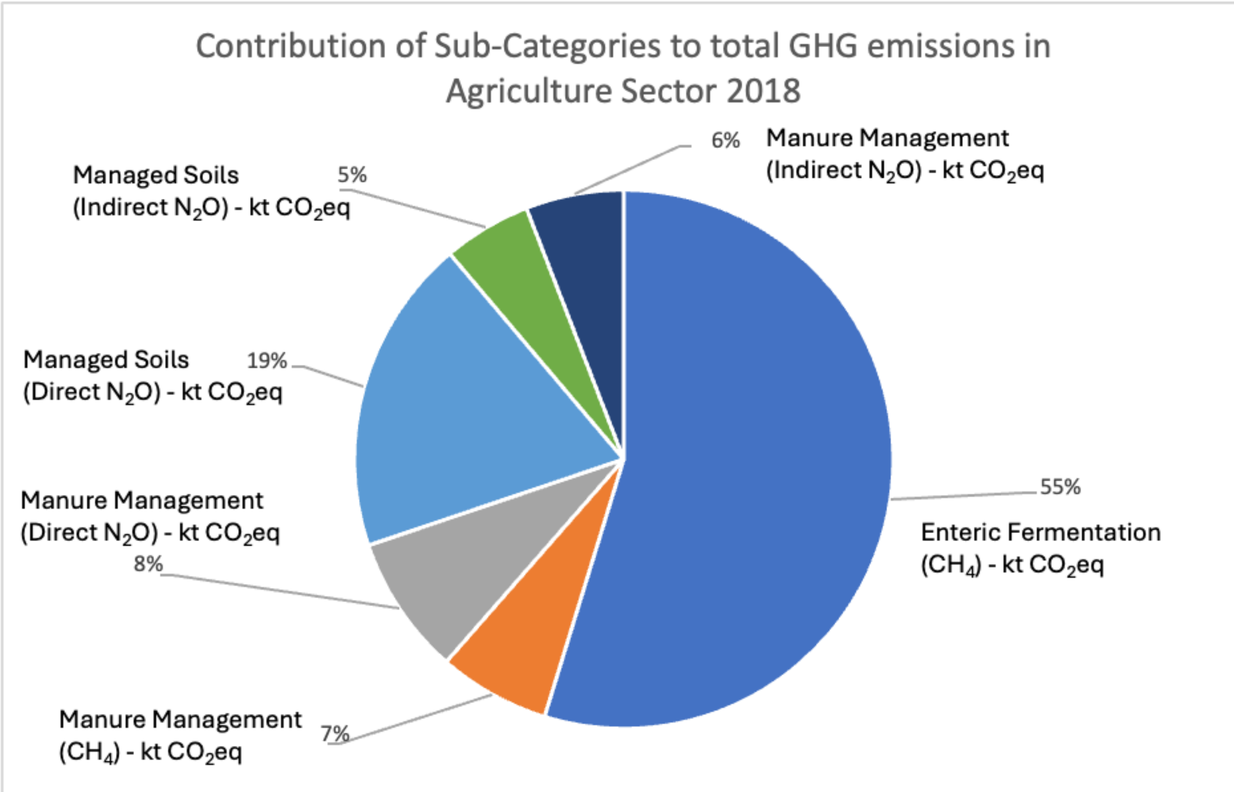


Figure 2.18. 2018 agriculture sector (sub-category profile)

The distribution of emissions from agricultural is illustrated in Figure 2.18 and Figure 2.19, categorized by sub-categories and gases, respectively. In 2018, enteric fermentation (CH_4) accounted for 55% of total emissions in the agriculture sector. Manure management (CH_4 and Direct N_2O) contributed approximately 15%. Direct N_2O emissions from managed soils emerged as the second highest emitting sub-category, accounting for 19% of total emissions. Indirect N_2O emissions from manure management made up about 6% of the 2018 estimate, while indirect N_2O emissions from managed soils, due to leaching and atmospheric volatilization of managed animal waste, accounted for the remaining 5%.

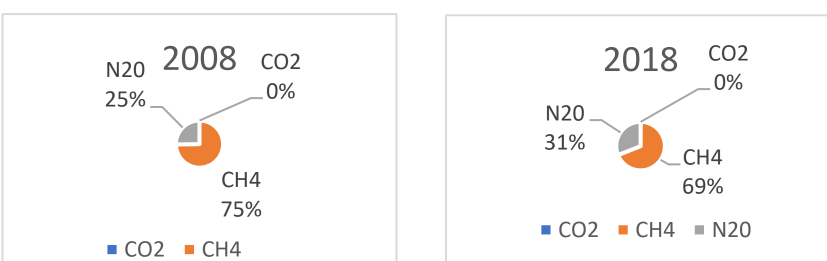


Figure 2.19. Share of gases - agriculture sector (2008 and 2018)

The shares of gases in total emissions have remained constant over the time series, with CH_4 accounting for 75% of emissions in 2008 and 69% and 2018, while N_2O accounted for 25% of emission in 2008 and 31% in 2018.

Emission estimates for all reported sub-categories in the agriculture sector have been included for the time series 2000-2018 (Table 2.21). Suggestions for improvement are detailed in the improvement plan section of this document, as in-country experts have initiated an intensive data collection effort to gather more country-specific information in preparation for the next GHG inventory reporting cycle.

Table 2.21. GHG emissions (kt CO_2eq) in the agriculture sector (2008-2018)

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
3. Agriculture	20,44	20,39	20,39	19,48	10,62	9,68	8,33	8,69	8,6	8,20	9,45
A. Enteric fermentation	14,95	14,95	14,95	14,08	7,11	6,48	5,18	5,59	5,19	5,17	5,17
B. Manure management	2,36	2,37	2,37	2,49	1,96	1,91	1,86	1,92	1,92	1,91	1,98
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D, Agricultural soils	3,12	3,06	3,06	2,91	1,54	1,28	1,28	1,17	1,13	1,11	2,29
E. Prescribed burning of savannahs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
H. Urea applications	0,01	0,00	0,00	0,00	0,01	0.00	0,00	0,00	0,01	0,00	0,01
I, Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Forestry and Other Land Use

The land use sector is distinct from other GHG emission reporting sectors because it can function as both a sink and source depending on land use management practices. St. Kitts and Nevis currently lack a nationally approved land use map or forest inventories to effectively access land use and land use changes. Previous National Inventory Reports (NIRs) included only the sub-category forest lands remaining forest lands, based on FAOSTAT data, which indicated that the forest area remained unchanged from 1990 to 2020, totalling 11,000 ha of forest land in the country. To address this limitation in the current NIR, it was decided to incorporate all six IPCC land classes.

St. Kitts and Nevis, like many developing countries, lacks regular forest inventory data or land use mapping, which are essential for generating activity data necessary for calculating GHG emissions from the FOLU sector. To address this gap, Landsat satellite imagery was used to generate activity data through the Google Earth Engine platform. Classification models were developed using training points derived from the GIS land cover map of 2017 for St. Kitts and Nevis, along with the ESRI 2020 land cover map that covers both islands.

Training points were digitally collected for the six IPCC land use categories: forestland, grassland, cropland, wetland, settlement and other land, along with an additional class for scrub/shrub. The scrub/shrub sub-category was subsequently combined with the grassland classification for GHG emission calculations. The models and classified land use maps were validated against high-resolution satellite maps within the Google Earth Engine. Land use maps were produced for the years 2000, 2005, 2008, 2012 and 2018.

However, the overall accuracy of the classified maps was relatively low, ranging from 52%-66%. Land use changes were tracked spatially only for the inventory period from 2008 to 2012, and GHG emissions were calculated using the gain-loss method, incorporating country-specific activity data and IPCC default emission factors. Due to lack of data on the other carbon pools, only above-ground and below-ground carbon pools were included in the calculations. The average annual emission from 2008 to 2012 were 117.8 kt CO_2eq which decreased to 85.8 kt CO_2eq during the period from 2012 to 2018.

In-country experts have emphasized that the FOLU sector should function primarily as a carbon sink rather than a source. Recent information indicates that following the closure of the sugar industry in 2005, abandoned sugarcane fields have transitioned into secondary forests. These areas, situate at elevations of 1,000 feet above sea-level, have historically been protected and are now contributing to carbon sequestration. As a result, it has been recommended to revisit the emission calculations for the FOLU sector. This process would involve ground-truthing to validate the new information and ensure that the current understanding of land use changes accurately reflets the carbon dynamics within these transitioning landscapes. This re-evaluation could lead to a more accurate representation of the FOLU sector's role in GHG emissions and carbon sequestration in St. Kitts and Nevis.

The GHGMI/CCMRVH FOLU expert collaborated with local experts to gain insights into the historical land use in St. Kitts and Nevis. Discussions with these local experts revealed that areas below 1,000 feet above sea-level were predominantly used for sugarcane farming until closure of the sugar industry in 2005. Dr. Eric Browne, a forest officer, provided approximate boundaries of the old sugarcane fields.

When these boundaries were overlaid on the land cover classification maps, it became clear that most of the grasslands data presented in the GIS map for land use in 2017 − derived from the very high-resolution satellite data (~1 m) – actually consisted of former sugarcane fields from the years 2000 and 2005. This misalignment occurred because the historical data classified these areas inaccurately as forests. As a result, emissions from 2000 to 2011 were significantly overestimated, as the harvesting of sugarcane was incorrectly interpreted as deforestation.

This misclassification highlights the importance of accurate historical land use data and its impact on understanding GHG emissions and carbon dynamics in the region. Correcting these errors will be important for developing a more accurate representation of the FOLU sector's emissions and its potential carbon sink.

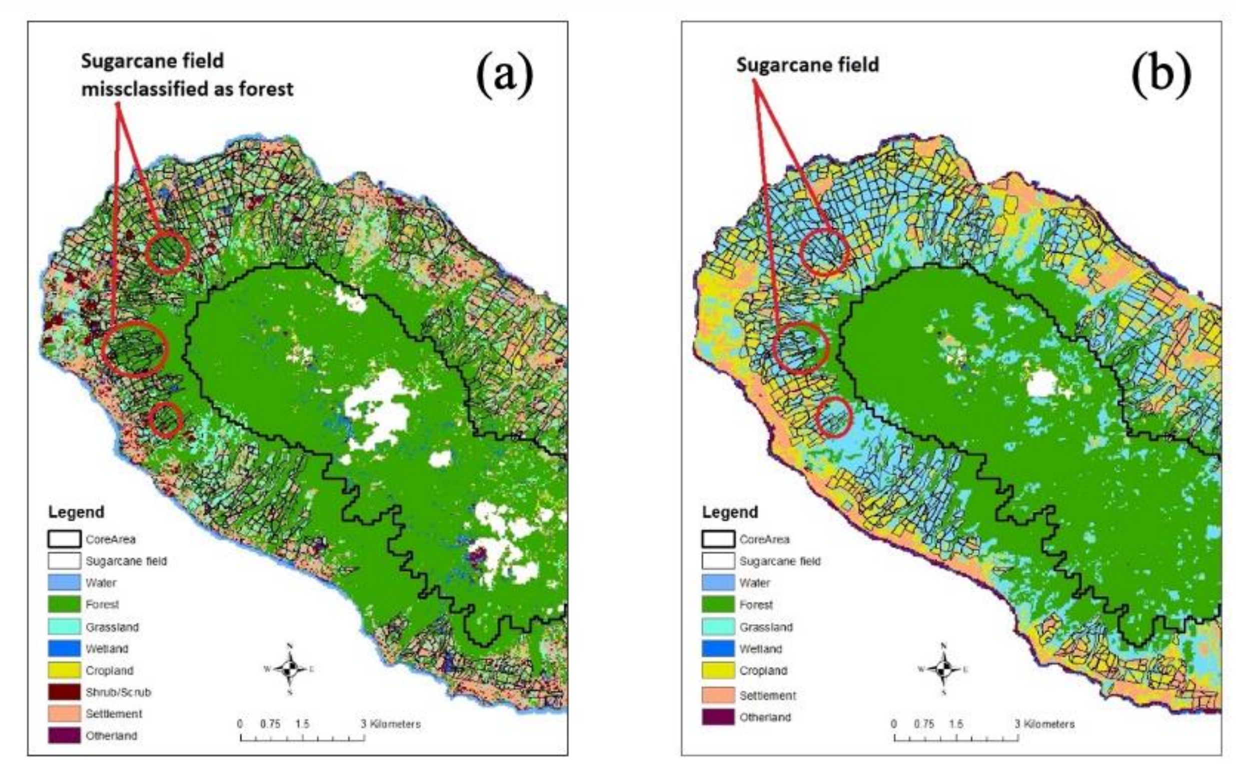


Figure 2.20. Sugarcane fields misclassified as forest in 2000 (a); corrected sugarcane fields (b).

Newly released, recalibrated surface reflectance images (collection 2) from Landsat 7 and Landsat 8 images for the years 2000, 2005, 2011, 2014 and 2018 were used for reanalysis of land use in St. Kitts and Nevis. The challenge in distinguishing reflections from dense, mature sugarcane fields and trees in mid-resolution Landsat satellite images was addressed by deriving the normalized difference vegetation index (NDVI) for each satellite image. NDVI values were instrumental in differentiating between forests, sugarcane fields, and grasslands.

Land use classification models were developed using training data gathered from the 2017 land cover map, along with auxiliary data on abandoned sugarcane fields and NDVI values corresponding to six IPCC land categories: forest, grassland, cropland, wetland, settlement and other land. All training points were digitally collected to train a random forest classification model. Using this model, land use maps were produced for the years 2000, 2005, 2011, 2014 and 2018, focusing on the years with minimal cloud cover.

The accuracy of the land use maps was verified digitally against high-resolution satellite images via the Google Earth Engine. Each land use pixel was tracked from 2000 to 2018, allowing for the generation of activity data for four time periods: 2000-2005, 2005-2011, 2011-2014 and 2014-2018. The classification map for 2018 and the land use change map for 2014-2018 underwent ground verification, in addition to digital verification for quality assurance. IPCC default emission factors were then applied to calculate GHG emission for all four time periods.

By spatially tracking land use changes pixels from 2000 to 2018, the GHGMI team effectively identified both the growth and loss of secondary forest that followed the abandonment of sugarcane fields. The emissions and removals of CO_2 resulting from the gains and losses of secondary forests were calculated using IPCC default growth rates for emission factors. This methodology provided a clearer picture of the dynamics within the FOLU sector, highlighting how land use practices influenced *carbon emissions and removals over time. The activity data and total CO2eq emissions for the four time periods are presented in Table 2.22 and*

Table 2.23.

Table 2.22. Activity data for four time periods between 2000 and 2018.

Land use category	2000-2005 (ha)	2005-2011 (ha)	2011-2014 (ha)	2014-2018 (ha)
Forest remaining forest	7,241	6,628	6,609	6,490
Land converted to forest	2,810	4,257	5,442	4,540
Grassland remaining grassland	4,070	2,053	1,012	901
Land converted to grassland	5,282	4,586	4,069	5,970
Cropland* remaining cropland	1,505	735	630	625
Land converted to cropland	2,259	3,828	4,994	4,462
Wetland remaining wetland	188	173	103	87
Land converted to wetland	142	172	134	229
Settlement remaining settlement	1,737	1,251	889	746
Land converted to settlement	662	2,167	2,021	1,990
Other land remaining other land	468	399	301	263
Land converted to other land	205	319	366	265
Total	26,569	26,569	26,568	26,568

* Croplands include agriculture fields and fallow lands.

Table 2.23. CO_2eq emissions (source) and removals (sink) for four time periods between 2000 and 2018. A negative sign denotes removal (sink).

Land use category	2000-2005 (t CO_2eq)	2005-2011 (t CO_2eq)	2011-2014 (t CO_2eq)	2014-2018 (t CO_2eq)
Forest remaining forest	-232,313	-255,160	-127,217	-166,587
Land converted to forest	-250,923	-524,932	-327,730	-394,783
Grassland remaining grassland	0	0	0	0
Land converted to grassland	211,902	125,018	92,262	54,902
Cropland remaining cropland	0	0	0	0
Land converted to cropland	27,862	98,951	67,741	41,310
Wetland remaining wetland	0	0	0	0
Land converted to wetland	469	0	426	0
Settlement remaining settlement	0	0	0	0
Land converted to settlement	2,699	20,330	9,400	3,008
Other land remaining other land	0	0	0	0
Land converted to other land	8,752	140,725	13,661	9,767
Total CO_2eq emissions	-231,552	-395,067	-271,458	-452,383
Annual CO_2eq emissions	-46,310	-65,844	-90,486	-113,096

Annual CO_2 removals (sink) increased from -46.3 kt CO_2eq in 2000 to -113.1 kt CO2eq in 2018. For the current inventory period 2008 to 2018, annual CO_2 removals (sink) increased from -65.8 kt CO_2eq in 2008 to -113.1 kt CO_2eq in 2018 (Figure 2.21).

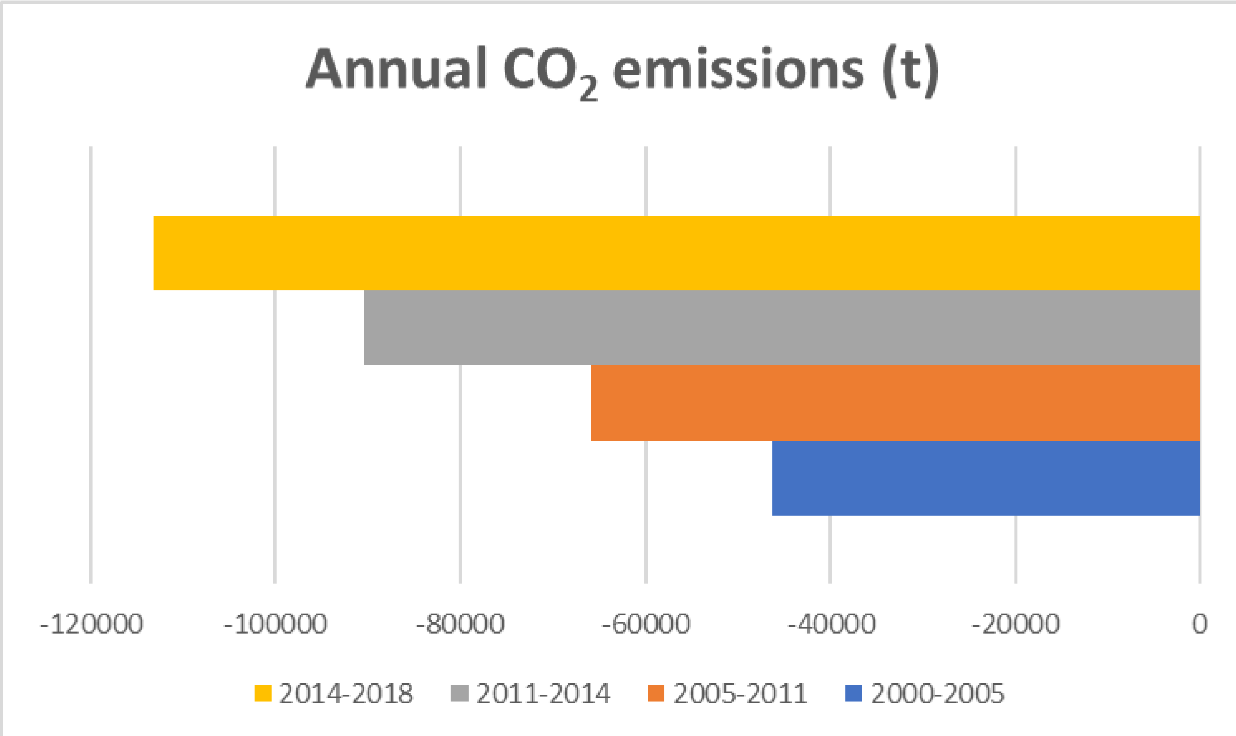


Figure 2.21. Annual CO_2eq removals (sinks) for four time periods between 2000 and 2018

2.1.14. Waste Sector

Overview of the waste sector

The waste sector is the second largest contributor to overall GHG emissions for St. Kitts and Nevis. GHG emission estimates accounted for approximately 16.2% of overall CO_2eq emissions (without considering LULUCF) in 2018, as illustrated in Figure 2.22. Emissions from this sector are from solid waste disposal (78%), domestic and industrial wastewater treatment and discharge (approximately 22%) and open burning of waste (less than 1%).

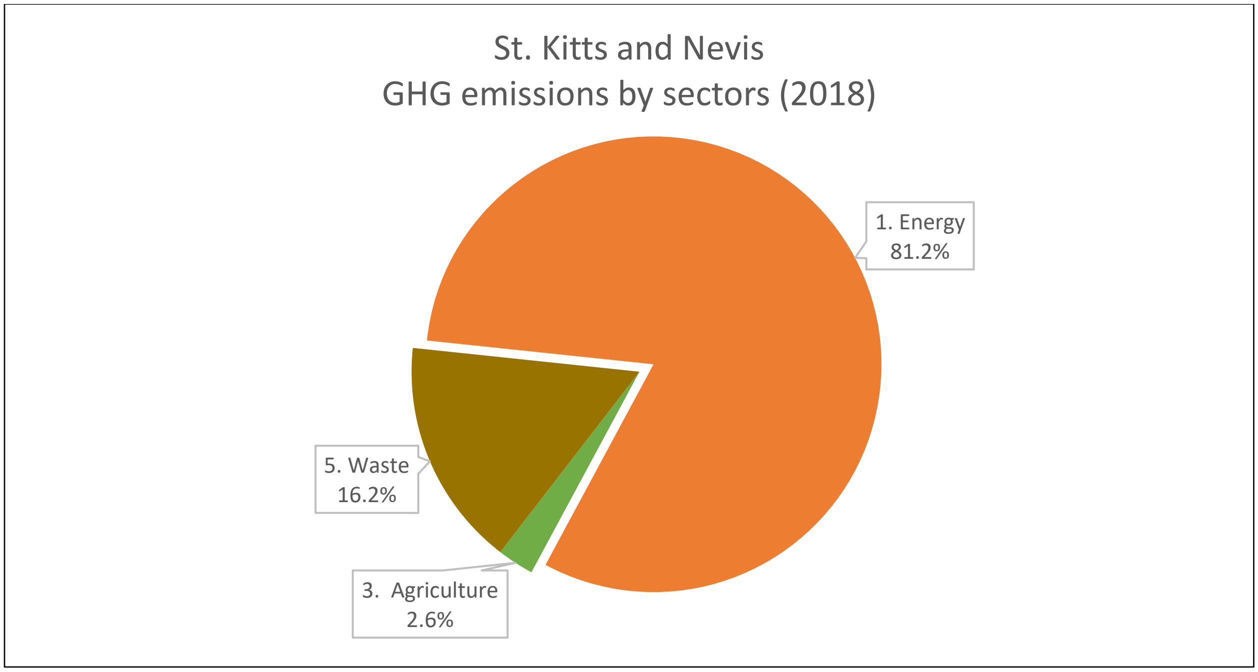


Figure 2.22. 2018 St. Kitts and Nevis GHG emissions by sector

GHG emissions in the waste sector are primarily attributed to the treatment of solid waste and the treatment and discharge of wastewater (industrial and domestic). In St. Kitts and Nevis, landfills are used to manage solid waste disposal and open burning of waste is a common practice. Local experts indicate that, given the national circumstances, neither biological treatment of solid waste nor large scale waste incineration is practiced. Information on the disposal of hazardous and medical waste was unavailable for the reported time series; however, tonnage values for these types of waste were included in the datasets provided by the Solid Waste Management Cooperation. Collecting country-specific information on open burning of waste and waste incineration is an identified area of improvement.

Based on these findings, GHG emission estimates for the gases CO_2, CH_4 and N_2O have been compiled for the waste sector categories, as presented in Table 2.24.

Table 2.24. Reported IPCC categories in the waste sector

IPCC Category	IPCC Category Name
4.A	Solid waste disposal
4.C.2	Open burning of waste
4.D.1	Domestic wastewater treatment and discharge
4.D.2	Industrial wastewater treatment and discharge

St. Kitts and Nevis did not calculate GHG emission estimates for the waste sector in their SNC submission due to a lack of available data. In the current inventory cycle, GHG emission estimates were prepared for the time series 2000-2018 to revise previously submitted GHG inventories. The results are shown in Figure 2.23, Figure 2.24, Figure 2.25, and Table 2.25.

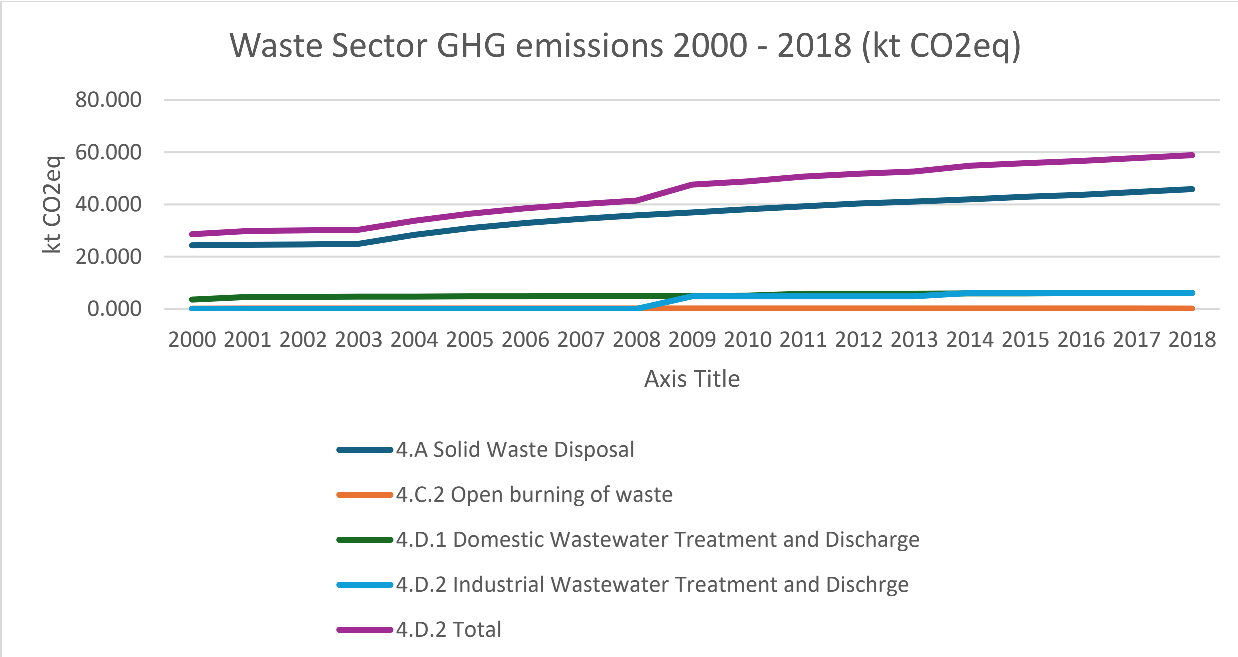


Figure 2.23. GHG emissions trends 2000-2018 by IPCC sub-category (waste)

Total GHG emissions for the waste sector amounted to 28.623 kt CO_2eq in 2000 and 58.918 kt CO_2eq in 2018, representing a 106% increase in emissions.

Solid Waste Disposal

It is important to note that calculations for solid waste disposal heavily relied on the IPCC default values and input parameters reflective of the Latin America and Caribbean (LAC) region. These current estimates take into account the population increase over the time series, as well as the change to the managed landfill categorisation from 2003 onwards.

In St. Kitts and Nevis, industrial waste is sent to solid waste disposal sites (SWDS) along with municipal solid waste. Discussions and guidance from local experts indicated that the volume of industrial waste is small compared to total waste tonnage. Given that country GDP is a key input parameter when using the Tier 1 FOD model for calculating industrial solid waste emissions, local experts felt that this methodology does not accurately reflect the national circumstance of St. Kitts and Nevis because the GDP is heavily reliant on the tourism industry. Consequently, estimates for solid waste disposal were not included in the time series and has been highlighted as an area for improvement.

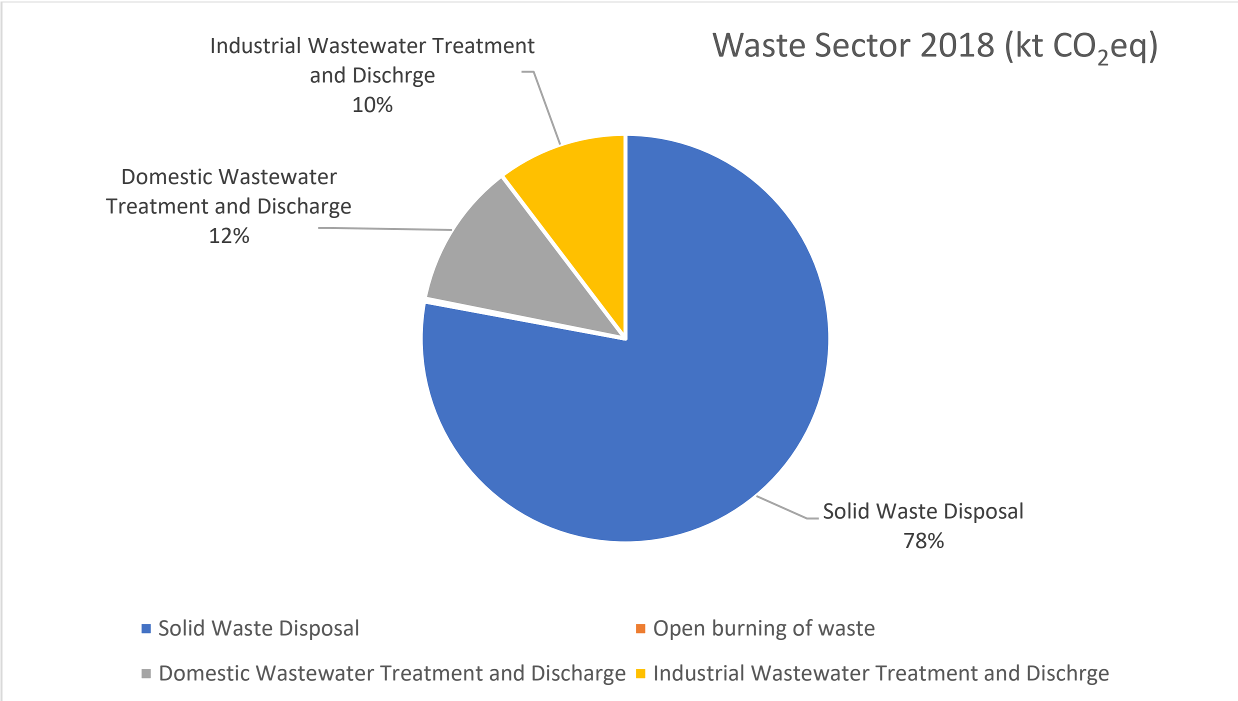


Figure 2.24. 2018 waste sector (sub-category profile)

In 2018, the majority of GHG emission from the waste sector were attributed to solid waste disposal (78%), while wastewater treatment and discharge accounted for less than 22% and open burning of waste contributed less than 1%.

Open Burning

Information provided by local experts indicated open burning of waste does occur, although no specific data was available. Consequently, expert judgement was used to estimate the percentage of the population that engages in open burning, with this category included at under 1% to adhere to the TACCC principles and ensure the completeness of the GHG inventory.

Wastewater Treatment and Discharge (Domestic and Industrial)

In 2018, domestic wastewater treatment and discharge accounted for less than 12% of emissions from the waste sector. Dues to the lack of country-specific information on urbanisation values and the degradable organic component (BOD), estimates relied on international sources and IPCC default values. However, data on these types of treatment and discharge pathways for the St. Kitts and Nevis population has been available since 1990 and was incorporated into the calculation estimates.

Estimates for industrial wastewater treatment and discharge were calculated for the time series 2009−2018, based on the data provided from the local brewery. While efforts were made to extend the time series to include 2000−2008, these earlier years were not included due to the need to validate wastewater values. This omission impacts the reported 106% increase in overall sectoral emissions between 2000 and 2018. It is anticipated that the GHG emissions reported under the sub-category of industrial wastewater for the period 2000−2008 will be included in the next inventory reporting cycle, pending receipt and validation of the missing dataset.

In the waste sector, CH_4 is the dominant greenhouse gas, accounting for 98.45% in 2008 and 98.82% in 2018. In contrast, N_2O contributed only 1.48% in 2008 and 1.13% in 2018, while CO_2 represents a minimal share of 0.07% in 2008 and 0.05% in 2018.

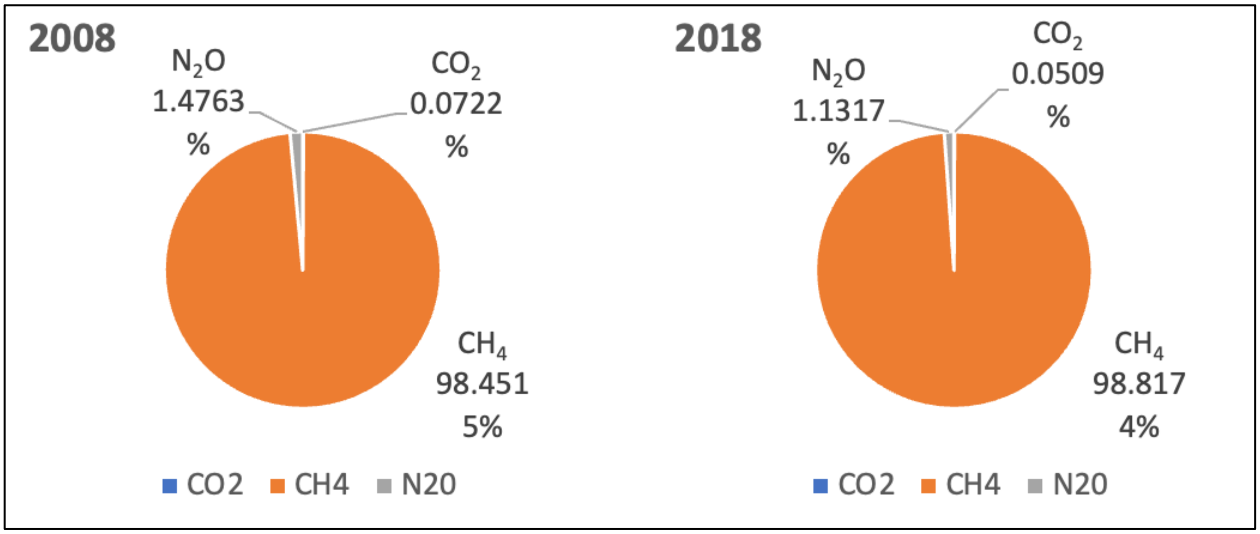


Figure 2.25. Share of gases- waste sector (2008 and 2018)

Table 2.25. GHG emissions (kt CO_2eq) in the waste sector (2008-2018)

IPCC Category	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
4. Waste	41.55	47.59	48.85	50.71	51.81	52.61	54.84	55.81	56.66	57.76	58.92
4.A. Solid waste disposal	35.85	36.97	38.18	39.31	40.35	41.09	42.04	42.96	43.76	44.80	45.90
4.B Biological treatment of solid waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C. Incineration and open burning of waste	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14
4.D. Wastewater treatment and discharge	5.58	10.50	10.54	11.27	11.33	11.39	12.66	12.72	12.77	12.83	12.88

Inventory Improvement Plan

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
S1	n.a.	MRV system not yet established	Matej Gasperic	Set-up MRV system with appropriate administrative capacity and with focus on the Department of Customs as main data source provider	2022-2023	HIGH
S2	n.a.	Data collection, processing and reporting efforts need to yield better data more efficiently.	Matej Gasperic	Establish and implement a sustainable MRV System with appropriate institutional procedural, and legal arrangements with clear reporting and documentation requirements	2022-2023	HIGH
S3	n.a.	Performance indicators are needed to monitor the level of implementation of mitigation and adaptation actions	Matej Gasperic	Develop and track set of national MRV performance indicators to monitor the implementation and progress of mitigation and adaptation actions	2022-2024	MEDIUM
S4	n.a.	Need for established MRV QA/QC procedures	Matej Gasperic	Embed QC procedures throughout the MRV system, and enact a set of QA procedures to assess the accuracy of final GHG inventory estimates	2022-2023	HIGH
S5	n.a.	Performance indicators need to be established and tracked	Matej Gasperic	Develop a system to monitor national MRV performance indicators to track the level of implementation of mitigation and adaptation actions	2022-2024	MEDIUM
E1	1.A.1.a	Need better dataset completeness for the period 2008-2010	Matej Gasperic	Collect the missing data of fuel consumption for Nevis Electricity Company Limited - Prospect Power Station Royal Utilities - Marriot Frigate Bay for the period 2008-2010	2022	LOW
E2	1.A.1.a	Royal Utilities - Marriot Frigate Bay- is measuring only one	Matej Gasperic	Identify which parameter is the producer de-facto measuring and which is	2022	LOW

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
		parameter (electricity production or fuel consumption) and calculate the other		calculated through efficiency		
E3	1.A.1 .c	Identify potential producers of charcoal and estimate the amount of produced charcoal (if any) in the charcoal sold to the market	Matej Gasperic	If charcoal is produced in St. Kitts and Nevis estimate the amount of wood used for charcoal production and estimate the emissions	2022/2023	LOW
E4	1.A.2 .k	AD allocation needs Improvement	Matej Gasperic	Collect the data on AD for construction using national MRV system	2023-2025	MEDIUM
E5	1.A.2 .e	AD allocation needs Improvement	Matej Gasperic	Collect the data on AD for construction using national MRV system	2023-2025	MEDIUM
E6	1.A.3 .a	No consistent data-series for Jet Kerosene and Jet Gasoline available	Matej Gasperic	Extract air control data for specific year to get the number of domestic flights and aircraft type between SKB-NEV (arrivals and departures)	2021/2022	HIGH
E7	1.A.3 .a	No consistent data-series for Jet Kerosene and Jet Gasoline available	Matej Gasperic	Collect data on passengers on domestic route (SKB-NEV) from departure fees from St. Kitts Sea and Port Authority	2021/2022	HIGH
E8	1.A.3 .b	Extraction of the fleet database is to be rearranged since currently there is only one fleet dataset (appears to be for 2020)	Matej Gasperic	Collect raw data frozen on 31.12 for every year of the period 2008-2018 (at the end of the year the back-ups are made)	2021/2022	MEDIUM
E9	1.A.3 .b	Current values under the dataset weight column does not represent GWT	Matej Gasperic	Extract maximum permissible weight of a vehicle in order to allow for proper classification of vehicles	2021/2022	MEDIUM
E10	1.A.3 .b	No data on engine volume	Matej Gasperic	Extract the data from the original database is this data is contained in the database of vehicles	2021/2022	MEDIUM
E11	1.A.3 .b	Currently there is no primary key in the database	Matej Gasperic	If VIN is collected add VIN number to the database as primary key	2021/2022	LOW

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
E12	1.A.3 .d	There in activity data on domestic navigation	Matej Gasperic	Collect the 2008-recent fuel consumption data from - Sea Bridge St Kitts & Nevis Inc and M&M Transportation Services Ltd	2021/2022	HIGH
E13	1.A.3 .d	There in activity data on domestic navigation	Matej Gasperic	Collect the 2008-recent fuel consumption data from operator of the Fisheries Gas Station	2021/2022	HIGH
E14	1.A.4 .a	2016 data for LPG consumption is an outlier	Matej Gasperic	Re-check the 2016 data as reported and identify if potential stock changes can contribute to the inconsistency (LPG storage capacity is at the level of inconsistency cca 700m3)	2021/2022	MEDIUM
E15	1.A.4 .b	Improve the AD allocation	Matej Gasperic	Collect the data on AD for construction using national MRV system	2023-2025	MEDIUM
E16	1.A.4 .c	Improve the AD allocation	Matej Gasperic	Collect the data on fuel used for domestic fishing activities	2022/2023	MEDIUM
I1	2.D.1	Emissions from lubricant use are not yet estimated	Matej Gasperic	Once the AD on road transport is improved estimate the lubricant use using bottom-up approach and calibrate the approach using customs data on lubricant imports	2023-2025	MEDIUM
I2	2.D.2	Emissions from paraffin wax use are not yet estimated	Matej Gasperic	Estimate the paraffin wax use using customs data	2023-2025	LOW
I3	2.D.3	Emissions from Solvent Use	Matej Gasperic	Estimate the solvent use using customs data or average regional data on solvent use per capita if available	2025	LOW
I4	2.F.1 .a	Emissions of F-gases from Refrigeration and stationary Air Conditioning are not yet estimates	Matej Gasperic	Estimate the amount of stationary air conditioning in place in households bottom up using the surveys, direct questionnaires for bigger commercial facilities and hospitality sector. Calibrate the approach with top-down information	2022-2023	HIGH

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
				on the import of F-gasses and AC appliances		
I5	2.F.1 .b	Emissions of F-gases from Mobile Air Conditioning are not yet estimates	Matej Gasperic	Once the AD on road transport (vehicle fleet) are improved, estimate the amount of F-gases emissions using leakage factors as used by Annex I parties from where the majority of the car imports occur	2022-2023	HIGH
I6	2.G.1 .b	Emissions of F-gases (SF6) from switchgear equipment's is not yet estimated or determined that it is not occurring	Matej Gasperic	Investigate with the electric distribution system if the switchgear equipment contains SF6	2023-2025	LOW
L1	4A-F	Generation of the country specific Emissions Factor for CO2 emission is critical to move from Tier 1 to higher Tier methodology	Anup Joshi	Field Survey and Measurements to develop country specific emission factors will help improve accuracy of GHG emissions	2022-2025	HIGH
L2	4A-F	To fully utilize Tier 3 activity data that St. Kitts and Nevis has for 2000-2020, generation of Emission Factors for all Land categories is crucial	Anup Joshi	Generating emission factors for forest, grasslands and wetlands with woody vegetation should be made priority	2023-2025	HIGH
L3	4A-F	Necessary methods and scripts have been developed. Training in-country personnel to estimate GHG emissions from FOLU sector should be a priority	Anup Joshi	The scripts to run classification and generate Tier 3 land activity data has been developed in Google Earth Engine	Should be done as a part of L1 and L2 2024-2025	MEDIUM
L4	4A-F	Generation of activity data for current reporting heavily relied on remote sensing data with digital verification by consultants. To improve the quality of data country experts with the		Training someone with ground knowledge of the country and some GIS expertise will build the capacity of St. Kitts and Nevis for future reporting requirements	L1-L4 should be done as a single training package to be efficient and cost-effective. 2022-2025	HIGH

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
		knowledge of land use history in the country will be required.				
A1		Submitted livestock population count data was reflective for St. Kitts for 2014 onwards but did not include complete estimates for Nevis. No information on the procedural elements for the collection of data was provided.	Ryan Deosaran	Country experts should begin to collect livestock population counts for Nevis to be integrated with estimates from St. Kitts. Information on collection procedures inclusive of timelines should be submitted to the inventory compilation team for future reporting cycles.	2022-2024	HIGH
A2		Manure Management System allocations were provided by the Party. Though MMS relevant to the party have been identified- no information on % allocation of livestock to the MMS was provided. An assumption of a 50-50 split was assumed when livestock was categorized into two MMS	Ryan Deosaran	Validation of MMS information during the current GHGI cycle by the country team. Given the different reporting sub-categories to be reported under between pasture/range/paddock and other manure management systems, it is important for the local team to provide expert judgement on the % of livestock for each given MMS	2022-2024	MEDIUM
A3		FAOSTAT livestock dataset for the years 2000-2018 were sourced by the inventory team. For the period of 2014 onwards- these datasets were not reflective of what was submitted by the St. Kitts and Nevis team for the same time period.	Ryan Deosaran	Investigate the source for the FAOSTAT dataset and compare results to census data and livestock counts provided by local team.	2022-2024	HIGH
A4		No country data was provided for total fertilizer imports with datasets being sourced through FAOSTAT	Ryan Deosaran	Investigate the source for the FAOSTAT dataset. As country specific information was not available during the preparation of the inventory- the local St. Kitts and Nevis expert team should highlight the	2022-2024	MEDIUM

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
				datasets needed to be collected by the Customs division and include in their data collection procedures for the next inventory cycle.		
A5		Urea Import data was available through FAOSTAT for the time series 2002-2017 and the St. Kitts and Nevis team through sales records from the local distributor (2015,2017 and 2018). The GHGI compilation team chose the FAOSTAT dataset due to differences in estimates, data gaps and a longer available time series	Ryan Deosaran	Investigate the source of the FAOSTAT dataset. The St. Kitts and Nevis team should request from the local distributor access to their historical sales records and compare against the FAOSTAT data set for validation.	2022-2024	LOW
W1		% Distribution by waste management type was provided by local experts without submitted background information and validation of estimates	Ryan Deosaran	Survey and/or study should be carried out by local experts to validate assumptions made for time series prior to 2002 (50-50 split for managed/unmanaged) and for the 100% allocation to managed waste disposal sites (2003-present)	2022-2024	MEDIUM
W2		Submitted waste tonnage values collected by the Party were available for 2009- 2018 with no submitted background information on the collection and validation process. Estimates for Nevis for some years were unavailable.	Ryan Deosaran	Continued work validating previous waste tonnage estimated as submitted to the inventory team and continued comparison with newly available 2019 refinement default values of waste per capita. Continued collection of waste tonnage values for all relevant disposal sites.	2022-2028	HIGH
W3		Information submitted for waste composition categorization were not in the required IPCC categories. Country definitions for	Ryan Deosaran	Collection of future waste composition data should be reflective of necessary IPCC categorisations or country definitions for current categorisations	2022-2024	MEDIUM

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
		composition categories.		should be provided to allow for integration of information by the GHGI compilation team		
W4		No information on the collection and disposal of Industrial solid waste	Ryan Deosaran	Survey and/or study should be carried out by local experts to track industrial solid waste flows by reporting entity as well as final disposal site.	2022-2023	MEDIUM
W5		No country definition for the inclusion of Industrial Waste in the MSW sub-category	Ryan Deosaran	Country experts as well as relevant government entities should provide the definition inclusive of any background information/expert judgement. (Relevant if Party assumes this allocation in the next reporting cycle.	2022-2024	LOW
W6		Assumption of 2% allocation of fraction of population burning waste was based on in-country expert judgement.	Ryan Deosaran	Survey and/or study should be carried out to validate 2% assumption before the next GHGI cycle.	2022-2024	LOW
W7		Data was submitted for St. Kitts and Nevis for applicable wastewater treatment and discharge systems for the entire population. No information was provided on the breakdown of treatment systems by rural, urban high income and urban low-income allocations.	Ryan Deosaran	Survey and/or study should be conducted based on degree of utilization of the identified wastewater treatment systems by IPCC urbanization characterisation	2022-2024	HIGH
W8		No country data was provided for Degradable Organic Component (BOD)in kg/capita/BOD/year	Ryan Deosaran	Data collection for this specific input should be identified and requested from the relevant in-country experts. Conduct initial study/survey if no historical information is available.	2022-2024	Low
W9		Wastewater generation values were provided to the GHGI compilation team for the years	Ryan Deosaran	Wastewater generation values should be validated by the data provider and Party to ensure that submitted information is	2022-2024	MEDIUM

N°	CRF code	Identified issues for improvements	Initiated by	Recommendations for the actions to be taken	Proposed timeline for implementation	Priority level
		2009-2018. It was noted that values for 2009-2013 and 2015-2018 were duplicative.		accurate (due to duplicative figures over the time series).		
W10		The identified wastewater treatment system identified by the data provider was the Evaporation Process. No additional information was provided to estimate the relevant emission factors using B_0 and MCF	Ryan Deosaran	Additional data and information on the identified evaporation process treatment system should be provided by the relevant stakeholder to local experts with estimates for B_0 and MCF if available	2022-2024	HIGH

3. Mitigation Assessment

Introduction

As a small island developing state (SIDS), St. Kitts and Nevis contributes very little to climate change but is extremely vulnerable to the damaging effects posed by these phenomena. According to the latest inventory (see Chapter 2),St. Kitts and Nevis's total emissions, including land use, land use change, and forestry (LULUCF), were 293.32 ktCO_2eq. This represents just 0.0006% of the total global emissions in 2018, which were estimated at 48.94 Gt CO_2eq (Hannah Ritchie, Max Roser and Pablo Rosado, 2020).

Similar to many SIDS, the primary focus of the St. Kitts and Nevis has been to adapt to the risks and vulnerabilities posed by climate change. The country aims to advance its ambitious targets o to mitigate greenhouse emissions while also striving to meet its commitment under the Paris Agreement.

Mitigation efforts in St. Kitts and Nevis primarily focus on advancing the use of renewable energy, improving energy efficiency, and maintaining carbon sequestration potential. The twin-island Federation is also promoting increased sustainable mobility while acknowledging that improvements in the power generation sector are of utmost importance. In addition, St. Kitts and Nevis recognises that mitigation actions offer numerous co-benefits, including enhancements to human health, energy security, biodiversity conservation, employment, economic growth, among others.

This chapter summarizes the policies, plans, and programmes that St. Kitts and Nevis has implemented or plans to implement to achieve its mitigation agenda and sustainable development goals. The chapter also includes the GHG emissions modelling projections related to the proposed mitigation pathway for the country.

Specifically, this chapter covers the following areas:

- Trends in greenhouse gas emissions and removals
- National policies
- Measures to reduce emissions
- GHG emissions projections, including methodology and assumptions for both baseline and mitigation scenarios
- Barriers and challenges
- Plans for improvement

Trends in St. Kitts and Nevis GHG Emissions and Removals

The trends in GHG emissions and removals for St. Kitts and Nevis have remained unchanged since the submission of BUR1, with the inventory data consistent between the BUR1 and the TNC. The 2018 NIR for St. Kitts and Nevis quantifies GHG emissions across four of the five IPCC sectors, and follows the 2006 IPCC guidelines. The IPPU sector was not estimated due to data limitations.

The 2018 NIR indicates that the top three key categories in level assessment as:

- Energy industries – CO_2
- Land converted to forest land – CO_2
- Road transport – CO_2

For the trend assessment, the top three key categories were:

- Road transport – CO_2
- Land converted to other land – CO_2
- Energy industries- CO_2

According to the latest NIR, total GHG emissions in St. Kitts and Nevis increased by 19.7%, or approximately 60 ktCO_2eq, in 2018 compared to the 2010 levels (excluding emissions/removals from LULUCF). This increase reflects a 26% increase in energy sector emissions, largely driven by a 91% increase in transport sector emissions from 2010 to 2018. The energy sector accounted for 77% of total GHG emissions in 2010, rising to 81% by 2018.

While GHG emissions, especially in the energy sector, are anticipated to decline during 2020-2021 due to the impact of the global COVID-19 pandemic, this reduction is expected to be temporary. If the identified mitigation actions are not implemented, a steady increase in emissions is projected to resume after 2021.

The St. Kitts and Nevis 2018 NIR indicates a slight upward trend of GHG emissions when including the LULUCF sector, showing a +5% increase compared to the 2010 levels, with a relatively stable trend throughout the time series, primarily driven by the energy sector. Previous emission estimates in the LULUCF sector showed significant fluctuations, prompting improvement actions by St. Kitts and Nevis. During the preparation of the SNC, no country specific data on land-use and forestry were available, leading to the use of FAO data. To address this deficiency in remote sensing results, a field assessment was conducted in early 2022 with assistance from the Caribbean Cooperative Measurement Reporting and Verification Hub (CCMRVH), resulting in substantial improvement to the land use matrix. Consequently, the trendline in the LULUCF sector now covers the entire period from 2008 to 2018 and aligns with the actual land use in St. Kitts and Nevis.

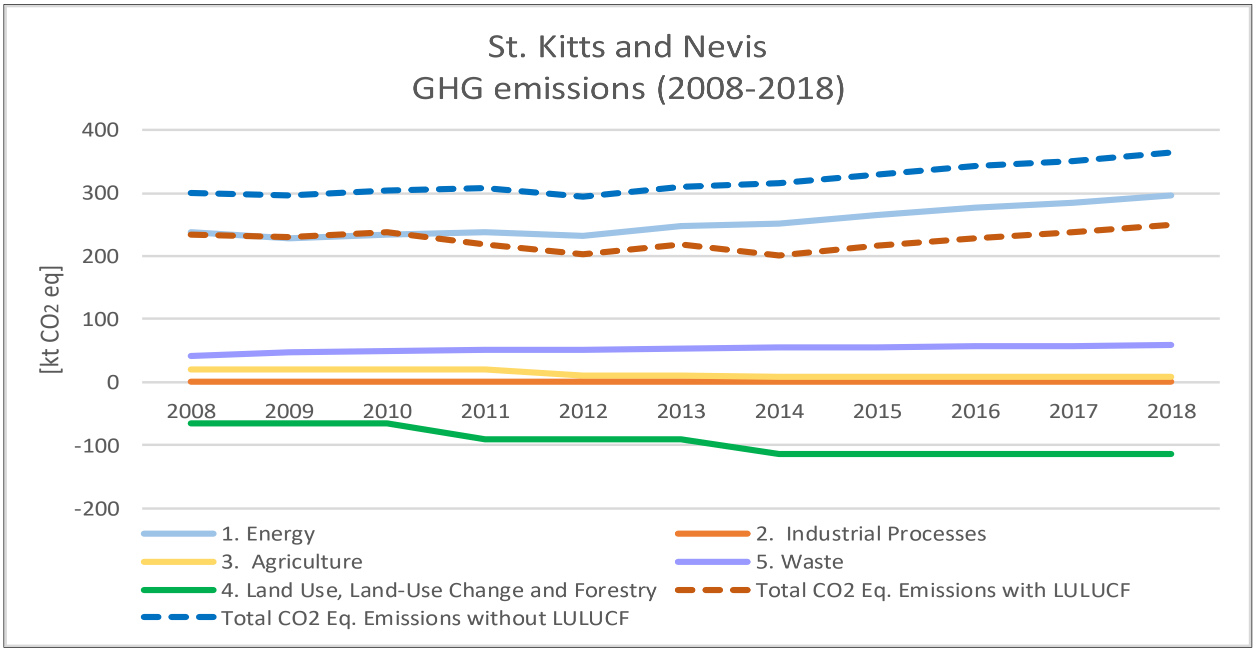


Figure 3.1. Total GHG emissions and removals by sector and total emissions with and without LULUCF (2008-2018)

As illustrated in **Figure 3.1**, the total GHG emissions, excluding LULUCF, are projected to increase if the identified mitigation actions outlined are not implemented. This chapter presents a mitigation strategy for St. Kitts and Nevis, showcasing potential methods to enable a low emissions development pathway.

National Policies

3.1.1. St. Kitts and Nevis Nationally Determined Contributions

St. Kitts and Nevis, in line with its commitment under the Paris Agreement, submitted its First Nationally Determined Contribution (NDC) on the 22nd April 2016, followed by an updated NDC on the 25th October 2021. The NDCs are national climate actions, including related targets, policies, and measures to address climate change. These contributions are a part of a global effort and operate on a five-year cycle. The NDC submitted by St. Kitts and Nevis is conditional and based upon available financing, capacity building, and technology support.

The first NDC proposed emission reduction targets of 22% and 35% of the absolute GHG emissions projected in the business-as-usual (BAU) scenario by 2025 and 2030, respectively. These targets were based on all economic sectors, with a particular emphasis on the energy and transport sectors (Federation of St. Kitts and Nevis, 2015).

St. Kitts and Nevis updated NDC aims to reduce economy-wide CO_2 emissions by 61% by 2030, compared to the base year of 2010 GHG emission levels. This reduction is based on achieving 100% renewable energy for electricity generation and increasing the share of electric vehicles in the vehicle fleet to at least 2%. As a result, St. Kitts and Nevis projects that emissions in the energy sector will decrease to 124 $GgCO_2eq$ (124 $ktCO_2eq$) by 2030 (Federation of St.

Kitts and Nevis, 2021). The updated NDC reflects this increased ambition for St. Kitts and Nevis compared to its first NDC.

3.1.2. National Policies and Plans

St. Kitts and Nevis has undertaken several measures to reduce national GHG emission, despite the country contributing very little to global GHG emissions. Recognising its vulnerability due to its geographical location and environmental conditions, the country aims to ensure that measures to reduce GHG are grounded in a sustainable development context. This approach ensures that measures to reduce GHG emissions also align with national economic and development goals.

The St. Kitts and Nevis Energy Policy and Energy Action Plan of 2011 outlines key policies aimed at transitioning the electricity generation sector to integrate more renewable energy into the grid and decrease reliance on imported fossil fuels.

To facilitate this transition, St. Kitts and Nevis developed an Integrated Resource Plan (IRP) that identifies a suitable mix of least-cost supply options based on projected demand requirements. Additionally, a study on cost-effective mitigation options laid the groundwork for the Intended Nationally Determined Contributions (INDC). St. Kitts and Nevis is currently updating its IRP by developing an Integrated Resource and Resilience Plan (IRRP) with the assistance of the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE).

The St. Kitts and Nevis Initial National Communication (INC) (Federation of St. Kitts and Nevis), highlighted mitigation actions focused on the sub-sectors of residential, transport, and energy industries, identifying several measures as priority actions within each sector.

St. Kitts and Nevis submitted their SNC in 2015. While the SNC did not include a specific chapter dedicated to mitigation assessment, it did address relevant issues in the technology needs assessment chapter. This chapter identified the need for continued development in the following technologies for electricity generation:

- Wind energy development in Nevis
- Geothermal energy development in Nevis
- Biomass energy development from sugarcane production
- Interconnection between the two islands to facilitate the interchange of renewable energy generation in the twin-island Federation.

Since the submission of the SNC, several initiatives have been launched to reduce GHG emissions in the energy sector and enhance carbon sequestration across the twin-island Federation. St. Kitts and Nevis has experienced significant land use changes over the years, transitioning from sugar production to a more service-oriented economy. The closure of the sugarcane industry in 2005 rendered several alternative electricity generation options obsolete, particularly the development of sugarcane biomass energy. These initiatives are in various stages of implementation, ranging from development to completion. The major initiatives are highlighted below:

General

- The Climate Change Policy of 2017 outlined the need for mitigation action, including the co-benefits of mitigation such as health benefits and ecosystem restoration (Department of Environment, Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlement, 2017).
- Assessment of cost-effective mitigation options to inform the update of the NDCs (Federation of St. Kitts and Nevis, 2021).
- Approval of the Global Environment Facility (GEF) 7 Project – Achieving rapid decarbonisation of the Energy sector in St. Kitts and Nevis. This includes the development of a revised energy policy, a roadmap, an investment plan for achieving the energy policy, an energy-efficient building pilot project and improved financing for renewable energy projects (Global Environment Facility (GEF)).

Energy Demand

- Retrofitting of street lighting
- Retrofitting sporting facilities floodlights
- Energy audits of public buildings and water pumps

Electricity Generation

- Commissioning of two solar PV farms of 0.75 kW and 0.5 kW
- Development of the Integrated Resource Plan and Assessment for the Power sector for St. Kitts and Nevis.
- Wind development of 1.9MW in Nevis
- Continued geothermal development in Nevis
- Approval of a 35.7 MW solar farm with battery storage
- The commissioning of a 970kW solar carport facility at the Eastern Caribbean Central Bank Headquarters[18]

Transport

- Piloting electric buses under the Italian government

IPPU

- Enabling activities for a phase-down of Hydrofluorocarbons (HFCs) and signing the Kigali Amendment with expected ratification of the amendment in 2022. This included a needs assessment for the refrigeration and air conditioning (RAC) sector.

[18] https://www.centralbanking.com/awards/7929971/green-initiative-operational-eastern-caribbean-central-bank

Waste

- Commencement of a recycling project to help reduce waste entering the landfill

LULUCF

- Development of a Concept Note to the Green Climate Fund (GCF) for reducing GHG emissions from Forests and Land Use and Increasing the Resilience of the livelihoods and communities and ecosystems they depend upon.
- Implementation of the Integrated Water, Land and Ecosystems Project (IWECO). One component of this project is the restoration of degraded lands in St. Kitts and Nevis.

Agriculture

- Implementation of the GEF 6 Project – Improving Environmental Management through Sustainable Land Management in St. Kitts and Nevis. This project promotes the use of agroforestry techniques and reforestation to increase the potential of carbon sequestration (Federation of St. Kitts and Nevis, 2019).

A list of significant policies related to mitigation are highlighted in **Table 3.1** below.

Table 3.1. Significant National Policies, Plans, Strategies

Significant National Policies, Plans, Strategies, and Initiatives
Significant Policies and Plans
Initial National Communications to the UNFCCC (2001)
National Conservation and Environment Protection Act (revised 2009)
National Energy Policy and Energy Action Plan (2011)
Second National Communications to the UNFCCC (2015)
Nationally Determined Contributions (2015)
National Climate Change Policy (2017)
Integrated Resource Plan and Assessment (2017)
National Climate Change Adaptation Strategy (2018)
Caricom Regional Energy Efficiency Building Code (Adopted 2019)
Updated Nationally Determined Contributions (2021)
Major Initiatives
Improving Environmental Management through Sustainable Land Management in St. Kitts and Nevis (GEF)
Achieving rapid decarbonisation of the energy sector in Saint Kitts and Nevis (GEF)
Integrated Resource and Resilience Plan (IRRP) for the electricity generation subsector (CCREEE)
Eastern Caribbean Central Bank (ECCB) Headquarters integration of battery storage to the solar car park facility to achieve 100% renewable energy for the building
Major Strategies/Targets
100% Renewable Energy Generation in electricity by 2030
61% reduction in GHG emissions by 2030

Measures to Reduce Emissions

The existing climate change policies, sectoral action plans, development strategies and priorities for St. Kitts and Nevis have been reviewed, as highlighted in the previous section. In addition, St. Kitts and Nevis recently updated their NDCs, which include a list of measures aimed at achieving their NDC targets. These measures to reduce GHG emissions were assessed based on their national circumstances, sustainable development goals, national development priorities, and level of implementation.

Further measures were defined based on the updated inventory information and data provided. These measures take into account various aspects, including economic, social, environmental and GHG reduction capabilities. The measures identified are in various stages of planning, preparation and implementation and were verified through stakeholder engagements during the process.

As a result, a total of eighteen (18) mitigation actions were identified for St. Kitts and Nevis. These mitigation actions are divided into the following categories: Energy Demand, Electricity Generation, Transport, Industrial Processes and Product Use (IPPU), Land Use, Land Use Change and Forestry (LULUCF) and Waste. This section provides a qualitative overview of the mitigation actions identified by St. Kitts and Nevis. These actions were developed and analysed based on extensive stakeholder consultations. Some actions were not assessed during the mitigation analysis due to factors such as data limitations and the type of action.

3.1.3. Description of Mitigation Measures

The mitigation actions for St. Kitts and Nevis encompass most sectors, with a total of 18 mitigation actions identified. It is important to note that while no baseline information was provided for the IPPU sector, a mitigation action was included with the expectation that improvements in the GHG inventory will enable assessment of this action in future years. **Table 3.2** below illustrates the distribution of mitigation actions by sector.

Table 3.2. Distribution of Mitigation Actions by sector

Sector	Number of Mitigation Strategies
Energy demand	5
Electricity generation	7
Transport	3
IPPU	1
LULUCF	1
Waste	1
Total	**18**

The following sections and tables provide the description and status of each mitigation action by sector.

Energy Demand

A total of **five (5) mitigation actions** related to the **energy demand subsector** were identified for St. Kitts and Nevis. These mitigation actions were identified based on ongoing projects, the updated NDC, and newly proposed projects for the twin-island Federation. Energy demand incorporates the end-use consumption of energy in St. Kitts and Nevis. This comprises energy demand for residential buildings, commercial buildings (public buildings, schools, churches, restaurants, hotels), industry and street light use. Mitigation actions for energy demand primarily relate to the affected changes in the end-use of electricity and fossil fuels. These actions are normally related to changes in fuel and/or equipment used for lighting, cooling, refrigeration, cooking, water heating and other appliances. Reductions in demand in the electricity sector due to mitigation actions in energy demand are normally considered indirect emissions reductions as the changes occur mainly in the electricity generation sector. The GHG impacts can be both supply changes and improvements in energy efficiency.

The mitigation actions in the Energy Demand subsector are outlined in Table 3.3 below.

Table 3.3. List of mitigation actions in the Energy Demand subsector

Sector	**Energy Demand**		
Status	**Action**	**Description**	**SDG Impact**
Ongoing	**Mitigation Action 1:** Increase the adoption of solar water heaters by 2030	Water heating is mainly done through electrical water heaters; although the current penetration is low, it is expected that with an increased GDP as projected, these numbers will increase. The promotion of solar water heaters will assist in the increased adoption of this technology on the islands. This can be achieved through education, awareness campaigns, as well as the introduction of incentives for solar water heaters. The energy unit for St. Kitts and Nevis participates in CARICOM energy awareness month activities in November each year.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action

Sector	Energy Demand		
Status	**Action**	**Description**	**SDG Impact**
Ongoing	**Mitigation Action 2:** Energy Efficient measures resulting in a 20% reduction in energy demand by 2030	Fossil fuels currently dominate St. Kitts and Nevis energy mix. The promotion of energy-efficient equipment will reduce the need for electricity from fossil fuel sources. In addition, St. Kitts and Nevis has adopted the Caricom Regional Energy Efficiency Building Code (CREEBC). The CREEBC is expected to improve building design by reducing energy demand and improving resilience. The building code is expected to help reduce energy demand, whereby GHG emissions will be reduced in both new and renovated commercial and residential buildings.	Goal 3: Good Health and Well-Being Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Completed	**Mitigation Action 3:** Streetlighting Retrofits by 2022	Retrofits of HPS streetlights to LEDs will help reduce energy consumption and GHG emissions. The retrofits were conducted for all streetlights in the twin-island Federation of St. Kitts and Nevis. The government of St. Kitts and Nevis previously replaced 1,150 streetlights with LEDs from a bilateral aid project. Funding was received from the Caribbean Development Bank to replace the remaining streetlights in the twin-island Federation. A total of 7,496 lamps were replaced throughout the twin-island Federation.	Goal 3: Good Health and Well-Being Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Ongoing	**Mitigation Action 4:** Retrofit of floodlights at sporting facilities by 2023	Retrofits of HPS floodlights to LEDs will help reduce energy consumption and GHG emissions. The retrofits will be conducted for all floodlights at sporting facilities in the twin-island Federation of St. Kitts and Nevis. The government of St. Kitts and Nevis has secured funding from the Caribbean Development Bank to undertake the project.	Goal 3: Good Health and Well-Being Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production

Sector	Energy Demand		
Status	**Action**	**Description**	**SDG Impact**
			Goal 13: Climate Action
Planned	**Mitigation Action 5:** Implementation of measures identified in energy audits of public buildings and water pumping stations by 2025	Energy Audits help identify specific energy efficiency options for buildings. Audits were completed at 35 locations. 16 public buildings; 8 public buildings in St. Kitts, and 8 in Nevis, including one school. Audits were also completed at 19 water pumping stations; 13 on St. Kitts and 6 on Nevis. The audits also included distributed generation systems to be implemented on the public buildings.	Goal 3: Good Health and Well-Being Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action

Electricity Generation

A total of **seven (7) mitigation actions** related to the **electricity generation subsector** were identified for St. Kitts and Nevis. These mitigation actions were derived from the updated NDC and the IRRP developed for St. Kitts and Nevis, with some actions revised based on their timelines. This subsector represents the electricity supply from both centralised and distributed resources, focusing on policies that enhance mitigation strategies for electricity generation and methods to improve electricity supply and maximise the use of renewable energy generation. All fuels combusted for electricity generation fall withing this subsector. However, off-grid electricity systems are not included in this assessment, as there is currently no developed system to accurately monitor off-grid installations. The identified mitigation actions include renewable energy generation, improvements in transmission and distribution networks, and the interconnection of transmission system to optimize renewable energy utilization.

The government of St. Kitts and Nevis has outlined specific renewable energy projects in its updated NDC. This clearly indicates the government's plan to improve its energy security and reduce its GHG emissions. Plans for many of these renewable energy projects are at the advanced planning stages, including the ceremonial launch of a 35.7MW solar farm in St. Kitts and the signing of an agreement for the construction of a geothermal power plant in Nevis. These projects are expected to position St. Kitts and Nevis as a leader in renewable energy penetration in the region.

The mitigation actions in the electricity generation subsector are outlined in Table 3.4 below.

Table 3.4. List of mitigation actions for the electricity generation subsector

Sector	Electricity Generation		
Status	**Action**	**Description**	**SDG Impact**
Ongoing	**Mitigation Action 6:** Transition to 100% renewable energy by 2035	Fossil fuels currently dominate St. Kitts and Nevis's energy mix. The twin-island Federation has set a goal to reach 100% renewable energy generation through the following renewable energy projects: 1. 35.7 MW utility-scale solar PV capacity with 44.2 MWh lithium-ion battery storage facility by 2025 2. 10 MW geothermal power in Nevis by 2030 3. 6.6 MW wind power in St. Kitts by 2030 4. 15 MW geothermal power capacity in St. Kitts by 2035	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Ongoing	**Mitigation Action 7:** 35.7 MW of utility-scale solar PV capacity for St. Kitts with 44.2 MWh Lithium battery storage by 2025	Solar PV is one of the cheapest, most accessible renewable energy resources and the islands have an abundance of solar potential. The government of St. Kitts and Nevis and SKELEC have signed a contract with a private developer for the installation of the 35.7 MW solar farm with storage on the island of St. Kitts. The overall system is expected to provide between 30-35% of St. Kitts' baseload energy needs for the next 20-25 years while reducing carbon dioxide emissions from year one of operation.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Ongoing	**Mitigation Action 8:** 6.6 MW of Wind Power capacity installed in St. Kitts by 2030	St. Kitts and Nevis has the potential to further explore wind energy. Already, Nevis has installed a 1.9 MW wind farm. Wind Power can provide renewable energy resources with the much-needed reactive power to the grid. The government of St. Kitts and Nevis is currently in negotiations on wind development. A pre-feasibility study has been	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities

Sector	Electricity Generation		
Status	**Action**	**Description**	**SDG Impact**
		conducted under the "North Star Wind Farm" project, and a Power Purchase Agreement (PPA) is expected to be signed by 2023.	and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Ongoing	**Mitigation Action 9:** 15 MW of geothermal capacity in St. Kitts by 2035	The government of St. Kitts and Nevis have been involved in geothermal development on the island of Nevis for several years. St. Kitts has also been identified as having geothermal potential. The government has identified a suitable site, and pre-feasibility studies have been conducted.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Ongoing	**Mitigation Action 10:** 10MW of geothermal capacity in Nevis by 2030	The government of St. Kitts and Nevis has been involved in geothermal development on the island of Nevis for years. Feasibility studies & drilling have been undertaken, and recent development for power plant construction has begun with site clearing and others. In addition, Nevis has invested in at least 3 people studying geothermal at a higher level in Iceland.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Planned	**Mitigation Action 11:** Improve efficiency in transmission and distribution of electricity by 2030	Improving efficiency in transmission and distribution lines will help reduce losses in both islands, thus aiding them in achieving their overall targets. In order to facilitate more sustainable sources of energy, Saint Kitts and Nevis shall undertake this project to create a more resilient infrastructure network. The government of Saint Kitts and Nevis has indicated the	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities

Sector	Electricity Generation		
Status	**Action**	**Description**	**SDG Impact**
		improvement of the transmission grid on both islands in its NDC. In addition, in the IRP, there is mention of the interconnection of the two island systems. Currently, an IRRP for the St. Kitts and Nevis is being developed.	Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Newly Proposed	**Mitigation Action 12:** Electricity Interconnection system for the two islands by 2030	St. Kitts and Nevis is a twin - island nation separated by waters, with the shortest distance between the two of 3.29 km. Therefore, the short distance would allow for underground cables to connect the islands allowing sharing of resources and maximising renewable energy potential where it is most available. Furthermore, the IRP produced for St. Kitts and Nevis indicated that the interconnection of the two islands would result in lower fuel costs and consumption, which would allow for the geothermal production to be increased on the island of Nevis to allow for transmission to St. Kitts and vice versa for solar energy. This would also increase the reliability of the two systems.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action

Transport

A total of **three (3) mitigation actions** related to the **transport subsector** were identified for St. Kitts and Nevis.

The NIR indicated that the transport subsector is the second largest GHG emitter within the energy sector. The mitigation actions identified were based on the updated NDC and the Energy Policy of St. Kitts and Nevis. While these mitigation actions have been modelled, there are still gaps in the available data regarding energy usage, vehicle types, and vehicle ages. The transport sub-sector includes energy-use of diesel and gasoline in road transport, as well as the rail line primarily used for tourism. Emissions estimates in the NIR focused solely on road transport and railway emissions; therefore, the mitigation actions for the transport subsector are focused on road transportation. These actions include increasing the electrification of the private and public transport system, promoting a shift from private to public transport, and implementing enabling measures such as installing charging infrastructure for electric vehicles and offering incentives to encourage the uptake of electric vehicles.

The mitigation actions in the transport subsector are outlined below.

Table 3.5. List of mitigation actions for the transport subsector

Sector	**Transport**		
Status	**Action**	**Description**	**SDG Impact**
Planned	**Mitigation Action 13:** Development of electric vehicles charging infrastructure by 2030	The development of EV infrastructure can aid the overall transition to use more EVs in the vehicle fleet. The government of St. Kitts and Nevis has indicated its plans for the development of electric charging stations on the islands. Currently, no charging stations are installed.	Goal 3: Good Health and Well-Being Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Planned	**Mitigation Action 14:** 2% of the total number of vehicles are electric and 2% of the total will be hybrid by 2030	Electrification of 2% of vehicles allows for a low carbon method of transport, thus reducing overall emissions from this sector. The government of St. Kitts and Nevis and the Caribbean Community Climate Change Centre (CCCCC), with financial support from the government of Italy, initiated a project to install two solar-powered battery charging stations and purchase three electric vehicles. The project encountered some difficulty, but the government is seeking efforts to restart this project.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action
Planned	**Mitigation Action 15:** Public transportation expansion and improvement for a shift of 20% of personal cars and SUVs after 2025	Increased access to public transport and increased reliability may help reduce the use of private vehicles, causing a modal shift and thereby reducing fossil fuel consumption in the transport sector and assisting in traffic management. Managing travel demand for different areas and increasing planning in the public transport system should be considered.	Goal 3: Good Health and Well-Being Goal 7: Affordable and Clean Energy Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation, and Infrastructure Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and

Sector	Transport		
Status	**Action**	**Description**	**SDG Impact**
			Production Goal 13: Climate Action

Industrial Processes and Product Use (IPPU)

One (1) mitigation action related to the **IPPU** sector has been identified for St. Kitts and Nevis. This sector covers anthropogenic emissions from industrial processes that do not result from fuel combustion. Given the small scale of industrial activity in the country, emissions from this sector are minimal. However, the main source of emissions is believed to originate from HFCs imported into St. Kitts and Nevis through the stock of refrigerators, air conditioning units and the bulk imports used to recharge these products. Due to limited data availability, the latest NIR did not establish a baseline for the IPPU sector. Nonetheless, a mitigation action was identified to improve future inventories and simultaneously work toward reducing emissions in the sector.

St. Kitts and Nevis is preparing to implement the Kigali amendment to the Montreal Protocol, which calls for the phase down in the use of HFCs. Currently, St. Kitts and Nevis is in the initial stages of the Kigali Amendment with ongoing work to enhance capacity within the refrigeration servicing sector (RSS). This includes strengthening the current licensing and quota systems to include HFCs and alternates and raising awareness within the RSS about global warming potential (GWP), natural refrigerants, and their associated technologies. St. Kitts and Nevis is expected to ratify the Kigali Amendment in the coming years, which is expected to improve data quality and tracking within this sector.

The mitigation action for the IPPU sector is defined in Table 3.6 below.

Table 3.6. Mitigation action for the industrial process and product use (IPPU) sector

Sector	Industrial Processes and Product Use		
Status	**Action**	**Description**	**SDG Impact**
Planned	**Mitigation Action 16:** 10% Phase-down of HFCs	Encouraging alternatives to HFC refrigerants through ratification of the Kigali amendment and improving the sector's energy efficiency. The ozone unit is currently in the initial phases of assessing HFCs in the country. St. Kitts and Nevis has been implementing the Montreal Protocol, and efforts are being made to ratify the Kigali amendment.	Goal 11: Sustainable Cities and Communities and Production Goal 13: Climate Action

Waste

One (1) mitigation action related to the **waste** sector has been identified for St. Kitts and Nevis. The waste sector includes emissions from solid waste disposal and wastewater treatment. Management of solid waste is overseen by the St. Kitts and Nevis Solid Waste Management Corporation (SWMC) under the Saint Christopher and Nevis Solid Waste Management Act (rev.2017) (Government of St. Christopher and Nevis, 2017). The St. Kitts Solid Waste Management Corporation (SWMC) manages solid waste in St. Kitts, and the Conaree Sanitary Engineered Landfill is the official waste disposal site. Nevis Solid Waste Management Authority (NSWMA) was formed to manage the solid waste in Nevis, and the official disposal site is the NSWMA landfill.

Wastewater is managed by the Ministry of Health. Some wastewater production for irrigation is done at the St. Kitts Marriott Hotel in St. Kitts; this water is primarily used for the irrigation of its golf course (Ian Chapman, Dennison Paul, Gerry Moise, Alexander Riley).

To further reduce waste, St. Kitts and Nevis is currently working with the government of the Republic of China on Taiwan to set up recycling points to collect recyclables, increase awareness, and organise activities to promote recycling. The project is expected to help build capacity and establish recycling models and mechanisms. Continuing this project, alongside a composting programme, will support reducing waste disposal sent to landfills through focused efforts on prevention, reduction, recycling, and reuse. This approach is expected to decrease emissions in the waste sector.

The mitigation action in the waste sector is outlined in Table 3.7 below.

Table 3.7. Mitigation action for the waste sector

Sector	Waste		
Status	**Action**	**Description**	**SDG Impact**
Ongoing	**Mitigation Action 17:**	The reduction of landfill waste can be implemented through various methods.	Goal 11: Sustainable Cities and

Sector	Waste		
Status	Action	Description	SDG Impact
	Reduction of landfill waste by 2% through recycling and composting systems	1. St. Kitts and Nevis is currently implementing a pilot recycling project to reduce plastic and other waste entering the landfill. 2. A composting system also helps reduce organic waste from entering the landfill. The government of St. Kitts and Nevis has initiated a recycling pilot project with support from the government of Taiwan on China. This project is in its implementation phase. The composting component is newly proposed, and no details on its implementation have been confirmed.	Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action Goal 14: Life Below Water Goal 15: Life on Land

Land use, land use change, and forestry (LULUCF)

One (1) mitigation action related to the LULUCF sector has been identified for St. Kitts and Nevis. The LULUCF sector covers estimated emissions and removals by sinks of GHGs on managed lands and protected areas. Land use changes occur over time and may result in the increase or decrease of carbon in living biomass. St. Kitts and Nevis land use has changed over the years with the shift from sugar production to a more service-oriented economy.

In addition, St. Kitts and Nevis lies within the tropical belt and is prone to extreme weather-related events such as intense hurricanes which may result in damage to the forestry sector. St. Kitts and Nevis hosts two national parks, the Central Forest Reserve National Park (CFRNP) and the Royal Basseterre Valley National Park. Through the St. Kitts and Nevis Global Environment Facility (GEF)- 6 projects, the country aims to support sustainable resource management as the country transitions from sugar production. The project entails the rehabilitation and protection of forest and mangrove systems and the restoration and maintenance of soil ecosystem services and carbon stocks through sustainable agriculture, agroforestry and reforestation. This project is expected to boost carbon sequestration across the country.

The mitigation action in the LULUCF sector is outlined in Table 3.8 below.

Table 3.8 List of mitigation actions for the land use, land use change and forestry (LULUCF) sector

Sector	Land Use, Land Use Change and Forestry (LULUCF)		
Status	**Action**	**Description**	**SDG Impact**
Ongoing	**Mitigation Action 18:** Increase of 3% of carbon sinks through reforestation and related practices.	The GEF-6 project "Improving Environmental Management through Sustainable Land Management in St. Kitts and Nevis" plans for 500ha of sustainable land management through agroforestry practices, reforestation, mangrove rehabilitation, and assisted natural regeneration.	Goal 11: Sustainable Cities and Communities Goal 12: Responsible Consumption and Production Goal 13: Climate Action Goal 14: Life Below Water Goal 15: Life on Land

GHG Emissions Projections

Overview of modelling approach

The mitigation analysis for St. Kitts and Nevis was developed using the Low Emissions Analysis Platform[19] (LEAP), a software tool developed by the Stockholm Environment Institute (SEI) and widely used for energy policy analysis and climate change mitigation assessments. LEAP is an integrated, scenario-based modelling tool that can quantify energy consumption and production and resource extraction in all sectors of the economy and under different scenarios. In addition, it allows for the consideration of both sources and sinks of GHG emissions from the energy sector and non-energy sectors.

The model simulates the dynamics of energy demand and supply in the country, along with the corresponding GHG emissions from both the energy and non-energy sectors. It assesses the mitigation potential of various sectoral measures. While treating St. Kitts and Nevis as a single country, the model incorporated some specific details differentiated by each island in the electricity generation sector. Notably, the country has two utility companies: Nevis Electricity Company Limited (NEVLEC) and St. Kitts Electricity Company Limited (SKELEC). Although the model includes some island-specific data from both companies regarding electricity generation sector, much of the data used is representative of the entire country. As such, it was challenging to develop two entirely separate models for each island.

A total of eighteen (18) mitigation actions were identified for St. Kitts and Nevis. These actions were assessed based on data availability and applicability for mitigation modelling. Of these, two (2) actions were considered enabling actions to implement other actions, and one (1) action was deemed unsuitable for modelling due to lack of data availability. As a result, fifteen (15) mitigation actions were modelled in LEAP.

The model used the period 2008 – 2018, aligning with the dates provided in the NIR. It incorporates the most recent economic, demographic and energy statistics, achieving close alignment the NIR data − within 0.3% of total net emissions in 2018. The projection period begins in 2019, with forward-looking scenarios created for 2030, 2035, and 2050.

[19] https://leap.sei.org/

The main drivers of energy demand in the projection period include GDP and population growth, with consideration for the estimated economic impact of COVID-19. Energy consumption has been disaggregated by sector and fuel, including residential, transportation, industrial, services, agriculture and fisheries, and other unspecified sectors.

These projections have been supplemented by more detailed modelling of the transportation sector, which includes a breakdown of the transport mode (rail and road), type (passenger and freight), vehicle type (cars, motorcycles, buses, etc.) and technology (internal combustion engines, hybrid, and electric vehicles). On the demand side, projections are based on historical energy balances, trends, and expected economic and demographic growth. On the supply side, the model represents power generation in terms of capacity expansion and dispatch of power plants for each island system, accounting for joint transmission and distribution losses. The non-energy sector encompasses the emission categories from the GHG inventory including IPPU, agriculture, LULUCF, and waste.

Three future scenarios were developed to evaluate the potential GHG mitigation: a baseline and two mitigation scenarios as described further below. Emissions were projected for each of the three scenarios, and the results were compared under the various scenarios. The mitigation effects reported in this chapter are referred to as emission reductions by comparing the baseline scenario to the mitigation scenarios.

The three scenarios developed for St. Kitts and Nevis are:

- **The baseline scenario** illustrates the expected emissions in St. Kitts and Nevis, assuming no changes in the policy actions from 2018 and that current trends in demographic and macroeconomic drivers, as well as in sectoral energy intensity, continue. It incorporates modest energy efficiency improvements that are likely to occur even in the absence of specific government policies. On the supply-side, this scenario assumes that additional power generation capacity will be met by diesel generators. The baseline scenario serves as the counterfactual scenario against which the emission reductions achieved through the implementation of various mitigation measures are estimated.

- **The mitigation scenario** uses the same macroeconomic and demographic assumptions as the baseline and implements the mitigation actions and assumptions described. This scenario models a total of fifteen mitigation actions across various sectors, including buildings, street lighting, electricity generation, waste reduction, transportation, and other sectors.

- **The additional mitigation** scenario includes the same assumptions and mitigation actions as above but also explores higher integration of electric and hybrid vehicles, increased use of public transportation, and the decoupling of the transport sector from the GDP of the country.

The establishment of the LEAP model for St. Kitts and Nevis not only facilitates ongoing mitigation assessment analysis but also enables local experts with the necessary skills to operate the model independently. In-country experts were trained on using LEAP to ensure that the government institutionalises the capacity to use this model. This capacity building initiative ensures that the government can continue to refine and update the model as needed, supporting long-term climate action strategies, supporting long-term climate action strategies.

Furthermore, a stakeholder validation workshop was conducted to review and validate the assumptions, analysis, and conclusions of the St. Kitts and Nevis Mitigation Assessment developed in LEAP. The final model reflects the feedback received from stakeholders at the validation workshop.

3.1.4. Baseline Scenarios

Baseline Scenario Description

The baseline scenario corresponds to the counterfactual scenario used to compare emissions and estimate mitigation potential for the modelled actions. The baseline scenario does not consider the targets, goals, and projects of the mitigation strategy; rather, the scenario reflects a continuation of existing trends and modest energy efficiency improvements in the residential, services, and industry sectors. The baseline also considers shifts in technologies that are expected to happen even without new policies, for example, increasing the use of electric appliances over other fuels in the residential and services sectors.

In the baseline, future emissions are estimated based on modelling the energy demand, supply, and non-energy sectors. These projections are driven by historical trends in energy consumption and projected macroeconomic indicators, such as population, number of households, GDP, and GDP per capita. The estimates of historical total energy consumption and trends were mainly based on energy balances produced from the latest inventory report. For the transport sector, this data was supplemented by national vehicle registration information, which allowed for more detailed modelling of the vehicle fleet, including different types of passenger and freight vehicles such as cars, motorcycles, SUVs, pickup trucks, minibuses, buses, taxis, vans, and trucks. The bottom-up fuel consumption projections were calibrated to align with historical transport sector energy requirements. The baseline does not consider the introduction of hybrid and electric vehicles in the future fleet.

Baseline Scenario Assumptions

For the projected period, the baseline presented corresponds to the best available realistic projection of future emissions based on current trends and market influences. In the energy sector, GDP is the key driver used for the baseline energy demand and GHG emissions projections in the residential, services, transportation, and industrial sectors. The demand and emissions in the residential sector are driven by the increasing number of households in the country, which relate to the expected population growth. In addition, modest energy efficiency improvements of approximately of 0.5% per year are assumed. In the electricity generation sector, no further additions of renewable capacity are considered from the 2018 levels (0.5 MW of solar in Saint Kitts and 1.93 MW of wind in Nevis), which results in 97-100% of electricity generated from diesel power throughout the modelling period. The retirement of existing diesel generators is indicated as planned by the utility companies for 2023 and 2025. All other generation capacity is retired is based on a 25-year lifetime for diesel generators and a 30-year lifetime for solar and wind capacity. All of the additional electricity generation capacity requirements are met through new diesel generators.

In the non-energy sectors, fugitive emissions and emissions from the agriculture sector were also projected based on GDP growth, while emissions from the waste sector followed the same growth as the population. The sequestration potential of the LULUCF sector is expected to remain constant relative to 2018 levels.

Baseline Scenario Results

Based on projections from United Nations World Population Prospects (United Nations- World Population Prospects, 2021), the total population in St. Kitts and Nevis (**Figure 3.2a**) will grow from 53.2 thousand in 2020 to 55.8 thousand in 2030 and 56.5 thousand in 2035. The population is expected to decline to 56.2 by 2050. The total number of households (**Figure 3.2b**) will grow from 23.5 thousand in 2020 to 25.4 thousand by 2030 and 25.5 thousand in 2050. In terms of economic growth (**Figure 3.3**), near-term projections from the International Monetary Fund (IMF) World Economic Outlook were used until 2025 (IMF WEO, 2021). These projections consider the impacts of COVID-19 on GDP, where a decrease of 14.4% in the GDP for 2020 was estimated. From 2025 to 2050, national-level GDP growth rates from the Shared Socioeconomic Scenarios database (SSP2= "Middle of the Road") were used (Keywan Riahi et al., 2017).

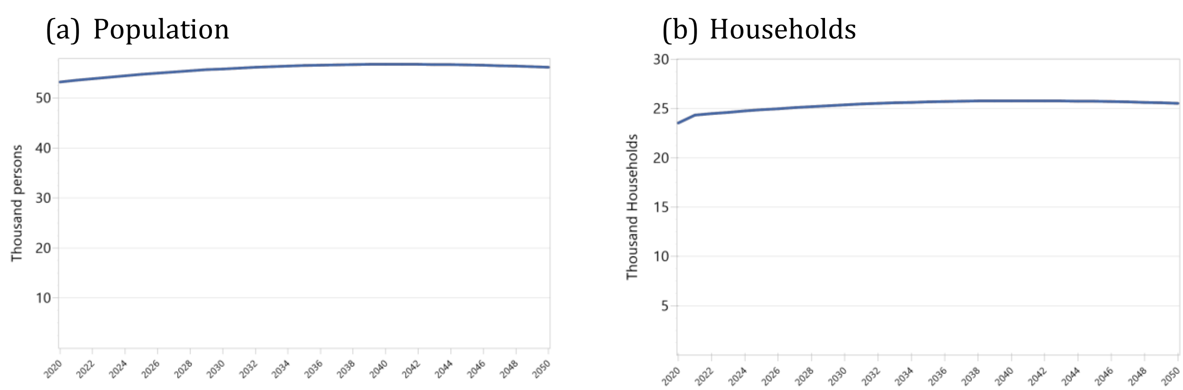


Figure 3.2. Population (a) and household (b) trends to 2050

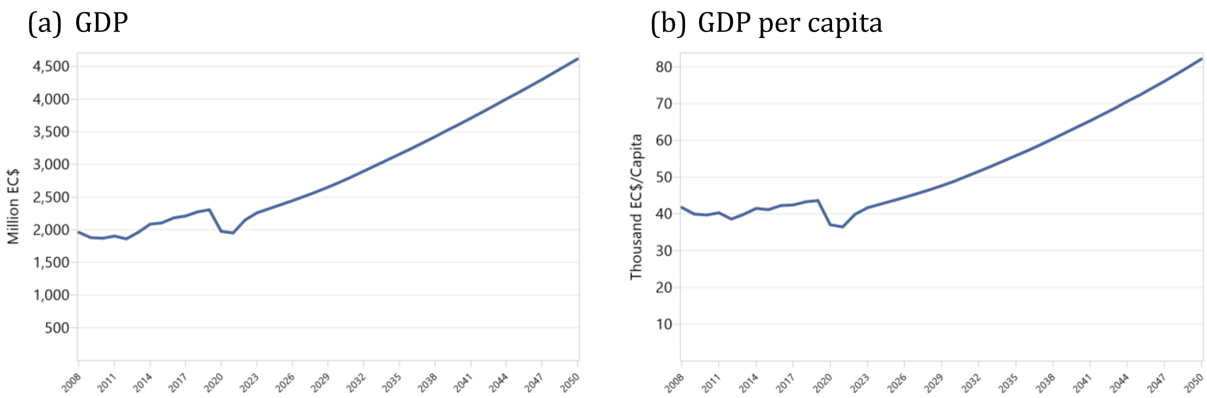


Figure 3.3. GDP (a) and GDP per capita (b) trends to 2050

Figure 3.6 and **Figure 3.7** show baseline emission projections by sector and gases, respectively. For the historical period (2008-2018), emissions are closely aligned with the most recent GHG Inventory for St. Kitts and Nevis. Total emissions for 2008, 2010 and 2018 were estimated at approximately 238.25 ktCO_2eq, 240.60 ktCO_2eq and 251.07 ktCO_2eq respectively. For the prospective period, the baseline presented corresponds to the best available realistic projection of future emissions based on current trends and market influences. The total net projected emissions reach 343.13 ktCO_2eq by 2030, 391.27 ktCO_2eq by 2035 and 536.05 ktCO_2eq by 2050.

Around 71% of the total net emission in 2018 corresponds to CO_2. As observed, electricity generation and transport sectors are the most carbon-intensive sectors, contributing to 48% and 32% of the total emissions in 2030. The LULUCF sector is an important emission sink, contributing to the sequestration of-113.1 ktCO_2eq, representing 25% of the total emissions in 2030.

GHG Emissions Projections

3.1.5. Overview of Modelling Approach

The mitigation analysis for St. Kitts and Nevis was developed using the Low Emissions Analysis Platform[20] (LEAP), a software tool developed by the Stockholm Environment Institute (SEI) and widely used for energy policy analysis and climate change mitigation assessments. LEAP is an integrated, scenario-based modelling tool that can quantify energy consumption and production and resource extraction in all sectors of the economy and under different scenarios. In addition, it allows for the consideration of both sources and sinks of GHG from the energy sector and the non-energy sector.

The model simulates the evolution of energy demand and supply in the country, as well as the GHG emissions corresponding to the energy and non-energy sectors and the mitigation potential of a series of sectoral measures. The model considers the twin-island Federation as a

[20] https://leap.sei.org/

single country with some specific details disaggregated by each island in the electricity generation sector. It is important to note that there are two utility companies within the Federation, namely Nevis Electricity Company Limited (NEVLEC) and St. Kitts Electricity Company Limited (SKELEC). Although there are some specific disaggregated details by both companies on matters relating to the electricity generation sector, some of the data used in the model was representative of the entire country. As such, it was difficult to generate two separate island specific models.

A total of eighteen (18) mitigation actions were identified for St. Kitts and Nevis. These actions were assessed based on data availability and applicability for mitigation modelling. Of these, two (2) actions were considered enabling actions to implement other actions and one (1) action was deemed unsuitable for modelling due to lack of data availability. As a result, fifteen (15) mitigation actions were modelled in LEAP.

The model covers the historical period 2008 – 2018, harmonious with the dates provided in the NIR. The model reflects the most recent economic, demographic and energy statistics and has been aligned to closely resemble the NIR data (within 0.3% of the total net emissions in 2018). The projections period commences in 2019 with forward-looking scenarios created for 2030, 2035, and 2050. The projection period uses GDP and population growth projections as the main drivers of energy demand and, to the extent possible, captures the estimated economic impact of COVID-19. Energy consumption has been disaggregated by sector and fuel, including residential, transportation, industrial, services, agriculture & fisheries, and other unspecified sectors. These projections have been supplemented by more detailed modelling of the transportation sector, which includes a breakdown of the transport mode (rail and road), type (passenger and freight), vehicle type (cars, motorcycles, buses, etc.) and technology (internal combustion engines, hybrid, and electric vehicles). On the demand side, projections are based on historical energy balances, trends, and expected economic and demographic growth. On the supply side, the model represents power generation in terms of capacity expansion and dispatch of power plants for each island system but with joint transmission and distribution losses. The non-energy sector encompasses the emission categories from the GHG inventory: IPPU, agriculture, LULUCF, and waste.

Three future scenarios were developed to assess GHG mitigation potential: a baseline and two mitigation scenarios as described further below. Emissions were projected for each of the three scenarios, and the results were compared under the various scenarios. The mitigation effects reported in this chapter are referred to as emission reductions by comparing the baseline scenario to the mitigation scenarios.

The three scenarios developed for St. Kitts and Nevis are:

- **Baseline:** Illustrates the expectations of emissions in St. Kitts and Nevis, assuming no changes in the policy actions from 2018 and considering a continuation of the current trends in demographic and macroeconomic drivers, as well as in sectoral energy intensity. It considers modest energy efficiency improvements, which can be expected even without government policies. The supply-side assumes that diesel generators meet additional power generation capacity requirements. The baseline scenario is used as the counterfactual scenario to estimate emission reductions achieved through the implementation of mitigation measures.

- **Mitigation** uses the same macroeconomic and demographic assumptions as the baseline and implements the mitigation actions and assumptions described. A total of fifteen mitigation actions were modelled comprising of mitigation in buildings, street lighting, electricity generation, waste reduction, transportation and other sectors.

- **Additional Mitigation**: It includes the same assumptions and mitigation actions as above but also explores higher integration of electric and hybrid vehicles, increased use of public transportation and the decoupling of the transport sector from the GDP of the country.

By building the model for St. Kitts and Nevis mitigation assessment analysis within LEAP, the model is readily available for future updated mitigation assessments. In addition, in-country experts were trained on using LEAP to ensure that the government institutionalises the capacity to use this model.

A stakeholder validation workshop was held to review and validate the assumptions, analysis, and conclusions of the St. Kitts and Nevis Mitigation Assessment developed in LEAP. The final model reflects the feedback from stakeholders at the validation workshop.

3.1.6. Baseline Scenarios

Baseline Scenario Description

The baseline scenario corresponds to the counterfactual scenario used to compare emissions and estimate mitigation potential for the modelled actions. The baseline scenario explicitly does not consider the targets, goals, and projects of the mitigation strategy; rather, the scenario reflects a continuation of existing trends and modest energy efficiency improvements in the residential, services and industry sectors. The baseline also considers shifts in technologies that are expected to happen even without new policies, for example, increasing the use of electric appliances over other fuels in the residential and services sectors.

In the baseline, future emissions are estimated based on modelling the energy demand, supply, and non-energy sectors. These projections are driven by historical trends in energy consumption and projected macroeconomic indicators, such as population, number of households, GDP, and GDP per capita. The estimates of historical total energy consumption and trends were mainly based on energy balances produced from the latest inventory report. For the transport sector, this data was supplemented by national vehicle registration information, which allowed for more detailed modelling of the vehicle fleet, including different types of passenger and freight vehicles such as cars, motorcycles, SUVs, pickup trucks, minibuses, buses, taxis, vans, and trucks. The bottom-up fuel consumption projections were calibrated to align with historical transport sector energy requirements. The baseline does not consider the introduction of hybrid and electric vehicles in the future fleet.

Baseline Scenario Assumptions

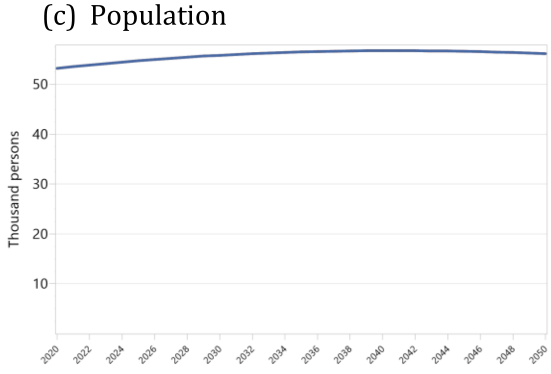
For the projected period, the baseline presented corresponds to the best available realistic projection of future emissions based on current trends and market influences. In the energy sector, GDP is the key driver used for the baseline energy demand and GHG emissions projections in the residential, services, transportation, and industrial sectors. The demand and emissions in the residential sector are driven by the increasing number of households in the country, which relate to the expected population growth. In addition, modest energy efficiency improvements of approximately of 0.5% per year are assumed. In the electricity generation sector, no further additions of renewable capacity are considered from the 2018 levels (0.5 MW of solar in Saint Kitts and 1.93 MW of wind in Nevis), which results in 97-100% of electricity generated from diesel power throughout the modelling period. The retirement of existing diesel generators is indicated as planned by the utility companies for 2023 and 2025. All other generation capacity is retired is based on a 25-year lifetime for diesel generators and a 30-year lifetime for solar and wind capacity. All of the additional electricity generation capacity requirements are met through new diesel generators.

In the non-energy sectors, the fugitive emissions and emissions from the agriculture sector were also projected based on GDP growth, while emissions from the waste sector followed the same growth as the population. The sequestration potential of the LULUCF sector is expected to remain constant relative to 2018 levels.

Baseline Scenario Results

Based on projections from United Nations World Population Prospects (United Nations- World Population Prospects, 2021), the total population in St. Kitts and Nevis (**Figure 3.2a**) will grow from 53.2 thousand in 2020 to 55.8 thousand in 2030 and 56.5 thousand in 2035. The population is expected to decline to 56.2 by 2050. The total number of households (**Figure 3.2b**) will grow from 23.5 thousand in 2020 to 25.4 thousand by 2030 and 25.5 thousand in 2050. In terms of economic growth (**Figure 3.3**), near-term projections from the International Monetary Fund (IMF) World Economic Outlook were used until 2025 (IMF WEO, 2021). These projections consider the impacts of COVID-19 on GDP, where a decrease of 14.4% in the GDP for 2020 was estimated. From 2025 to 2050, national-level GDP growth rates from the Shared Socioeconomic Scenarios database (SSP2= "Middle of the Road") were used (Keywan Riahi et al., 2017).

(c) Population



(d) Households

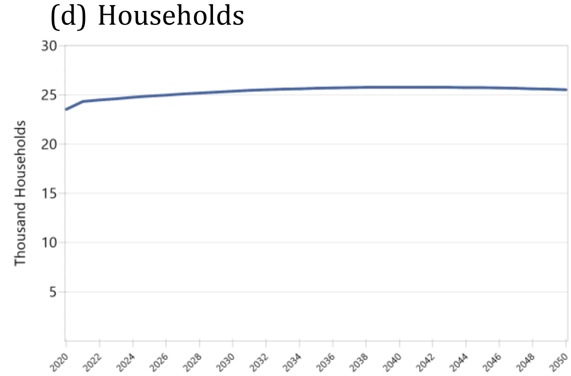


Figure 3.4. Population (a) and household (b) trends to 2050

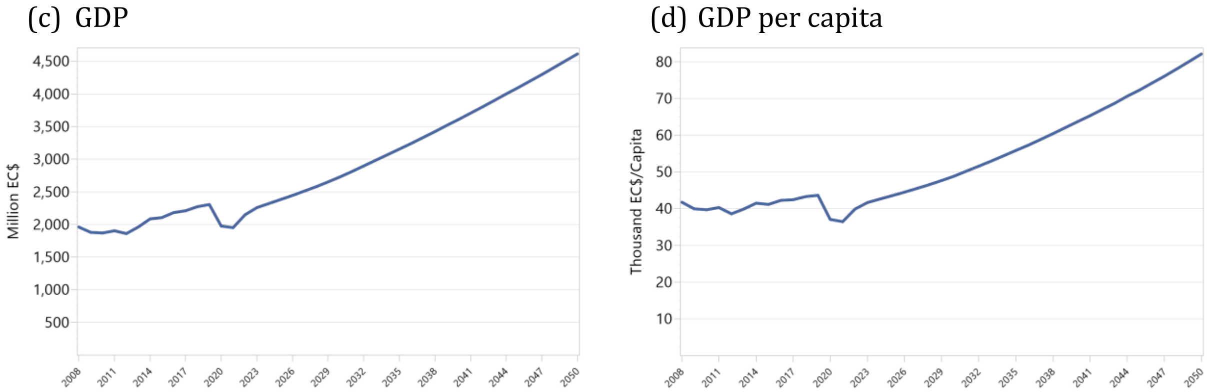


Figure 3.5. GDP (a) and GDP per capita (b) trends to 2050

Figure **3.6** and **Figure 3.7** show baseline emission projections by sectors and gases, respectively. For the historical period (2008-2018), emissions are closely aligned with the most recent GHG Inventory for St. Kitts and Nevis. Total emissions for 2008, 2010 and 2018 were estimated at approximately 238.25 $ktCO_2eq$, 240.60 $ktCO_2eq$ and 251.07 $ktCO_2eq$ respectively. For the prospective period, the baseline presented corresponds to the best available realistic projection of future emissions based on current trends and market influences. The total net projected emissions reach 343.13 $ktCO_2eq$ by 2030, 391.27 $ktCO_2eq$ by 2035 and 536.05 $ktCO_2eq$ by 2050.

Around 71% of the total net emission in 2018 corresponds to CO_2. As observed, electricity generation and transport sectors are the most carbon-intensive sectors, contributing to 48% and 32% of the total emissions in 2030. The LULUCF sector is an important emission sink, contributing to the sequestration of-113.1 $ktCO_2eq$, representing 25% of the total emissions in 2030.

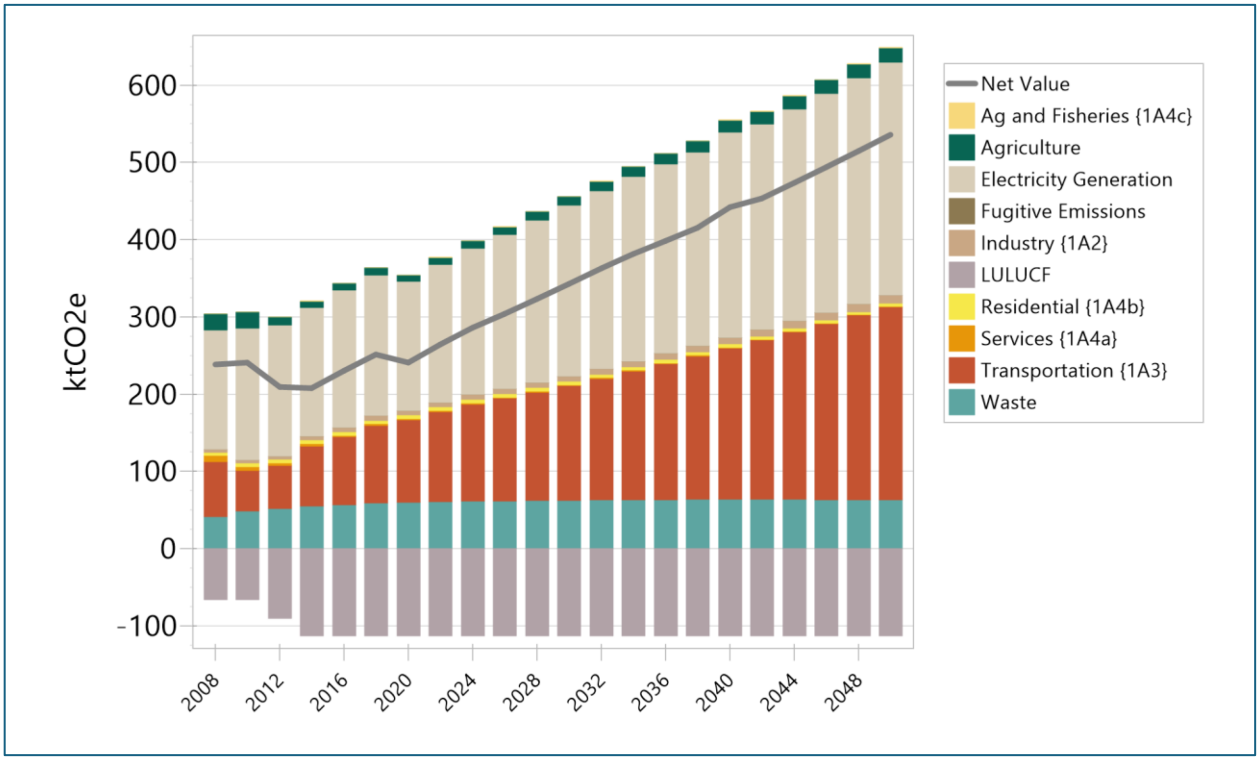


Figure 3.6. Projected GHG emissions in the baseline by sector

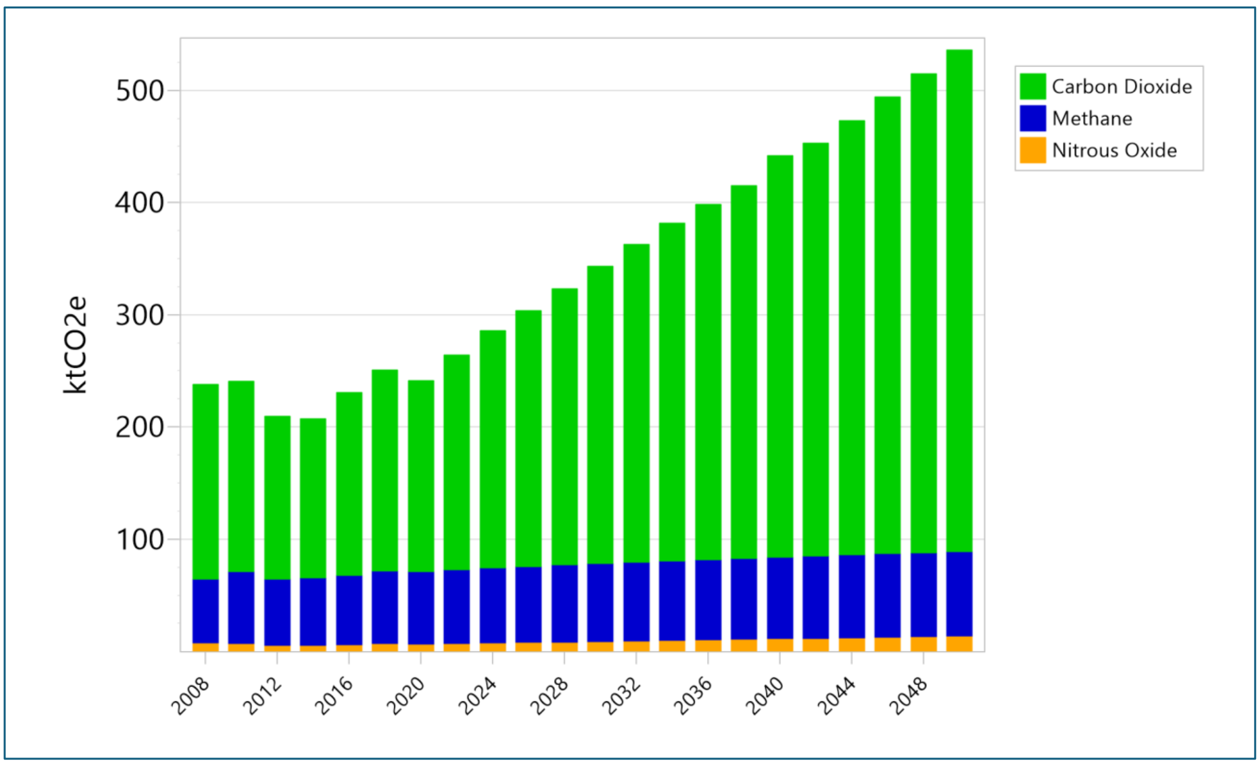


Figure 3.7. Projected net GHG emissions in the baseline by gas

Table ***3.9*** and **Table** ***3.10*** show the expected installed capacity and electricity generation in the baseline scenario, respectively. The baseline scenario does not reflect newly installed renewable energy capacity, and all future generation is expected to be met through diesel powerplants. Based on data provided by the electricity companies, it is expected that there will be retirement of diesel plants in 2023 at SKELEC of 9.6 MW and NEVLEC in 2025 and 2027, 4.7 MW and 2.7MW respectfully. New diesel capacity is added, totalling 1.4 MW by 2025 and no further diesel capacity is added until after 2030 to replace the retired plants and meet the expected demand.

Table 3.9. Expected installed capacity by technology in Baseline Scenario

Scenario	Year	Thermal (MW)	Solar PV (MW)	Wind (MW)	Geothermal (MW)	Total (MW)
Baseline	2018	69.3	0.5	1.9	-	71.7
	2025	57.5	0.5	1.9	-	59.9
	2030	54.8	0.5	1.9	-	57.2
	2035	58.8	0.5	1.9	-	61.2

Table 3.10. Anticipated electricity generation by technology in Baseline Scenario

Scenario	Year	Thermal (GWh)	Solar PV (GWh)	Wind (GWh)	Geothermal (GWh)	Total (MW)
Baseline	2018	252.1	1.0	4.9	-	258.0
	2025	265.5	1.0	4.9	-	271.3
	2030	290.8	1.0	4.9	-	296.7
	2035	320.4	1.0	4.9	-	326.2

3.1.7. Mitigation Scenarios

Mitigation Scenario Description

In the mitigation scenarios, fifteen (15) mitigation measures were modelled in LEAP, which corresponds to actions implemented in the residential, services, transportation, electricity generation, waste and LULUCF sectors. Descriptions of the mitigation measures are provided above**.** The two mitigation scenarios described consider the simultaneous implementation of the measures included in each scenario, accounting for possible interactions between measures. For example, the mitigation potential of the electrification of the transport sector is enhanced by the higher uptake of renewable energies in the power generation sector. On the other hand, the estimated mitigation potential of energy efficiency measures would be different if the power generation is based on diesel generators or renewable energy.

Mitigation Scenario Assumptions

The following section details the assumptions made in modelling the mitigation scenarios in LEAP. The assumptions for each mitigation action are given in the respective sector.

Energy Demand

The estimates of historical total energy consumption were based on the energy balances obtained from the latest inventory report for St. Kitts and Nevis. The historical energy consumption trends, together with key demographic and macroeconomic drivers, were used to project future energy demands by sector. The policy measures in the Energy Demand subsector which covers the residential and services sectors were represented as expected energy savings, estimated outside of LEAP based on the technical characteristics, uptake rates, and other assumptions. This was done due to the limited available data on energy end-use by sector which limits the ability to conduct a bottom-up analysis of energy demand for St. Kitts and Nevis. The main assumptions used in the model are described in **Table 3.11** below.

Table 3.11. Assumptions for mitigation actions in the Energy Demand subsector

Energy Demand	
Modelled Action	**Main Assumptions**
Mitigation Action 1: Increase the adoption of solar water heaters by 2030	• Water heaters are either solar or electric • The ownership rate for residential water heaters is assumed to grow from 15% in 2020 to 30% in 2030 and 50% in 2050. The fraction of solar water is expected to increase from 2.5% in 2020 to 40% in 2030 and 70% in 2050. • The ownership of commercial water heaters is assumed to be 10% and remains constant through the years. • Approximately 1% of these water heaters are solar in 2020, and this is expected to increase to 40% by 2030 and 70% by 2050.
Mitigation Action 2: Energy Efficient measures resulting in a 20% reduction in energy demand by 2030	It was assumed that the promotion of energy-efficient equipment and CREEBC will reduce energy demand by 20% nation-wide.
Mitigation Action 3: Streetlighting Retrofits by 2022	The number of lights to be replaced 7, 298 lamps. The average wattage of the bulbs was 165 W and replaced with 60 W LEDs. The streetlights are assumed to be in use for 12 hours per day. The replacement begins in 2019 and was completed by 2021
Mitigation Action 4: Retrofit of floodlights at sporting facilities by 2023	The number of lights to be replaced was 1,021. The original wattage of the bulbs is 1000W, and they will be replaced with bulbs of 400 W The lights are assumed to be in use for 4 hours per day The replacement begins in 2019 and is completed by 2022
Mitigation Action 5: Implementation of measures identified in energy audits of public buildings and pumping stations by 2025	The energy audits estimated that the total electricity savings from energy efficiency measures would result in the reduction of electricity consumption by 3,627,335 kWh/ year and from PV systems would result in 4,464,296 kWh/ year. These reductions are expected to be achieved by 2025.

Electricity Generation

The electricity generation assumptions determine the underlying GHG emissions from the supply and production of electricity. The measures in the power generation sector include planned additions of renewable capacity and a reduction in transmission and distribution losses in both islands. The LEAP model estimates projected electricity requirements and power generation capacity and dispatch from different types of power plants on each island. Due to data limitation, the supply of power to the demand is not considered for St. Kitts and Nevis separately. As a result, Mitigation Action 12 related to the interconnection of the two islands is modelled as it is implicitly considered in the model.

The main assumptions for the electricity generation subsector are described in **Table 3.12** below.

Table 3.12. Main assumption mitigation actions for the Electricity

Electricity Generation	
Modelled Action	**Main Assumptions**
Mitigation Action 6: Transition to 100% renewable energy by 2035	All renewable energy projects will be financed and implemented during the time frame indicated. It is assumed that some of the diesel generators will be retired. 100% renewable energy generation by 2035.
Mitigation Action 7: 35.7 MW of utility scale solar PV capacity for St. Kitts with 44.2 MWh Lithium battery storage by 2025	The assumption is that the current grid system can manage the increase of renewables without any upgrades. Storage was not modelled in this assessment.
Mitigation Action 8: 6.6 MW of Wind Power capacity installed in St. Kitts by 2030	The assumption is that the current grid system can manage the increase of renewables without any upgrades.
Mitigation Action 9: 15 MW of geothermal capacity in St. Kitts by 2035	Due to the level of preparation for the St. Kitts geothermal system, the expected completion date would be 2035 compared to 2030 in the updated NDC.
Mitigation Action 10: 10MW of geothermal capacity in Nevis by 2030	The construction of a geothermal powerplant and operation of the system may take a few years. Therefore, the powerplants are assumed to be in operation by 2030 and not 2025 as assumed in the updated NDC.
Mitigation Action 11: Improve efficiency in transmission and distribution of electricity by 2030	It was assumed that the current technical losses for transmission and distribution are 8.5% for Nevis and 12.5% for St. Kitts; an average was assumed at 11.3%. The total losses are assumed to reduce to 5% by 2030.

The following **Table 3.13** and **Table 3.14** shows the expected installed capacity and generation by technology for the years 2018, 2025, 2030 and 2035 under each of the modelled scenarios. In both mitigation scenarios the diesel power plants are not retired until their lifespan is reached but the expected generation is reduced and by 2035, they only provide spinning reserves for the electricity supply in St. Kitts and Nevis.

Table 3.13. Expected installed capacity by technology in mitigation scenarios

Scenario	Year	Thermal (MW)	Solar PV (MW)	Wind (MW)	Geothermal (MW)	Total (MW)
Mitigation	2018	69.3	0.5	1.9	-	71.7

	2025	57.5	36.2	4.9	-	98.6
	2030	54.8	36.2	8.5	10.0	109.5
	2035	35.3	36.2	8.5	25.0	105.0
Ambitious mitigation	2018	69.3	0.5	1.9	-	71.7
	2025	57.5	36.2	4.9	-	98.6
	2030	54.8	36.2	8.5	10.0	109.5
	2035	35.3	36.2	8.5	25.0	105.0

Table 3.14. Expected electricity generation by type in mitigation scenarios

Scenario	Year	Thermal (GWh)	Solar PV (GWh)	Wind (GWh)	Geothermal (GWh)	Total (GWh)
Mitigation	2018	252.1	1.0	4.9	-	258.0
	2025	150.0	69.7	12.3	-	232.1
	2030	63.9	69.5	21.6	70.1	225.2
	2035	0.8	69.8	21.7	131.1	223.0
Ambitious mitigation	2018	252.1	1.0	4.9	-	258.0
	2025	157.4	69.8	12.3	-	239.5
	2030	74.7	69.7	21.7	72.6	238.7
	2035	4.3	69.8	21.7	148.8	244.6

Transport

In the transportation sector, the historical energy consumption was based on the recent inventory report and was disaggregated by mode of transportation and fuel. This information was supplemented by the vehicle registration information to develop bottom-up modelling in LEAP. The bottom-up modelling of the different transport modes and vehicle types allowed for modelling sectoral mitigation actions and the resulting energy and emissions savings directly in LEAP.

Based on this model, the fuel demand for road transport including the rail line, increased by 50% of the 2018 value. In 2018, hybrid and electric vehicles (EV) represented 0% of the total stock of vehicles. The electrification of vehicles was modelling in the mitigation and ambitious mitigation scenarios using a different set of assumptions. In addition, the mitigation scenario also considered the impact of increasing public transport to offset growth in car sales. Mitigation Action 13 related to charging infrastructure for electric vehicles was not modelled as it was considered as an enabling action for electric vehicle introduction. The main assumptions are described in the Table 3.15 below.

Table 3.15. Main assumptions for mitigation actions in the Transport subsector

Transport	
Modelled Action	**Main Assumptions**
Mitigation Action 14: 2% of the total number of vehicles are electric vehicles and 2% of the total will be hybrid by 2030	In the mitigation scenario, electric and hybrid vehicles will account for 2% of the total fleet, respectively and 10% by 2050. A more ambitious scenario assumes a 12% each for electric vehicles and hybrid vehicles by 2030 with an increase of 40% by 2050.
Mitigation Action 15: Public transportation Expansion and Improvement for a shift of 20% of personal cars and SUVS after 2025	The assumption assumes that 20% of the sales of personal cars and SUVs will be reduced, and that shift will be towards the increased use of public transportation trend. A more ambitious scenario considers a reduction of 30% in sales of SUVs and Cars and increases in the public transport system.

Industrial Processes and Product Use (IPPU)

Due to data constraints the Mitigation 16 related to the phase down of HFC use is not modelled. St. Kitts and Nevis is working on improvements in their data collection methods and intends for this mitigation action to be modelled in the future.

Waste

In the waste sector, the historical emissions were based on the latest inventory report. From 2019 onwards, population is used as the key driver for projected future emissions in the waste sector. Table 3.16 describes the main assumptions for the mitigation action in this sector.

Table 3.16. Main assumption for mitigation action in the Waste sector

Waste	
Modelled Action	**Main Assumption**
Mitigation Action 17: Reduction of landfill waste by 2% through recycling and composting systems	It is assumed that a 2% reduction by 2030 in solid waste disposal emissions will be achieved through recycling and composting systems

Land Use, Land Use and Forestry (LULUCF)

In the LULUCF sector, the historical emissions were based on the latest inventory report. From 2019 onwards, the carbon sequestration is modelled to remain constant for the projected period. **Table 3.17** describes the main assumptions for the mitigation action in this sector.

Table 3.17. Main Assumption for Mitigation Action in the LULUCF sector

LULUCF	
Modelled Action	**Main Assumption**
Mitigation Action 18: Increase of 3% of carbon sinks through	3% increase by 2030 in carbon sinks through reforestation and related practices

reforestation and related practices.	

Mitigation Scenarios Results

As described above, two mitigation scenarios were modelled, which have the same demographic and macroeconomic assumptions as to the baseline, and consider a series of mitigation actions, detailed in above. The scenario with additional mitigation actions explores all of the measures in the mitigation scenario, with higher integration of electric and hybrid vehicles, increased use of public transportation and the decoupling of the transport sector from the GDP of the country.

Figure 3.8 shows the results of the total net emissions in the three modelled scenarios and the NDC target for 2030 as reference. The mitigation scenario with the current mitigation actions reduces emissions 34% by 2030 and 44% by 2035 compared to the 2010 value (240.6 $ktCO_2eq$). By 2035, the scenario with additional mitigation actions results in a 57% reduction compared to 2010 levels.

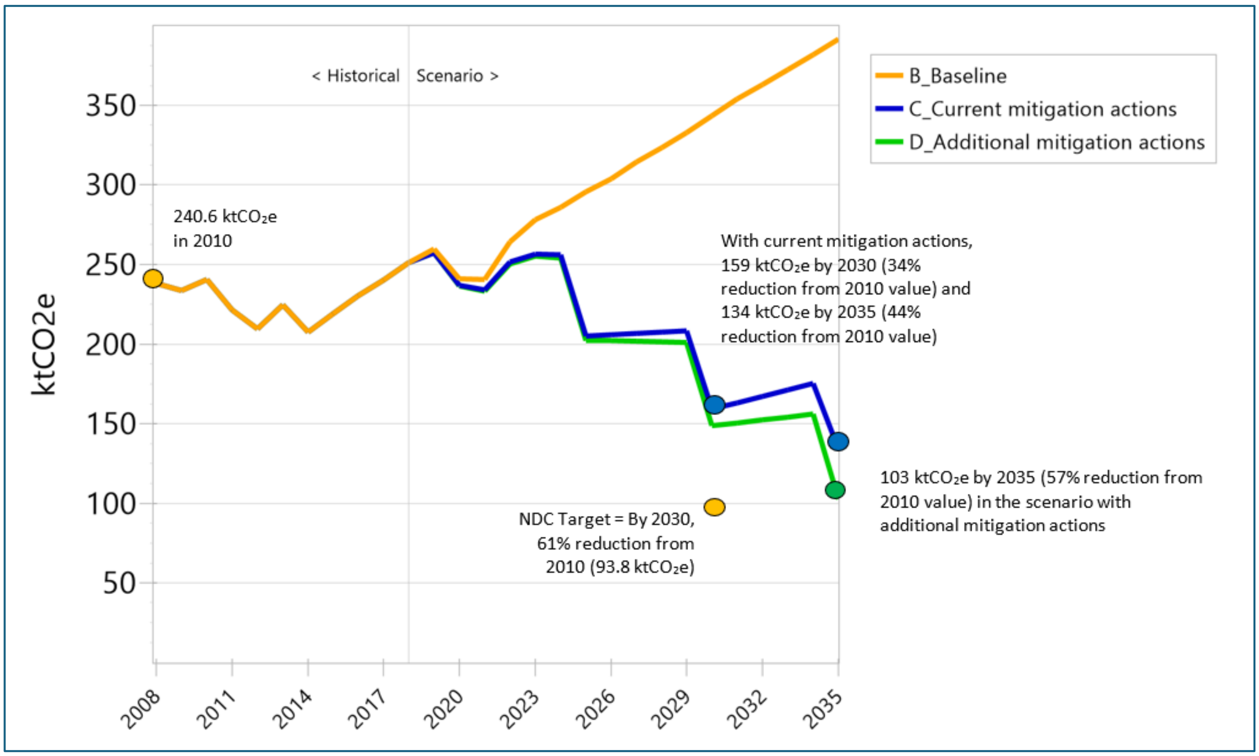


Figure 3.8. Projected total net emissions in St. Kitts and Nevis under three scenarios

Figure 3.9 and **Figure 3.10** show the total net emissions by sector and gas, respectively, in 2010, 2020, 2030 and 2035 for the three scenarios.

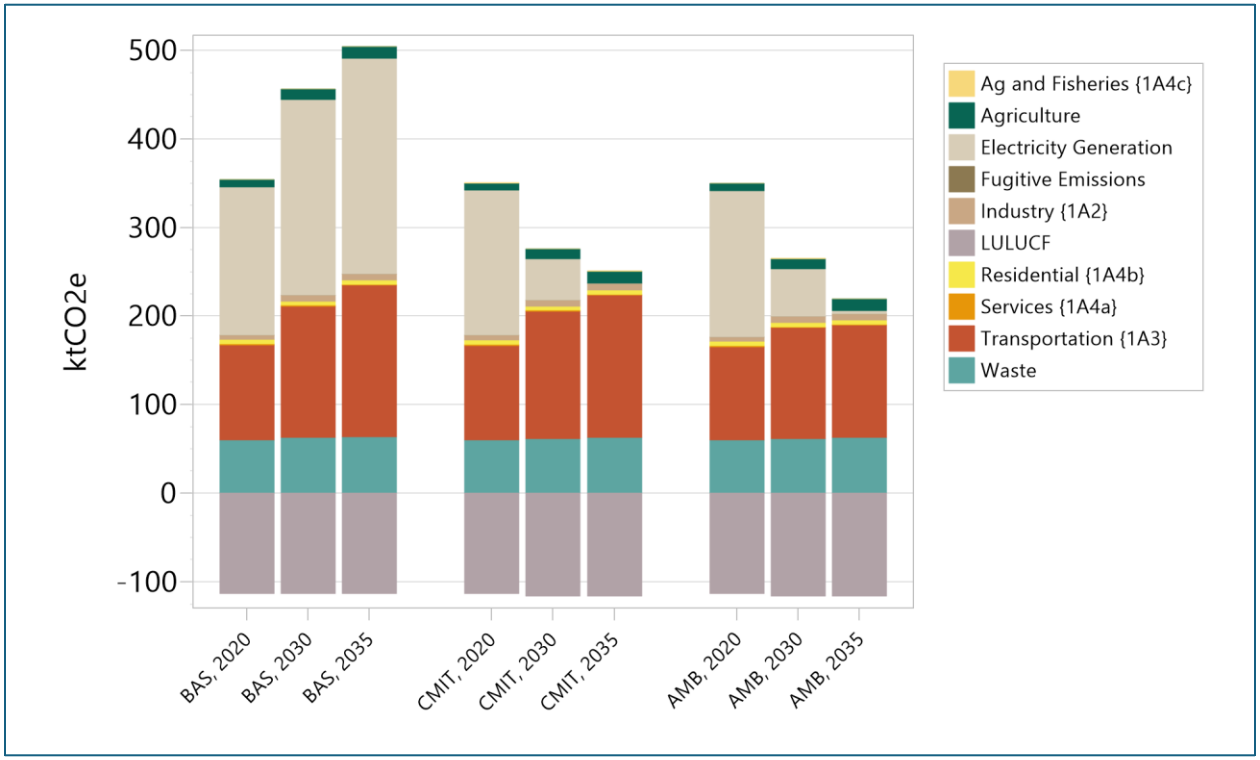


Figure 3.9. Projected total net emissions by sector under three scenarios

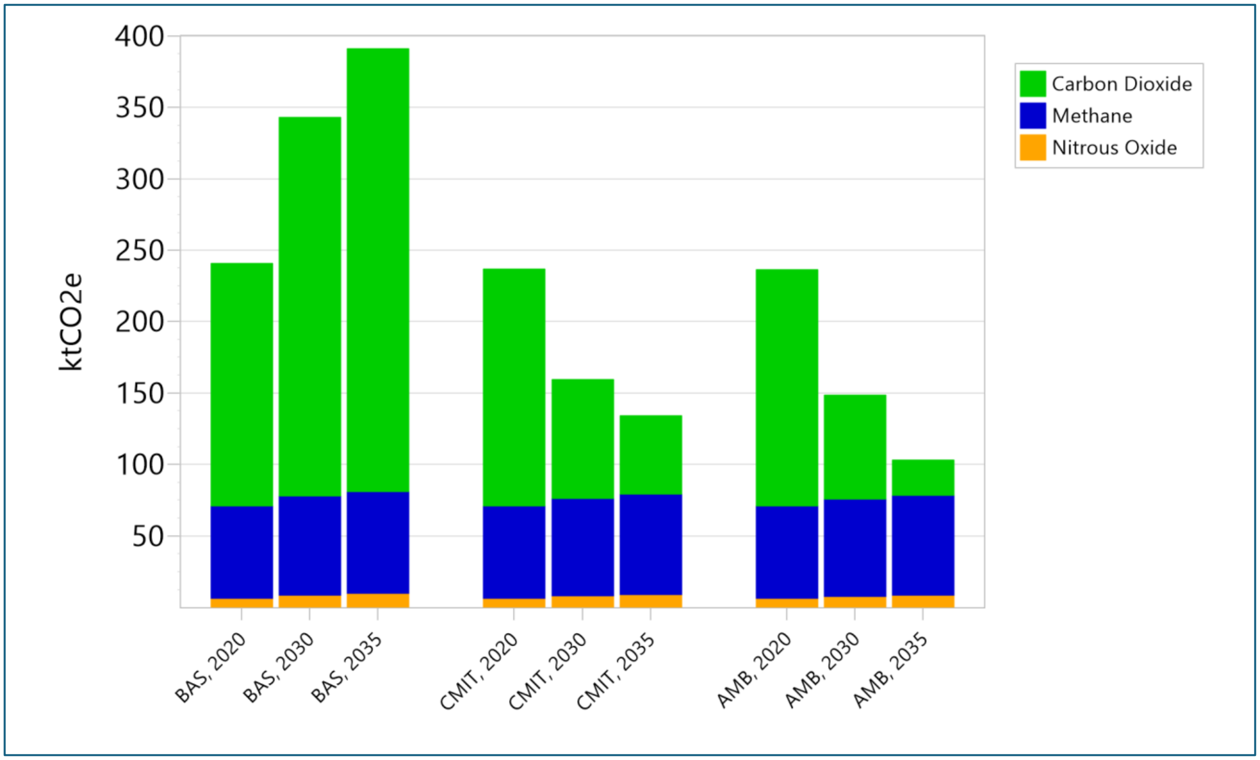


Figure 3.10. Projected total net emissions by gas under three scenarios

Error! Reference source not found. and Figure 3.11 show the emission reductions by sector in the scenario with the current mitigation actions and additional measures compared to the baseline scenario. The largest emission reductions occur in CO_2 emissions from the power generation sector, which will reach practically zero by 2035. By that same year, the transport and waste sectors are responsible for the majority of the remaining emissions, while the LULUCF sector continues to act as an important sink.

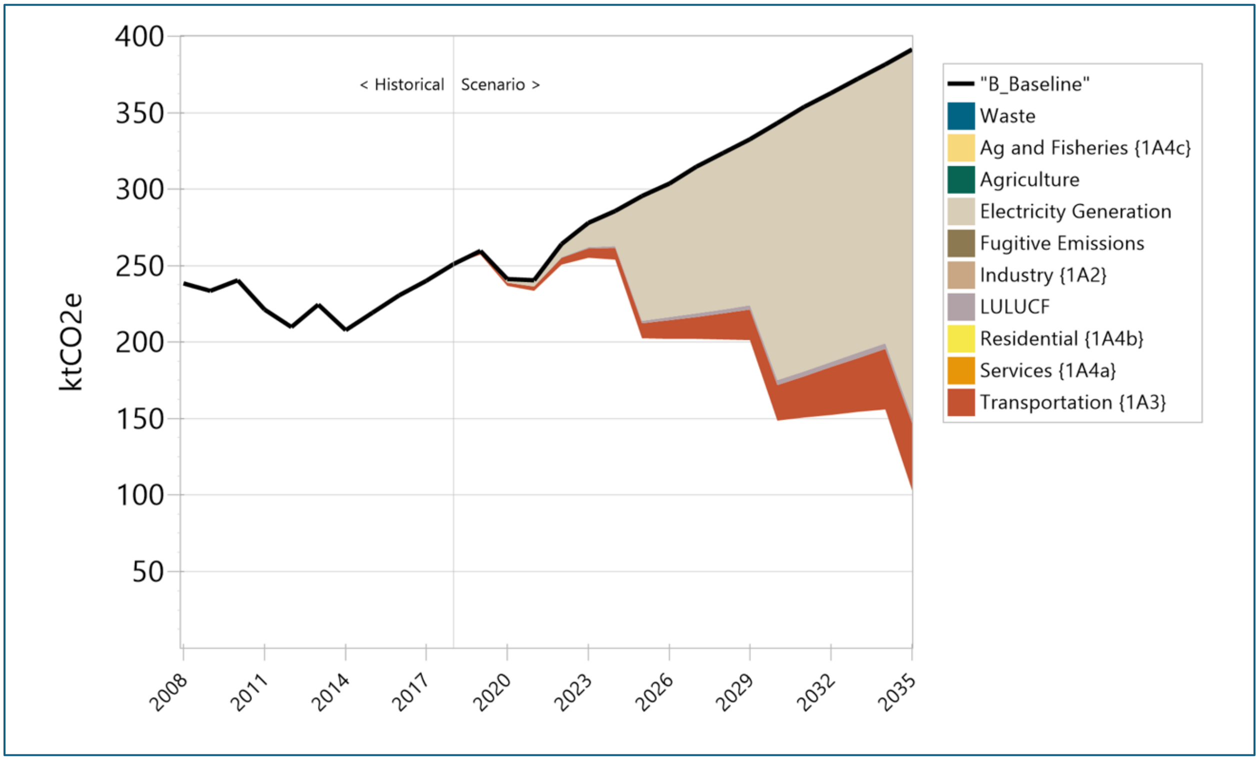


Figure 3.11. Projected emission reductions by sector in the mitigation scenario with additional actions compared to the baseline

Figure 3.12 and Figure 3.13 show the current and projected power generation capacity (MW) and power generation (GWh) by technology for the three modelled scenarios. In the baseline, the installed capacity by 2035 is 61 MW, with 4% of renewable capacity. In terms of power generation, 98% of the total electricity is produced from diesel generators. In the mitigation scenarios, the renewable energy capacity by 2035 includes 36.2 MW of solar, 8.5 MW of wind, and 25 MW of geothermal, which results in nearly 100% renewable generation, corresponding to a five (5) year delay in the NDC target of reaching 100% renewable generation by 2030.

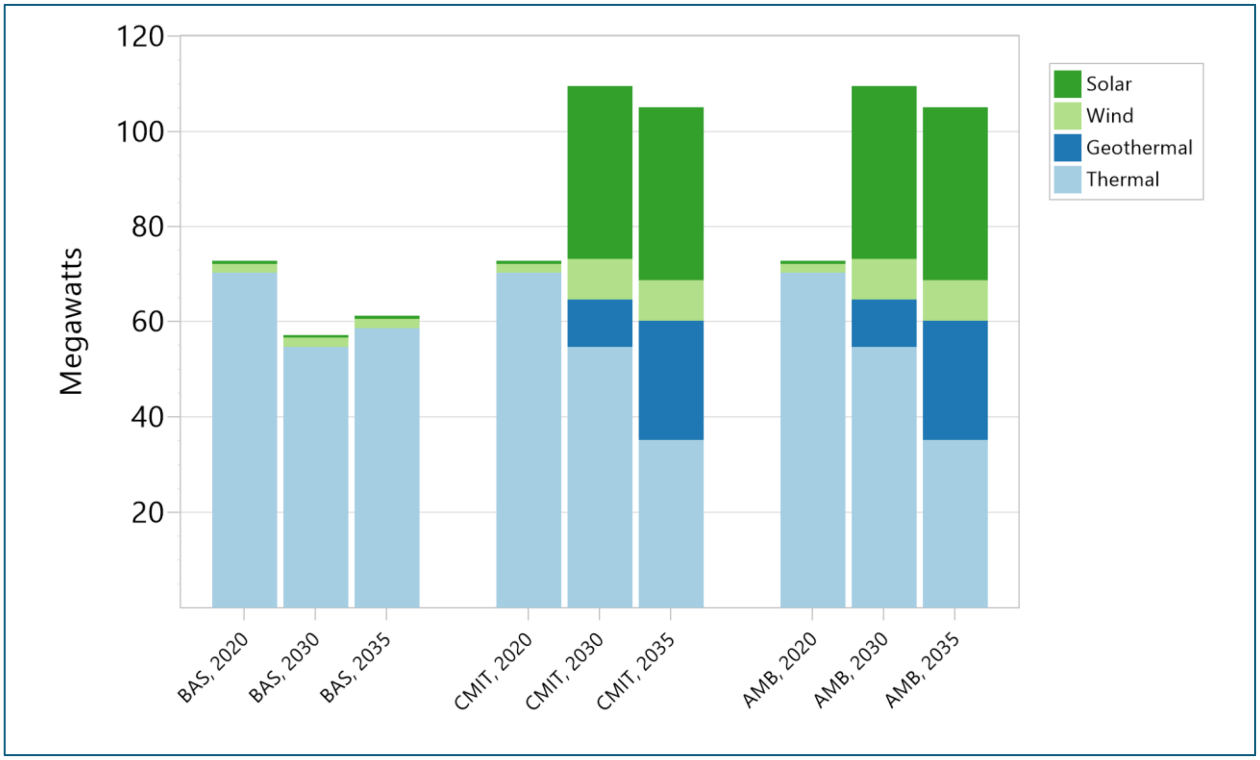


Figure 3.12. Current and projected power generation capacity under three scenarios

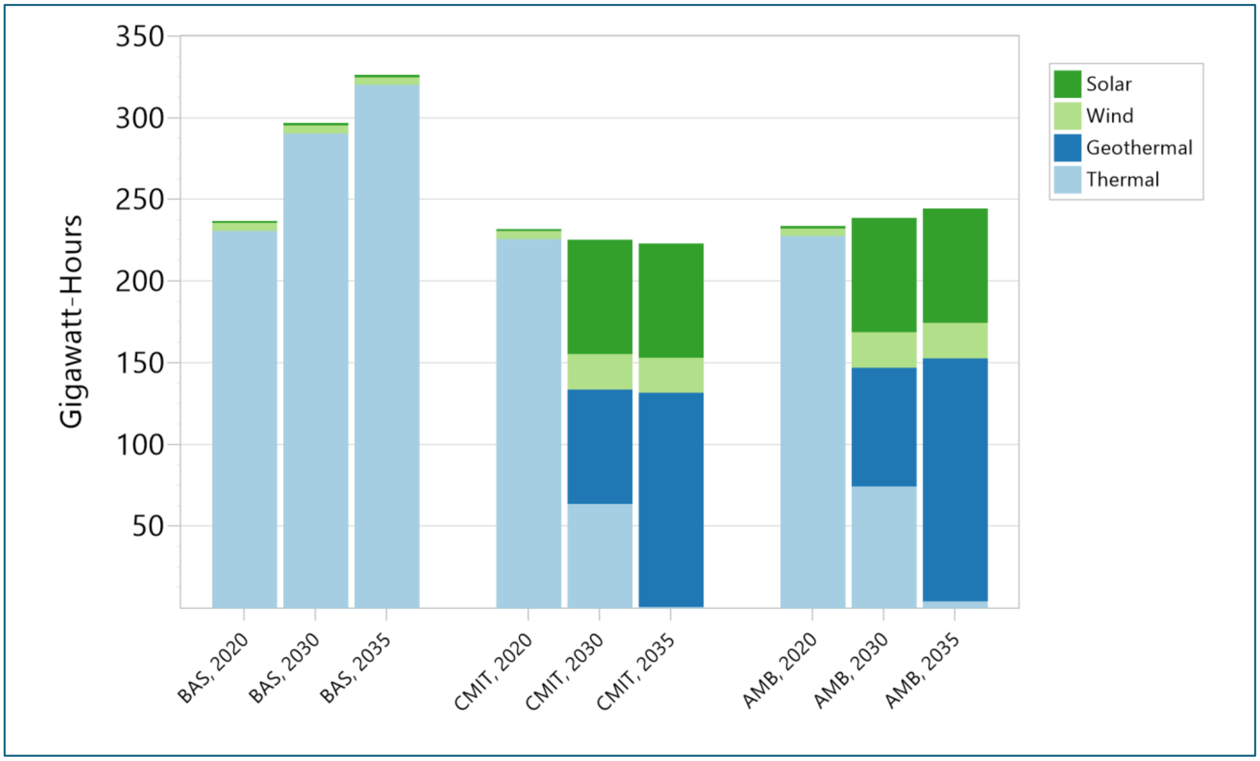


Figure 3.13. Current and projected power generation under three scenarios

Figure 3.14 shows the projected net emissions to 2050, assuming an increasing share of electric and hybrid vehicles as described previously. All additional power generation capacity requirements after 2035 are met by new solar and wind technologies. Without additional measures in the transport sector, the total net emissions in the mitigation scenario increase after 2035. Higher ambition in this sector could result in overall constant emissions between 2035 and 2050.

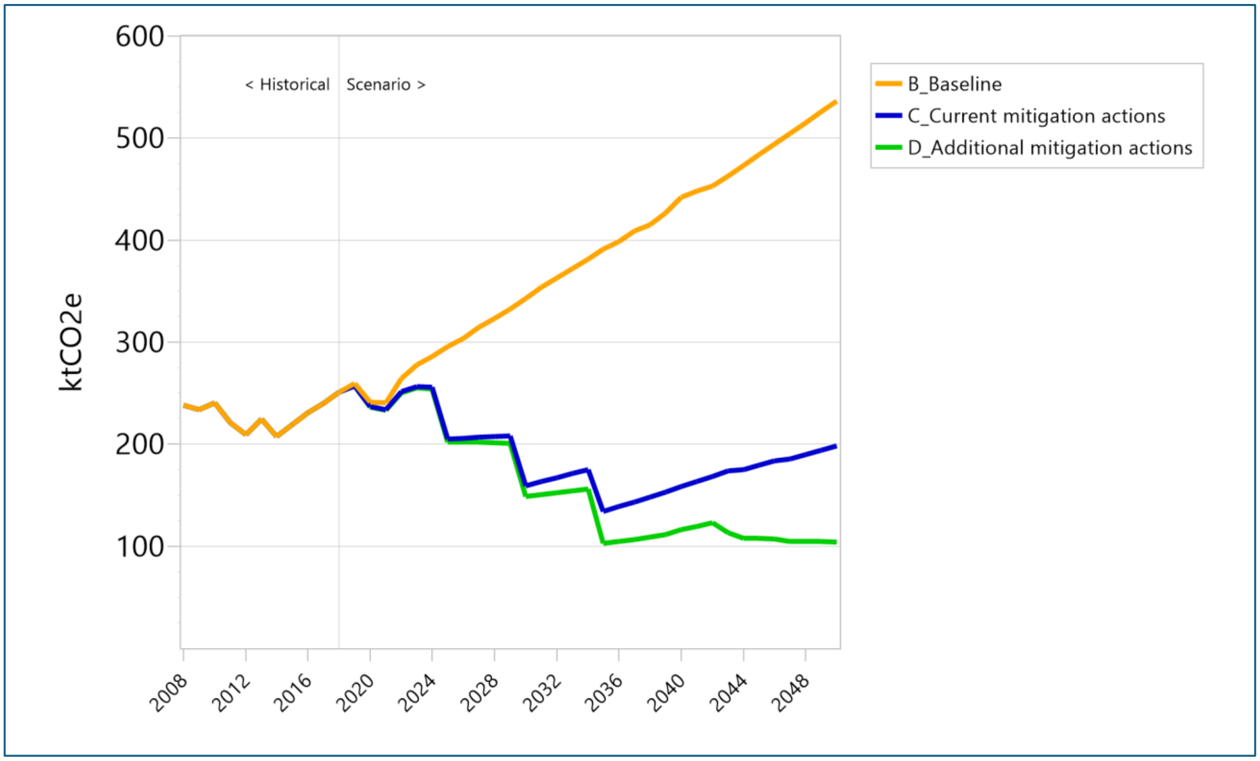


Figure 3.14. Projected total net emissions in St. Kitts and Nevis under three scenarios by 2050

The data for Figure 3.2- Figure 3.14 can be found in the Annex: Mitigation Assessment Data.

Summary of Results

This section provides an overview of the mitigation analysis for St. Kitts and Nevis. The actions were developed and analysed based on extensive stakeholder consultations. The actions not assessed during the mitigation analysis were a result of several factors including: data limitations, the type of action, such as an enabling action which is necessary to implement other actions and limitations of the software used.

The mitigation actions for St. Kitts and Nevis cover the majority of the sectors. A total of 18 mitigation actions were identified, with 15 mitigation actions modelled. It should be noted that although there was no baseline information provided for the IPPU sector, a mitigation action was included with the expectation that improvements in the Inventory will allow for this action to be assessed in future years. The mitigation analysis indicates that the revised mitigation actions do not currently meet the NDC target of 61% reduction in emissions by 2030. This is as a consequence of several factors such as the updated inventory information, revision of some of the mitigation actions and revised target dates.

Table 3.18 shows total net mitigation by 2030. Although these results provide an overview of the magnitude of mitigation potential from each mitigation action, it should be noted that interactions exist between mitigation actions, so the mitigation that results from implementing multiple actions may not necessarily be the sum of those individual actions. For example, when considered alone, the electrification of vehicles results in an increase in emissions from the power generation sector and a reduction in emissions from the transport sector due to the higher efficiency of electric vehicles compared to internal combustion engines (ICEs). As shown in the table, the net result is higher emissions than in the baseline, because the electricity generation continues to be entirely based on fossil fuels and renewables are not considered. However, if the electrification of vehicles were to be implemented in parallel to increasing the share of renewables in the power generation sector, this would result in a reduction in emissions rather than an increase. Therefore, it is essential when considering the overall effect of the mitigation actions that they are not considered in isolation.

Table 3.18. Summary of the mitigation actions and emissions reduction potential by 2030

Mitigation Action Number	**Mitigation Action Description**	**Potential Emission Reduction in ktCO_2eq by 2030**
Mitigation Action 1	Increase the adoption of solar water heaters	5.54
Mitigation Action 2	Energy Efficient measures resulting in a 20% reduction in energy demand	34.22
Mitigation Action 3	Streetlighting Retrofits	3.99
Mitigation Action 4	Retrofit of floodlights at sporting facilities	1.07
Mitigation Action 5	Implementation of measures identified in energy audits of public buildings and pumping stations	Energy efficiency measures: 4.31 Distributed generation: 5.3
Mitigation Action 6	Transition to 100% renewable energy	129.15
Mitigation Action 7	35.7 MW of utility-scale solar PV capacity for St. Kitts with 44.2 MWh lithium battery storage	Modelled with Mitigation Action 6
Mitigation Action 8	6.6 MW of Wind Power capacity in St. Kitts	Modelled with Mitigation Action 6
Mitigation Action 9	15 MW of geothermal power capacity in Saint Kitts	Modelled with Mitigation Action 6
Mitigation Action 10	10 MW in geothermal power in Nevis	Modelled with Mitigation Action 6
Mitigation Action 11	Improve efficiency in transmission and distribution of electricity	20.24
Mitigation Action 12	Electricity Interconnection system for the two islands	Not Modelled
Mitigation Action 13	Development of Electric Vehicles Charging infrastructure by 2030	Not Modelled
Mitigation Action 14	2% of the total number of vehicles are electric vehicles, and 2% of the total number	+0.03

	will be hybrid by 2030	
Mitigation Action 15	Public Transportation Expansion and Improvement for a shift of 20% from personal cars and SUVs after 2025	1.67
Mitigation Action 16	10% Phase-Down of HFC	Not Modelled
Mitigation Action 17	Reduction of landfill waste by 2% through recycling and composting systems	0.98
Mitigation Action 18	Increase of 3% of carbon sinks through reforestation and related practices	3.40
Total	Note: The sum of all the individual measures is not the same as the mitigation measures achieved through the simultaneous implementation of the measures because of the interactions between some of the measures. The total represents the sum when simultaneously implementing the measures.	183.76

Barriers and Challenges

A summary of the main barriers and challenges in conducting the mitigation assessment and the implementation of the mitigation actions are highlighted below:

- **Lack of Adequate Data** - Data quality and availability were identified as the main challenges throughout the development of the model. Insufficient data will result in limited accuracy in the modelling and create major challenges for monitoring, verification, and reporting. Kitts and Nevis currently has a licencing system for HCFCs that tracks and reports the import of F-gases. However, no such system exists for HFCs, consequently data on these gases are unavailable. It is expected that through the ratification of the Kigali Amendment of the Montreal Protocol, a similar licensing system for HFCs will be operationalized. This will enable provision of disaggregated data from the national ozone unit and though online data repository of the ozone secretariat.
- **High Capital Costs** – Renewable energy initiatives normally require high capital costs. Although St. Kitts and Nevis is considered a high-income country, the unique challenges of SIDS need to be taken into consideration. Therefore, it is essential that access to climate finance grants and low-interest loans be made available to SIDS to help reduce the costs of implementation.
- **Technology Suitability/Availability** – St. Kitts and Nevis have identified geothermal development on the island of St. Kitts and the island of Nevis. The development of this technology is in its advanced stage in Nevis but in its infancy in St. Kitts. Therefore, it is important that St. Kitts verify the availability of the resource. Furthermore, it is essential that capacity building in suitable technologies is conducted for the sustainability of implementation.
- **Natural Disasters** – St. Kitts and Nevis lies within the tropical belt and is the direct path of hurricanes. It is expected that extreme weather events will become more frequent

and intensify with increased global warming and climate change. This creates major challenges for the sequestration potential of the LULUCF sector.

- **Land Availability** – St. Kitts and Nevis have limited surface area. Therefore, there is a need to balance the enhancement and protection of the LULUCF sector and the increase the renewable energy generation. Land-use zoning will be of critical importance.
- **Political Will** – Implementing mitigation actions requires broad political support and effective planning to maximise opportunities. Therefore, it is essential that sensitisation and education of high-level decision-makers to the climate change needs are sustained.

Plans for Improvement

3.1.8. Data Collection

- Collection of more disaggregated data on the building sector in Nevis and the level of use of appliances St. Kitts and Nevis would allow for more detailed modelling. This would create a more transparent assessment of mitigation actions.
- Collection of data on HFCs in the IPPU sector through the ratification of the Kigali Amendment of the Montreal Protocol and introduction on licensing systems for HFCs and natural refrigerants.
- Disaggregation of macroeconomic data to enable modelling the islands separately.
- Further disaggregation of data for the transport sector to allow for a more comprehensive model for the subsector.

3.1.9. Modelling Upgrades

- Further examination of the LEAP model as a tool for monitoring the implementation of projects.
- Once the necessary data is acquired, modelling of the two islands separately and inclusion of a scenario with interconnection.
- More comprehensive modelling for the transport subsector, once data can be obtained.
- Bottom-up modelling for the energy demand subsector is required to improve the ease of updating the modelling.

3.1.10. Enhanced Capacity

- Continued development of a mitigation team to continuously update the mitigation assessment.
- Identifying and retaining staff skilled in monitor the implementation of projects and updating the LEAP model.
- Continued development of staff skilled in IPCC guidelines and GHG accounting
- Development of data collection team for mitigation assessment.

4. Adaptation

INTRODUCTION

The main objective of this output is to identify and describe adaptation strategies (both existing and recommended) with the greatest potential to address climate change vulnerabilities in priority sectors. These are presented as a master inventory of adaptation options, with recommendations for updating the existing adaptation portfolio. The process for identifying suitable adaptation options included a review of sectoral information (governance, climate change impacts, and experience in adaptation implementation) and an adaptation gap analysis. This, along with the findings of the integrated vulnerability modelling and a review of best practices and stakeholder inputs, served as the basis for recommending opportunities to expand the range of feasible adaptation strategies that can be considered by St. Kitts and Nevis in its report. Aside from the recommended adaptation options, the report also provides decision-makers with a framework for screening, prioritization, and evaluation of adaptation options moving forward.

The overarching goal and final outcome of this Chapter include, inter alia;

- To boost understanding of climate change impacts, approaches to vulnerability, and adaptation assessment.
- To update the evidence basis on climate vulnerability, adaptation needs, constraints and opportunities.
- To enable stakeholders to prioritize adaptation projects and develop appropriate policies to reduce vulnerability to climate change, avoid maladaptation and ultimately ensure low-carbon climate resilience at national and sectoral levels.
- To facilitate development of national and sectoral proposals to access adaptation funds.
- To ensure alignment with the 2018 National Adaptation Strategy (NAS) as well as other sustainable development goals and indicators (including UN Sustainable Development Goal, SDG 13).

Adaptation Planning to Date

National Adaptation Mandates & Priority Areas

Adaptation planning in St. Kitts & Nevis is currently guided by two documents: the 2018 National Adaptation Strategy (NAS) and the 2015 2nd National Communication (SNC) to the UNFCCC (Oderson et al., 2015), which will be superseded by the 3rd National Communication (TNC). Between these two national adaptation documents, there are over a hundred different adaptation measures that were recommended for the various sectors in the country. The following table (Table 4.1) shows the focal sectors/areas for the two existing adaptation mandates.

Table 4.1. Number of recommendations per adaptation priority area in the 2nd National Communication and National Adaptation Strategy

Priority Areas	SNC (2015)	NAS (2018)
Coastal & Marine Resources & Fisheries	10	7
Tourism21	-	6
Settlements (including coastal) & Infrastructure (& Physical Development)	20	5
Water Resources	7	5
Agriculture	5	6
Forestry & Terrestrial Ecosystems	5	11
Human Health	4	4
Finance & Banking		4
Cross-cutting Areas		
Capacity Building & Engagement		4
Information Management, Research and Monitoring & Evaluation		5
Integrated Adaptation & Disaster Risk Reduction		5
Investment & Economic Planning		7
Intersectoral Coordination		5

The adaptation measures included in these main national adaptation documents can be reclassified as contributing to three strategies (a) building adaptive capacity and readiness or the enabling conditions needed for implementing effective adaptation (governance, partnerships, institutional capacity and knowledge) (b) reducing exposure to climate hazards and (c) reducing inherent sensitivities to climate impacts.

Building Adaptive Capacity

The SNC included recommendations aimed at enabling more effective climate change adaptation planning and public policies, which mainly focused on addressing climate risk and vulnerability in the coastal and marine areas. This involved updating and improving enforcement of existing governance mechanisms, such as the following:

- Development controls, such as building codes and standards,
- Engineering design criteria,
- Land use policies and plans,
- National Action Plans, such as the 2004 National Biodiversity Strategy & Action Plan (NBSAP), the National Environmental Action Plan (NEAP) and National

21 In the 2nd National Communication to the UNFCCC, tourism was integrated into a theme called “Tourism, Settlement & Infrastructure” and no specific adaptation measures for the sector were identified, although to some extent these were addressed in other priority areas like infrastructure and water.

Disaster Management Plan,

- Legislation and regulations relating to protection and conservation of ecological resources to ensure in the process that effective, implementable enforcement mechanisms and sanctions are included.

The NAS (2018) made further recommendations for strengthening provisions for Climate Change Adaptation (CCA) or mainstreaming of CCA into sectoral governance frameworks/mechanisms for settlements & infrastructure, water resources management, fisheries, forestry, finance & banking, and tourism. A point of departure from the NC2 was the greater attention to vulnerable groups and the need to integrate CCA into poverty reduction strategies.

Major new planning mechanisms identified in the SNC included marine protected areas (MPAs) and fisheries management plans (FMPs) to support building resilience in marine ecosystems by reducing non-climate stressors. While a draft national FMP has been developed, the 2018 NAS reiterated the need for better integration of CCA, ecosystem-based adaptation (EbA) and disaster risk reduction (DRR) into this and other frameworks like the National Conservation and Environmental Protection Act (NCEPA). EbA is focused on managing stressors on ecosystems and their services, with a view to reducing climate change risks and impacts and improving the resilience of communities (Terton & Greenwalt, 2020). The NAS also recognized the need for the establishment of both a dedicated Coastal Zone Management Unit (CZMU) and a Protected Areas Systems Plan within the DOE.

Both the SNC and the NAS have made recommendations for developing institutional capacity, knowledge and information systems to support better CCA planning and decision-making. The SNC made recommendations specifically in relation to coastal & marine resources, fisheries and the health sector, whilst the NAS recognized institutional capacity building needs for CCA in relation to agriculture, fisheries, forestry, health, disaster risk management (DRM), finance & banking, and investment & economic planning. The NAS also specifically recommended the expansion of DOE capacity to function as a National Climate Change Secretariat and to coordinate with climate change focal points in various other government agencies and ministries.

The SNC also identified several areas where information systems and knowledge capacity could be improved for more effective CCA planning and risk reduction in two main sectors: coastal and marine resources (e.g., use of Early Warning Systems, public awareness programmes etc) and the health sector (e.g., improved training and surveillance). The SNC also recommended wider adoption of proven "traditional" technologies and knowledge.

The NAS greatly expanded recommendations for improved evidence-based CCA, through:

- Sector-based vulnerability and adaptation assessments for the agricultural, health and tourism sectors;

- Expanded agricultural and fisheries extension services and technical support;

- Research into best practices for coastal ecosystems, EbA (especially for coastal and marine systems), Climate Smart Technologies (CSTs), DRM and Early Warning Systems (EWS) for natural hazards; health/epidemics and climate hazards;

- Use of climate adaptation tools like CCORAL to enable adaptation mainstreaming into public projects;
- Development of a database of all on-going public CCA initiatives;
- Integrated national IMS/GIS system that includes climate hazard information;
- Monitoring and baseline surveys for coastal ecosystems, fisheries stocks etc., capacity-building recommendation in the NAS included increased understanding of Global Climate Fund (GCF) requirements and capacity building for resource managers in fisheries, forestry, and public health.

A gap in the SNC that was addressed in the NAS was the lack of attention to partnerships and institutional coordination. The NAS clearly identified several cross-cutting areas and opportunities for collaboration and cooperation on CCA strategies. These thematic areas included specific measures to integrate CCA into multiple sectors by:

- Increased capacity building and engagement;
- Improved information management, research and monitoring and evaluation;
- Explicitly considering climate resilience in disaster risk reduction (DRR); and investment & economic planning and,
- Improved intersectoral coordination.

Reducing Climate Risk/Exposure

In the SNC the recommendations for use of climate-smart technologies (CSTs) were made mainly in relation to infrastructure (structural elevation, improved drainage, ventilation technology) and agriculture (adapted genotypes, drip irrigation systems). In the NAS, recommendations for CSTs were generally limited to climate-proofing buildings & infrastructure: (e.g., incentives for retrofitting) and water resources management in the agricultural sector. There was also a recommendation for the use of “climate-proof considerations” into new investments in the fisheries sub-sector (infrastructure, retrofitting, communications etc).

In the SNC, five recommendations were made in respect of climate risk reduction (CRR). These included measures to provide incentives and access to funding for increased insurance in relation to settlements and infrastructure (including the coastal zone), exploration of alternative livelihoods for fishers, intervention programmes to protect species at risk from climate change, and expansion of health care facilities. In the NAS, CRR measures included insurance and diversification (including cross-sectoral synergies) for the agricultural sector and tourism sector.

The NAS also recommended the use of cost benefit analysis (CBA) for climate impacts on economic development and investment opportunities, and identification of market-based incentives to promote sustainability in the tourism sector. These CRR measures would have to be informed by evidence and would therefore be expected to rely on the implementation of the recommended information systems and knowledge base development measures also described in the NAS.

Reducing Sensitivity to Climate Impacts

Increasing the resilience and coping capacity of systems by reducing non-climate stressors to those systems is a commonly used adaptation strategy. Generally, this is done in two main ways: (a) through improvements to operational efficiencies in systems where resources are impacted by climate change and (b) reducing anthropogenic pressures and impacts on by natural systems that are also being impacted by climate change.

Operational Efficiencies

With projections of increasing temperatures and declining rainfall, the SNC made several recommendations for increasing efficiencies in the water sector, including:

- Optimization of the existing supply;
- More extensive application of recycling;
- Investment in more efficient and extensive water storage facilities (e.g., reservoirs); wastewater recycling;
- Wider adoption of proven water-saving technologies, e.g. Low-flush toilets; and,
- Consideration of artificial recharge of aquifers and desalination.

The NAS added recommendations for the water sector to improve source water protection and energy use efficiencies. The stress on the agricultural sector and food insecurity are closely tied to water sector and water insecurity associated with climate change. The 2NS also recommended reduction of stress in relation to pests (chemical and biological pest control, pest resistant genotypes). Similarly, the health sector is closely related to the water sector, and recommendations were made in the 2NS to more widely adopt protective technologies and systems, (e.g. water purification; quality standards for potable water) and maintain cost-efficient, environmentally-sound waste management systems. The NAS also suggested integration of waste management systems.

Adaptation

Both the SNC and the NAS placed emphasis on the use of EbA to create coping capacity in systems where climate risk is more difficult to manage (Table 4.2).

Table 4.2. EbA climate adaptation measures in the St. Kitts and Nevis National Adaptation Strategy and the 2nd National Communication

SNC Recommendations for EbA CCA	NAS Recommendations for EbA CCA
Coastal & marine ecosystems: • Ban activities that compromise natural coastal protection and public acquisition of vulnerable lands at fair market value • Where possible, leave undeveloped coastal lands • Restore coastal habitats (coral reefs, mangroves and seagrasses) • Use more effective land-use planning and best practices to control contaminants • Protect & restore of critical fish habitats (e.g. Mpas) • Ensure that coastal protection and other adaptation measures do not adversely affect fisheries resources	• Reduce non-climate threats for coastal and marine ecosystems • Promote EbA through integrated coastal zone management (ICZM) and ridge to reef approaches
Terrestrial ecosystems • Abandon unproductive (agricultural) lands • Maintain sustained yields, preserve/maintain species endemicity, variety and uniqueness • Reforest previously cleared lands • Convert lands not under forest-to-forest regimes • Maintain balance between native and non-native species and high endemicity • Apply alternate and more efficient harvesting methods to minimize damage to non-target species	• Eba for integrated pest and soil management (agricultural) • Promote integrated water resources management (IWRM) • Enhance carbon sinks through more effective natural resource management

NAS Implementation

Adaptation plans and recommendations are not always implemented as intended.

Therefore, to assess actual progress toward adaptation, stakeholder perspectives and a literature review were used. A stock taking survey was conducted amongst sectoral stakeholders between January and March 2021. The survey sought to understand the status of implementation of the adaptation measures that were outlined in the 2018 NAS. Nine surveys were completed, with respondents identifying their main areas of work as environment (including climate change, forestry/terrestrial ecosystems), fisheries & marine resources, water resources, DRR, public health, infrastructure & physical planning and agriculture. The literature review included reviews of information provided by the government of St. Kitts and Nevis as well as searches of grey literature and academic publications in respect of priority sectors, including likely climate impacts, policy processes, development context and records of existing or proposed adaptation strategies.

Stock Take Survey Results

Sectoral Action Planning

When asked about whether any more detailed adaptation planning was developed for their sector further to the outline given in the NAS, the majority (nine out of ten) indicated that no additional action plans had been developed to support the NAS outline. It was indicated that a national adaptation plan had been developed for the forestry sector. Respondents also provided examples of planning activities that could contribute to climate change adaptation. Additionally, it was reported that the Ministry of Health had participated in an online regional workshop hosted by PAHO/WHO, EU and CARICOM aimed at advancing the development of National Health Adaptation Plans. It is also noted that the Ministry of Health has finalized its National Multi-hazard Health Disaster Management Plan, 2019, which outlines the specific roles and responsibilities of key stakeholders, outlines procedures for responding to health disasters and emergencies and provides a framework for cross-sector coordination.

Six out of the nine respondents indicated that less than 50% of the NAS recommendations had been integrated into their agency’s annual operational plans. Fisheries, terrestrial ecosystems, and forestry sector respondents indicated that more than 50% of the NAS recommendations had been integrated into their annual plans. However, this does not necessarily mean that the requisite budgets were approved.

When asked whether the action plans developed for the NAS were supported by recent annual budgets by the government, it was indicated that support had been received for fisheries & marine resources in the 2019 and 2020 budgets, and for water resources in 2019, and for forestry in 2020.

Respondents were asked whether, in their view, the 2018 NAS had identified and addressed the major adaptation needs in their sector. The purpose of this question was to determine whether the NAS was comprehensive enough. The majority (seven out of nine respondents) indicated that it had identified their sectors’ major needs. However, representatives from DRR (NEMA) and Agriculture indicated that it had not. The latter indicated that a key issue was the measures had not been carried forward into their work plans.

NAS Implementation

Question 6 of the survey was aimed at determining what proportion of the total number of NAS measures recommended for the sector had been implemented since 2018. Most (seven out of nine) indicated less than 50% had been implemented. This included DRR, which indicated none had been implemented. Two sector representatives from the DOE (climate change planning and forestry) indicated that more than 50% of the measures had been implemented.

Respondents were asked to list specific NAS adaptation measures that were wholly or partly implemented by their agency. Poor responses on the survey precludes comprehensive assessment of the real level of implementation in respect of the 71 separate recommendations made for each of 13 sectors represented in the NAS (see Table 4.1).

The DOE has played a strong role in catalysing implementation of NAS recommendations in respect of the following five priority areas:

- The Coastal & Marine Resources sector reported progress on strengthening institutional capacity (CZMU), policy reform, EbA promotion (MSP, MPA System Plan) and a sustainable financing mechanism to support these.
- The Terrestrial Ecosystems & Forestry sector reported progress mainly in respect of enabling conditions such as multi-sectoral coordination mechanisms, capacity building for managers in protected areas (PAs), improved PAs patrols and surveillance, review of legislation, a PA development plan and community awareness building activities. EbA adaptation measures that were implemented included development of a plant nursery and maintenance of forest trails.
- Progress in the agriculture sector included vulnerability assessment, and development of measures to increase climate resilience (e.g., a livestock feed bank in Nevis). The DOE collaborated with the Ministry of Agriculture on three pilot projects which included the use of organic mulch as an adaptation response to climate change, forage banking to provide feed for livestock during dry periods and the use of a shade house to intensify production.
- Progress in the Water sector included coordination with the DOE to improve private sector resilience (e.g., an adaptation project that outfitted learning institutions with water storage tanks or retrofitted existing cisterns).

The National Emergency Management Agency (NEMA) also worked closely with the DOE and other agencies to enhance data availability for CCA decision-making and planning.

- The Water Services Department reported advances in respect of data collection, which was facilitated by hydro-meteorological equipment installed by the Disaster Management Department.
- The DOE reported collaborating with NEMA to establish and maintain EWS for major climate hazards (droughts, floods, heatwaves, hurricanes and storm surge) e.g., the Sandy Point EWS. Additionally, efforts were made to integrate EbA into CCA and DRR, e.g. stabilizing College Street Ghaut by planting vetiver grass.

It is also noted that NEMA maintains a GIS database of critical infrastructure and hazard mapping which can be used in CCA planning and vulnerability assessment.

Challenges and Success Factors

Questions 8 -11 of the survey attempted to investigate some of the challenges and success factors involved in implementation of adaptation recommendations.

Respondents were asked whether they felt there was adequate funding. More than half of them indicated there was no funding available for implementation, whilst two respondents suggested that with the funding already available, they could accomplish significant implementation. Three of the respondents indicated that implementation was indirectly facilitated by piggybacking adaptation objectives onto other, better-funded project agendas.

When asked about the adequacy of technical and human resources available to support implementation of sectoral priorities in the NAS, four respondents indicated that these resources were completely inadequate, whilst two respondents suggested that with available resources, they could accomplish significant implementation (>50%). Three of the respondents indicated that implementation was indirectly facilitated by piggybacking adaptation objectives onto other, better-resourced project agendas. DOE respondents indicated that the adaptation work is primarily dependent on funded projects and support from external organizations. The health sector respondent indicated that climate adaptation measures are being included in new project development, whereby consultants are required to include climate change and adaptation measures in all new health sector capital projects. The DRR sector respondent indicated adaptation capacity benefited from the 5C's training in the use of the CCORAL tool for capital projects. In terms of capacity deficits, a DOE respondent suggested that capacity building sessions would have equipped persons in implementing various recommendations under the NAS. The Water Resources Department respondent suggested that with only a director and public information officer available, human resources capacity was a constraint.

When asked about the main challenges facing their agency in implementing the NAS recommendations, the respondents indicated various constraints ranging from the current pandemic restrictions, a lack of dedicated staff & technical capacity, coordination and coherence in national adaptation strategies across sectors (versus silo approaches), funding & policy prioritization, and public awareness.

Similarly, when what factors were critical to successful implementation of the programme of action in the agency's adaptation mandate, respondents indicated the need for continued support, governance reform and prioritization (political will), HR (more staff and additional training/technical capacity); improved coordination across sectors, and mainstreaming NAS recommendations into annual plans and new projects. The adequacy of data resources was only implied in relation to the need for equipment and technical capacity.

Impact & Sustainability

Question 5 asked respondents if there were any other projects, programmes or policies implemented in the past five years that had reduced weather/climate change-related hazard exposure, or the sensitivity of receptors to these, or had increased adaptive capacity.

The following projects were named:

- Fisheries and Aquaculture - Climate Change Adaptation in the Eastern Caribbean Fisheries sector (CC4Fish) Project
- Health - The National Multi-hazard Health Disaster Management Plan, 2019.
- Infrastructure and Physical Planning - Enforce building codes
- Forestry - capacity building for PA managers and rangers and implementation of PA patrols and surveillance implemented.
- Agriculture – The St. Kitts and Nevis Enhancing Agricultural Adaptive Capacity to Climate Variability Project.

Question 12 suggested to respondents that transformational adaptation involved far-reaching strategies that create very fundamental changes to the business-as-usual functioning of a system, in contrast to smaller easier "wins" (low hanging fruit) and incremental adjustments. When asked whether they considered any of the delivered or expected outcomes of the adaptation programme of action for their sector to be transformational in terms of reducing the vulnerability of their sector to climate impacts, three out of the nine respondents gave positive response. A DOE representative indicated the changes in fishing practices as well as changes in management of fisheries and marine resources could occur with effective implementation of the policies, plans and regulations that are currently being drafted. Another DOE representative gave the example of the Royal Basseterre Valley National Park (RBVNP) which converted sugar-cane lands into a biologically diversified recreational area that supports a sustainable water supply. The health representative indicated that the importance of integration of environmental health and climate change into poverty reduction programmes. The Water Department respondent indicated the transformative potential of increased information from water audits and stakeholder consultations along with innovative water sector project developments.

When asked how adaptation measures implemented by their agency have contributed to making stakeholders more resilient to climate change, most respondents indicated it was too soon to tell. When asked how the adaptation measures (not yet realized) were likely to contribute to stakeholders' climate resilience, respondents indicated that various measures are expected to lead to improved resource sustainability, improved water & food security, energy efficiency, and improved coastal and flood protection.

When asked about other non-climate co-benefits associated with the implemented adaptation measures, four responded positively, citing reduced cost of implementing certain activities; improved efficiency in some programmes; heightened public awareness and participation on climate-related issues; strengthened legislative framework.

In terms of long-term sustainability of the CCA NAS programming, respondents were asked to rate on a scale of 1 to 10 (with 1 being the least likely), how likely it was that the benefits of the adaptation measures implemented would continue when funding was discontinued. Eight respondents answered this question, all of whom rated the likelihood of sustained benefits being between 5 and 8. Although uncertainties were expressed about funding and resource availability, respondents were encouraged by increased public awareness, foundational programmes and trends towards governance reform.

Tracking

When asked whether their agency was tracking the results of adaptation measures implemented for their sector, three out of eight respondents said yes. Reasons for not tracking included a lack of capacity, lack of commitment/prioritization and scheduling.

When asked whether the objective stated in the 2018 NAS for their sector was on track to being achieved, only six respondents replied. The Health and Water respondents gave a low estimation of being on track (2 on a scale of 1 to 10 with 1 being not at all). The representative from Forestry and Agriculture estimated their agency's to be about 5 (middle of the road), whilst Marine Resources & Fisheries were more positive with a 7. The DOE representative for Terrestrial Resources indicated a 9.

Cooperation & Partnerships

Question 18 asked whether the respondent's agency had worked with other agencies in implementing cross-cutting (e.g., investment and economic planning or inter-sectoral coordination) adaptation actions. Six gave a positive response. Both the DOE and Water Departments cited the need for partnering with other agencies and other stakeholders.

Question 19 asked about problems or difficulties their agencies encountered in collaborating on inter-sectoral adaptation actions. The responses included the need to build relationships, differences in the prioritization of climate change adaptation, reluctance to share information, lack of funding and competing responsibilities, and lack of a formal coordination arrangement.

When asked about what worked well in the implementation of inter-sectoral adaptation actions, responses included IWRM assistance, clear understanding of project benefits and roles, good communications, building capacity and HR training.

Sectoral Adaptation Implementation

The findings of the stocktaking survey were augmented with reviews of project documents and reports provided by agencies with responsibility for the priority sectors/areas as additional evidence for evaluating the level of adaptation implementation in St. Kitts and Nevis in the past five years.

Marine Ecosystems and Fisheries

Several of the reported projects that address climate vulnerability in this sector are geared towards strengthening adaptive capacity. These include:

1. Improving policy, legislation and planning:
    - Promulgation of the Fisheries Aquaculture and Marine Resources Act in 2016, and the drafting of the regulations. Fisheries management has adopted EbA approaches.
    - The National Conservation and Environmental Management Bill (which will

repeal the 1987 Act once passed).

- The St. Kitts and Nevis Marine Management Area (SKNMMA) declared in August 2016. The SKNMMA Management Plan 2020-2021 is currently being revised.
- Drafting of a Habitat Monitoring Plan

2. Building knowledge & information systems:
   - The St. Kitts - Nevis' Country Biodiversity Profile was updated in 2018.
   - National Hazard Mapping System and Atlas was completed in 2018 (Yan 2018)
   - Coral Reef Early Warning Systems (CREWS): The Department of Marine Resources (DMR) launched CREWS in 2018 to monitor meteorological parameters (Niland 2018).
   - Data management systems improved to reflect fisheries stocks.
3. Strengthening institutional capacity:
   - The DMR more than doubled its staff contingent between 2014 and 2018. In 2018, there were nine staff members, including a Fisheries Enforcement Officer.
   - Capacity has also been enhanced through a partnership with the St. Kitts and Nevis Coast Guard for monitoring coastal and marine activities and enforcing regulations (GSKN 2018).
   - Ongoing training for fisheries extension officers and support for businesses.
4. Increasing public awareness:
   - The public awareness campaign called "It's All About Balance" was undertaken in 2017 by the DOE to promote sustainable use and conservation of biological diversity (GSKN 2018).
   - The Anjolique Dance Company See Life Sea St. Kitts and Nevis project introduces the Marine Awareness Consortium (MAC). This operated as a technical-based interagency group of government and NGOs to promote climate change education in primary- to tertiary-level education institutions. The St. Kitts and Nevis Reef Guardian training was a derivative from the outputs of the MAC. The teaching material was used to further educate youth by combining theory and practice in water experiences in order to demonstrate the impacts of climate change using a holistic approach.
   - St. Kitts Ministry of Tourism Education Awareness Program also integrates Climate Change mitigation messaging.
5. Reducing climate risk and sensitivities:
   - A lionfish market was set up by DMR to encourage fishers to target invasive lionfish by developing a restaurant market for it.

- The OECS Livelihood Support Grant for Fishers explored the options for retraining and alternative livelihood opportunities for fishers and those dependent on marine fisheries.

Water Resources

Adaptation in this sector focuses mainly on reducing the risks associated with water deficits. Because of recent inter-annual droughts in the region, and the effects that are already impacting institutions, communities, as well as priority sectors like tourism and agriculture, there has been more urgency in taking action to manage non-climate related stressors on this resource.

1. Strengthening institutional capacity:
    - Training of technical staff at schools and the water and public works departments supported by the GEF-IWEco Project.
2. Increasing public awareness:
    - "The One Thing" campaign encouraged citizens to do one thing to conserve water (GSKN 2019). The WSD acted as a project partner and attempted to monitor water consumption of participating citizens.
    - IWECo provided support to develop a public education programme related to water in the school and community at the Bronte Welsh Primary School.
3. Reducing climate risk:
    - Improved water management in the agricultural sector including the restoration of three dams which were damaged years ago; ongoing project for the continuous upgrade of water provision; the DOA is also in process of writing proposals to GEF and IWEco for a water harvesting project.
    - Under this same programme an emergency water storage system (EWSS) was installed at the Beach Allen Primary School, benefitting 400 students and 40 staff. IWECo provided support for another EWSS at the Bronte Welsh Primary School.
    - The 5Cs launched a four-year (2019-2023) regional project entitled "the Intra-ACP GCCA+ Programme in the Caribbean: Enhancing Climate Resilience in CARFORUM Countries". St. Kitts and Nevis is one of 16 beneficiary countries in the region. One of the key objectives of the project is to enhance the climate resilience of water infrastructure and improving water security. Under this regional project, St. Kitts and Nevis submitted a proposal entitled "*Enhancing Climate Resilience by Improving Water Security and Supply Management in St. Kitts and Nevis*". This includes provisions for installation of water storage tanks at schools, health care facilities and government offices. Provisions have also been made to curb water wastage through installation of pressure reducing valves in high pressure zones and data monitoring equipment. The retrofitting and installation of cisterns and water storage tanks at schools through the 5Cs/USAID CCAP. Over 4,000 students and staff have benefited from this programme.

Tourism, Settlements & Infrastructure

In St. Kitts and Nevis, adaptation options explored in relation to settlements have incorporated action at multiple scales, with varying levels of success at multiple levels. A range of climate adaptations exist for human settlements, with each requiring cross-sectoral implementation and prioritizing financially.

1. Improving policy, legislation and planning:

    - Government-led development policy has incorporated provisions for land swap options for residents living in high-risk coastal areas. In key coastal villages like Halfway Tree, residents have been relocated away from the coast.

2. Reducing climate risk:

    - Telecommunication companies have moved their utility lines below ground, and the island's main road rehabilitation project included engineering of roads that are highly susceptible to flooding and coastal erosion. In previous years, high-risk roads were relocated and buffered with coastal engineering heavily reliant on the placement of huge boulders on the coast below the road (GOSKN, 2006).
    - Coastal protection projects: e.g., Old Road, Bay Rehabilitation Project
    - In 2019, St. Kitts and Nevis' Ministry of Tourism announced a coastal erosion mitigation project that will protect major tourism infrastructure and products in the country's coastal areas (SKNIS 2019, web page) by undertaking beach nourishment activities and establishing groynes and breakwaters.
    - In a joint effort with the CARICOM Development Fund, the government of St. Kitts and Nevis undertook refurbishment of the popular "De Strip" area at South Frigate Bay (SKNIS 2020). Improvements included coastal engineering efforts to minimize erosion.

Agriculture

The government of St. Kitts and Nevis has identified agriculture as one of the pillars of its economic reform plan.

1. Strengthening Adaptive Capacity:

    - The St. Kitts and Nevis Enhancing Agricultural Adaptive Capacity to Climate Variability Project (Taiwan Technical Cooperation and Development Fund). This project seeks establish data systems to support an EWS, and an information dissemination mechanism to support farmers' efforts to reduce damage and loss. As of March 2021, the project had set up four weather stations, operated model farms and fields that demonstrate responses to extreme weather and pests, built technical capacity (training and knowledge transfers amongst farmers and officials), supported EWS through radio broadcasts, and established the information platform. The success of the latter will depend on farmers' access to the internet.

- Provision of information in the on-going climate vulnerability assessment for the sector.
- Capacity building through training of extension officers, increasing the ratio of extension officers to farmers. Farmers have been trained on best management practices (BMPs) to reduce run-offs, prevent erosion, and improve soil water retention.
- CARDI is also evaluating crops that are more resistant to pests and diseases, and trial pest management models for sweet potato (weevil) and cabbage (diamond back).
- A quarantine unit has established a surveillance programme monitoring for the West Indian fruit fly and black sigatoka disease affecting banana and plantain.
- Soil fertility programme at Needsmust Estate enables the DOA to sell compost to the general public as a means of improving soil quality.

2. Reducing climate risk:
    - Diversification efforts included the ECO Park with the agro-tourism ventures; support of farmers who have been positioning their farms as agro-tourism sites/ projects and linkages between tourism and the agro-processing sector.
    - Reduced reliance on field cropping through promotion of shade houses, and hydroponic systems.
    - CARDI St. Kitts is working on drought tolerant varieties of sweet potato

Public Health

Health sector projects that had some level of adaptation planning tended to be focussed on other aspects of public health like nutrition or WASH (water, sanitation and hygiene). These kinds of projects can generally increase the adaptive capacity of climate-change impacted communities. Health projects that were implemented in the past five years included:

1. Improving policy, legislation and planning:
    - St. Kitts and Nevis' Ministry of Health is addressing disaster risk management through establishment of the Health Disaster Management Plan (GSKN 2019). The plan establishes response protocols for addressing disasters, with the aim of ensuring all public and private sector players are prepared to respond to potential health emergencies causes by natural hazards.
2. Building knowledge & information systems:
    - Air pollution research (Whittaker et al. 2020) estimated the concentrations of air pollutants at transportation, recreation, and construction sites in St. Kitts and Nevis. This research uncovers some seasonal variability in air pollution and may have implications for health outcomes of residents.
3. Strengthening institutional capacity:

- The Mary Charles Hospital was rebuilt with expanded capabilities (including dental services and an ambulance) (GSKN 2019).
- The '*Farm to Fork*' school feeding model was piloted in St. Kitts and Nevis by the University of the West Indies, McGill University (Canada), and St. Kitts and Nevis' agencies for health, education, and agriculture (Phillips et al. 2014).
- In the 2020 budget address, the government of St. Kitts and Nevis reiterated its commitment to establishing Universal Health Care Coverage (GSKN 2019). More recent news reports suggest that this initiative will be targeted in 2021 (St. Kitts and Nevis Observer 2021).

4. Reducing climate risk
    - The Pogson Hospital was retrofitted under the PAHO SMART Health Care Facilities project, which aims to reduce climate change vulnerability in health facilities of the Eastern Caribbean. The retrofit included development of a toolkit for establishing green building design, operations, and maintenance. Decision-making and investments can be guided by the toolkit, which includes a Hospital Safety Index, Baseline Assessment tool, checklists, and approaches for cost-benefit analyses.

Climate Impacts and Hotspots

The Vulnerability Report identified projected changes in climate parameters based on a comprehensive literature review and model outcomes using best available baseline data. Given the range of uncertainties in climate projections with increasing time, and with increasing resolution (moving from regional to sub-regional area predictions), it is recommended that practical adaptation planning for the 3rd. National Communication focus on projections for the next 30 years (to 2050) for RCP 8.5. This emissions scenario is considered the worst case or business as usual scenario; emissions trends are tracking most closely with that scenario (e.g., Schwalm et al., 2020). Changes in climate parameters under RCP 8.5 by the 2050s:

1. **Rainfall**: drier conditions in general, with an expected decrease in mean annual rainfall of an estimated 12% by the 2050s. Increasing drying between September and November. No significant change in dry season rainfall. Extreme rainfall intensity may increase by 2100, although *frequency* of heavy rainfall is likely to decrease. The severity of flash-flooding may increase. No robust trend in drought impact potential is seen before 2050 (CIMH, 2020). Beyond the 2050s in RCP 8.5 there is increasing potential for drought predicted. Nevis is particularly vulnerable to low and unreliable rainfall and extended periods of drought. The Hadley Centre Coupled Model Version 2 (HADCM2) model predicts that by the second quarter of the century conditions would be too dry for rain-fed agriculture.
2. **Heat:** warming in all parameters (max, min, mean). Overall average increase of 1.79°C predicted. More warm days and nights, and fewer cool days and nights. It is predicted that there will be high to extremely high potential for heat waves as a hazard during July

to October, with an observed trend increase in the number of hot days (32.2 °C) of +30 days per decade since 1995 (CIMH, 2020).

3. **SLR**: Global SLR has been about 0.17 cm per year between 1901 and 2010. Projected SLR in the Lesser Antilles to 2050 suggests a considerably higher mean increase of about 1 cm per year. Over a longer period of time, there is more uncertainty about the range of SLR, although an upper limit of 1.5 m is suggested for the Caribbean. Other sub-regional modelling suggests a maximum SLR rate of 0.27 cm for St. Kitts and Nevis (Chatenoux & Wolf, 2013).

4. **Sea surface temperatures (SSTs), Salinity and Acidification**: increase by 1.46°C increase in summer SSTs. It is also suggested that the region would maintain SSTs above 28°C year-round. General predictions have been made in respect of ocean conditions in the Caribbean Sea, suggesting higher acidity and warming would be accompanied by increased salinity, less oxygenation, and generally lower primary production (CRFM, 2019). There is generally insufficient research into ocean parameters around St. Kitts and Nevis to make more specific predictions in this location.

5. **Hurricanes**: Between 1980 and 2017 32 hurricanes passed within 200 km of St. Kitts and Nevis, 12 of which were above Cat 3. The most intense storms (Cat 4 and 5) are likely to become up to 11% stronger in terms of maximum wind speeds and possibly occur more frequently. Rainfall associated with hurricanes could increase by up to 30%. It is unlikely that there will be changes in the genesis and tracks of hurricanes.

Climate Impacts on Priority Sectors

Climate impacts on priority sectors have been discussed in the recent "State of the Caribbean Climate" (Climate Studies Group Mona, 2020) and the recent report on "Climate Trends and Projections for the OECS Region" (CIMH, 2020). The generalized, regional findings of these key reports were assessed in relation to the more specific findings of the Vulnerability Report and the sectoral literature review undertaken for this study to generate a sector specific list of climate impacts that are more tailored to the St. Kitts and Nevis development context.[22]

Infrastructure & Settlements

This analysis focuses on the built environment, including physical infrastructure and buildings associated with communities and population centres. Most of the urban population of St. Kitts and Nevis live in low-lying coastal plains, with at least a quarter of the total population residing in the capital town of Basseterre.[23] In general, most of the urban centres in St. Kitts are located on the leeward side of the island, including Basseterre, Challengers, Old Road Town, Half-Way Tree and Sandy Point. On the windward (eastern side) coastal towns include St Paul's (in the north), Saddlers, and Conaree, all with populations below 3,000. In Nevis the towns of Charlestown, Cotton Ground and Newcastle are coastally located, and also have populations below 3,000. The largest towns in Nevis are located in the southern parishes in interior locations (Fig Tree and Market Shop).

22 Additional references are specified within each of the tables.

[23] https://worldpopulationreview.com/countries/saint-kitts-and-nevis-population

In respect of this sector, rapid-onset climate hazards (i.e., extreme events) that result in physical damage are of concern – these include flooding and erosion related to SLR, hurricanes and intense rainfall events. In a survey of stakeholders conducted for this study, respondents were asked about the hazard that caused most loss and damage in their sector in the past five years. Overwhelmingly, the concern was related to rapid-onset hazards.

There is also the potential for structural damage in relation to slow-onset climate hazards, like inland reach of salt spray associated with SLR, which can cause damage to metals used in construction, power transmission and electronics. Sustained hot temperatures can also cause gradual damage to roads and building surfaces, requiring more frequent maintenance. Vulnerability to heat was found [where?] to be higher in the built-up urban areas, compounded by the urban heat island effect. Higher elevation areas can be expected to be less vulnerable to heat due to lapse rates or temperature declines with increasing elevation.[24] The highest elevations on St. Kitts and Nevis are Mount Liamuiga and Nevis Peak, which are respectively 1,156 m and 960 m above mean sea level. Higher elevations on the islands tend to be less disturbed and more heavily vegetated as well. Southwestern and southeastern Nevis were generally more vulnerable to heat in baseline and other emissions scenarios.

Table 4.3 is a compilation of climate impacts that are likely to affect Settlements and Infrastructure, based on the findings of CIMH (2020) and the CSGM (2020) as well as the findings of the vulnerability modelling and qualitative assessments based on relevant literature.

Table 4.3. Climate Impacts on Settlements & Infrastructure

Projected Change in Climate Parameter	Sectoral Impact
Gradual changes	
Drier conditions with lower rainfall between September to November & rainfall variability or unpredictability. Decrease in number of wet days, increase in number of dry days	• Decreased availability of and competition for freshwater for municipal uses: residential (urban and rural), institutional (public agencies, schools, hospitals etc.) and commercial, industrial, agricultural, landscaping, and fire services. • Impact on availability of water for landscaping (lawns, urban parks etc.) • Impacts on visibility and urban smog/air quality • Increased unreliability in piped water supply and possible increased rationing and water shortages becoming more ‘normal’ practice
Warmer air temperatures	• Increased demand for year-round cooling – increased energy

[24] The Environmental Lapse Rate refers to the lowering of air temperature with increasing elevation, as a result of changes in radiation, convention and condensation. The adiabatic lapse rate refers to an inverse correlation between air temperature and elevation as a result of air density (rising of air masses) https://www.britannica.com/science/lapse-rate

	consumption • Higher temperatures impact efficiency in power generation in renewables like solar (PV)
Sea level rise	• Loss of coastal lands, shoreline recession and beach erosion; likely flooding of lower portions of the Conaree Landfill and possible coastal water contamination • Possible breaches of saline coastal ponds which could lead to impacts on adjacent coastal ecosystems – Frigate Bay, South Friars Pond, Great Heeds, Half Moon, Major's Bay, and Cockleshell Ponds • Salinization of coastal soils and aquifers • Increased costs associated with maintenance of coastal defences and coastal infrastructure (roads, pipes, ports, wharfs & piers, submarine channels etc) • Increased reach of salt spray and associated adverse impacts on above ground electrical and metal infrastructure integrity • Exacerbation of flooding in low-lying areas during periods of high tides • Low-lying areas below 3m above mean sea level are highly vulnerable and include Basseterre
Warming SSTs and possible ocean acidification and changes in salinity	• Possible adverse impacts on submarine infrastructure cables and pipelines – increased corrosion
Increasing intensity of extreme rainfall events	• Flash flood risk increases in low-lying built-up areas (urban areas) particularly within floodplains of waterways • Landslide risk increases in areas with disturbed slopes (deforested areas and along steeper roadways) • Physical damage to property and infrastructure (including roads and bridges) from debris laden floodwaters • Choking of waterways, culverts and drains with transported sediment, which may lead to additional flooding downstream, or higher maintenance courses • Overflows of wastewater treatment plants and septic systems (groundwater contamination) • Mold damage in buildings due to higher humidity levels
Drought (normal level of risk up to 2050)	• Hotspots include Basseterre, Fig Tree and St Thomas Lowland (Nevis)

	• Water shortages and rationing • Costs associated with maintenance of silted up water and wastewater systems due to low flows
Greater risk of extreme heat events (July to October)	• Increased need for shade and green spaces to off-set heat island compounding effects in urban areas • Reduced energy efficiency. • Buckling or damage to road surfaces, and potential increase in maintenance costs for transportation networks
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Loss and damage to physical buildings, property and infrastructure caused by high winds and floodwaters (including storm surge) • Ports and shoreline infrastructure highly vulnerable due to effects of storm surge action combined with other storm hazards (wind, rain etc) • Loss of productivity caused by disruptions and downtimes in electricity and water supply • Disruptions in the road networks caused by road failures or blockages (related to landslides, fallen objects and trees etc) • Increased fire hazards related to use of small generators and gasoline systems • Prioritization of spending on recovery and rebuilding sets back the economy and national development priorities • Poor communities living in marginal flood plains or riverbanks may suffer greater loss of property (poorly built housing stock)

Coastal & Marine Ecosystems

Coastal and marine ecosystems were not included in the quantitative vulnerability modelling exercise as there is relatively less data available on spatial variability of indicators in this area, and this requires coupled atmospheric and oceanographic global climate modelling that is not broadly available for the region. Therefore, a more qualitative assessment based on available information was conducted. St. Kitts has 167km of shoreline, while Nevis has 94km of shoreline. St. Kitts and Nevis have a total Economic Exclusion Zone (EEZ) of ~10,206km^2. Of this area, only ~742km^2 are classified as shelf (The Nature Conservancy, 2016). Most of the marine biodiversity, fisheries and tourism-related resources are found on this narrow shelf area (Figure 4.1); deeper water pelagic fisheries extend beyond the coastal shelf.[25]

25 http://firms.fao.org/firms/fishery/982/en

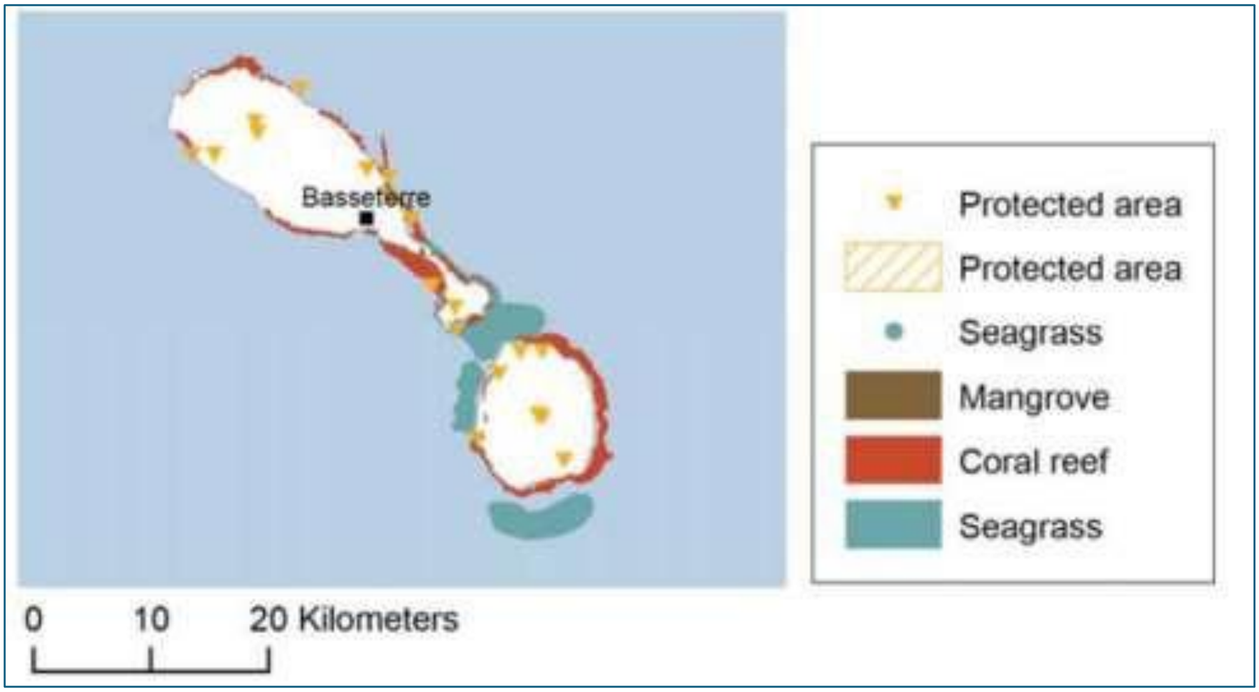


Figure 4.1. Coastal Ecosystems in St. Kitts and Nevis. Source: Chatenoux & Wolf, 2013.

The Nature Conservancy report (2016) estimated that 10 years ago (2011) there were:

- 53km^2 of coral reefs
- 34.6km^2 of seagrass meadows located mainly in the Narrows between St. Kitts and Nevis and the SW side of Nevis
- less than 1km^2 of mangroves: Southeast Peninsula and Sandy Point in St. Kitts and a few small areas in Nevis

No more up-to-date spatial information is available. Reportedly there are three species of nesting marine turtles on these beaches. The Nature Conservancy Coral Reef Report Card indicated lower coral cover than in other islands in the region although corals were generally healthy. Macro-algae cover was relatively high, indicating a lack of grazers (parrotfish and diademas). Coral reefs and other coastal ecosystems provide a range of ecosystem services including coastal protection from storms, production of sediment for beaches, habitat for fish (supporting fisheries) and attractions for tourists.

Hurricanes, SLR, increasing SSTs and changes in marine water chemistry (salinity and acidity) are the main threats associated with climate change in this sector (Table 4.4). These climate stressors are compounded by non-climate stressors like coastal development, over-fishing and invasive alien species (e.g., lionfish). Mega-algal blooms (sargassum) have impacted nearshore ecosystems and are likely to connected to warming seas.

Table 4.4. Climate Impacts on Coastal and Marine Ecosystems

Projected Change in	Sectoral Impact

Climate Parameter	
Slow onset drier conditions	• Potential lower influxes of freshwater into the nearshore, impacting salinity
Increasing intensity of extreme rainfall events	• Sedimentation in the nearshore • First flush from urban areas with high pollutant loads – especially if septic systems are flooded or compromised
Slow onset increase in air temperature (WARMING)	• Increasing SSTS and coral bleaching • Impacts on fish and marine ecosystems – heat stress • Increasing female to male ratio of marine reptiles
Greater risk of extreme heat events (July to October)	• Increasing female to male ratio of marine reptiles • Fire risk in coastal mangroves
SLR (slow-onset)	• Inland migration of ecosystems. If ecosystems are unable to shift inland due to coastal land uses and constraints (like cliffs), some shallow water systems will have reduced areas (e.g., beaches or nearshore benthic ecosystems) • Loss of nesting beaches for turtles and seabirds • Loss of coastal habitat • Loss of beaches – it is estimated that with 50 cm of SLR, there will be a loss of 36 to 54% of current beach area (Chatenoux & Wolf, 2013)
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Loss and damage to physical marine resources: shorelines, beaches, nearshore systems (benthic ecosystems like coral reefs, seagrasses etc) • Smothering of reefs and nearshore benthic ecosystems with sediment plumes from river systems • Damage or loss of coastal nesting sites for marine reptiles and birds • Spread of invasive algal species in the aftermath of storms • Degradation of coastal wetlands due to sedimentation
Warming SSTs, ocean acidification and changes in salinity	• Changes in biogeographical ranges of marine species, with fisheries targets migrating further offshore/deeper waters • Impacts on biodiversity due to potential increase in alien invasive species and diseases caused by climate-related stress • Heat stress on biological productivity (e.g. spawning numbers and sizes) • Indirect fisheries impacts: longer trips, different gear types,

	safety & communications issues, fuel needs • Possible coral bleaching and decline in the health and ecosystem services generated by coral reefs, seagrass meadows and mangrove systems • Possible impacts on year-round risk of mega-algal blooms (sargassum) and impacts associated with strandings on shorelines • Possible changes in ocean circulation patterns affecting spawning, migration routes and seasonal movement of marine species • Acidification impacts shellfish production (USAID, 2018) • Salt ponds may be more susceptible to hypoxia and drying out with increasing SST

Water & Terrestrial Ecosystems

The water resources sector has been interpreted broadly to include watersheds as well as water supply infrastructure. Flows from surface sources of freshwater (Lodge, Franklands, Wingfields River, and Stone Fort) are variable and insufficient to meet demands (USACE, 2004) and are estimated to contribute and estimated 3.6 million m^3 per annum, compared to 20 million m^3 produced annually from groundwater sources (FAO, 2015). Groundwater is mainly located in coastal aquifers like the Basseterre Valley aquifer and other important aquifers like Cayon, Mansion, Northwest, Middle Island, Stone Fort and Camp. In Nevis, the main water supply systems are Maddens, Camp Spring-Jessup, Peak-New River and Charlestown. Groundwater accounts for 80% of the municipal supply. There is an estimated 160km of water pipelines in St. Kitts. Much of this is old and may be a significant source of loss (FAO, 2015).

Freshwater resources are vital to major economic sectors (such tourism and agriculture), municipal demand (residential, institutional and commercial) as well as the viability of terrestrial ecosystems. Agriculture in St. Kitts and Nevis is primarily rainfed, whilst tourism is supported by a combination of municipal supplies and reverse osmosis (desalination) plants. The latter was estimated to produce 3.3 million m^3 per annum in 2012 (FAO, 2015). Water insecurity not only impacts food insecurity, but also has implications for energy intensity as energy is needed to produce, treat and distribute potable water. There are also major implications for the health sector, including potential for water borne diseases and breeding of biological vectors when there are chronic disruptions to piped water services, inadequate water for sanitation and hygiene, as well as inadequate availability for cooling (water sprinklers, swimming pools, etc). Table 4.5 summarizes impacts expected on water resources.

Table 4.5. Climate Impacts on Water Resources

Projected Change in Climate Parameter	Sectoral Impact
Slow onset drier conditions with lower rainfall between	• Reduced aquifer recharge and reducing sustained yields from

September to November & rainfall variability or unpredictability	ground water sources • Possible over-pumping in coastal aquifers leading to salinization • Water deficits for all users – compounded by increasing evapo-transpiration losses • Possible increased reliance on desalination, imported or bottled water sources • Indirect waste management issues related to bottled water packaging • Water stress to vegetation and increase in fire risk • Increased watershed degradation and changes in vegetation succession to less humid-adapted plants • Desertification of marginal lands in extreme cases – with increased dustiness • Reduced infiltration capacity related to denuded soils • Increasing hillside denudation can lead to increases in windspeeds, which can exacerbate dustiness and wildfire risk
Increasing intensity of extreme rainfall events	• Lower rates of infiltration and aquifer recharge - more water lost as flash floods • Damage to water infrastructure and distribution systems – increased losses and non-revenue water • Increased sedimentation of water storage and treatment facilities – loss of efficiency and increased repair or maintenance costs • Impacts on water quality due to contamination of aquifers (dead animals, sewage, etc) • Indirect effects of these on water supply and possible shortages and rationing of piped/municipal water supplies
Drought (normal level of risk up to 2050)	• Loss of forest cover and decline in infiltration rates, which impact aquifer recharge potential and water supply
Slow onset increase in air temperatures (WARMING)	• Increased water demand from natural assets – possible decline or change community assemblages or shift in land cover • Effects of warming seas on seafood storage and potential for spoilage
Greater risk of extreme heat events (July to October)	• Watershed vegetation may be impacted by heat stress

	• Higher risk of bush-fires due to dry hot conditions; maybe windier as well
SLR (slow-onset)	• Salinization of coastal aquifers affecting water supplies
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Physical damage and loss to facilities and water infrastructure • Increased sediment loads and suspended solids clogging water uptake and treatment facilities • Maintenance costs and indirect impacts on design life of facilities • Damage to forests and upper watersheds (recharge areas)
Warming SSTs, ocean acidification and changes in salinity	• Possible impacts on reverse osmosis uptake systems and efficiency

Agriculture

Approximately 24% of the total land area in St. Kitts and Nevis is under agricultural land use (63.4km^2). The main export crops include peanuts, sea-island cotton and coconuts, while the main crops grown for local consumption include a range of tropical vegetables and fruit. While agriculture contributes less than 2% of the GDP, it is estimated that as much as 20% of the labour force may be engaged in agricultural activities.[26] Table 4.6 summarizes impacts expected on the agriculture sector.

Table 4.6. Climate Impacts on agriculture

Projected Change in Climate Parameter	Sectoral Impact
Slow onset drier conditions with lower rainfall between September to November & rainfall variability or unpredictability	• Higher losses in farms unable to transition away from rainfed agriculture – farmers rely on rains between September and October • Increasing demand for irrigation and soil moisture retention technologies • Declining profitability of producing high-water demand crops • Declines in yields • Decline in soil fertility with lower organic and moisture content, increasing friability and erosivity • Declining quality of pasturelands and increased demand for feedstock or greater acreage to support herds
Increasing intensity of	• Increased competition with non-agricultural consumers for

26 https://agricarib.org/country/st.-kitts-nevis

extreme rainfall events	water supply • Shortages of traditional foods and national staples • Increased reliance on imported, frozen and processed foods • Possible impacts on crop diversity (which affects the economics of farming and resilience to shocks) • Costs of providing increasing support and relief to farmers to maintain domestic food production systems • Increased susceptibility to diseases and pests, resulting in higher costs • Possible impacts on pollinators • Physical damage to crops and immediate financial setbacks for farmers • Water-logging of agricultural soils (FAO. 2015) • Leaching of soil nutrients • Storage facilities impacted • Grain storage may be lost with increased humidity or flood damage – mold • Transportation corridors and markets impacted (for crops, livestock and fisheries) • Landslides and erosion in hilly areas may impact marginalized small- farmers disproportionately • Damage to hillsides from soil erosion or landslides may result in small farmers going into more pristine areas in the interior for cultivation and subsistence farming (cycle) – link to watershed resources • Increased susceptibility to diseases and pests – resulting in higher costs
Drought (normal level of risk up to 2050)	• High vulnerability and risk of economic losses of rainfed systems (90% of all farms in St. Kitts and Nevis) – Hutchinson 2017 • Increased costs associated with irrigation and soil moisture retention • Possible declining productivity and yields of crops that require higher moisture – according to Oderson et al (2016) most tropical crops cannot manage more than two 7-day dry-spells during the 3-4 month growing season • Nevis is particularly vulnerable to low and unreliable rainfall

	and extended periods of drought, limiting food security on that island and increasing reliance on imported food
Slow onset increase in air temperatures (WARMING)	• Decrease in crop yields for crops not adapted to higher prevalent temperatures throughout growing season. Potential for low-quality crops (Mohammed and Tarply, 2009). Indirectly, attempts to increase yields may involve higher use of fertilizers and pesticides, which may have far reaching implications for water quality (both freshwater and coastal). Caribbean farmers tend to rely extensive on persistent organic pollutants (POS) – Williams, 2013 • Decreased weight gain livestock • Potential impacts on productivity (breeding) • Increased prevalence of diseases in soils and water • Declining quality of pasturelands – and need for more acreage to support herds • Impacts of sargassum mega blooms on fish landing beaches and nearshore fisheries • Impacts on productivity outdoor agricultural labour force
Greater risk of extreme heat events (July to October)	• Heat stress and possible death in livestock (DeShazer et al 2009) • Heat damage to crops in field • Increased demand for irrigation water and electricity for pumping • Farmers and fishermen working outdoors are impacted – lower productivity
SLR (slow-onset)	• Salinization of coastal aquifers affecting water supplies • Salinization of coastal plains and soils affecting crops
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Physical damage to crops in field, irrigation systems, storage facilities, agro-processing facilities etc. • Soil erosion • Potential injury and loss of livestock
Warming SSTs, ocean acidification and changes in salinity	• Implications for availability and cost of supplementary water from reverse osmosis systems

Health & Social Well-being

In 2020, St. Kitts and Nevis had a total estimated population of 53,821, with approximately

70% being of working age (15 to 64),[27] 20% being under 15 and 10% being over 64. Infant mortality stands at 7.8 deaths per 1000 live births, and the average life expectancy is 75.7 years.[28] More than 98% of the population has access to improved drinking water sources, while an estimated 87% has access to improved sanitation facilities. Approximately 5% of the GDP is spent on health care. Although St. Kitts and Nevis can be considered one of the highest income countries in the Caribbean (19,000 USD per capita),[29] PAHO/WHO estimated that the poverty rate is relatively high (22% in 2008). Table 4.7 summarizes impacts expected on the health and social well-being sector.

Table 4.7. Climate Impacts on Health

Projected Change in Climate Parameter	Sectoral Impact
Slow onset drier conditions with lower rainfall between September to November & rainfall variability or unpredictability	• Increase storage on property of rainwater, which may be susceptible to contamination and vector breeding for diseases like dengue and chikungunya • Heavy use of pesticides in vector control activities may impact human health • Increased need to disinfect and protect domestic water supplies (boil water etc.) • Increased dustiness and smoke (from wildfires) impact respiratory health • Dehydration and illness • Declines in hygiene and sanitation due to water shortages, lock-offs and low pressure • Water & food insecurity and malnutrition in the poorest communities that rely on subsistence farming and rainwater
Increasing intensity of extreme rainfall events	• Increased risk of waterborne diseases due to water contamination and vectors (mosquitos) • Increased need to disinfect surface water sources. • Higher risk of contamination of recreational (contact) waters due to leaching • Mental health issues related to trauma of extreme events and loss of social cohesion
Drought (normal level of risk up to 2050)	• Increased water storage domestically (black tanks and barrels) which may lead to increased waterborne illnesses and vectors • Declines in sanitation and hygiene, impacting overall health

[27] https://www.indexmundi.com/saint_kitts_and_nevis/demographics_profile.html
[28] https://www.paho.org/salud-en-las-americas-2017/?page_id=
[29] https://www.statista.com/statistics/1068461/gross-national-income-per-capita-st-kitts-nevis/

	• Mental health issues related to trauma of extreme events and loss of social cohesion
Slow onset increase in air temperatures (WARMING)	• Increased bacterial activities in soil and water – possible diseases – speeding up of pathogen life cycles • Impacts on marine pathogens and diseases • Reproductive health - effects on pregnancies (gestational health) of heat and testicular temperatures
Greater risk of extreme heat events (July to October)	• Increased mortality –elderly at higher risk • Increased heat stroke as well as other stress related illness (heart disease, stroke, hypertension etc.) • Decreased productivity in workforce – loss of person-hours • Adverse impacts on learning • Increased need for air conditioning in homes and offices (and power consumption) and associated energy costs • Increased demand for water for cooling centres: swimming pools and recreational beach use may increase • Mental health issues
SLR (slow-onset)	• Risks to swimmers and recreational beach users that may be associated with changing circulation patterns, riptides and currents in areas they think they know well
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Disruption in basic services: food supply, water, health care, emergency services, transport lifelines • Physical damage to health care facilities and institutional buildings • Loss of productive time • Potential risk of water contamination due to flooding • Potential for loss of life or injury from flooding and landslides as well as windborne debris • Damage to homes causes by winds and water, and loss of property Potential for increased homelessness and displacement amongst the poor and indigent • Increasing insurance premiums • Increased reliance on imported canned foods while agricultural supplies may be down; malnutrition • Lower teacher and student attendance of schools • At-risk groups disproportionately impacted: poor, women &

	children, elderly, immigrants. Greater loss of income for rural women • Social impacts associated with displaced or sheltered people – sexual assault and gender-based violence etc.

Tourism

Travel and tourism accounted for 28.2% of the national GDP in 2019, and almost 60% of the total employment of the island.[30] According to the World Travel & Tourism Council, two thirds of the arrivals originated from North American markets (with only 6% of that being from Canada). Between 2015 and 2019 the country reported over a million visitor arrivals per year.[31] Table 4.8 summarizes impacts expected on the tourism sector.

Table 4.8. Climate Impacts on Tourism

Predicted Change in Climate Parameter	Sectoral Impacts
Slow onset drier conditions with lower rainfall between September to November & rainfall variability or unpredictability.	• Visual aesthetics decline with lower levels of landscaping, dustiness etc. • Lower tourism product and experience due to water lock offs, low pressure etc. POSITIVE IMPACT: • Increase in dry days better for tourists' participation in outdoor activities and benefits to the tourism value chain outside of the hotel
Increasing intensity of extreme rainfall events	• Declines in visitation or repeat visitation • Lower spending outside of hotels – impacts on restaurants, tours, and shopping areas
Drought (normal level of risk up to 2050)	• Vector-driven epidemics (e.g. dengue) may discourage visitation
Slow onset increase in air temperatures (WARMING)	• Decreased efficiency of cooling systems • Increased demand for air conditioning and swimming facilities or misters
Greater risk of extreme heat events (July to October)	• Increased demand for bottled water • Cooling demand – electricity consumption • Natural assets impacted – landscaping, reefs etc.

30 https://wttc.org/Research/Economic-Impact

31 https://data.worldbank.org/indicator/ST.INT.ARVL?locations=KN

	• Tourism workers productivity impacted • Visitor satisfaction levels • Indirect impacts on value-chain – restaurants, transportation, tours, entertainment, shopping etc.
SLR (slow-onset)	• Beach erosion • Possible decreased accessibility of dive and snorkeling sites • Beach front properties impacted POSITIVE IMPACT: • Interior and upland tourism ventures may make market gains
Increase in the intensity and frequency of stronger storms (>Cat 3)	• Fall in arrivals/demand • Damage to port and hotel infrastructure and property and costs associated with repairs • Indirect effects on revenues and employment • Damage & loss to natural assets on which tourism relies – beaches, reefs, pristine waters • Costs of clean-up of beaches littered with storm debris and seagrass • Costs of beach replenishment if erosion has occurred • Increased insurance
Warming SSTs and possible ocean acidification and changes in salinity	• Increased maintenance costs for marinas and sub-marine infrastructure due to possible metal corrosion. • Possible increased sargassum occurring due to higher SSTs – impacts on beaches and clean-up costs.[32]

Adaptation Readiness

As indicated in Section 1.3, understanding adaptation readiness is as important to adaptation implementation as is the understanding of the vulnerability factors of exposure, sensitivity and adaptive capacity. Adaptation readiness can be considered in terms of the conditions that enable or hinder implementation of adaptation measures. Readiness factors include governance (both legal mechanisms as well as institutional capacity), human capacity and knowledge, the availability of information to support decision-making (including data management systems and technology needed to collect data) and most importantly, funding to support these requisite resources and capitalize adaptation programming.

32 12 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/605072/5._Biodiversity.pdf

Gap Analysis

Mandates & Agendas

The government of St. Kitts and Nevis adopted the National Climate Change Policy in 2017. The NAS was adopted in 2018 as a means of operationalizing stakeholder-vetted adaptation responses to climate change. The NCCP is the overarching legal mandate and policy framework that codifies international obligations for climate action, as well as the governance of national low carbon resilience building that is aligned with national frameworks for sectoral development. That NCCP also establishes the policy mandate for the conduct of the vulnerability and adaptation assessment which is the subject of this report. This policy is further supported by the various other policies and plans:

- 2011 National Energy Policy
- 2013 National Disaster Plan
- 2014 NAS and Plan for the Water Sector
- National Environmental Management Strategy (NEMS)
- 2019 National Multi-Hazard Health Disaster Management Plan
- 2020 Protected Area System Plan
- Draft Fisheries Management Plan

Additionally, the National Biodiversity Strategy and Action Plan 2-14-2020, the St. Kitts Agricultural Development Strategy (2013-2016) and the St. Kitts Tourism Sector Strategy and Action Plan (2014-2019) are all due for updating and revision. This represents a significant opportunity for mainstreaming and cross-sectoral coordination in respect of CCA/DRR.

In general terms, these national agendas are aligned with international best practices as well regional and global agendas for CCA, DRR (such as the CARICOM Regional Framework for Achieving Development Resilient to Climate Change and the Implementation Plan 2011-2021, the St Georges Declaration of Principles of Environmental Sustainability, and Sendai Framework for Disaster Risk Reduction 2015-2030) as well as the UN's integrated sustainable development which was launched in 2015 - the 2030 Agenda for Sustainable Development and its 17 SDGs (including SDG 13 on Climate Action).

However, St. Kitts and Nevis has not made specific legislative or policy provisions in respect of the UN SDGs. It also appears that there is a general lack of reporting on several of the SDGs, which was reflected in the 2020 SDG report.[33] The report indicates that in respect of SDG 13, there were challenges remaining and insufficient performance ("*score stagnating or increasing at less than 50% of the required rate"*). However, it is also noted that this index only considered indicators in respect of carbon mitigation (emissions) and did not report on adaptation performance. The relevant SDG 13 goals include:

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[33] https://dashboards.sdgindex.org/profiles/KNA

Strengthening of resilience and adaptive capacity to climate-related hazards and natural disasters – specific indicators include adoption of a national DRR strategy, as well as loss and damage reporting on numbers affected by disasters per 100,000.

Integration of climate change measures into national policies, strategies and planning; the relevant indicator is operationalization of a national adaptation plan.

Improvement in education, awareness-raising and human & institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. Relevant indicators include integration of these considerations into the educational curricula and strengthening of capacity for implementation.

Legislation

Although the country does not have unifying legislation specifically regulating climate action (both mitigation and adaptation), several existing legislative mechanisms can be effectively used for this purpose, including the National Conservation and Environmental Protection Act (NCEPA), the Fisheries Act, the Agricultural Development Act, and the Development Control and Planning Act.

Major sectors for which strong dedicated legal mechanisms (legislation and regulations) for mandating action to address climate and enforcement of climate action or establishment of statutory institutions, controls (penalties and permissions) are lacking:

- Integrated water resources management (IWRM)
- Integrated coastal zone management (ICZM)
- Extractive industries (mines and quarries) and forestry
- Environmental and public health.

The Public Health Act of 1969 is outdated (CCCCC and DSD 2014). An updated act is needed to address health issues that have emerged or magnified in the past fifty years, such as health considerations related to climate change.

The NAS identified the following major governance gaps that were to be addressed in respect of implementation climate change adaptation strategies. These included recommendations for CCA/DRR considerations in relation to:

1. Statutory reforms and establishment of statutory bodies in relation to the water sector coastal zone, and forestry. Of these, the CZMU has been established and significant progress reported in relation to the other two.
2. Mainstreaming CCA/DRR and EbA into sector strategies and action plans for:
    a. Physical development planning (conflicts, gaps, insecure tenure, and “perverse incentives”)
    b. Environmental management through the establishment of a MSP, and MPA System Plan with sustainable financing
    c. Tourism (including building codes)

d. Agriculture (best practices for land, water and waste management)

e. Health sector (as it relates to poverty reduction and vulnerable groups)

No updates were available in relation to progress with the NAS climate change adaptation mainstreaming agenda, which is geared towards improving adaptive capacity.

Institutional Capacity & Human Resources

The DOE remains the primary focal agency for climate change adaptation in St. Kitts and Nevis with responsibility for compliance with the reporting requirements under the UNFCCC. Within the DOE itself are units with responsibility for CZM/marine resources, forestry and climate action. In terms of intersectoral coordination, the DOE is responsible for ensuring coherence between the various government departments (physical planning, water, health, agriculture, and tourism) and agencies (including NEMA and units with responsibility for data management and statistics).

The adequacy of technical and human resources was found to be a major CCA challenge for some sectors. The lack of sector-specific action planning for NAS recommendations, as well as the reported low implementation, performance tracking and reporting suggests that there is an urgent need for capacity building. In some cases (e.g. WSD) understaffing or lack of staff to serve as dedicated CCA focal contacts was the problem. These resources are essential for CCA to be successfully integrated into sectoral plans, project development and annual budgeting. Technical capacity is also at issue with reported training needs in respect of IWRM, hydrology and hydrogeology in the WSD. Understaffing and a lack of technical capacity, as with lack of other resources needed to generate data to support planning and decision-making (discussed below), is a function of lack of climate finance.

Information, Technology and Data Systems

The difficulties encountered in gathering sufficient sub-national spatially disaggregated data sets in suitable digital formats for climate change vulnerability modelling was telling. Availability of data varied across sectors, and between the two islands. Notably, there was a lack of Nevis data needed to characterize adaptive capacity. A major constraint was related to the collection of, and access to, downscaled climate data, which considerably hindered the production of higher resolution outputs needed to develop adaptation measures at a community scale.

Another critical challenge is the lack of a mechanism for sharing data among sectors. Developing a data sharing platform for climate and water data is needed to improve collaboration among the health, water, agriculture, and tourism sectors, which are all impacted by changes in rainfall and temperature (CCCCC and DSD 2014).

In terms of information systems, some progress has been made in developing early warning systems (e.g. CREWS, the Sandy Point EWS, Beach Allen and Bronte Welsh school emergency EWS). However, no early warning systems are in place for the health sector. An early warning system for disease outbreaks could use temperature signatures for vector- borne diseases to identify the potential for diseases to emerge and therefore allow health authorities to prepare and respond in a timely manner (Simpson et al. 2012). An early warning system for respiratory infections could also be developed.

Effective CCA requires monitoring of weather variables as well as responses/impacts in the baseline condition of affected systems. There is currently insufficient data being collected in relation to basic receptors like sea level, streamflow etc. Associated with this is a need for more research, particularly in sectors like agriculture, tourism and health. Scientific research into agronomic responses to climate change, suitable hybrids or alternative crops is critical to agricultural adaptation to climate change. A land resource analysis (LRA) project funded by the Department for International Development (DFID) indicated that the current climatic conditions in St. Kitts are suitable for a wide variety of crops. However, another LRA should be conducted that takes into consideration projected future climatic conditions and their suitability for a range of crops. Another agricultural example is the need to understand how various actors in the sectors are already adapting to weather variability and extreme events, and what their specific information services needs might be to better enable them given uncertainties and non-stationarities associated with climate change.

While it is possible to start adaptation programming using the precautionary principle and a no-regrets/co-benefits approach, in general, lack of technical data and information systems preclude not only effective CCA planning, but also hamper development of project proposal development and planning that require an evidence base for justification. Moreover, lack of data also hinders the adoption of innovative technologies that may become available but require feasibility assessment for the particular site and application.

Funding

The availability of funding for adaptation planning and implementation is a critical enabling factor. In general, financing of adaptation comes from (1) international donor programmes that support government proposals, (2) government financing of public projects and provision of financial incentives to stimulate private sector investment, and (3) private sector investments in adaptation. Generally, in the Caribbean there is a heavy reliance on international climate financing to support both adaptation readiness and implementation. The stock take survey revealed that (government) budgetary support for climate action had been allocated in relation to marine ecosystems, water resources and forestry in recent years. Despite this, only two of the respondents indicated that they had adequate funding to implement the recommendations of the NAS.

Government and private sector funding for CCA is often driven by the need to respond to disaster risks. Consequently, CCA in many vulnerable Caribbean SIDS like St. Kitts and Nevis is a DRR exercise. There is a significant adaptation deficit in that the country is trying to catch up to where it should be in DRR, because of the previous set-backs and continuing vulnerability to large-scale disruptions like hurricanes and the on-going global pandemic that disrupt an economy that is largely dependent on tourism, and significantly slowdown sustainable development. Added to this are the relatively high costs associated with coastal protection, which is a critical issue for St. Kitts and Nevis, where much of the population and infrastructure are located in the coastal areas.

Public and private sector investment in coastal protection is constrained by the significant investments required for coastal engineering. Current projects like the Old Road Bay Rehabilitation Project, have become increasingly expensive, not just in the cost of construction but also the recent relocation of the road and associated coastal engineering to mitigate against sea-level rise. Similarly, although insurance is as an option to reduce climate risk, its feasibility for St. Kitts and Nevis requires further exploration and sensitization of stakeholders. Adaptation solutions to the increased frequency and intensity of hurricanes and storms remain a persistent challenge with limited solutions. Consequently, the government has heavily invested in development control solutions that require investment and participation of the wider society. This includes promotion of the use of hurricane-resistant building materials and enforcement of suitable building codes and standards.

Adaptation to the risks associated with increasing freshwater deficits because of the combination of warming with lower rainfall, and the higher risk of drought may also be significantly challenged by funding issues. For example, development of alternative water sources like desalination plants is relatively more expensive than pumping from production wells in coastal aquifers or uptake from depleted surface waters or springs. Another example comes from possible adaptation in the agricultural sector transitioning away from rainfed small farming systems. Development of irrigation schemes particularly for small farms in the interior or hilly areas of the country are not only challenging from an engineering design perspective but also in terms of the actual costs, and potential for returns on the investment. Another critical consideration is that small islands often cannot achieve economies of scale that might reduce per unit costs.

Recommendations for Improving Readiness

1. Address legislative gaps and statutory reform needs for climate change integration into IWRM, ICZM, Mining & Forestry and Public Health.
2. Using the CCORAL tool, promote wider application a national "climate lens" which provides individual sectors with guidance on how to mainstream CCA/DRR and EbA into the relevant sector strategies and action plans.
3. Ensure that each government department or agency with sectoral jurisdiction for implementing adaptation measures has a "climate focal desk". This lead/point person does not have to be dedicated to climate action but should be a technical officer that represents the agency at intersectoral meetings on climate change.
4. Form an intersectoral climate coordination mechanism lead by the climate change unit of the DOE. This group should comprise the climate leads from each agency. The objectives of this group would be to explore opportunities for interagency coordination and collaboration on cross-cutting programmes and funding, track performance in implementing adaptation measures that have been adopted, track performance in achieving climate objectives and facilitate data-sharing.
5. Explore opportunities for leveraging synergies with other international agendas such as the UN SDGs and the Blue Economy, which is supported by the Caribbean Development Bank, World Bank and the IADB. To do this, it is critical to use the lens that sustainable development must be closely aligned with low-carbon resilience, and to explore possibilities for mutually supporting both agendas (Hammill & Price- Kelly, 2017).

Recommendations

The following recommended adaptation measures complement the ones in the NASCC (2018). and are based on the assessment of gaps and opportunities.

Sectoral Recommendations

Physical Planning (Infrastructure & Settlements)

1. Improvements to knowledge base and capacity to support evidence-based planning and implementation. At a minimum there is a need for GIS-based modelling to determine coastal areas most at risk to inundation given current elevations and projected SLR rates at a high resolution. One of the recommendations of the 3rd National Conference on SIDS SKN National Preparatory Process – Background Report in 2014 was to "map areas vulnerable to sea level rise and develop computer-based information systems covering the results of surveys, assessments and observations as part of the development of adequate response strategies, adaptation policies and measures to minimize the impact of climate change, climate variability and sea level rise."

2. A national land development policy with a coastal degrowth strategy, which goes beyond just restricting development in this zone. This should have intersectoral initiatives to foster sustainable growth in agriculture, tourism and urban development in areas located at elevations with substantively lower risk from SLR and extreme storm surges. This may require creation of an inventory and relocation plan of at-risk public and institutional buildings and infrastructure that are currently within the zone likely to be severely impacted by 2050. Ultimately, this may inform town planning and infrastructure development to support resettlement strategies aimed at reducing risk.

3. Urgent consideration is needed for measures to protect key natural and built assets or prevent adverse environmental impacts on coastal ecosystems associated with flooding or breaches of:

   - The low-lying sections of the landfill at Conaree which have the potential to contaminate coastal waters;
   - Coastal salt ponds that may have high loads of nutrients;
   - Lower elevation segments of the main road connecting the south-east peninsula to the Basseterre, especially the segment separating North and South Friar's Bays;
   - Lower lying sections of Bay Road in Basseterre;
   - Integrity of septic systems and gas stations (current and disused) that may be at elevations below 5m above mean sea level.

4. Considerably more attention and planning are needed in respect of development of CSTs for public buildings and infrastructure above the high impact relocation zone.

This may include retrofitting to make buildings more resilient to extreme events or increasing temperatures. For example, consideration could be given to painting buildings white or having gardens on rooftops. New buildings should have doubled paned windows or fewer windows to reduce heating up of interiors. Hot air venting fans may be necessary as well. Consideration could be given to the feasibility of seawater air-conditioning (SWAC),[34] which involves uptake of cold seawater from off the island shelf (water depths great than 700 m) and conveying via pipelines to cool buildings. Pumping would have to be supported using renewable energy.

5. Consideration of installation of offshore breakwaters to protect communities, public institutional land uses and buildings, as well as infrastructural assets in the coastal area.

6. Audit of public infrastructure to determine integrity given higher and more prevalent temperature conditions.

7. Building designs/codes need to be updated to explicitly provide for insulation for air-condition and energy efficiency, use of renewable energy (and possible battery storage), use of double paned windows or reduced number of windows, reduction of exposure of bedrooms to afternoon sun (aspects and layouts). Currently building codes focus on standards for extreme events (e.g. winds, earthquakes etc.) and do not include CSTs and maintaining the efficiency of the building heat envelope.

Coastal and Marine Ecosystems

1. The GIS modelling will also generate information on the development of new shallow marine areas that can be evaluated for creation of mangroves and other coastal ecosystems that offer some level of coastal protection or other ecosystem services like fish nurseries. Additionally, some of these areas may be feasible locations for small-scale sustainable mariculture development (e.g. sea moss, shellfish).

2. Seasonal and post-storm (recovery) monitoring of priority beaches: recreational, fish landing, and turtle-nesting.

3. Emergency response measures to prevent mega rafts of sargassum from entering bays (possibly using oil booms or breakwaters that also protect the shoreline from wave action).

4. Extensive coastal modelling and coastal asset mapping will be needed to determine where it is more cost effective to protect coasts from extreme events rather than relocate assets further inland.

5. Careful evaluation of the likely impacts of SLR on the coastal salt ponds and assessment of whether these can be used for sectoral adaptation purposes (e.g. mariculture, over-water tourism or mangrove development).

[34] http://www.makai.com/brochures/Seawater%20Air%20Conditioning%20by%20Makai.pdf

Water Supply

1. More research is needed about the feasibility of creating interior water reservoirs or catchments. These may require large dams across viable river systems where the environmental impact and engineering feasibility have been properly evaluated.

2. A public awareness campaign for increased water conservation based on the predicted climate risk to the freshwater supplies is needed – possibly targeting tourism, health, agriculture and urban areas. This can also be accompanied by integrating conservation technologies for water into building codes.

3. The range of options for augmenting the current water supply that were proposed by the GCF project should be fully explored. These include increasing desalination production, improving operational efficiencies and monitoring, ensuring capacity to capture and store rainfall from extreme events. Additionally, the recommendations made by Cole Engineering (2013) should be evaluated for feasibility and funding, e.g., community storage, pipe replacement, watershed restoration, etc. Consideration may also be given to using treated sewage effluent for irrigation purposes.

Agriculture

1. In respect of agricultural adaptation, the government can consider creating a demonstration greenhouse that is built to withstand hurricanes with sustainable energy and waste recycling technologies options built-in. Incentives for adoption by small farmers and entrepreneurs can include availability of design templates, possible incubator agricultural sub-divisions (with centralized water, clean energy and waste management) and access to capital. Higher yielding food crops can be grown in greenhouses.

2. More R & D is needed to support diversification away from traditionally grown but at- risk crops. A food security strategy should take into account domestic consumer needs (including the restaurant and tourism sectors, as well as green markets etc) as well as the needs for export-oriented producers (e.g. sweet potatoes, peppers, peanuts, sea island cotton and coconuts etc). This should also include consideration of small-scale fisheries' current and potential contribution to food security.

3. Development of adaptive capacity for Nevis food supply chains as domestically grown food crops may become less viable as agricultural water demands may not be able to compete with tourism and municipal water demands.

4. Development of alternative livelihoods for persons in Nevis currently engaged in commercial small farming.

Health

- Implement a public awareness programme aimed at measures to encourage storage of rainwater to prevent incubation of vectors.

- Encourage of household gardens to augment food supply, and rainwater harvesting to augment water supply – resilience to water and food insecurity.
- Phase out or actively discourage the continued construction of septic/soak-away systems for new homes, and incentivize investment in wastewater treatment plants for subdivisions, institutions and tourism developments. This will reduce the risk of groundwater contamination after extreme rainfall events.
- Attention to mental health issues in the aftermath of major disasters that result in relocation of families or communities to emergency shelters.
- Urban heat response planning, forecasting, and monitoring for heat waves. Responses include cooling centres for elderly and children, reliable supply of water for cooling systems, and energy to run air conditioning, communication of information about heat levels, maintenance emergency response systems (health/ambulance, fire, hotlines, etc.). During heat waves there may higher demands on the electricity grid, so it may be necessary to have load shedding plans in place that prioritize human life and emergency systems as well as productivity (schools, offices etc).
- Consideration of EbA adaptation to heat impacts for larger urban areas like Basseterre, Fig Tree. Market Shop, Saint Paul's, and Middle Island. These should include consideration of urban forests, increased green spaces, green roofs, etc.

Tourism

1. Provisions for alternative/renewable energy generation at larger scale resorts and hotels to augment municipal energy supply and offset increased power demand for air-conditioning.
2. Promote investment in electric tour buses with air conditioning.
3. Provision of water coolers to support re-usable water bottle use and offset plastics demand
4. Promote the use of saltwater pools in lieu of reliance on chlorinated freshwater pools. These may rely on pumped seawater or may be constructed at the shoreline.
5. Sustainable use of natural assets (reefs, seagrass meadows, forest trails etc) used for tourism and restoration as necessary.
6. Beach replenishment and installation of breakwaters or groynes to prevent beach erosion. This can be a follow-on from the findings of the Coastal Erosion Mitigation Project that was undertaken by the Ministry of Tourism.
7. Enforcement of setbacks from shoreline.
8. Considerations for having new resorts located further inland with beach access provided by shuttle services or shared beach park amenities.
9. Exploration of marine tourism opportunities (yachting, sailing, sport-fishing) as well as eco-tourism in upland areas to reduce tourism pressure on coastal zone.
10. Development and implementation of Emergency Response Plans for hotels and resorts.

Community-Based Adaptation

1. There is a need to catalyse development of community-based organizations (CBOs) in St. Kitts and Nevis. This may build on work done by NEMA in communities, social welfare or other NGOs or youth groups. Grass-roots CBOs can health promote awareness and implementation of key climate actions that result in growing resilience and adaptive capacity of communities. This can be in connection with co-management or stewardship initiatives involving EbA to reduce non-climate stressors, as well as water and energy conservation.

2. Encouragement of "building back better" in the aftermath of extreme events where there has been significant damage and need for rebuilding. In the pre-webinar survey, participants were asked about the commonest measures used by communities to cope with weather-related hazards. Almost two-thirds of the respondents (63%) indicated that the commonest community coping measures was building back better; the next most common measure was increasing capacity by reducing non-climate stressors.

3. More research is needed to determine how the measures currently or historically used by communities in St. Kitts and Nevis helped them cope with and recover from extreme natural hazards, and whether this can be adapted to the expected new normal of climate. Particular attention should be paid to identifying grassroots innovations and technologies that are in use.

4. It may be necessary to develop alternative livelihoods (and training) and cooperatives to increase adaptive capacity for climate-impacted occupations and sectors such as rainfed small-farming. These measures should consider the vulnerability and needs of female-headed poor households. The Poverty Alleviation Programme currently underway is has prioritized this group as beneficiaries. Some examples include:

    a. In St Lucia, community-based adaptation has included support for handicrafts industries that rely on sustainable forest products (GoSL, 2017).

    b. To the extent possible restoration or protection of ghauts/riparian banks should involve hiring of community members or farmers when project funding is available for watershed restoration projects (e.g. IWEco initiatives).[35]

    c. Persons from climate-impacted occupations like small farming can also be deployed to assist with urban greening programmes.

    d. Consideration for training in blue economy eco-tourism can be given to smaller fisher folk who maybe cannot easily do longer fishing trips further out to sea.

5. Adaptation in the agricultural sector overlaps with adaptation needs for both the water sector as well as rural communities. Issues of rural development present significant problems for transforming the sector. Most rural populations engaging in agricultural livelihoods are considered rural poor, whose practices sometimes exacerbate agricultural risks. Agriculture and rural development remain a challenge as "*most of poor live in rural areas*" engaging in highly unproductive forms of rain fed agricultural

[35] https://www.unep.org/news-and-stories/story/staunching-flow-st-kitts-and-nevis-fight-keep-its-soil

activity and also engaging in "*rural development practices which exacerbate some hazards*" impacting the sector (Climate Studies Group Mona, 2020).

6. Rural to urban migration may be driven by climate change, particularly if this is exacerbated by loss and damage to infrastructure (transportation etc.), water and power supply, health care services etc. People may opt to move to urban areas where they perceive more food/water security, more services, and lower climate risk/exposure. The extent to which climate risk/impact is a driver of urbanization in St. Kitts and Nevis will have to be further studied to understand what planning measures can be put in place to offset adverse impacts, accommodate increasing urban demands, and prevent maladaptation.
7. The use of EWS, digital technologies and citizen science may be challenged where communities and households lack access to cell phones or internet. However, it is likely that most individuals do have access (based on available statistics[36]). To offset the challenges that rural communities or poorer households may lack these resources, there should be priority placed on ensuring that there are public access points (like schools, libraries and internet cafes) that allow community members to access EWS and other climate-related information services that may allow them to better cope with or recover from weather-related impacts and predicted longer term climate change or variability.

Adaptation Prioritization Workshop

To obtain feedback on the recommendation adaptation options that appear above,, a virtual workshop was held on May 13, 2021, bringing together 52 sectoral stakeholders. The core activity of the workshop was the application by participants of Multi-Criteria Analysis (MCA) to evaluate the merits of the recommended adaptation options.

MCA is a tool that facilitates trade-off analysis when choosing among alternatives in making a decision. MCA helps divide a complex decision into smaller, more tractable parts, participants then analyse each part according to pre-defined criteria and then integrate the parts to produce a meaningful decision. During the workshop, participants completed an MCA exercise in smaller, sectoral sub-groups and then reported back to plenary on high-level results. The criteria used to evaluate each recommended adaptation measure were as follows:

1. **Contribution to Social Equality:** The option targets groups disproportionately impacted or at risk from climate change (e.g., youth, elderly, people with disabilities, low socio-economic status, migrants);
2. **Ease of Implementation / Feasibility:** The option builds on or supports existing commitments and plans. The option presents few barriers to implementation (e.g., no/limited policy, regulatory, institutional, legal, technical, financial, business, social and gender barriers);

36 https://data.worldbank.org/indicator/IT.CEL.SETS.P2?locations=KN

3. **Sustainability, Scalability and Replicability:** The option maximizes sustainability co-benefits (e.g., low carbon resilience, sustainable use of coastal and marine resources) and / or is applicable in other locations or at other scales;

4. **Effectiveness and Impact:** The option positively impacts multiple sectors; it has a number of benefits (economic benefits, social benefits, benefits to ecosystems) and / or addresses problems in vulnerability hotspots;

5. **Potential Environmental Risks**: The option presents no significant environmental risks or adverse effects on the environment, natural resources or people. It avoids maladaptation (carbon-intensive or adverse impacts on other environmental & social priorities).

The scoring system corresponding to these criteria appears in Table 4.9.

Table 4.9. Criteria and scoring system used for the Multi-Criteria Analysis (MCA)

Score	Description (criteria 1- 4)	Description (criterion 5, risk)
1	Lowest	Highest
2	Low-Medium	Medium-High
3	Neutral/don’t know	Neutral/don’t know
4	Medium-High	Low-Medium
5	Highest	Lowest

The following tables (Table 4.10 - Table 4.15) show the results of participatory use of MCA to evaluate the alternative adaptation measures proposed to complement those in the 2018 National Climate Change Adaptation Strategy. Time constraints and different dynamics within sub-groups prevented the completion of the MCA exercise for all sectors. However, the rich feedback received through the group scoring and discussions provided a solid foundation for the refinement of the adaptation priorities for inclusion in the TNC.

Table 4.10. MCA results for agriculture and water resources

Agriculture and Water Resources	Contribution to social equity	Ease of implementation/feasibility	Sustainability, scalability and replicability	Effectiveness and impact	Potential for environmental risks	Total Score
Agriculture 1: demonstration greenhouse	4.00	4.00	5.00	5.00	4.00	4.40
Agriculture 2: food security strategy	5.00	5.00	3.00	5.00	4.00	4.40
Agriculture 3: Food supply chains	3.00	2.00	5.00	5.00	5.00	4.00
Agriculture 4: Alternative livelihoods	5.00	2.00	4.00	5.00	3.00	3.80
Water Resources 1: Interior water reservoirs	2.00	2.00	1.00	1.00	1.00	1.40
Water Resources 2: Public awareness campaign	5.00	5.00	5.00	4.00	5.00	4.80
Water Resources 3: Augment water supply	4.00	2.00	3.00	4.00	3.00	3.20

Table 4.11. MCA results for Human Health

Human Health	Contribution to social equity	Ease of implementation/ feasibility	Sustainability, scalability and replicability	Effectiveness and impact	Potential for environmental risks	Total Score
Health 1: Public awareness	4.00	5.00	4.00	4.00	5.00	4.40
Health 2: Household gardens and rainwater harvesting	4.00	3.00	4.00	4.00	5.00	4.00
Health 3: Phase out septic tanks	3.00	1.00	3.00	3.00	3.00	2.60
Health 4: Mainstreaming mental health in disasters management	5.00	2.00	2.00	4.00	5.00	3.60
Health 5: Urban heat planning	2.00	1.00	2.00	3.00	4.00	2.40
Health 6: EbA Adaptation/Increase in green space	4.00	3.00	4.00	4.00	5.00	4.00

Table 4.12. MCA results for Coastal & Marine Ecosystem and Community Based Adaptation

Coastal & Marine Ecosystem and Community Based Adaptation	Contribution to social equity	Ease of implementation/ feasibility	Sustainability, scalability and replicability	Effectiveness and impact	Potential for risks	Total Score
Costal and Marine Ecosystem 1: GIS modelling	4.00	5.00	4.00	4.00	5.00	4.40
Costal and Marine Ecosystem 2: Monitoring beaches	4.00	4.00	4.00	3.00	5.00	4.00
Costal and Marine Ecosystem 3: Sargassum prevention	5.00	1.00	1.00	3.00	3.00	2.60
Costal and Marine Ecosystem 4: Coastal asset mapping	4.00	4.00	4.00	4.00	5.00	4.20
Costal and Marine Ecosystem 5: Evaluation of SLR	5.00	3.00	3.00	3.00	5.00	3.80
Community Based Adaptation 1: Development of CBOs	5.00	3.00	4.00	4.00	5.00	4.20
Community Based Adaptation 2: Building back better	5.00	4.00	4.00	5.00	5.00	4.60
Community Based Adaptation 3: Research on recovery	4.00	4.00	5.00	4.00	5.00	4.40
Community Based Adaptation 4: Alternative livelihoods	5.00	4.00	4.00	5.00	4.00	4.40
Community Based Adaptation 5: Climate change impact on rural-urban migration	2.00	3.00	1.00	2.00	2.00	2.00
Community Based Adaptation 6: Early warning systems	5.00	4.00	5.00	5.00	5.00	4.80

Table 4.13. MCA results for Planning and Infrastructure

Planning and Infrastructure	Contribution to social equity	Ease of implementation / feasibility	Sustainability, scalability and replicability	Effectiveness and impact	Potential for environmental risks	Total Score
Planning and Infrastructure 1: GIS mapping for coastal risk	4.00	4.00	5.00	4.00	5.00	4.40
Planning and Infrastructure 2: National land development policy	3.00	5.00	3.50	4.00	5.00	4.10
Planning and Infrastructure 3: Protection of natural and built assets	5.00	2.00	2.00	4.00	3.50	3.30
Planning and Infrastructure 4: CST development for public buildings	4.00	3.50	3.50	4.00	2.50	3.50
Planning and Infrastructure 5: Installation of offshore breakwaters	5.00	2.00	4.00	5.00	2.00	3.60
Planning and Infrastructure 6: Public infrastructure audit	4.00	4.50	4.50	4.00	5.00	4.40
Planning and Infrastructure 7: Building codes	Not scored	Not scored	Not scored	Not scored	Not scored	Not scored

Table 4.14. MCA results for Institutional Readiness

Institutional Readiness	Contribution to social equity	Ease of implementation / feasibility	Sustainability, scalability and replicability	Effectiveness and impact	Potential for environmental risks	Total Score
Readiness 1: Legislative gaps	3.50	2.00	3.25	4.00	4.25	3.4
Readiness 2: CCORAL tool and climate lens	4.00	3.33	4.00	4.00	4.67	4
Readiness 3: Climate focal desks	3.33	5.00	4.67	4.67	5.00	4.5
Readiness 4: Inter-sectoral climate coordination mechanism	3.33	5.00	4.67	4.67	5.00	4.5
Readiness 5: Synergies with international agendas	3.33	3.33	4.33	4.33	5.00	4.1

Table 4.15. Summary stakeholder feedback on adaptation options for Tourism

Tourism	Stakeholder Feedback
Tourism 1: Renewable energy generation at large scale resorts	Should not be restricted to large-scale resorts. Legislation might be a barrier to off-grid solutions.
Tourism 2: Electric buses	Recharge infrastructure and the cost of electric tour buses can be prohibitive for Nevis tourism operators. High investment costs.
Tourism 3: Water coolers to offset plastic	There's interest in having new technologies that have bottle-filling stations and fountains. Need to carefully manage hygiene issues.

Tourism 4: Saltwater pools	Seen as a better option than seawater pools. Coastal water needs strong monitoring because of high levels of bacterial contamination.
Tourism 5: Sustainable use of natural assets (reefs, trails etc.)	Not discussed
Tourism 6: Beach replenishment	Need to build on lessons learned through experience, such as the beach replenishment work in Frigate Bay.
Tourism 7: Shoreline setbacks	Not discussed
Tourism 8: Inland resorts	Not discussed
Tourism 9: Marine and eco-tourism exploration	Not discussed
Tourism 10: Emergency Response Plans	Not discussed

5. Other Relevant Information

Overview

This chapter includes Other Relevant Information considered germane to the convention's objectives. The convention encourages non-Annex 1 Parties to provide information on steps taken to integrate climate change considerations into relevant social, economic, and environmental policies and actions to facilitate the implementation of sustainable development programmes according to Article 4, paragraph 1 f). The chapter contains information relevant to the areas listed below and includes challenges, opportunities, emerging issues and recommendations across each section. This chapter was not reported in St. Kitts and Nevis' Second National Communications (SNC).

- Technology Transfer
- Research and Systematic Observations
- Education, Training and Public Awareness
- Capacity Building
- Information and Networking

The report is based on a desk review of the relevant documents in St. Kitts and Nevis, online research and discussions with key stakeholders. The Department of the Environment staff was critical in gathering key data and conducting interviews with key stakeholders. The other relevant information chapter was built on work completed from previous chapters and interviews with key stakeholders. A stakeholder validation workshop was held where the draft report was circulated for review, and the main information was presented to the key stakeholders for validation. The chapter was then finalised based on the feedback presented.

Technology Transfer

Technology transfer is crucial to the global response to climate change, with developing countries being the main proponent for its deployment and benefits. The relevance of developing countries' roles in this is also reflected in article 4.5 of the Convention, establishing that Parties: "shall take all practicable steps to promote, facilitate, and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention."

St. Kitts and Nevis TNC outlines the proposed and planned adaptation and mitigation actions, many of which require technologies (equipment, infrastructure, techniques, knowledge and skills, approaches, etc.). Additional funding and capacity are needed to promote and expedite the transfer and implementation of these technologies in compliance with UNFCCC.

To support in identifying these needs, St. Kitts and Nevis initiated work on its second Technology Needs Assessment (TNA) in 2020 as part of the 4th phase of the Global TNA project funded by the Global Environmental Facility (GEF) and implemented by UNEP in collaboration with UNEP DTU Partnership, now the UNEP Copenhagen Climate Centre. The TNA is a country-driven process that enables Parties to determine their top climate technology priorities and provides support through a portfolio of environmentally sustainable technology (EST) projects and programmes. This process also facilitates building national capacity and a mechanism to track and document country needs for new technologies, skills, and equipment that impact vulnerable sectors to climate change and areas where GHG emission potential is greatest.

St. Kitts and Nevis completed its first TNA in 2012, and its results on technology needs are described in the Second National Communication. The ongoing TNA initiated in 2020 as part of the TNA IV project has some identified priority sectors and technologies for mitigation and adaptation.

Identified Adaptation Technology Needs

Priority sectors were identified based on the significance of the Party's socio-economic well-being and the need as well as the need to implement quick and effective adaptation measures. Working groups were used to help identify pertinent technologies based on their understanding of the national situation; sector expertise was comprised of stakeholders from the commercial sector, public sector, and NGOs. The prioritised sectors for adaptation were water and agriculture.

This is the prioritised list of adaptation technologies for the agriculture sector in St. Kitts and Nevis:

- Integrated pest management
- Soil moisture conservation monitoring and techniques
- Agrisilviculture

The water sector is one that is very important for St. Kitts and Nevis. Water demands in the drier, hotter months of the year must be met. There must also be availability for agricultural use for livestock and crop irrigation, as well as support for domestic and tourist activities. Therefore, in order comprehensively and efficiently address the water resources sector, the following prioritised adaptation technologies for were identified:

Non-revenue water and demand management programme (including smart metering)
Leakage detection and repair and pressure management
Integrated water resources management

Barriers to Implementation and Support Needs for Adaptation

The main barriers to the identified adaptation technology needs are cost and technical capacity. The lack of funding to implement identified adaptation actions, as well as the unavailable technical and human resources, are currently stymieing the implementation of these adaptation actions. Furthermore, there is a need for increased coordination across different agencies to implement the National Climate Change Adaptation Strategy that covers all adaptation priorities and mainstreams these areas of work into annual operational plans of the relevant entities. Further study under the TNA IV project is underway to prioritise these technology needs and their associated barriers.

Identified Mitigation Technology Needs

This section should be read in conjunction with the chapter on mitigation. St. Kitts and Nevis' updated NDC (2021) and its Mitigation Chapter for the BUR/TNC (2022) identify the energy and transport sectors as priority sectors for reducing GHG emissions based on reduction potential. The mitigation technologies identified directly link to increasing energy supply to meet growing demands, conserving existing energy, and transitioning to lower-cost (particularly renewable) energy sources. Among them, geothermal and wind energy sources have been shown to be feasible and desirable. The exploration of electric and hybrid vehicle expansion across the country is also a main technological focus with high mitigation potential.

The following list of technology needs was identified through the mitigation assessment conducted in St. Kitts and Nevis during the TNC reporting cycle in consultation with relevant stakeholders:

- Technology to undertake an assessment of electric and hybrid vehicle integration
- Technology to undertake an assessment of charging infrastructure for electric vehicles into the transmission and distribution grid and its impacts
- Monitoring systems for electric and hybrid vehicles
- Technology to assess vehicle efficiency
- Technology to assess the impact of improved public transit
- Technology to assess the possibilities of enabling conditions for EV uptake
- Technology to undertake geothermal assessments for St. Kitts
- Wind technology assessments
- Technology to assess and implement grid interconnection between the two islands
- Knowledge exchange for electricity legislation
- Solar water heaters installation
- Energy efficient equipment
- Technology to assess building usage data
- Data collection and monitoring systems
- Capacity to improve public awareness programmes

Work is underway at the time of this report to prioritise these technologies by need and feasibility.

Barriers to Implementation and Support Needs for Mitigation

The main barriers to implementation of the mitigation technology needs are cost and the technical expertise required to roll out various renewable energy and energy efficiency technologies, as well as the uptake of EV and hybrid vehicles in the transportation sector. Further study under the TNA IV project is underway to prioritise these technology needs and their associated barriers.

The common barriers identified include:

- Electric Vehicles and Hybrid Vehicles

- High cost of EVs and charging infrastructure
- EV importation costs and challenges in making charging infrastructure available to consumers
- Technical expertise required for maintenance of EVs and charging stations
- Potential impacts on transmission and grid
- Cultural acceptability

While wind power technology is well-developed and demonstrated in other parts of the world, for small islands like St. Kitts and Nevis, the likely barriers to the application of this technology may be:

- Availability of land
- Variable power output
- Environmental impact (noise, aesthetics, cultural acceptance)
- Availability of data for feasibility assessment
- The possible impact of hurricanes

Geothermal PowerBoth islands, St. Kitts and Nevis, indicate feasibility for geothermal energy resources,[37] with Nevis' showing numerous geothermal indicia being larger, hotter, and more geographically concentrated. As a result, it is considered that geothermal resources beneath Nevis could be characterised and produced more quickly and inexpensively than on St. Kitts. However, cost and limited incentives to attract investors are considered barriers in this regard.

Identified Technology Transfer

Technology transfer has been limited in St. Kitts and Nevis. However, there are a few areas where technology transfer has occurred, and these are listed below:

- Efficient irrigation for crop production
- New geothermal extracting heat from rooms to create energy at Sunset Reef Resort
- Technology transfers in the geothermal energy production in Nevis
- Automated sensors for water tanks that relay low-level information to the Water Services Department (WSD)
- The Supervisory Control and Data Acquisition System installed at the Nevis Water Department
- Installation of GEONETCAST Systems in St. Kitts

[37] Geothermal potential of St. Kitts and Nevis conducted by G-C Geoscientists

Research and Systematic Observations

Systematic Observations

Overview

Climate service is processing climate information that would assist in helping governments and organisations to improve decision-making for future outcomes. Appropriate and iterative engagements are required to produce timely advisories that users can comprehend and enable early action and preparedness.[38] Climate services need to respond to the users' needs and requirements and be provided in a seamless manner. Climate information is helpful in preparation for the weather that is experienced. Long-term climate information, particularly meteorological and hydrological observations, is required to detect changes in the climate.

Article 7 of the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) calls on Parties to strengthen scientific knowledge on climate, including research, and systematic observation of the climate systems, in a manner that informs climate services and supports decision-making.[39]

This section outlines the efforts made by the government of St. Kitts and Nevis in research and systematic observations and highlights the challenges experienced.

Current Status

The Meteorological Services Office or Met Office in St. Kitts and Nevis (SKNMS) has two entities: the St. Kitts Meteorological Services is an entity within the St. Christopher Air and Seaport Authority (SCASPA), and the Vance W. Amory Air Traffic Services/Meteorological Service is an entity with the Nevis Air and Seaports Authority (NASPA) on the island of Nevis. St. Kitts and NevisMS is supported by the Water Services Department (WSD), the Department of the Environment (DOE) and the Nevis Disaster Management Department (NDMD). The Met Office is a member of the Caribbean Meteorological Organization (CMO). The CMO is one of several regional organisations considered critical for the overall global coordination of meteorological and hydrological activities of the World Meteorological Organisation (WMO).[40] Although some members of the CMO are also members of the WMO, this does not include St. Kitts and Nevis. The CMO is supported by the Caribbean Institute for Meteorology & Hydrology (CIMH), a technical arm of the CMO for data collection and the development of climate services. The CIMH also serves as a repository for meteorological data for the English-speaking Caribbean, a training institute, and the designated calibration centre for the region.

St. Kitts and Nevis Met Office, which is mainly an Aeronautical Meteorological Office as defined by the CMO, conducts surface and weather observations, climate data collection and aeronautical meteorological forecasts and warnings. The Antigua and Barbuda Meteorological Office is responsible for forecasts and warnings of severe weather events for the Federation of St. Kitts and Nevis according to resolution 1 of the 51st session of the Caribbean Meteorological

[38] https://public.wmo.int/
[39] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[40] http://www.cmo.org.tt/organization.html#:~:text=Membership%20of%20the%20WMO%20enables,the%20WMO%20Global%20Telecommunication%20System.

Council (CMC). [41]

There is no legislation mandating St. Kitts and Nevis Met Office to collect climate data or other functions, which is similar in most CMO member states. As a result, the CMO under the Climate Risk and Early Warning System (CREWS) Initiative Caribbean project prepared a model meteorological legislation policy.[42] The model legislation was adapted to national circumstances, and national meteorological legislation was developed for St. Kitts and Nevis. This legislation is currently in the draft phase and has been submitted to the relevant Ministry officials for approval. In addition to the policy and legislation under the CREWS project, a strategic plan and national framework for weather, water and climate services were developed for St. Kitts and Nevis, which was endorsed in August 2021. The implementation time frame for the plan and framework is 2021-2025.

Data Collection & Management

The SKNMS team comprises fourteen (14) officers excluding the support staff within the NDMD in Nevis. The agencies collect meteorological data in accordance with WMO standards and maintain the weather stations. The Nevis Met and Air Traffic Control staff are cross-trained across the various units. Data is collected through the weather stations on the two islands but with inadequate spatial coverage on the western and southern sides of St. Kitts. St. Kitts has manual and automatic weather stations (AWS), with most of the AWS installed within the last ten (10) years. In Nevis, the island has adequate spatial coverage; this was developed through a project in 2015 funded by the Organisation of Eastern Caribbean States (OECS) and USAID. Five (5) automatic weather stations were installed under the project, and three (3) other stations were added to the total. These weather stations are all automatic and situated in all the parishes in Nevis. There are also flood management systems in St. Pauls' parish and St. James parish, in areas that are flood prone, populated, and contain critical infrastructure. The NDMD mainly manages these weather station and flood management systems with some support from CIMH. In addition, there is one weather station near the airport that is maintained by the Nevis Met Office.

The SKNMS have digitised data on rainfall in St. Kitts from 1971, with a gap in 1998 due to the passage of Hurricane Georges, which caused severe destruction to the island and damage to the weather stations, but the majority of the data sets for other parameters begin from 1991. The Department of the Environment had historical data sets on rainfall from the early 1900s when the sugar industry thrived. However, these data sets are not used for official reporting as they were not collected in accordance with WMO standards for data collection. The network stations in St. Kitts transmit via General Packet Radio Service (GPRS) through a unique platform or via satellite to the CIMH. Therefore, some stations do not report to the SKNMS in St. Kitts in real-time.

Data is collected on a monthly basis on both islands, coinciding with the maintenance schedule, to prepare reports. However, the SKNMS and the NDMD do not have a vehicle assigned to the office, which poses additional challenges to data collection. Arrangements are being made with CIMH to have a better system for data collection and even request the data from the automatic

[41] http://www.cmo.org.tt/docs/Resolution/Resolution.pdf
[42] http://cmo.org.tt/Press_Projects.html

repository for St. Kitts. In St. Kitts, the automatic weather stations have data sets from the last ten (10) years, but some may experience technical faults leading to gaps in the data sets.

Data analysis is mainly completed by one officer in St. Kitts who recently completed training in applied meteorology. This officer was recently assigned, and therefore, data analysis for St. Kitts is very limited. The St. Kitts Met Office has not been able to generate any reports over the last five (5) years. This is expected to change with the new assignment of the data analysis officer. The Water Services Department conduct weekly analysis of the data retrieved. In Nevis, analysis is done through basic excel analysis. Still, the NDMD is in discussions with teams from the University of the West Indies (UWI) and a university in Canada to have better data analysis through a programme that can automatically do some of the analysis. Unfortunately, these discussions have yet to be realised. The available data in Nevis for NDMD is fairly young, only (5) years, but the NDMP hopes to generate some pictorial diagrams for selected parishes and integrate the data collected for farming. The analysis will also lend support to the Water Department as it relates to aquifer recharge and drought. The information would also lend value to the geothermal drilling.

St. Kitts Met Office currently does not have a repository for data; this is mainly stored within the CIMH. The St. Kitts Met Office is preparing a project for submission to the Green Climate Fund (GCF) through its readiness proposal to address the issue of an in-country repository for data. The Terms of Reference (TORs) are currently being developed by the SKNMS for the data repository and will also include an online platform.

SKNMS also received information from the Caribbean Climate Outlook Forum (CARICOF),[43] which was re-established in 2012 by the Applied Meteorology and Climatology Section (AMCS) of CIMH and the National Oceanic and Atmospheric Administration (NOAA) and supported by the WMO. CARICOF provides rainfall and drought forecasts for the region along with other climate services. The SKNMS assists in the delivery of these forecasts, which is essential for many national and regional stakeholders.

The SKNMS face many challenges as it relates to data collection. Some of these are listed below:

- There is no vehicle assigned to SKNMS and NDMD to facilitate the acquisition of data from the manual weather stations and for the maintenance of the stations. In addition, some stations are difficult to access, and off-road vehicles are required.
- Many constraints exist in the collection and analysis of groundwater data.
- Many of the weather stations do not transmit data in real-time, and most of the real-time data is transmitted to the CIMH and not to the St. Kitts Met Office.
- Precipitation usually increases in elevation on tropical islands, but the interior of St. Kitts comprises forested lands and protected areas with strict regulations on the use of the area. Therefore, siting weather stations according to WMO standards in these areas can be difficult.

[43] https://rcc.cimh.edu.bb/about/about-the-rcc/

- Data gaps exist in St. Kitts when the AWS is not functioning adequately; since most stations do not report in real-time to SKNMS, it is difficult to verify when the system is down.
- Lack of adequately skilled staff to conduct advanced processing of data.
- Access to microclimate information due to the inadequate spatial distribution of weather stations in St. Kitts.
- Some more recent weather stations have suffered degradation to salt erosions and weather-related damages and have become unrepairable.
- Limited resources: both human and financial resources.

Maintenance of weather stations

The maintenance of the weather stations is done in a collaborative effort with the SKNMS, the Department of the Environment (DOE), the Water Services Department (WSD), and the Nevis Disaster Management Department (NDMD).

The Department of the Environment is the climate change communications focal point and has a mission to mitigate and/or reverse environmental degradation through scientific and technological excellence, raising public awareness, standard setting, advocacy and resource mobilisation.

The WSD has a mission to ensure all reasonable needs of customers are met in a timely and efficient manner through the effective management of water resources. The WSD is responsible for the identification, upkeep and protection of water supply sources for human consumption and watershed management. This is completed with collaboration from the Environmental Health Department, The Department of Agriculture, the Department of Planning and the Department of Public works responsible for water quality for human consumption, protection of surface and groundwater, regulating land use practices and building and maintaining roads, respectively.

The NDMD's mission is to maximise the use of available resources to promote effective communication, collaboration, safety concerns, and critical thinking.

The St. Kitts Met Office currently has two (2) staff members who work on maintenance and have received basic training from the CIMH. The St. Kitts Met Office anticipates that these officers will receive more advanced training in the coming years. The St. Kitts Met Office is also in discussions with the National Emergency Management Authority (NEMA) to formulate a team from the relevant ministries to maintain the network of weather stations. The St. Kitts Met Office hopes to engage the CIMH in the delivery of in-country training for the maintenance team.

In Nevis, the weather stations are maintained mainly by the NDMD, while the Nevis Met Office maintains one weather station near the airport.

Early Warning Systems (EWS)

There are some early warning systems, especially those related to flooding. Currently, the EWSs are not functioning as designed in St. Kitts. St. Kitts hopes to develop projects to have the EWS systems up to standard and functioning properly.

Water Sector

WSD, in collaboration with the DOE, Department of Agriculture, and Environmental Health, is working on a project with the Climate Technology Centre and Network (CTCN). The project aims to assess drought risk and water resources in St. Kitts and Nevis, design and implement a drought prediction model and train the officers in the use of the drought prevention model. St. Kitts and Nevis's water distribution is mainly through underground water well. As a result, the water system is experiencing the effects of climate variability due to increased atmospheric temperatures and reduced precipitation.

Very little data on the water system currently exists, mainly due to a lack of adequate human resources and equipment. In addition, there is currently no telemetry system or technology for collection or remote monitoring to support data management in the water sector. As part of this project, a working group has been established with the anticipation that this inter-agency working group will be maintained to provide quarterly discussions on climate-related services. In Nevis, studies were completed for fracking and hydrology studies as it relates to geothermal.

St. Kitts and Nevis Revised Met Bill and Strategic Plan

Draft Revised Meteorological Bill

A Draft National Meteorological Bill was developed for St. Kitts and Nevis, financed by the CMO in agreement with WMO. This bill establishes one Meteorological Department for St. Kitts and Nevis and is expected to be the national provider of meteorological and climate services for the Federation. In addition, the bill establishes specific objectives of the Department, including continued collection and updating of meteorological and climatological data and the functions of the Department.

The bill is divided into nine (9) parts and outlines the necessary administration, staffing, provision of services, regulatory provision, financial and other general provisions.

Draft St. Kitts and Nevis National Strategic Plan

The SKNMS National Strategic Plan and Framework for Weather, Water and Climate Services is a 5-year action plan for 2021-2025 to improve the climate services provided by the SKNMS; this is encompassed in four strategic goals as outlined below.

- Strategic goal 1: Ensure that the SKNMS has an enabling policy and institutional environment.
- Strategic goal 2: Strengthen the SKNMS' human and infrastructural capacity to deliver effective weather and climate services.
- Strategic goal 3: Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, hydrology, marine and climate products, and ensure successful risk communication.

- Strategic goal 4: Strengthen the SKNMS' human capacity, performance management, and operational efficiency.

Research

Research and data collection are essential to understand the climate and its changes. Research helps to inform actions, gather evidence for theories and contribute to developing knowledge. The importance of research cannot be understated, but the level and advancement of research depend on various factors, including access to finance.

St. Kitts and Nevis has no distinct policy related to research, but several agencies are responsible for data collection, and some analysis and research is done at these agencies to fulfil their daily duties; sometimes, research is completed on an as-needed basis. These agencies also provide relevant information to researchers and engineers and benefit from climate change-related projects, which aid in addressing some of the areas identified due to the research or data analysis undertaken.

- Department of the Environment (DOE) – As the climate change focal point, the DOE is instrumental in ensuring that data collection necessary for adapting to and mitigating climate change is collected. The DOE funnels and supports many climate-related projects to the relevant agencies and assists in the proper dissemination of information to the relevant ministries and the general public. The DOE enables other agencies to ensure that research serves as the repository for climate-related reporting requirements.
- Department of Agriculture (DOA) – The DOA works with research with farmers in climate-smart agriculture.
- Department of Marine Resources (DMR) – The DMR 2010 has adopted an ecosystem-based approach to sustainable fisheries management. The ecosystem-based approach integrates marine habitat management and sustainable use of resources. The DMR works with the St. Kitts Nevis Aquaculture Pilot Project and Environment Research (SNAPPER). In addition, a Seamoss Pilot Project, which does research into alternative livelihoods, has also been established by the DMR.[44] The Seamoss Pilot Project assisted in the enhancement of the Liamuiga Seamoss group and the establishment of new sea moss plots.
- Water Services Department (WSD) – collects water quality and water-related data and assists in the maintenance of the weather stations. In addition, the WSD assist with water-related research.
- Department of Energy – The Department of Energy supports research in related renewable energy technologies for planning and project implementation.
- NEMA and NDMD are responsible for pre- and post-event assessments. Although the agency may not be directly responsible for research, NEMA is the focal the Caribbean Disaster Emergency Management Agency (CDEMA) and other agencies where research is conducted. Research has been conducted in the summertime with the NDMD; the University of Illinois Chicago; and the University of Northern Colorado.

[44] https://dmrskn.com/about/

In 2019 research was done on the impact of the NDMD public awareness campaign and in 2022 research was done on food security for agriculture, home gardening and the impact of psychosocial support, particularly the support provided during the COVID-19 pandemic.

- The Saint Mary's Biosphere Reserve, comprised of cloud forests, mangroves, and coral reefs, has done a few research projects and is preparing a study involving Cayon river/water source.

Education, training and public awareness

The government of St. Kitts and Nevis has made a significant effort to impact change in the agriculture sector and to increase national climate change resilience in response to trends in increasing national and global food security concerns caused by the changes in climate. In 2017, the Ministry of Agriculture et al. and the Ministry of Education undertook a consultative process to develop an agriculture science syllabus aimed at increasing interest in, and knowledge of, careers in agriculture at the primary education level. The aim of the developed syllabus is to create a scientifically grounded and technologically forward generation of agricultural practitioners and thus increase agricultural contribution to GDP and enhance food security. The new curriculum was piloted in four schools: Beach Allen, Joshua Obadiah Williams, Saddlers and St. Pauls Primary Schools from January to July 2018. The programme was a success, and the new curriculum was fully implemented in these schools for grades two to six.[45]

Training in the agriculture sector was also conducted through the GCF-Readiness Project titled "Strengthening the Foundation for a Climate Responsive Agricultural sector in the Caribbean" (GCF CARICOM AgREADY, in short), funded through a Grant Agreement with the Green Climate Fund (GCF) with The Bahamas - The Ministry of Environment and Housing as the lead National Designated Authority (NDA) and the Inter-American Institute of Cooperation on Agriculture (IICA) as the delivery partner.[46]

Project objectives and activities related to:

- Improve the enabling conditions to design, implement and evaluate options for enhanced climate data collection action in the agricultural sector by strengthening policies, capacities, frameworks, methods and institutional arrangements for the collection, monitoring, measuring, reporting, verifying (MRV), and analysing agricultural and associated activity data from the sector. This includes work with national and regional stakeholders and data keepers to improve agriculture data collection across the board and the countries listed.
- Increase the number of projects identified for development and investment in a pipeline of evidenced-based and bankable projects aligned with regional and national priorities as informed by climate risk assessments of the agriculture sector.

[45] https://www.sknis.gov.kn/wp-content/uploads/2022/01/Budget-Address.pdf
[46] https://www.greenclimate.fund/sites/default/files/document/strengthening-foundation-climate-responsive-agricultural-sector-caribbean.pdf

- Dissemination of best practices for institutional capacity building, coordination, and pipeline development of more robust proposals for building climate resilience along prioritised agricultural value chains, with a focus on cultivating the innovative capacity of the region's youth.

The first training series provided experts in the agricultural sector with an understanding of which agricultural activities produce GHG emissions and how to calculate the emissions from the various activities. By the end of the training, the experts understood the basic concepts of agricultural GHG emissions and major processes leading to emissions; methodological approaches for calculating GHG emissions; data requirements for determining agricultural GHG emissions; and the data requirements to move from a Tier 1 to Tier 2 methodological approach. In addition, the training provided materials and templates which participants can reference and utilise to refine quality and accuracy during the data collection process.

The second series trained national facilitators, local farmer organisation representatives and extension agents on the importance of accurate data collection, types of data to collect, data archiving and the relevance of the data collection to the sectoral and national inventory and the country. In addition, trainees were sensitised to the importance of sustainable farming with minimal emissions and the benefits for the farmer. Each participant was expected to become familiarised with the course material adequately to facilitate two workshops on Data Collection Awareness with livestock farmers, cropland farmers, and/or rice cultivators.

St. Kitts and Nevis stakeholders participated in a regional Training of Trainers event (June 2018) under the ACP-EU-CDB National Disaster Risk Management (NDRM) programme on how to establish robust and implementable climate resilience water sector policies and investment plans by strengthening regional and national capacity to respond to climate change, to mainstream climate resilience, and to design transformative sector-wide interventions.[47] As an outcome of the training, participants prepared action plans to initiate country processes for the preparation of national climate-resilient policies, strategies and investment plans. The programme, "Resilience in the Caribbean water sector - Strengthening regional and national capacity to respond to climate change", was funded by Caribbean Development Bank (CDB), Global Water Partnership Caribbean and the Climate and Development Knowledge Network (CDKN) and led by HR Wallingford. They also led the planning and development of a Training Manual, *Supporting the Integration of Climate Resilience in the Water Supply Sector in the Caribbean,* and Caribbean-specific tools and approaches that sector practitioners can use to assess, design, and implement effective climate resilient development actions in the water sector.[48]

Improvements observed during the 3rd national communication (TNC)/BUR1 cycle as it relates to MRV systems, GHG inventory, mitigation, and adaptation included the draft of a National Adaptation Strategy with an implementation process beginning in 2018. The aim is primarily to effect improved attention to partnerships and institutional coordination by increased capacity building and engagement, improved information management, research, and monitoring and evaluation, explicitly considering climate resilience in disaster risk reduction (DRR), and

[47] https://www.theukwaterpartnership.org/wp-content/uploads/2022/08/be-096_resilience-in-the-caribbean-water-sector-r1.pdf
[48] https://www.caribank.org/sites/default/files/publication-resources/Task%205_Training%20Manual.pdf

investment and economic planning, as well as improved intersectoral coordination. In addition, training activities were undertaken by local stakeholders in the fields of GHG inventory, mitigation assessments and LEAP modelling and MRV. Stakeholders were trained in the technical elements of the reporting requirements and procedural elements to increase the institutional memory of local stakeholders and experts.

St. Kitts and Nevis participated in the Greenhouse Gas Management Institute (GHGMI) training in 501 IPCC – Introduction to Cross-Cutting Issues and 511 IPCC Waste in March 2020. This training provided successful participants with a certificate of proficiency for the course.

St. Kitts and Nevis participated in the development and training of the Drought Risk Modelling Tool, which was developed for the country in 2022; this training was funded by the Climate Technology Centre and Network (CTCN).

St. Kitts Met Services were trained in the GEONETCast (GNC) System, a global network of satellite-based dissemination systems that delivers earth observations data and products to and from GEO community activities initiatives and others. This system was also installed at the St. Kitts Met Services.

The Nevis Disaster Management Department (NDMD) has an extensive Comprehensive Public Education Department and Awareness Campaign that involves schools, faith-based organisations and the business sector. A five (5) year public awareness campaign was developed by NDMD from 2017-2022, but due to the COVID-19 pandemic, this was extended to 2024. The NDMD has partnered with CDEMA and the West Indies Cricket Disaster Fighters. In 2023, the focus will be on the business sector, with discussions with the Caribbean Development Bank (CDB) and CDEMA. Through their campaign, students have been able to interact with the “Hurricane Hunters” and astronauts. In addition, the NDMD promotes the sensitisation of students through inter-school sports, where each school carries the banner of a natural disaster.

In addition, St. Kitts and Nevis have developed a climate change public education and awareness strategy for 2022-2024. The strategy has five objectives:

- Increase awareness at all levels of society about climate change, its causes, risks, and impacts
- Increase awareness of climate change adaptation and its benefits to individuals, households, climate-vulnerable communities and livelihoods
- Build capacity of households, climate-vulnerable communities and sectors to be resilient to climate shocks and hazards
- Build the capacity of government, civil society and private sector stakeholders in climate change communication
- Increase belief among sectoral stakeholders and citizens that government is serious about addressing climate change and finding solutions

Capacity-building

The government of St. Kitts and Nevis has identified the need to institutionalise the implementation of Nationally Determined Contributions (NDC) through its proposed MRV System reporting arrangements. Thus, they have prioritised building human, technical, and institutional capacity through project action tasks. These include the Mitigation Analysis and Assessment Introductory and Advanced Training Workshop, a virtual workshop series. The training was developed and facilitated by a team of Greenhouse Gas Management Institute (GHGMI), the Caribbean Cooperative Measuring Reporting and Verification Hub (MRV Hub) and the Stockholm Environment Institute (SEI) instructors. Selected trainees comprised stakeholders from the utility companies, St. Kitts Electricity Company (SKELEC), Nevis Electricity Company (NEVLEC), and public stakeholders from key institutions and departments. This is in alignment with prioritised capacity-building needs in mitigation identified during TNC/BUR1 reporting process. In addition, there will be development of a mitigation team to support continuous updates of the mitigation assessment, identification of adequately skilled persons to monitor implementation and update the LEAP model; continued development of persons skilled in IPCC guidelines and inventory; development of a national data collection team for mitigation assessment; and assessment of data transparency issues and development of agreements to facilitate data sharing among institutions, for example, by anonymising data (e.g., sharing semi-aggregate information by power plant type instead of by individual facilities so that interests of private companies are protected while also contributing to the public knowledge). Stakeholders were further engaged during the mitigation assessment process for participated in an accompanying sensitisation workshop.

Capacity building of recently assigned individuals involved in the preparation and reporting of the national greenhouse gas (GHG) inventory in the Caribbean Cooperative MRV Hub (MRV Hub) 2022 Summer Academy online training programme, focused on overarching and introductory greenhouse gas inventorying principles and tools and resources to support inventory work. This was followed by the 2022 Summer Academy (in-person) Capstone supporting experienced staff in climate change-related ministerial offices in building their applied GHG inventory measurement and reporting experience.

Several other capacity-building activities focused on refining skillsets and providing opportunities for integrating adaptation measures to climate change into medium and long-term national planning. These included:

- **St. Kitts and Nevis Reef Guardian Training** of newly positioned Reef Guardians
- **Lidar Training** for Technical Officers from the Physical Planning divisions of St. Kitts and of Nevis, the Lands and Surveys Department, Disaster management, Project Management Unit of Nevis, the Water Services of Nevis, and the Maritime Affairs
- **Best Practices for Beach Clean-up Data Collection** youth workshop
- **Operation and Maintenance of Emergency Water Systems Basic & Technical Training** of teachers and their auxiliary staff from across 18 learning institutions, Officers from Water Services Departments of St. Kitts and Nevis, Public Works Department, and the Ministry of Education Facilities Maintenance staff of Nevis

- **Coral Reef Restoration Training on** artificial reef management with stakeholders from the Department of Marine Resources, Department of Environment, St. Kitts and Nevis Reef Guardians, Caribbean Youth Environment Network (CYEN), Anjolique Dance Group, Local Dive Shops and Dive Enthusiasts
- **Water Quality Testing Training Online Theory Component & Field with practical application**

The [MRV Hub/GHGMI] consulting team led sessions within each sector focusing on increasing the national inventory team's capacity to perform tasks related to the inventory process via sensitisation on climate change information and strengthening applied knowledge of IPCC Guidelines, methodological choice, use of data collection templates, quality assurance and quality control. In addition, it demonstrated the use of expert judgement approaches in cases of limited data availability and accuracy, such as in analysis and ultimate annotation of subcategory 2. F Product Uses as Substitutes for Ozone Depleting Substances and subcategory 3.C.2 Liming as not estimated (NE).

Data gaps were identified during the second national communication (SNC) in the Forestry and Other and Use (FOLU) sector. Improvements have been highlighted and key stakeholders identified and engaged in GIS training to improve data sources and estimate emissions for the third national communication (TNC). Throughout the inventory and reporting process, the consultant team conducted simultaneous training and land site visits with national experts to demonstrate effective plot sampling, tree measurement, and data validation. This model improved estimates and provided opportunities for validation of field surveys and measurements using the most recent NASA Landsat images integrated into the Collect Earth software, thereby moving St. Kitts and Nevis closer to country-specific emission factors.

Information and networking

This section provides information on national, regional, and international measures taken to promote the exchange of climate change-relevant information among stakeholders, establishes and strengthens pathways and networks in the region, and facilitates exchange.

St George's Declaration of Principles for Environmental Sustainability in the Organisation of Eastern Caribbean States (OECS) – St. Kitts and Nevis is a signatory to the St George's Declaration of Principles for Environmental Sustainability in the Organisation of Eastern Caribbean States (OECS), an environmental policy framework that aims to respond to the rapidly evolving global policy environment to better reflect the context and priorities of the small island states within the OECS.

The Caribbean Cooperative MRV Hub – St. Kitts and Nevis has been a country member of the Caribbean Cooperative MRV Hub since its start in 2019. The Hub is a sustainable and country-driven partnership enabling Caribbean countries to cooperate on technical challenges underlying climate change mitigation.[49] Its overall objective is to foster regional technical

[49] The 12 countries currently participating in the CCMRVH include: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent & the Grenadines,

excellence and generate strong policy-relevant accounting outputs such as GHG inventories, mitigation assessments, tracking NDCs, and other MRV activities that support the implementation of the Paris Agreement and domestic policy implementation. The MRV Hub has supported St. Kitts and Nevis in various areas of country-specific work on mitigation assessments and modelling, GHG inventory, and MRV and support need assessments, each coupled with national expert capacity building and transfer of expertise.

Eastern Caribbean Solar Challenge (an initiative of the **NDC Finance Initiative, managed by the OECS and government of Saint Lucia**) – St. Kitts and Nevis supports the Solar Challenge Initiative launched in 2021 supporting decarbonisation of the regional energy and transport sectors linked to the implementation of St. Kitts and Nevis 2021 NDC update.

Caribbean Community Climate Change Centre (CCCCC) – Through its "Enhancing Climate Resilience in CARIFORUM Countries" project, aims to build resilience to water utilities in Small Island Development States (SIDS) in the CARIFORUM Region, as well as through its other regional support services such as the climate change repository tool CCORAL.

Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) – St. Kitts and Nevis engages the regional services of CCREEE to support its renewable energy mix pathway, including exploring possibilities of geothermal energy with the St. Kitts Electricity Company (SKELEC).

Cooperation for Adaptation and Resilience to Climate Change in the Caribbean Project (led by **Mexico, CARICOM and the Food and Agriculture Organization (FAO) –** This joint initiative aims to address the water-energy nexus in the agriculture sector to improve water resource efficiency for increased agricultural productivity. Technology options include (micro-) solar-powered irrigation systems to increase agricultural water productivity through climate-smart energy.

Protecting and Restoring the Ocean's natural Capital, Building Resilience and supporting region-wide Investments for sustainable Blue socio-Economic development (PROCARIBE +) – (led by UNDP/GEF -CLME+) – St. Kitts and Nevis participates in a region-wide multi-stakeholder cooperation, coordination, collaboration and communication for the protection, restoration and sustainable use of marine and coastal ecosystems in the Caribbean and North Brazil Shelf Large Marine Ecosystems (utilising ecosystems-based managed approach)

Port State Measures Agreement (PSMA) Implementation Support – FAO PSMA global capacity development programme - The impact of the project is: "Sustainability of marine fisheries improved by preventing, deterring and eliminating illegal, unreported, and

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and Trinidad and Tobago.

unregulated (IUU) fishing." Ports and landing sites in Saint Kitts and Nevis were assessed, and a strategy and action plan to effectively implement the PSMA was completed.

Improving National Sargassum Management Capacities in the Caribbean (government of Japan, UNDP for Barbados and East Caribbean – St. Kitts and Nevis is one of five OECS countries participating in a capacity-building exchange for the removal and disposal of sargassum including use of equipment as well as expertise, and technical knowledge to collect, remove and transport sargassum seaweed.

Strengthening the Foundation for a Climate Responsive Agricultural Sector in the Caribbean (GCF CARICOM AgREADY, implemented by Inter-American Institute for Cooperation on Agriculture (IICA) – This project targets nine countries in the CARICOM sub-region (The Bahamas, Belize, Dominica, Haiti, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago) aiming to improve the enabling conditions to design, implement and evaluate options for enhanced climate action in the agricultural sector by strengthening policies, capacities, frameworks, methods and institutional arrangements for the collection, monitoring, measuring, reporting, verifying (MRV) and analysing agricultural and associated activity data from the sector. St. Kitts and Nevis participated in this first phase of the project and received capacity for its agricultural extension officers and farmers in the areas of GHG emissions in the agriculture sector, as well as participating in wider climate-smart agriculture discourse.

6. Finance, Technology and Capacity-Building Needs and Support Received

Constraints, gaps, and prioritised needs

St. Kitts and Nevis, in its previous submissions to the UNFCCC (NC1, NC2, and NDC) has identified data gaps, institutional barriers and transparency issues that have impeded its attempts to adhere to the transparency, accuracy, completeness, comparability and consistency (TACCC) principles (guiding principles for preparing and reporting inventories) during previous reporting cycles.

The newly enhanced reporting requirements under the Enhanced Transparency Framework (ETF) and its associated modalities, procedures, and guidelines (MPGs) along with the need to improve the overall national reporting cycle (inventory, NDC, adaptation and support) has guided St. Kitts and Nevis to identify the following during the BUR1 reporting process:

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

Table 6.1 and Table 6.2 summarise the observed constraints, gaps, and priorities identified by the relevant compilation teams. These are further validated by in-country stakeholders and identified as prioritised needs.

Table 6.1. Constraints and gaps by reporting type

GHG Inventory - Constraints and Gaps Observed during TNC/BUR1 Process	
Lack of adequate data	Availability of data with the requisite quality from national sources and stakeholders for key emitting sectors was the main challenge for estimating emissions and removals for this inventory cycle. Data issues by sector are identified in the areas of improvement Section 2.5 in the GHGI chapter.
Limited coordination for GHG inventory cycle	As with most countries in the Caribbean region, St. Kitts and Nevis has been heavily reliant on international consultants for its previous inventory cycles. For the TNC/BUR1, the project team selected a blend of local, regional, and international consultants. Though institutional arrangements and legal arrangements for coordinating timely GHG inventory reports was noted as a limiting factor in this reporting cycle. It should be noted that efforts have been made to identify the roles/responsibilities of the envisaged coordinating entity, data providers and sector experts, with the aim of institutionalising the process for the next reporting cycle.
Capacity constraints in	Familiarity with the IPCC guidelines and lack of sectoral technical

applying GHG inventory methodologies	capacity was noted as a major constraint and affected the overall flow of information with regards to data collection, quality control checks and choice of methodology. Initial capacity building activities were embedded within the project with identified data providers and GHGI compilers participating in multiple workshops.
Limited understanding of all GHG emitting activities in the country (completeness)	A clear understanding of all emitting categories was difficult to determine during the data collection process leading to some categories not being estimated. Example, 2F Product Uses as substitutes for ozone depleting substances and 3C2 Liming. As capacity increases in understanding all emitting categories to be reported as well as the required activity data and input parameters needed for GHGI calculations, completeness of reporting is expected to improve.
Lack of archiving from previous reporting cycles	Most data, methods, and calculations from the two previous GHG inventories were not successfully documented and archived. Excel sheets provided from the previous inventory cycle was minimal with accompanying activity data and background information not provided. New efforts were required to source historical data for the time series to allow for revision/recalculation of previous estimates.
Mitigation - Constraints and Gaps Observed during TNC/BUR1 Process	
Lack of adequate data	Availability of quality data was identified as one of the main challenges throughout the development of the model. The following were identified as the main constraints/gaps with regards to data: • Population growth projections by island • Long-term GDP forecasts by island and by major sectors • No building use data for fuels and electricity • Lack of data on HFCs imported • No comprehensive data on vehicle fuel efficiency • Adequate costing information for mitigation actions not available • Inadequate data to allow cost analysis for mitigation measures • Data limitations in energy and end-use sectors • Comprehensive data on energy end-use such as lighting, water heating, air conditioning was not available, and many assumptions were made in the analysis
Limited technical and human capacity of stakeholders	The mitigation sector was identified as a major challenge. The following was noted: • Limited human resource capacity to adequately undertake and understand mitigation assessments • Need of education on the technology installation completion timeframes
Intra-ministerial coordination and communication	Although the mitigation actions in the NDC are clearly identified under separate sectors, the governance and responsibility for some of these actions were not always clearly defined across ministries

	and departments. It is important to empower coordination through an established National Climate Change Committee for St. Kitts and Nevis. This committee should consist of relevant persons from identified ministries to address and minimise this challenge.
High Capital Costs	Renewable Energy Initiatives normally require high capital costs. Although St. Kitts and Nevis is considered a high-income country, the unique challenges of SIDS need to be taken into consideration. Therefore, it is essential that access to climate finance grants and low-interest loans be made available to SIDS to help reduce the costs of implementation.
Technology Suitability/Availability	St. Kitts and Nevis has identified geothermal development on the island of St. Kitts and the island of Nevis. The development of this technology is in its advanced stage in Nevis but in its infancy in St. Kitts. Therefore, it is essential that St. Kitts verify the availability of the resource as well as to ensure that capacity building activities are suitable and sustainable.
Data transparency issues	Lack of development and implementation of legislation and agreements to facilitate data collection and sharing among institutions.
Energy Balances by island and subsector	Though the energy balances developed by the CCMRVH team during the TNC/BUR1 project and previous estimates from OLADE (2010-2012) assisted with mitigation analysis, there is no system to continuously update these energy balances. Additionally, balances were not disaggregated by island.
Land Availability	St. Kitts and Nevis has limited surface area. Therefore, there is a need to balance the enhancement and protection of the LULUCF sector as well as increase the renewable energy penetration. Land-use zoning will be of critical importance.
Political Will	Implementing mitigation actions requires broad political support and effective planning to maximise opportunities. Therefore, it is essential that sensitisation and education of high-level decision-makers to the climate change needs are sustained.
Adaptation - Constraints and Gaps Observed during TNC/BUR1 Process	
Mandates and Agendas	No specific policy or legislative provisions with relevant sustainable development goals (SDG) inclusive of SDG 13 on climate action. SDG 13 goals include: • Integration of climate change measures into national policies, strategies, and planning • Education and awareness raising on climate change mitigation, adaptation, impact reduction and early warning • Human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning • Strengthening of resilience and adaptative capacity to climate related hazards and natural disasters
Legislation	No unifying legislation specifically regulating climate action but

	does have several legislative mechanisms that can be effectively used for this purpose (see section 4.1.2- legislation-adaptation chapter). Gaps include stronger dedicated mechanisms for mandating actions to address climate change such as: • Integrated water resources management (IWRM) • Integrated coastal zone management (ICZM) • Extractive industries (mines and quarries) and forestry • Environmental and public health
Institutional and Human Resource Capacity	• Lack of sector specific action planning using National Adaptation Strategy as guidance • Understanding and/or lack of staff to serve as dedicated CCA focal points • Lack of resources to generate data to support decision making and planning
Information, Technology and Data Systems	• Lack of Nevis data needed to characterise adaptive capacity • Lack of data sharing mechanism amongst sectors (Example, health, water, and tourism) • No early warning system for the health sector
Funding	Lack of funding to implement recommendations of the St. Kitts and Nevis National Climate Change Adaptation Strategy.
MRV Assessment - Constraints and Gaps Observed during TNC/BUR1 Process	
Intra-organisational coordination and communication	Lack of coordination across ministries, local government, private sector, and other stakeholders who participate in climate change actions across all sectors.
Need for greater public awareness	Climate change initiatives through planned education and awareness campaigns from primary education to broader public awareness campaigns to increase general public buy-in.
Limited staff at envisaged Coordinating Entity	Particularly full-time staff to keep up with the demands of new national commitments for enhancing national climate MRV systems, and other related permanent functions such as participation in National GHGI preparation, tracking of implementation and progress of NDC goals, adaptation actions and climate support tracking.
Limited sectoral technical capacity (data collection and calculations)	Due to limited institutionalised technical capacity, some entities/stakeholders responsible for data collection are also responsible as the sectoral expert for compilation of the GHGI. Balancing previous responsibilities in addition to these new action tasks was identified as a limitation to the sustainability of the proposed national MRV system.
Lack of adequate funding	To implement climate goals and monitor execution in the medium to long term.
Limited legislation or compliance mechanisms	To mandate the execution and continuity of climate related activities that are internationally binding (reporting under the Paris Agreement, Montreal Protocol, etc.) inclusive of mandatory data

	collection/reporting by stakeholders.
Stakeholder hesitation	In providing information whilst mapping data flows and communication channels across climate reporting pillars (mitigation and adaptation) was a limiting factor in the drafting of new institutional arrangements for the proposed St. Kitts and Nevis National MRV System.
Difficulty in collecting data and reporting	Across all sectors, as data is not currently collected for the purpose of climate change reporting. During the TNC/BUR1 process, initial sensitisation of necessary datasets was conducted with data collectors and stakeholders involved in the process.

Table 6.2. Identified prioritised needs by reporting type

GHG Inventory - Prioritised Needs Identified during TNC/BUR1 reporting process	
Institutional Arrangements and GHG Inventory Cycle	• Set up appropriate institutional, procedural, legal arrangements, and documentation for recurring preparation of the national GHG inventory. • Appoint a national GHG inventory compilation team. • Fully establish and implement QA/QC procedures for the national GHG inventory. • Fully establish data collection and archiving procedures for the national GHG inventory.
Energy sector	• Extract air control data for a specific year to get the number of domestic flights and aircraft types between SKB-NEV (arrivals and departures). • Collect data on passengers on domestic route (SKB-NEV) from departure fees from St. Kitts Sea and Port Authority • Collect activity data related to domestic navigation.
IPPU sector	Estimation of the amount of stationary air conditioning in place in households using the bottom-up approach by conducting surveys. Direct questionnaires should be used for bigger commercial facilities and the hospitality sector. Approach should be calibrated using top-down information on the import of F-gases and AC appliances.
Agriculture sector	Data from FAOSTAT was used during the TNC/BUR1 inventory cycle as country specific information was unavailable. • Investigate differences between FAOSTAT dataset and those initial datasets collected by in-country team. • Collect livestock estimates for Nevis to be integrated with estimates from St. Kitts.
FOLU sector	• Conduct field surveys and measurements in the FOLU sector to develop country specific emission factors to help improve accuracy of GHG emissions.

	• Generate emission factors for forest, grasslands, and wetlands with woody vegetation as a priority. • Conduct training of Forestry staff who have ground knowledge of the country as well as some GIS expertise to embed capacity in the St. Kitts and Nevis team for future reporting requirements.
Waste sector	• Conduct survey and/or study on the degree of utilisation of the identified wastewater treatment systems by IPCC urbanisation characteristics. • Validate previous waste tonnage estimates at solid waste disposal sites and compare against current IPCC (2006 and 2019 refinement) default values used of waste per capita. Collect information on the wastewater treatment system used by brewery to update estimates of the relevant emission factors using Bo and MCF.
Mitigation - Prioritised Needs identified during TNC/BUR1 reporting process	
Data Collection	• More disaggregation of the building sector in Nevis and the level of use of appliances St. Kitts and Nevis would allow for more detailed modelling. This would create a more transparent assessment of mitigation actions. • Improvement in the data collection for the HFCs in the IPPU sector through the ratification of the Kigali Amendment of the Montreal Protocol and introduction on licensing systems for HFCs and natural refrigerants. • Improvement in the macroeconomic data per island. Although both St. Kitts and Nevis have distinguished data in most areas, their economic data is not disaggregated and therefore it is difficult to model as separate islands. • Improvement in the collection of transport data. Further disaggregation of data for the transport sector will allow for a more comprehensive model of the aforementioned subsector. • Develop and track identified performance indicators to monitor the progress and implementation of mitigation actions.
Modelling Prioritised needs	• The LEAP model can be a useful tool for monitoring the implementation of projects. Therefore, further examination of the model needs to be conducted. • Once the necessary data is acquired, modelling of the two islands can occur separately with the inclusion of a scenario with interconnection. • More comprehensive modelling for the transport subsector, once data can be obtained. • Bottom-up modelling for the energy demand subsector is required to improve the ease of updating the modelling.
Capacity Building	• Continued development of a mitigation team to continuously update the mitigation assessment. • Adequately skilled persons identified to monitor the implementation projects and update the LEAP model. • Continued development of persons skilled in IPCC guidelines and inventory.

	• Development of data collection team for mitigation assessment. • Assessment of data transparency issues and development of agreements to facilitate data sharing among institutions, for example, by anonymising data (e.g., sharing semi-aggregate information by power plant type instead of by individual facilities so that interests of private companies are protected while also contributing to the public knowledge).
Adaptation - Prioritised Needs identified during TNC/BUR1 reporting process	
As highlighted in the adaptation chapter, the consultant team prepared a list of prioritised improvements for consideration by the St. Kitts and Nevis project team as well as all identified stakeholders involved in the sector. Through a workshop, participants were asked to prioritise identified actions by applying Multi-Criteria Analysis (MCA) to evaluate the merits of the recommended adaptation options (see Table 4.10 - Table 4.15*). Based on the scoring rubric, identified actions rated 4 out of 5 or higher have been included as prioritised needs below:*	
Planning and Infrastructure	• Improvements to knowledge base and capacity to support evidence-based planning and implementation. At a minimum there is a need for GIS-based modelling to determine coastal areas most at risk to inundation given current elevations and projected SLR rates at a high resolution. • Audit of public infrastructure to determine integrity given higher and more prevalent temperature conditions.
Human Health	• Implementation of a public awareness programme aimed at measures to encourage storage of rainwater to prevent incubation of vectors. • Encouragement of those with household gardens to augment food supply and use rainwater harvesting technique to augment water supply (resilience to water and food insecurity). • Consideration of ecosystem-based adaptation (EbA) adaptation to heat impacts for larger urban areas like Basseterre, Fig Tree, Market Shop, Saint Paul’s, and Middle Island. These should include consideration of urban forests, increased green spaces and green roofs.
Agriculture	• Creation of a model greenhouse to demonstrate hurricane resilience using sustainable energy and waste recycling technologies options built in. Incentives for adoption by small-farmers and entrepreneurs can include availability of design templates, possible incubator agricultural sub-divisions (with centralised water, clean energy, and waste management) as well as access to capital. Higher yielding food crops can be grown in greenhouses. • Research and development is needed to support diversification away from traditionally grown but at-risk crops. A food security strategy should take into account domestic consumer needs (including the restaurant and tourism sectors, as well as green markets etc) and the needs for export-oriented producers (e.g., sweet potatoes, peppers, peanuts, sea island cotton and coconuts etc). This should also include consideration of small-

	scale fisheries' current and potential contribution to food security.
Water Resources	Public awareness campaign for increased water conservation based on the predicted climate risk to the freshwater supplies is needed – possibly targeting tourism, health, agriculture, and urban areas. This can also be accompanied by integrating conservation technologies for water into building codes.
Coastal and Marine ecosystem	• The GIS modelling will also generate information on the development of new shallow marine areas that can be evaluated for creation of mangroves and other coastal ecosystems that offer some level of coastal protection or other ecosystem services like fish nurseries. Additionally, some of these areas may be feasible locations for small-scale sustainable mariculture development. • Seasonal and post-storm (recovery) monitoring of priority beaches: recreational, fish landing, and turtle-nesting. • Careful evaluation of the likely impacts of sea level rise on the coastal salt ponds and assessment of whether these can be used for sectoral adaptation purposes.
Community-Based Adaptation	• Need to catalyse development of community-based organisations (CBOs) in St. Kitts and Nevis. This may build on work done by NEMA in communities, social welfare or other NGOs or youth groups. Grass-roots CBOs can promote awareness and implementation of key climate actions that result in growing resilience and adaptive capacity of communities. This can be in connection with co-management or stewardship initiatives involving EbA to reduce non-climate stressors, as well as water and energy conservation. • More research is needed to determine how the measures currently or historically used by communities in St. Kitts and Nevis aided in recovery from extreme natural hazards, and whether this can be adapted to the expected new climate "normal". • Development of alternative livelihoods (and training) and cooperatives to increase adaptive capacity for climate-impacted occupations and sectors such as rain-fed small-farming. These measures should consider the vulnerability and needs of female-headed low-income households. • The use of early warning systems, digital technologies and citizen science may be challenging where communities and households lack access to mobile phones or internet. However, it is likely that most individuals do have access to the aforementioned. To offset the challenges in rural communities or low-income households, priority should be placed on ensuring that there are public access points (like schools, libraries and internet cafes) for community members to access early warning systems and other climate-related information services. This aids in more adequate preparation and recovery from weather-related impacts and predicted longer term climate change effects or variability.

Improving Readiness	• Address legislative gaps and statutory reform needs for climate change integration into IWRM, ICZM, Mining & Forestry and Public Health. • Explore opportunities for leveraging synergies with other international agendas such as the UN SDGs and the Blue Economy, which is supported by the Caribbean Development Bank, World Bank and the IADB.
MRV Assessment - Prioritised Needs identified during TNC/BUR1 reporting process	
MRV System Planning, Preparation, and Implementation	• Ensure that all relevant government agencies, private stakeholders, and data collectors are involved in the inventory process. • Initiate appropriate legislation to facilitate access to data and data collection. In the interim, efforts should be made to implement Memorandums of Understanding to facilitate data sharing between stakeholders and the GHGI compilation team. • Contact the main industries in the country and open a communication channel for data collection/exchange, considering the confidentiality option. • Establish a process to ensure a common understanding of data needs and a consensus on data to use. • Organise meetings and open communication channels between all stakeholders to ensure a common understanding of the data requirements throughout the inventory process. • Set up a national inventory management system, that includes the procedural arrangements to produce the inventory in a timely manner. • Set up a National GHG Inventory Management System, that includes legal arrangements for inventory planning, preparation, and management. • Establish and implement a sustainable MRV system with appropriate institutional, procedural, and legal arrangements with clear reporting and documentation requirements. • Ensure appropriate administrative capacity within MRV system and with focus on the Department of Customs as one of the main data source providers. • Embed quality control procedures throughout the MRV system and enact a set of QA procedures to assess the accuracy of final GHG inventory estimates. • Establishment of National Climate Change Committee for St. Kitts and Nevis.

6.1.1. Progress towards addressing constraints and gaps

St. Kitts and Nevis has made progress towards addressing constraints and gaps since submission of its second national communication (SNC). Table 6.3. highlights the identified improvements observed during the 3rd national communication (TNC)/BUR1 cycle as it relates to MRV systems, GHG inventory, mitigation, and adaptation.

Table 6.3. Progress made from SNC to TNC

Gaps identified in SNC	Progress identified during TNC/BUR1
Availability and Suitability of Technology	Conducting country driven Technology Needs Assessment (TNA) in prioritised sectors. At the time of writing, a prioritised list of technologies for adaptation has been identified. The mitigation actions and activities as part of the TNA process has not yet been identified.
Data gaps - energy sector (prioritisation of the transport sector	Identified and engaged key stakeholders in the transportation sector, and identified main data sources for improvement.
Data Gaps - waste sector	Identified and engaged key stakeholders in the solid waste and wastewater sub-categories and identified main data sources for improvement.
GHG emission estimates- waste sector	GHG emission estimates for the waste sector were not estimated in the SNC. The TNC includes estimates for both the current time series (2008 onwards) as well as the time series covered during the SNC. Tier 1 methodology used for estimates.
Data Gaps - FOLU sector	Identified and engaged key stakeholders in the FOLU sector and conducted GIS training to improve data sources and estimate emissions for the TNC.
Establishing a measurement, reporting and verification (MRV) mitigation system for St. Kitts and Nevis	Conducted an MRV Assessment during the TNC/BUR1 reporting cycle and indicated prioritised actions to implement an integrated National MRV System comprising all reporting sectors.
Updating of the information relevant for the reporting of Mitigation actions	Updated mitigation assessment conducted during the TNC cycle inclusive of the use of the LEAP model. Outputs used to guide the St. Kitts and Nevis revised NDC submission as well as identification of potential feasible mitigation actions.
Updating the information relevant for the reporting of Adaptation actions	National Adaptation Strategy drafted with implementation process beginning in 2018. Improved attention to partnerships and institutional coordination by: • Increased capacity building and engagement • Improved information management, research, and monitoring and evaluation • Explicitly considering climate resilience in disaster risk reduction (DRR) and investment and economic planning • Improved intersectoral coordination
Provision of training to build or improve the capacities of the relevant stakeholders to complete all required sections for UNFCCC reporting, taking into consideration the new reporting requirements of the Paris Agreement	Capacity building activities undertaken by local stakeholders in the fields of GHG inventory, Mitigation assessments and LEAP modelling and MRV. Stakeholders were trained not just in the technical elements of the reporting requirements but procedural elements as well to increase institutionalised memory of local stakeholders/experts.

Technology needs

The Technology Needs Assessment (TNA) is a country-driven process that allows Parties to determine their climate technology priorities and supports national sustainable development through a portfolio of environmentally sustainable technology (EST) projects and programmes, whilst building national capacity and tracking their needs for new technologies, skills, and equipment to reduce the vulnerability of sectors and livelihoods attributed to climate change as well as to reduce GHG emissions.

The Global TNA project is funded by the Global Environmental Facility (GEF) and implemented by UNEP in collaboration with UNEP DTU Partnership. In October 2020, the 4th phase of the Global TNA project was initiated including the small island developing state of St. Kitts and Nevis. National mitigation and adaptation consultants were hired in March 2021 with only information on the adaptation sector available at the time of writing.

Technology needs associated with the mitigation sector were identified through action tasks on mitigation policies and assessment conducted during the TNC process. Timeline for the TNA for the adaptation sector is highlighted in Figure 6.1.

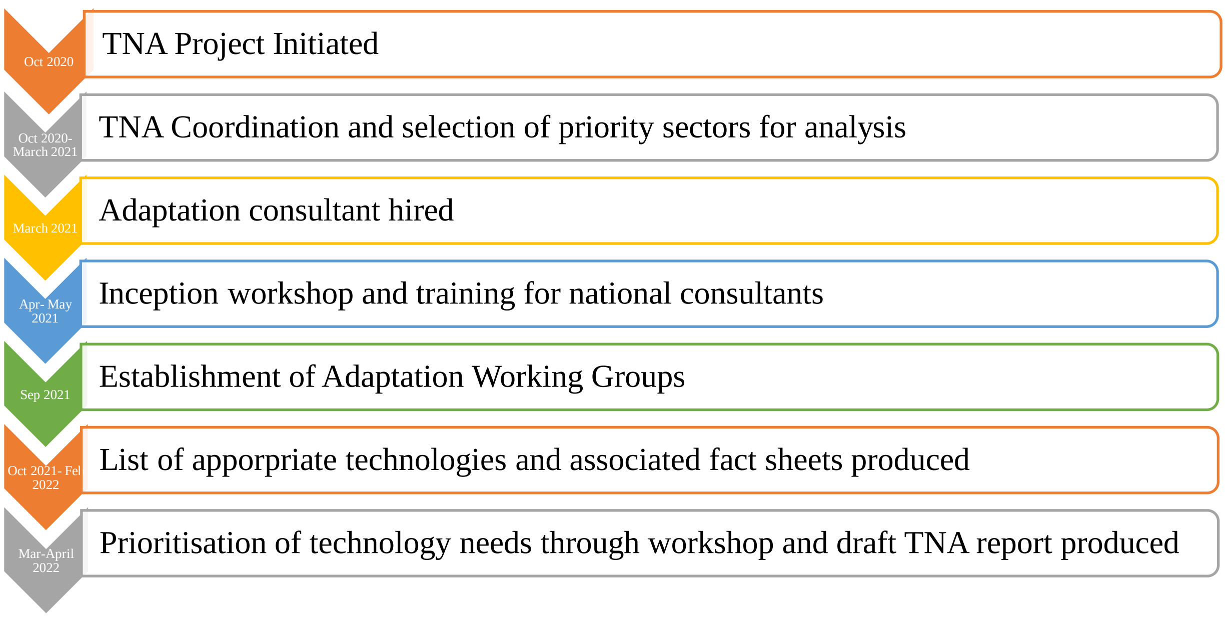
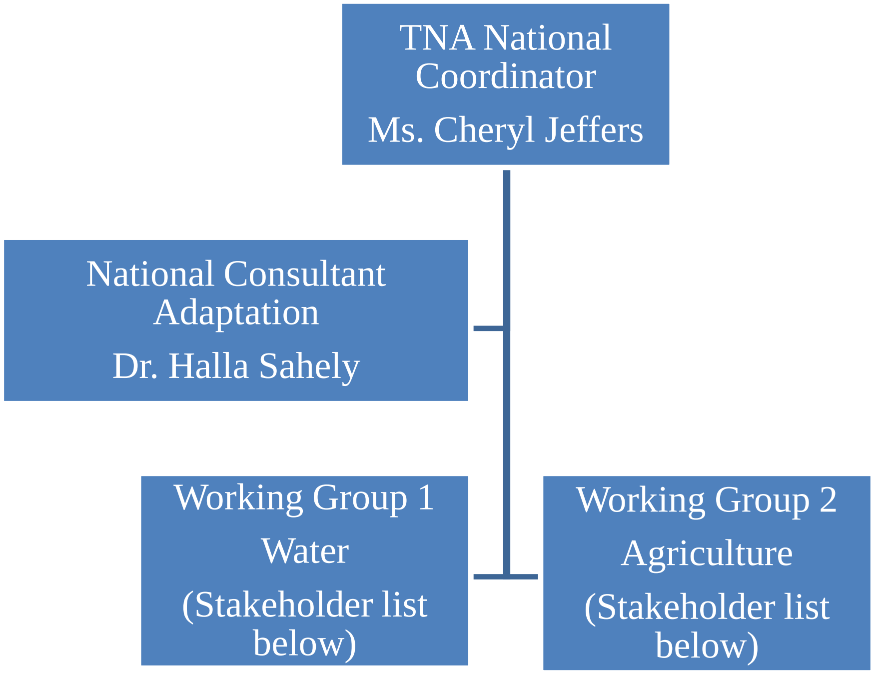


Figure 6.1. Timeline of Technology Needs Assessment (TNA) Project

In St. Kitts and Nevis, priority sectors for the TNA were chosen due to their importance to the overall socioeconomic wellbeing of the Party as well as the need for prompt and effective adaptation actions. The institutional arrangements for the TNA are shown in Figure 6.2. Stakeholders from the private sector, public sector and NGOs were identified in the chosen priority sectors of water and agriculture to participate in working groups to assist in the identification of relevant technologies based on their expertise and knowledge of national circumstance. The working groups, through a series of consultations, assisted in whittling down the list of potential adaptation technologies for each sector that was compiled by the national adaptation TNA consultant based on review/analysis of national policies, strategies, submitted UNFCCC reports and stakeholder consultation.



Stakeholders in Working Group 1 (Water)

Stakeholder	Responsibility
Integrated Water Resources Management Unit, Ministry of Communications, Nevis Island Administration	Responsible for the identification, upkeep, and protection of water supply sources on Nevis.
Water Services Department, Ministry of Public Infrastructure, Utilities, Posts and Urban Development	Maintains control over water production and distribution.
Private sector – Waterworks Solutions Inc.	Provision of services to the water sector including installation of water distribution and storage systems.

Stakeholders in Working Group 2 (Agriculture)

Stakeholder	Responsibility
Nevis Department of Agriculture, Ministry of Agriculture	Provides technical support that is needed to ensure that the citizens and residents of the Federation are food and nutritionally secured through various initiatives and programmes.
Department of Agriculture, Ministry of Agriculture, Fisheries and Marine Resources	Provides technical support that is needed to ensure that the citizens and residents of the Federation are food and nutritionally secured

	through various initiatives and programmes.
Private sector – agriculture consultant	Provision of services to the agricultural sector through consultancy services.
GEF – Small Grants Programme / UNDP GEF-SGP	Provides financial and technical support to community-based projects that conserve and restore the environment while enhancing well-being and livelihoods. Further, the National Coordinator for the GEF-SGP is an Agronomist by profession was able to provide technical support to the process.

Figure 6.2. Institutional Arrangements for TNA Project

6.1.2. Water Sector - Adaptation

An extensive list of technological options was prepared for the water sector with technologies grouped into the following categories:

- Water conservation
- Water quality control
- Improved knowledge of water resources and its demand
- Diversification of water supply
- Stormwater management

Of the 27 possible technologies, 10 were initially identified with 9 identified for consideration (refinement of initial list and removal of one action) based on surveys with the water working group. See Table 6.4 for water sector technologies listed for prioritisation.

Table 6.4. Initial Prioritisation list of Technologies in Water sector (Adapted from TNA)

Technology Category	No	Specific Technology
Water Conservation	1	Leakage detection and repair and pressure management
	2	Non-revenue water and demand management programme and smart-metering
Improved knowledge of water resources and demand	3	Groundwater assessment, mapping, modelling and development
	4	Water safety plans
	5	Real-time data monitoring / GIS / SCADA
	6	Integrated Water Resources Management
	7	Enhanced potable water storage
Diversification of Water Supply	8	Stormwater catchment
	9	Desalination

Multicriteria analysis was completed by the sectoral working group using agreed criterion and weights for the water sector. See below Table 6.5 for agreed criterion and weights for the water sector. Based on the weighted scores, the prioritised list of adaptation technologies for the water sector is St. Kitts and Nevis are:

- Non-revenue water and demand management programme (including smart- metering)
- Leakage detection and repair and pressure management
- Integrated water resources management

Table 6.5. Agreed criterion and weights for the water sector (Adapted from TNA)

Category	Criteria	Description	Weight
Costs	Capital	Costs of set-up of the technology generally incurred during start-up phase.	10
	Operational and Maintenance	Costs of the technology over time, which encompasses the operational costs as well as the maintenance of the technology.	10
Economic Benefits	Improve economic performance	Technologies should aim to improve economic performance in the water sector including aspects of increasing productivity as well as generating interest and demand in the market for its output.	20
Social Benefits	Build technical capacity	This criterion assesses the effect of technologies in building the technical capacity of target beneficiaries.	10
	Improve health	This criterion is associated with health improvements to the population that is affected by the technology improvements. Such technology should ideally reduce morbidity and mortality rates resulting from climate change.	10
Environmental Benefits	Protect environmental (water) resources	Water quality, quantity and integrity needs to remain intact, and at best improved following the introduction of the technology.	15
Climate-related Benefits	Reduces vulnerability to climate change impacts	Adaptation to climate change works towards reducing the vulnerability of populations facing climate change and building their resilience to cope with the impacts.	15
Technology-related Benefits	Ease of implementation / Replicability / Appropriateness	The technology should be easy to implement and replicate and be appropriate to conditions on the ground.	10

6.1.3. Agriculture Sector - Adaptation

Review of the St. Kitts and Nevis adaptation chapter for the TNC provided a summary of existing technologies in the aforementioned sector. Based on these current identified technologies and the proposed list of actions identified in the NDC, an extensive list of technology options was prepared and grouped into the following categories:

- Crop management
- Livestock management

- Sustainable farming systems
- Sustainable water use/management
- Sustainable waste management
- Planning for climate change and variability
- Soil conservation and management
- Capacity building and stakeholder organisation
- Post-harvest/processing/distribution

Of the 34 possible technologies, a short list of 10 were identified for potential prioritisation. See Table 6.6 for agriculture sector technologies listed for prioritisation.

Table 6.6. Initial Prioritisation list of Technologies in agriculture sector (Adapted from TNA)

Technology Category	No	Specific Technology
Crop management	1	Integrated Pest Management
	2	Crop diversification and new varieties
	3	Plant tissue culture
Livestock management	4	Livestock disease management including selective livestock breeding
	5	Livestock feed production
Sustainable farming systems	6	Agrosilviculture
	7	Soilless agriculture / aquaponics / hydroponics
Soil conservation and management	8	Soil moisture conservation monitoring and techniques
	9	Integrated soil nutrient management
Post-harvest / processing / distribution	10	Food storage, preservation, and processing

Multicriteria analysis was completed by the sectoral working group using agreed criterion and weights for the agriculture sector. See below Table 6.7 for agreed criterion and weights for the agriculture sector. Based on the weighted scores, the prioritised list of adaptation technologies for the agriculture sector in St. Kitts and Nevis are:

- Integrated pest management
- Soil moisture conservation monitoring and techniques
- Agrosilviculture

Table 6.7. Agreed criterion and weights for the agriculture sector (Adapted from TNA)

Category	Criteria	Description	Weight
Costs	Capital	Costs of set-up of the technology generally incurred during start-up phase.	10
	Operational and Maintenance	Costs of the technology over time, which encompasses the operational costs as well as the maintenance of the technology.	10
Economic Benefits	Improve economic	Technologies should aim to improve economic performance in the agriculture sector including aspects	20

	performance	of increasing crop and livestock productivity as well as generating interest and demand in the market for its output.	
Social Benefits	Build technical capacity	This criterion assesses the effect of technologies in building the technical capacity of target beneficiaries.	10
	Improve health	This criterion is associated with health improvements to the population that is affected by the technology improvements. Such technology should ideally reduce morbidity and mortality rates resulting from climate change.	10
Environmental Benefits	Support to ecosystems services	This criterion assesses how the given technology contributes to supporting ecosystem services - broadly categorised into provisioning, regulating, supporting and cultural services. Provisioning services relate to the production of food and water. Regulating services relate to regulation of climate and disease/pest control. Supporting services relate to nutrient cycles, seed dispersal, and pollination, where cultural ecosystem services relate to the spiritual and recreational benefits.	15
Climate-related Benefits	Reduces vulnerability to climate change impacts	Adaptation to climate change works towards reducing the vulnerability of populations facing climate change and building their resilience to cope with the impacts.	15
Technology-related Benefits	Ease of implementation / Replicability / Appropriateness	The technology should be easy to implement and replicate and be appropriate to conditions on the ground.	10

6.1.4. Identified Mitigation Technology Needs

The following list of technology needs were identified through the mitigation assessment conducted in St. Kitts and Nevis during the TNC reporting cycle in consultation with relevant stakeholders:

- Solar water heaters installation
- Technology to undertake assessment of electric and hybrid vehicles integration
- Technology to undertake assessment of charging infrastructure for electric vehicles into the transmission and distribution grid and its impacts
- Technology to undertake geothermal assessments for St. Kitts
- Technology to assess and implement grid-interconnection between the two islands
- Monitoring systems for electric and hybrid vehicles
- Technology to assess for vehicle efficiency
- Wind technology assessments
- Data collection and monitoring systems

- Energy efficient equipment
- Knowledge exchange for electricity legislation
- Technology to assess the impact of improve public transit
- Technology to assess the possibilities of enabling conditions for EV uptake
- Technology to improve public awareness programmes
- Technology to assess building usage data

At the time of writing, no prioritisation of mitigation needs was conducted. The government of St. Kitts and Nevis intends to compare the list identified above with the output of the TNA mitigation project to ensure that all potential technologies identified are prioritised by need and feasibility.

Support needed

An assessment and quantification of support needed has not yet been conducted for the prioritised needs identified during the TNC/BUR1 reporting cycle for St. Kitts and Nevis. Across all areas of climate MRV in St. Kitts and Nevis: technology transfer, capacity-building, and financial support is needed as soon as possible. Prioritised needs for GHGI, Mitigation, Adaptation and MRV that require support are identified in Table 6.2.

Support received

6.1.5. Support received for the preparation of BUR1

St. Kitts and Nevis received multilateral financial support from the GEF in the amount of 852,0000 (USD) to develop its first BUR (352,000 USD) and its Third National Communication (500,000 USD). The funding was administered through the Global Environment Facility (GEF) with the United Nations Environment Programme (UNEP) having the responsibility as the Implementing Agency, and the Department of Environment in the Ministry of The Environment and Cooperatives serving on behalf of the government of St. Kitts and Nevis, as the Executing Agency. The funding was used to contract the Caribbean Cooperative MRV Hub, Stockholm Environment Institute (SEI), ESSA Technologies Limited, Island Planning Services, Greenhouse Gas Management Institute and RELATE Consultancy.

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8. Annex

GHG emission tables

Summary Table

Table 8.1. IPCC Short Summary Table (2018)

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**Other halogenated gases with CO_2eq conversion factors (3)**	**Other halogenated gases without CO_2eq conversion factors (4)**	**NOx**	**CO**	**NMVOCs**	**SO_2**
Total national emissions and removals	292,29	2,30	0,03	NE	NE	NE	NE	NO	NE,NO	NE, NO	NE,NO	NE,NO
1 - energy	292,26	0,02	0,01	NA	NA	NA	NA	NA	NE,NO	NE, NO	NE,NO	NE,NO
1.A - fuel combustion activities	292,25	0,02	0,01						NE	NE	NE	NE
1.B - fugitive emissions from fuels	0,00	NO	NO						NE	NE	NE	NE
1.C - carbon dioxide transport and storage	NO								NO	NO	NO	NO
2 - industrial processes and product use	0,00	0,00	0,00	NE, NO	NE, NO	NE, NO	NE,NO	NO	NE,NO	NE, NO	NE,NO	NE,NO
2.A - mineral industry	NO								NO	NO	NO	NO
2.B - chemical	NO	NO	NO	NA	NA	NA	NA	NO	NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
Industry												
2.C - metal industry	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D - non-energy products from fuels and solvent use	NE	NA	NA						NE	NE	NE	NE
2.E - electronics industry				NO	NO	NO	NO	NO	0,00	0,00	0,00	0,00
2.F - product uses as substitutes for ozone depleting substances				NE	NE			NO	0,00	0,00	0,00	0,00
2.G - other product manufacture and use	NA	NA	NE	NO	NO	NE	NO	NO	NE	NE	NE	NE
2.H - other	NO	NO	NO						NO	NO	NO	NO
3 - agriculture, forestry, and other land use	0,01	0,21	0,01	NA	NA	NA	NA	NA	NE,NO	NE, NO	NE,NO	NE,NO
3.A - livestock		0,21	0,00						NE	NE	NE	NE
3.B - land	0,00		0,00						0,00	0,00	0,00	0,00
3.C - aggregate sources and non-CO2 emissions sources on land	0,01	0,00	0,01						0,00	0,00	0,00	0,00
3.D - other	NE	NA	NA						NO;NE	NO; NE	NO;NE	NO;NE

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
4 - waste	0,03	2,08	0,00	NA	NA	NA	NA	NA	NE,NO	NE, NO	NE,NO	NE,NO
4.A - solid waste disposal		1,64							NE	NE	NE	
4.B - biological treatment of solid waste		0,00	0,00						NO	NO	NO	
4.C - incineration and open burning of waste	0,03	0,00	0,00						NE	NE	NE	NE
4.D - wastewater treatment and discharge		0,44	0,00						NE	NE	NE	
4.E - other (please specify)	NO	NO	NO						NO	NO	NO	NO
5 - Other	NO	NO	NE, NO	NO	NO	NO	NO	NO	NE,NO	NE, NO	NE,NO	NE,NO
5.A - indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3			NE						NE	NE	NE	NE
5.B - other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
Memo Items (5)												
international bunkers	NE,IE	NE, IE	NE,IE	NA	NA	NA	NA	NA	NE,NE	NE, NE	NE,NE	NE,NE
1.A.3.a.i - international aviation (international bunkers)	NE	NE	NE						NE	NE	NE	NE
1.A.3.d.i - international water-borne navigation (international bunkers)	NO,IE	NO, IE	NO,IE						NE	NE	NE	NE
1.A.5.c - multilateral operations	NO	NO	NO						NO	NO	NO	NO

Table 8.2. IPCC Summary Table (2018)

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	**Net CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**Other halogenated gases with CO_2eq conversion factors (3)**	**Other halogenated gases without CO_2eq conversion factors (4)**	**NOx**	**CO**	**NMVOCs**	**SO_2**
Total national emissions and removals	292,29	2,30	0,03	NE	NE	NE	NE	NO	NE	NE	NE	NE
1 - energy	292,26	0,02	0,01	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.A - fuel combustion activities	292,25	0,02	0,01	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.A.1 - energy industries	181,15	0,01	0,00						NE	NE	NE	NE
1.A.2 - manufacturing industries and construction	5,900	0,0002	5E-05						NE	NE	NE	NE
1.A.3 - transport	98,17	0,01	0,01						NE	NE	NE	NE
1.A.4 - other sectors	7,04	0,00	0,00						NE	NE	NE	NE
1.A.5 - non-specified	NO	NO	NO						NO	NO	NO	NO
1.B - fugitive emissions from fuels	0,0023	NO	NO	NA	NA	NA	NA	NA	NO	NO	NO	NO
1.B.1 - solid fuels	NO	NO	NA						NO	NO	NO	NO
1.B.2 - oil and natural gas	0,0023	NO	NO						NO	NO	NO	NO
1.B.3 - other emissions from energy production	NO	NO	NO						NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
1.C - carbon dioxide transport and storage	NO	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
1.C.1 - transport of CO2	NO								NO	NO	NO	NO
1.C.2 - injection and storage	NO								NO	NO	NO	NO
1.C.3 - other	NO								NO	NO	NO	NO
2 - industrial processes and product use	NE	NO	NE	NE	NE	NE	NE	NA	0	0	0	0
2.A - mineral industry	NO	NO	NO	NA	NA	NA	NA	NA	NO	NO	NO	NO
2.A.1 - cement production	NO								NO	NO	NO	NO
2.A.2 - lime production	NO								NO	NO	NO	NO
2.A.3 - glass production	NO								NO	NO	NO	NO
2.A.4 - other process uses of carbonates	NO								NO	NO	NO	NO
2.A.5 - other (please specify)	NO	NO	NO						NO	NO	NO	NO
2.B - chemical industry	NO	NO	NO	NA	NA	NA	NA	NO	NO	NO	NO	NO
2.B.1 - ammonia production	NO								NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NO_x	CO	NMVOCs	SO_2
2.B.2 - nitric acid production			NO						NO	NO	NO	NO
2.B.3 - adipic acid production			NO						NO	NO	NO	NO
2.B.4 - caprolactam, glyoxal and glyoxylic acid production			NO						NO	NO	NO	NO
2.B.5 - carbide production	NO	NO							NO	NO	NO	NO
2.B.6 - titanium dioxide production	NO								NO	NO	NO	NO
2.B.7 - soda ash production	NO								NO	NO	NO	NO
2.B.8 - petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
2.B.9 - fluorochemical production				NO	NO	NO	NO	0	NO	NO	NO	NO
2.B.10 - other (Please specify)	NO	NO	NO	0	NO	NO	NO	0	NO	NO	NO	NO
2.C - metal industry	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C.1 - iron and steel production	NO	NO			NO				NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
2.C.2 - ferroalloys production	NO	NO							NO	NO	NO	NO
2.C.3 - aluminum production	NO				NO	NO		0	NO	NO	NO	NO
2.C.4 - magnesium production	NO				NO	NO		0	NO	NO	NO	NO
2.C.5 - lead production	NO								NO	NO	NO	NO
2.C.6 - zinc production	NO								NO	NO	NO	NO
2.C.7 - other (please specify)	NO	NO	NO	NO	NO	NO	NO	0	NO	NO	NO	NO
2.D - non-energy products from fuels and solvent use	NE	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO	NO
2.D.1 - lubricant use	NE								NO	NO	NO	NO
2.D.2 - paraffin wax use	NE								NO	NO	NO	NO
2.D.3 - solvent use									NO	NO	NO	NO
2.D.4 - other (please specify)	NO	NO	NO						NO	NO	NO	NO
2.E - electronics industry	NA	NA	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E.1 - integrated circuit or semiconductor				NO	NO	NO	NO	NO	NO	NO	NO	0
2.E.2 - TFT flat panel					NO	NO	NO	NO	NO	NO	NO	0

Categories	Emissions (kt) Net CO_2	CH_4	N_2O	Emissions CO_2eq (kt) HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Emissions (kt) Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
Display												
2.E.3 - photovoltaics					NO			NO	NO	NO	NO	0
2.E.4 - heat transfer fluid					NO			NO	NO	NO	NO	0
2.E.5 - other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
2.F - product uses as substitutes for ozone depleting substances	NA	NA	NA	NE	NE	NO	NE	0	NO	NO	NO	NO
2.F.1 - refrigeration and air conditioning				NE				NO	NO	NO	NO	0
2.F.2 - foam blowing agents				NE				NO	NO	NO	NO	0
2.F.3 - fire protection				NE	NE			NO	NO	NO	NO	0
2.F.4 - aerosols				NE				NO	NO	NO	NO	0
2.F.5 - solvents				NE	NE			NO	NO	NO	NO	0
2.F.6 - other applications (please specify)				NE	NE			NO	NO	NO	NO	0
2.G - other product manufacture and use	NA	NA	NE	NO	NO	NE	NO	0	0	0	0	0

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
2.G.1 - electrical equipment					NO	NE		NO	NO	NO	NO	NO
2.G.2 - SF6 and PFCs from other product uses					NO	NO		NO	NO	NO	NO	NO
2.G.3 - N2O from product uses			NE						NO	NO	NO	NO
2.G.4 - other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.H - other	NO	0	0	NO	NO	NO	NO	NA	NO	NO	NO	NO
2.H.1 - pulp and paper industry	NO	NO							NO	NO	NO	NO
2.H.2 - food and beverages industry	NO	NO							NO	NO	NO	NO
2.H.3 - other (please specify)	NO	NO	NO						NO	NO	NO	NO
3 - agriculture, forestry, and other land use	-113,09	0,21	0,01	NA	NA	NA	NA	NA	NO	NO	NO	NO
3.A - livestock	NA	0,2072	0,003	NA	NA	NA	NA	NA	NO	NO	NO	NO
3.A.1 - enteric fermentation		0,18							NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
3.A.2 - manure management		0,02	0,00						NO	NO	NO	NO
3.B - land	-113,10	0	0	NA	NA	NA	NA	NA	NO	NO	NO	NO
3.B.1 - forest land	-140,34								NO	NO	NO	NO
3.B.2 - cropland	10,33								NO	NO	NO	NO
3.B.3 - grassland	13,73								NO	NO	NO	NO
3.B.4 - wetlands	0,00		0,00						NO	NO	NO	NO
3.B.5 - settlements	0,75								NO	NO	NO	NO
3.B.6 - other land	2,44								NO	NO	NO	NO
3.C - aggregate sources and non-CO2 emissions sources on land	0,01	0,00	0,01	NA	NA	NA	NA	NA	NO	NO	NO	NO
3.C.1 - emissions from biomass burning		0,00	0,00						NO	NO	NO	NO
3.C.2 - liming	NE								NO	NO	NO	NO
3.C.3 - urea application	0,01								NO	NO	NO	NO
3.C.4 - direct N2O emissions from managed soils			0,01						NO	NO	NO	NO
3.C.5 - indirect N2O			0,00						NO	NO	NO	NO

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
emissions from managed soils												
3.C.6 - indirect N2O emissions from manure management			0,00						NO	NO	NO	NO
3.C.7 - rice cultivation		NO							NO	NO	NO	NO
3.C.8 - other (please specify)		NO	NO						NO	NO	NO	NO
3.D - other	0	0	0	NA	NA	NA	NA	NA	NO	NO	NO	NO
3.D.1 - harvested wood products	NE								NO	NO	NO	NO
3.D.2 - other (please specify)	NO	NO	NO						NO	NO	NO	NO
4 - waste	0,03	2,08	0,00	NA	NA	NA	NA	NA	NE	NE	NE	NE
4.A - solid waste disposal	0,00	1,64		NA	NA	NA	NA	NA	NE	NE	NE	NA
4.B - biological treatment of solid waste		0,00	0,00	NA	NA	NA	NA	NA	NA	NA	NA	NA
4.C - incineration and open burning of waste	0,00	0,00	0,00	NA	NA	NA	NA	NA	NE	NE	NE	NE
4.D - wastewater treatment and discharge		0,44	0,00	NA	NA	NA	NA	NA	NA	NA	NA	NA

	Emissions (kt)			Emissions CO_2eq (kt)				Emissions (kt)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (3)	Other halogenated gases without CO_2eq conversion factors (4)	NOx	CO	NMVOCs	SO_2
4.E - other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 - other	NE	NE	NE	NA	NA	NA	NA	NA	NO	NO	NO	NO
5.A - indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE	NE	NE	NA	NA	NA	NA	NA	NO	NO	NO	NO
5.B - other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
memo items (5)												
international bunkers	NE,IE	NE,IE	NE,IE	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.A.3.a.i - international aviation (international bunkers)	NE	NE	NE						NE	NE	NE	NE
1.A.3.d.i - international water-borne navigation (international bunkers)	NO,IE	NO,IE	NO,IE						NE	NE	NE	NE
1.A.5.c - multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NE

Energy Sector

Table 8.3. IPCC sectoral Table - Energy (2018)

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
1 - energy	292,26	0,02	0,01	NE	NE	NE	NE
1.A - fuel combustion activities	292,25	0,02	0,01	NE	NE	NE	NE
1.A.1 - energy industries	181,15	0,01	0,00	NE	NE	NE	NE
1.A.1.a - main activity electricity and heat production	181,15	0,01	0,00	NE	NE	NE	NE
1.A.1.a.i - electricity generation	181,15	0,01	0,00	NE	NE	NE	NE
1.A.1.a.ii - combined heat and power generation (CHP)	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.iii - heat plants	NO	NO	NO	NO	NO	NO	NO
1.A.1.b - petroleum refining	NO	NO	NO	NO	NO	NO	NO
1.A.1.c - manufacture of solid fuels and other energy industries	NE	NE	NE	NE	NE	NE	NE
1.A.1.c.i - manufacture of solid fuels	NE	NE	NE	NE	NE	NE	NE
1.A.1.c.ii - other energy industries	NO	NO	NO	NO	NO	NO	NO
1.A.2 - manufacturing industries and construction	5,900399	0,000239	4,78E-05	NE	NE	NE	NE
1.A.2.a - iron and steel	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.b - non-ferrous metals	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.c - chemicals	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.d - pulp, paper, and print	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.e - food processing, beverages, and tobacco	0,15	0,00	0,00	NE	NE	NE	NE
1.A.2.f - non-metallic minerals	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.g - transport equipment	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.h - machinery	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.i - mining (excluding fuels) and quarrying	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.j - wood and wood products	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.k - construction	5,75	0,00	0,00	NO	NO	NO	NO

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
1.A.2.l - textile and leather	0,00	0,00	0,00	NO	NO	NO	NO
1.A.2.m - non-specified industry	0,00	0,00	0,00	NO	NO	NO	NO
1.A.3 - transport	98,17	0,01	0,01	NE	NE	NE	NE
1.A.3.a - civil aviation	NE	NE	NE	NE	NE	NE	NE
1.A.3.a.i - international aviation (international bunkers) (1)	NE	NE	NE	NE	NE	NE	NE
1.A.3.a.ii - domestic aviation	NE	NE	NE	NE	NE	NE	NE
1.A.3.b - toad transportation	98,00	0,01	0,01	NE	NE	NE	NE
1.A.3.b.i - cars	61,82	0,01	0,01	NE	NE	NE	NE
1.A.3.b.i.1 - passenger cars with 3-way catalysts	61,77	0,01	0,01	NE	NE	NE	NE
1.A.3.b.i.2 - passenger cars without 3-way catalysts	0,05	0,00	0,00	NE	NE	NE	NE
1.A.3.b.ii - light-duty trucks	12,36	0,00	0,00	NE	NE	NE	NE
1.A.3.b.ii.1 - light-duty trucks with 3-way catalysts	11,07	0,00	0,00	NE	NE	NE	NE
1.A.3.b.ii.2 - light-duty trucks without 3-way catalysts	1,28	0,00	0,00	NE	NE	NE	NE
1.A.3.b.iii - heavy-duty trucks and buses	23,66	0,00	0,00	NE	NE	NE	NE
1.A.3.b.iv - motorcycles	0,16	0,00	0,00	NE	NE	NE	NE
1.A.3.b.v - evaporative emissions from vehicles	NE	NE	NE	NE	NE	NE	NE
1.A.3.b.vi - urea-based catalysts	IE	IE	IE	NE	NE	NE	NE
1.A.3.c - railways	0,17	0,00	0,00	NE	NE	NE	NE
1.A.3.d - water-borne navigation	NE	NE	NE	NE	NE	NE	NE
1.A.3.d.i - international water-borne navigation (international bunkers) (1)	NO,IE	NO,IE	NO,IE	NO,NE	NO,NE	NO,NE	NO,NE
1.A.3.d.ii - domestic water-borne navigation	NE	NE	NE	NE	NE	NE	NE
1.A.3.e - other transportation	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
1.A.3.e.i - pipeline transport	NO	NO	NO	NO	NO	NO	NO

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
1.A.3.e.ii - off-road	NE	NE	NE	NE	NE	NE	NE
1.A.4 - other sectors	7,04	0,00	0,00	NE	NE	NE	NE
1.A.4.a - commercial/institutional	2,13	0,00	0,00	NE	NE	NE	NE
1.A.4.b - residential	4,57	0,00	0,00	NE	NE	NE	NE
1.A.4.c - agriculture/forestry/fishing/fish Farms	0,34	0,00	0,00	NE	NE	NE	NE
1.A.4.c.i - stationary	0,34	0,00	0,00	NE	NE	NE	NE
1.A.4.c.ii - off-road vehicles and other machinery	NE	NE	NE	NE	NE	NE	NE
1.A.4.c.iii - fishing (mobile combustion)	NE	NE	NE	NE	NE	NE	NE
1.A.5 - non-Specified	NO	NO	NO	NO	NO	NO	NO
1.A.5.a - stationary	NO	NO	NO	NO	NO	NO	NO
1.A.5.b - mobile	NO	NO	NO	NO	NO	NO	NO
1.A.5.b.i - mobile (aviation component)	NO	NO	NO	NO	NO	NO	NO
1.A.5.b.ii - mobile (water-borne component)	NO	NO	NO	NO	NO	NO	NO
1.A.5.b.iii - mobile (Other)	NO	NO	NO	NO	NO	NO	NO
1.A.5.c - multilateral operations (1)(2)	NO	NO	NO	NO	NO	NO	NO
1.B - fugitive emissions from fuels	0,002288	NO	NO	NO	NO	NO	NO
1.B.1 - solid fuels	NO	NO	NA	NO	NO	NO	NO
1.B.1.a - coal mining and handling	NO	NO		NO	NO	NO	NO
1.B.1.a.i - underground mines	NO	NO		NO	NO	NO	NO
1.B.1.a.i.1 - mining	NO	NO		NO	NO	NO	NO
1.B.1.a.i.2 - post-mining seam gas emissions	NO	NO		NO	NO	NO	NO
1.B.1.a.i.3 - abandoned underground mines	NO	NO		NO	NO	NO	NO
1.B.1.a.i.4 - flaring of drained methane or conversion of methane to CO2	NO	NO		NO	NO	NO	NO
1.B.1.a.ii - surface mines	0	0		0	0	0	0
1.B.1.a.ii.1 - mining	NO	NO		NO	NO	NO	NO
1.B.1.a.ii.2 - post-mining seam gas emissions	NO	NO		NO	NO	NO	NO
1.B.1.b - uncontrolled combustion and burning	NO	NO		NO	NO	NO	NO

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
coal dumps							
1.B.1.c - solid fuel transformation	NE	NE	NE	NE	NE	NE	NE
1.B.2 - oil and natural gas	0,002288	NO	NO	NO	NO	NO	NO
1.B.2.a - oil	0,00	NO	NO	NO	NO	NO	NO
1.B.2.a.i - venting	NO	NO		NO	NO	NO	NO
1.B.2.a.ii - flaring	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii - all other	0,00	0,00	NO	NO	NO	NO	NO
1.B.2.a.iii.1 - exploration	NO	NO		NO	NO	NO	NO
1.B.2.a.iii.2 - production and upgrading	NO	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.3 - transport	0,00	NO	NO	NO	NO	NO	NO
1.B.2.a.iii.4 - refining	NO	NO		NO	NO	NO	NO
1.B.2.a.iii.5 - distribution of oil products	NO	NO		NO	NO	NO	NO
1.B.2.a.iii.6 - other	NO	NO	NO	NO	NO	NO	NO
1.B.2.b - natural gas	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.i - venting	NO	0,00		NO	NO	NO	NO
1.B.2.b.ii - flaring	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii - all other	NO	NO	NO	NO	NO	NO	NO
1.B.2.b.iii.1 - exploration	NO	NO		NO	NO	NO	NO
1.B.2.b.iii.2 - production	NO	NO		NO	NO	NO	NO
1.B.2.b.iii.3 - processing	NO	NO		NO	NO	NO	NO
1.B.2.b.iii.4 - transmission and storage	NO	NO		NO	NO	NO	NO
1.B.2.b.iii.5 - distribution	NO	NO		NO	NO	NO	NO
1.B.2.b.iii.6 - other	NO	NO	NO	NO	NO	NO	NO
1.B.3 - other emissions from energy production	NO	NO	NO	NO	NO	NO	NO
1.C - carbon dioxide transport and storage	NO	NO	NO	NO	NO	NO	NO
1.C.1 - transport of CO2	NO			NO	NO	NO	NO
1.C.1.a - pipelines	NO			NO	NO	NO	NO
1.C.1.b - ships	NO			NO	NO	NO	NO
1.C.1.c - other (please specify)	NO			NO	NO	NO	NO

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
1.C.2 - injection and Storage	NO			NO	NO	NO	NO
1.C.2.a - injection	NO			NO	NO	NO	NO
1.C.2.b - storage	NO			NO	NO	NO	NO
1.C.3 - other	NO	NO		NO	NO	NO	NO

	Emissions (kt)						
Categories	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
memo items (3)							
international bunkers	NE,IE	NE,IE	NE,IE	NE	NE	NE	NE
1.A.3.a.i - international aviation (international bunkers) (1)	NE	NE	NE	NE	NE	NE	NE
1.A.3.d.i - international water-borne navigation (international bunkers) (1)	NO,IE	NO,IE	NO,IE	NE	NE	NE	NE
1.A.5.c - multilateral operations (1)(2)	NO	NO	NO	NE	NE	NE	NE
information items							
CO2 from biomass combustion for energy production	0,17						

IPPU Sector

Table 8.4. IPCC sectoral Table – IPPU (2018)

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
2 - industrial processes and product use	NE	NO	NE	NE	NE	NE	NE	0	0	0	0	0
2.A - mineral industry	NO	NA	NA	NA	NA	NA	NA	0	0	0	0	0
2.A.1 - cement production	NO								0	0	0	0
2.A.2 - lime production	NO								0	0	0	0
2.A.3 - glass production	NO								0	0	0	0
2.A.4 - other process uses of carbonates	NO	NA	NA	NA	NA	NA	NA	0	0	0	0	0
2.A.4.a - ceramics	NO								0	0	0	0
2.A.4.b - other uses of soda ash	NO								0	0	0	0
2.A.4.c – non-metallurgical magnesia production	NO								0	0	0	0
2.A.4.d - other (please specify) (3)	NO								0	0	0	0
2.A.5 - other (please specify) (3)									0	0	0	0
2.B - chemical	NO	NO	NO	NA	NA	N	NA	0	0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
industry						A						
2.B.1 - ammonia production	NO								0	0	0	0
2.B.2 - nitric acid production			NO						0	0	0	0
2.B.3 - adipic acid production			NO						0	0	0	0
2.B.4 - caprolactam, glyoxal and glyoxylic acid production			NO						0	0	0	0
2.B.5 - carbide production	NO	NO							0	0	0	0
2.B.6 - titanium dioxide production	NO								0	0	0	0
2.B.7 - soda ash production	NO								0	0	0	0
2.B.8 - petrochemical and carbon black production	NO	NO	NA	NA	NA	NA	NA	0	0	0	0	0
2.B.8.a - methanol	NO	NO							0	0	0	0
2.B.8.b - ethylene	NO	NO							0	0	0	0
2.B.8.c - ethylene dichloride and vinyl chloride monomer	NO	NO							0	0	0	0
2.B.8.d - ethylene	NO	NO							0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
oxide												
2.B.8.e - acrylonitrile	NO	NO							0	0	0	0
2.B.8.f - carbon black	NO	NO							0	0	0	0
2.B.9 - fluorochemical production	NA	NA	NA	NO	NO	NO	NO	0	0	0	0	0
2.B.9.a - by-product emissions (4)					NO	NO	NO	0	0	0	0	0
2.B.9.b - fugitive emissions (4)					NO	NO	NO		0	0	0	0
2.B.10 - other (please specify) (3)					NO	NO	NO		0	0	0	0
2.C - metal industry	NO	NO	NA	NO	NO	NO	NO	0	0	0	0	0
2.C.1 – iron and steel production	NO	NO			NO	NO			0	0	0	0
2.C.2 - ferroalloys production	NO	NO							0	0	0	0
2.C.3 - aluminum production	NO				NO	NO		0	0	0	0	0
2.C.4 - magnesium production (5)	NO			NO	NO	NO	NO	0	0	0	0	0
2.C.5 - lead	NO								0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
production												
2.C.6 - zinc production	NO								0	0	0	0
2.C.7 - other (please specify) (3)									0	0	0	0
2.D - non-energy products from fuels and solvent use (6)	NE	NA	NA	NA	NA	NA	NA	0	0	0	0	0
2.D.1 - lubricant use	NE								0	0	0	0
2.D.2 - paraffin wax use	NE								0	0	0	0
2.D.3 - solvent use (7)									0	0	0	0
2.D.4 - other (please specify) (3), (8)									0	0	0	0
2.E - electronics industry	NA	NA	NA	NO	NO	NO	NO	0	0	0	0	0
2.E.1 - integrated circuit or semiconductor (9)				NO	NO	NO	NO	0	0	0	0	0
2.E.2 - TFT flat panel display (9)				NO	NO	NO	NO	0	0	0	0	0
2.E.3 - photovoltaics (9)				NO	NO	NO	NO	0	0	0	0	0
2.E.4 - heat transfer fluid (10)				NO	NO	NO	NO	0	0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
2.E.5 - other (please specify) (3)				NO	NO	NO	NO		0	0	0	0
2.F - product uses as substitutes for ozone depleting substances	NA	NA	NA	NE	NE	NO	NE	0	0	0	0	0
2.F.1 - refrigeration and air conditioning	NA	NA	NA	NE	NE	NO	NE	0	0	0	0	0
2.F.1.a - refrigeration and stationary air conditioning				NE	NE	NO	NE	0	0	0	0	0
2.F.1.b - mobile air conditioning				NE	NE	NO	NE	0	0	0	0	0
2.F.2 - foam blowing agents				NE	NE	NO	NE	0	0	0	0	0
2.F.3 - fire protection				NE	NE	NO	NE	0	0	0	0	0
2.F.4 - aerosols				NE	NE	NO	NE	0	0	0	0	0
2.F.5 - solvents				NE	NE	NO	NE	0	0	0	0	0
2.F.6 - other applications (please specify) (3)				NE	NE	NO	NE	0	0	0	0	0
2.G - other product	NA	NA	NE	NO	NO	NE	NO	0	0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
manufacture and use												
2.G.1 - electrical equipment	NA	NA	NA	NO	NO	NE	NO	0	0	0	0	0
2.G.1.a - manufacture of electrical equipment				NO	NO	NE	NO	0	0	0	0	0
2.G.1.b - use of electrical equipment				NO	NO	NE	NO	0	0	0	0	0
2.G.1.c - disposal of electrical equipment				NO	NO	NE	NO	0	0	0	0	0
2.G.2 - SF6 and PFCs from other product uses	NA	NA	NA	NA	NO	NO	NO	0	0	0	0	0
2.G.2.a - military applications					NO	NO	NO	0	0	0	0	0
2.G.2.b - accelerators					NO	NO	NO	0	0	0	0	0
2.G.2.c - other (please specify) (3)					NO	NO	NO	0	0	0	0	0
2.G.3 - N2O from product uses	NA	NA	NE	NA	NA	NA	NA	0	0	0	0	0
2.G.3.a - medical applications			NE						0	0	0	0
2.G.3.b - propellant for pressure and aerosol products			NE						0	0	0	0

Categories	(kt)			CO_2eq (kt)				(kt)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2eq conversion factors (1)	Other halogenated gases without CO_2eq conversion factors (2)	NOx	CO	NMVOCs	SO_2
2.G.3.c - other (please specify) (3)			NO						0	0	0	0
2.G.4 - other (Please specify) (3)									0	0	0	0
2.H - other	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0
2.H.1 - pulp and paper industry	NO	NO	NO	NO	NO	NO	NO		0	0	0	0
2.H.2 - food and beverages industry	NO	NO	NO	NO	NO	NO	NO		0	0	0	0
2.H.3 - other (please specify) (3)	NO	NO	NO	NO	NO	NO	NO		0	0	0	0

AFOLU Sector

Table 8.5. IPCC sectoral Table – AFOLU (2018)

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3 - Agriculture, Forestry, and Other Land Use	-113,09	0,21	0,01	NE	NA	NE
3.A - livestock	NA	0,21	0,00	NA	NA	NE
3.A.1 - enteric fermentation	NA	0,18	NA	NA	NA	NA
3.A.1.a - cattle	NA	0,13	NA	NA	NA	NA
3.A.1.a.i - dairy cows		0,07				
3.A.1.a.ii - other cattle		0,06				
3.A.1.b - buffalo		NO				
3.A.1.c - sheep		0,03				
3.A.1.d - goats		0,02				
3.A.1.e - camels		NO				
3.A.1.f - horses		NE				
3.A.1.g - mules and asses		0				
3.A.1.h - swine		0,01				
3.A.1.j - other (please specify)		NO				
3.A.2 - manure management (1)	NA	0,02258302	0,002983017	NA	NA	NE
3.A.2.a - cattle	NA	0,00	0,00	NA	NA	NE
3.A.2.a.i - dairy cows		0,00	0,00			NE
3.A.2.a.ii - other cattle		0,00	0,00			NE
3.A.2.b - buffalo		NO	NO			NO
3.A.2.c - sheep		0,00	0,00			NE
3.A.2.d - goats		0,00	0,00			NE
3.A.2.e - camels		NO	NO			NO
3.A.2.f - horses		NE	NE			NE
3.A.2.g - mules and asses		0	0			NE

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3.A.2.h - swine		0,02	0,00			NE
3.A.2.i - poultry		0,00	0,00			NE
3.A.2.j - other (please specify)		NO	NO			NE
3.B - land	-113,10	NA	0,00	NO	NO	NO
3.B.1 - forest land	-140,34	NA	NA	NO	NO	NO
3.B.1.a - forest land remaining forest land	-41,65			NO	NO	NO
3.B.1.b - land converted to forest land	-98,70	NA	NA	NO	NO	NO
3.B.1.b.i - cropland converted to forest land	0,00			NO	NO	NO
3.B.1.b.ii - grassland converted to forest land	0,00			NO	NO	NO
3.B.1.b.iii - wetlands converted to forest land	0,00			NO	NO	NO
3.B.1.b.iv - settlements converted to forest land	0,00			NO	NO	NO
3.B.1.b.v - Other Land converted to forest land	0,00			NO	NO	NO
3.B.2 - cropland	10,33	NA	NA	NO	NO	NO
3.B.2.a - cropland remaining cropland	0,00			NO	NO	NO
3.B.2.b - land converted to cropland	10,33	NA	NA	NO	NO	NO
3.B.2.b.i - forest land converted to cropland	0,00			NO	NO	NO
3.B.2.b.ii - grassland converted to cropland	0,00			NO	NO	NO

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3.B.2.b.iii - wetlands converted to cropland	0,00			NO	NO	NO
3.B.2.b.iv - settlements converted to cropland	0,00			NO	NO	NO
3.B.2.b.v - other land converted to cropland	0,00			NO	NO	NO
3.B.3 - grassland	13,73	NA	NA	NO	NO	NO
3.B.3.a - grassland remaining grassland	0,00			NO	NO	NO
3.B.3.b - land converted to grassland	13,73	NA	NA	NO	NO	NO
3.B.3.b.i - forest land converted to grassland	0,00			NO	NO	NO
3.B.3.b.ii - cropland converted to grassland	0,00			NO	NO	NO
3.B.3.b.iii - wetlands converted to grassland	0,00			NO	NO	NO
3.B.3.b.iv - settlements converted to grassland	0,00			NO	NO	NO
3.B.3.b.v - other land converted to grassland	0,00			NO	NO	NO
3.B.4 - wetlands	0,00	NA	0	NO	NO	NO
3.B.4.a - wetlands remaining wetlands	0,00	NA	0,00	NO	NO	NO
3.B.4.a.i - peatlands remaining peatlands	0,00		0	NO	NO	NO
3.B.4.a.ii - flooded land remaining flooded land				NO	NO	NO

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3.B.4.b - land converted to wetlands	0,00	NA	0,00	NO	NO	NO
3.B.4.b.i - land converted for peat extraction			0	NO	NO	NO
3.B.4.b.ii - land converted to flooded land	0,00			NO	NO	NO
3.B.4.b.iii - land converted to other wetlands				NO	NO	NO
3.B.5 - settlements	0,75	NA	NA	NO	NO	NO
3.B.5.a - settlements remaining settlements	0,00			NO	NO	NO
3.B.5.b - land converted to settlements	0,75	NA	NA	NO	NO	NO
3.B.5.b.i - forest land and converted to settlements	0,00			NO	NO	NO
3.B.5.b.ii - cropland converted to settlements	0,00			NO	NO	NO
3.B.5.b.iii - grassland converted to settlements	0,00			NO	NO	NO
3.B.5.b.iv - wetlands converted to settlements	0,00			NO	NO	NO
3.B.5.b.v - other land converted to settlements	0,00			NO	NO	NO
3.B.6 - other land	2,44	NA	NA	NO	NO	NO
3.B.6.a - other land remaining other land				NO	NO	NO
3.B.6.b - land converted to other land	2,44	NA	NA	NO	NO	NO

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3.B.6.b.i - forest land converted to other land	0,00			NO	NO	NO
3.B.6.b.ii - cropland converted to other land	0,00			NO	NO	NO
3.B.6.b.iii - grassland converted to other land	0,00			NO	NO	NO
3.B.6.b.iv - wetlands converted to other land	0,00			NO	NO	NO
3.B.6.b.v - settlements converted to other land	0,00			NO	NO	NO
3.C - aggregate sources and non-CO2 emissions sources on land (2)	0,01	0,00	0,01	NE	NO,NA	NE
3.C.1 - emissions from biomass burning	NA	0,00	0,00	NA	NA	NE
3.C.1.a - biomass burning in forest lands		0,00	0,00			NE
3.C.1.b - biomass burning in croplands		0,00	0,00			NE
3.C.1.c - biomass burning in grasslands		0,00	0,00			NE
3.C.1.d - biomass burning in all other land		0,00	0,00			NE
3.C.2 - liming	NE			NO	NO	NO
3.C.3 - urea application	0,01			NO	NO	NO
3.C.4 - direct N2O emissions from managed soils (3)			0,01	NE	NA	NE
3.C.5 - indirect N2O emissions from managed soils			0,00	NE	NA	NE

Categories	(kt)					
	Net CO_2 emissions / removals	Emissions				
		CH_4	N_2O	NOx	CO	NMVOCs
3.C.6 - indirect N2O emissions from manure management			0,00	NO	NO	NO
3.C.7 - rice cultivation		NO		NO	NO	NO
3.C.8 - other (please specify)				NO	NO	NO
3.D - other	NE	NA	NA	NO	NO	NO
3.D.1 - harvested wood products	NE			NO	NO	NO
3.D.2 - other (please specify)				NO	NO	NO

Waste Sector

Table 8.6. IPCC sectoral Table – waste (2018)

Categories	Emissions [Gg]						
	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
4 - waste	0,03	2,08	0,00	NE	NE	NE	NE
4.A - solid waste disposal	0,00	1,64	NA	NE	NE	NE	
4.A.1 - managed waste disposal sites	0,00	1,64		NE	NE	NE	
4.A.2 - unmanaged waste disposal sites	0,00	0,00		NE	NE	NE	
4.A.3 - uncategorised waste disposal sites	0,00	0,00		NE	NE	NE	
4.B - biological treatment of solid waste		0	0	NA	NA	NA	
4.C - incineration and open burning of waste	0,03	0,00	0,00	NE	NE	NE	NE
4.C.1 - waste incineration	0,00	0,00	0,00	NE	NE	NE	NE
4.C.2 - open burning of waste	0,03	0,00	0,00	NE	NE	NE	NE
4.D - wastewater treatment and discharge	NA	0,44	0,00	NA	NA	NA	
4.D.1 - domestic wastewater treatment and discharge		0,22	0,00	NA	NA	NA	
4.D.2 - industrial wastewater treatment and discharge		0,22	NE	NA	NA	NA	
4.E - other (please specify)	NO	NO	NO	NO	NO	NO	NO

Table 8.7. Uncertainty Assessment: GHG Inventory for year 2008 – (without LULUCF)

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
1.A.1-energy industries/liquid fuels	CO_2	149,5	5	7	9	4,3	5,5
1.A.1- energy industries/liquid fuels	CH_4	0,2	5	100	100	0,1	0,1
1.A.1-energy industries/liquid fuels	N_2O	0,3	5	150	150	0,2	0,2
1.A.1-energy industries/solid fuels	CO_2	0,0	5	7	9	0,0	0,0
1.A.1-energy industries/solid fuels	CH_4	0,0	5	100	100	0,0	0,0
1.A.1-energy industries/solid fuels	N_2O	0,0	5	150	150	0,0	0,0
1.A.1-energy industries/gaseous fuels	CO_2	0,0	5	7	9	0,0	0,0
1.A.1-energy industries/gaseous fuels	CH_4	0,0	5	100	100	0,0	0,0
1.A.1-energy industries/gaseous fuels	N_2O	0,0	5	150	150	0,0	0,0
1.A.1-energy industries/other fossil fuels	CO_2	0,0	5	7	9	0,0	0,0
1.A.1-energy industries/other fossil fuels	CH_4	0,0	5	100	100	0,0	0,0
1.A.1-energy	N_2O	0,0	5	150	150	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
industries/other fossil fuels							
1.A.1-energy industries/biomass	CH_4	0,0	5	150	150	0,0	0,0
1.A.1-energy industries/biomass	N_2O	0,0	5	150	150	0,0	0,0
1.A.2-manufacturing industries/liquid fuels	CO_2	4,4	20	7	21	0,3	0,4
1.A.2-manufacturing industries/liquid fuels	CH_4	0,0	20	100	102	0,0	0,0
1.A.2-manufacturing industries/liquid fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.2-manufacturing industries/solid fuels	CO_2	0,0	20	7	21	0,0	0,0
1.A.2-manufacturing industries/solid fuels	CH_4	0,0	20	100	102	0,0	0,0
1.A.2-manufacturing industries/solid fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.2-manufacturing industries/gaseous fuels	CO_2	0,0	20	7	21	0,0	0,0
1.A.2-manufacturing industries/gaseous fuels	CH_4	0,0	20	100	102	0,0	0,0
1.A.2-manufacturing industries/gaseous fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.2-manufacturing industries/other fossil fuels	CO_2	0,0	20	7	21	0,0	0,0
1.A.2-manufacturing	CH_4	0,0	20	100	102	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
industries/other fossil fuels							
1.A.2-manufacturing industries/other fossil fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.2-manufacturing industries/biomass	CH_4	0,0	60	150	162	0,0	0,0
1.A.2-manufacturing industries/biomass	N_2O	0,0	60	150	162	0,0	0,0
1.A.3-transport/-	CO_2	69,0	10	5	11	2,6	3,3
1.A.3-transport/-	CH_4	0,4	10	50	51	0,1	0,1
1.A.3-transport/-	N_2O	1,6	10	380	380	2,0	2,6
1.A.4-commercial, resid., agriculture…/liquid fuels	CO_2	12,6	20	7	21	0,9	1,1
1.A.4-commercial, resid., agriculture…/liquid fuels	CH_4	0,0	20	100	102	0,0	0,0
1.A.4-commercial, resid., agriculture…/liquid fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.4-commercial, resid., agriculture…/solid fuels	CO_2	0,0	20	7	21	0,0	0,0
1.A.4-commercial, resid., agriculture…/solid fuels	CH_4	0,0	20	100	102	0,0	0,0
1.A.4-commercial, resid., agriculture…/solid fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.4-commercial, resid., agriculture…/gaseous fuels	CO_2	0,0	20	7	21	0,0	0,0
1.A.4-commercial, resid.,	CH_4	0,0	20	100	102	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
agriculture…/gaseous fuels							
1.A.4-commercial, resid., agriculture…/gaseous fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.4-commercial, resid., agriculture…/other fossil fuels	CO_2	0,0	60	7	60	0,0	0,0
1.A.4-commercial, resid., agriculture…/other fossil fuels	CH_4	0,0	60	100	117	0,0	0,0
1.A.4-commercial, resid., agriculture…/other fossil fuels	N_2O	0,0	20	150	151	0,0	0,0
1.A.4-commercial, resid., agriculture…/biomass	CH_4	0,0	60	100	117	0,0	0,0
1.A.4-commercial, resid., agriculture…/biomass	N_2O	0,0	60	150	162	0,0	0,0
1.B.1-fugitive emissions / solid fuels/-	CO_2	0,0	0	0	0	0,0	0,0
1.B.1-fugitive emissions / solid fuels/-	CH_4	0,0	5	20	21	0,0	0,0
1.B.1-fugitive emissions / solid fuels/-	N_2O	0,0	0	0	0	0,0	0,0
1.B.2-fugitive emissions / oil and natural gas/-	CO_2	0,0	10	2	10	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt $CO_{2\text{-eq}}$	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
1.B.2-fugitive emissions / oil and natural gas/-	CH_4	0,0	10	100	100	0,0	0,0
1.B.2-fugitive emissions / oil natural gas/-	N_2O	0,0	10	100	100	0,0	0,0
2.A-mineral industry /-	CO_2	0,0	2	2	3	0,0	0,0
2.B-chemical industry/-	CO_2	0,0	5	6	8	0,0	0,0
2.B-chemical industry/-	CH_4	0,0	2	2	3	0,0	0,0
2.B-chemical industry/-	N_2O	0,0	2	40	40	0,0	0,0
2.C-metal industry/-	CO_2	0,0	10	25	27	0,0	0,0
2.C-metal industry/-	CH_4	0,0	10	25	27	0,0	0,0
2.C-metal industry/-	SF_6	0,0	20	5	21	0,0	0,0
2.D-non-energy products from fuels and solvent use /-	CO_2	0,0	15	50	52	0,0	0,0
2.F-product uses as substitutes for ODS/-	HFC	0,0	20	20	28	0,0	0,0
3.A-enteric fermentation/-	CH_4	15,0	20	40	45	2,2	2,9
3.B-manure management/-	CH_4	0,8	20	30	36	0,1	0,1
3.B-manure management/-	N_2O	1,6	20	50	54	0,3	0,4
3.D.1-direct N2O emissions from managed soils/-	N_2O	2,5	5	300	300	2,5	3,2
3.D.2-indirect N2O emissions from managed soils /-	N_2O	0,6	5	300	300	0,6	0,8
3.F-field burning of	CH_4	0,0	30	100	104	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
agricultural residues/-							
3.F-field burning of agricultural residues/-	N_2O	0,0	30	100	104	0,0	0,0
3.G-liming/-	CO_2	0,0	20	20	28	0,0	0,0
3.H-urea application/-	CO_2	0,0	5	50	50	0,0	0,0
4.A-forest Land/-	CO_2	-130,0	10	20	22		12,4
4.A-forest Land/-	CH_4	0,0	10	100	100		0,0
4.A-forest Land/-	N_2O	0,0	10	100	100		0,0
4.B-cropland/-	CO_2	16,5	10	40	41		2,9
4.B-cropland/-	N_2O	0,0	10	100	100		0,0
4.C-grassland/-	CO_2	20,8	10	50	51		4,5
4.C-grassland/-	CH_4	0,0	10	100	100		0,0
4.C-grassland/-	N_2O	0,0	10	100	100		0,0
4.D-wetlands/-	CO_2	0,0	10	70	71		0,0
4.D-wetlands/-	N_2O	0,0	10	100	100		0,0
4.E-settlements/-	CO_2	3,4	10	30	32		0,5
4.E-settlements/-	N_2O	0,0	10	100	100		0,0
4.F-other Land/-	CO_2	23,5	10	80	81		8,1
4.F-other Land/-	N_2O	0,0	0	0	0		0,0
4.G-harvested wood products/-	CO_2	0,0	10	100	100		0,0
5.A-solid waste disposal on land/-	CH_4	35,8	77	65	101	12,0	15,4
5.C- incineration and open burning of waste/0	CO_2	0,0	30	40	50	0,0	0,0
5.C- incineration and open	CH_4	0,1	30	100	104	0,0	0,0

IPCC Category/fuels	Gas	Emissions 2008 kt CO_{2-eq}	Activity data uncertainty 2008 (%)	Emission factor uncertainty 2008 (%)	Combined uncertainty 2008 (%)	Uncertainty combined (%) in the total national emissions excl. LULUCF 2008 (%)	Uncertainty combined (%) in the total national emissions incl. LULUCF 2008 (%)
burning of waste/0							
5.C- incineration and open burning of waste/0	N_2O	0,0	30	100	104	0,0	0,0
5.D-wastewater treatment and discharge/-	CH_4	5,0	50	50	71	1,2	1,5
5.D-wastewater treatment and discharge/-	N_2O	0,6	50	100	112	0,2	0,3
uncertainty of total emissions- 2008						13,7	23,6

Table 8.8. Uncertainty Assessment GHG Inventory for year 2018 – (without LULUCF)

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
1.A.1	energy industries	liquid fuels	CO_2	149,481	181,145	5	7	8,6	5,3	0,2	0,5	1,1	3,7	3,8
1.A.1	energy industries	liquid fuels	CH_4	0,169	0,205	5	100	100,1	0,1	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	liquid fuels	N_2O	0,321	0,389	5	150	150,1	0,2	0,0	0,0	0,1	0,0	0,1
1.A.1	energy industries	solid fuels	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	solid fuels	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	solid fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	gaseous fuels	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	gaseous fuels	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	gaseous fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	other fossil	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
		fuels												
1.A.1	energy industries	other fossil fuels	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	other fossil fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	biomass	CH_4	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	biomass	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	liquid fuels	CO_2	4,41205219	5,90039869	20	7	21,2	0,4	0,0	0,0	0,0	0,5	0,5
1.A.2	manufacturing industries	liquid fuels	CH_4	0,005001517	0,006688711	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	liquid fuels	N_2O	0,009467157	0,012660775	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	solid fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A	manufactu	solid	CH	0	0	2	10	102	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
.2	ring industries	fuels	4			0	0	,0						
1.A.2	manufacturing industries	solid fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	other fossil fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	other fossil fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	other fossil fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A	manufactu	biom	CH	0	0	6	15	161	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
.2	ring industries	ass	4			0	0	,6						
1.A.2	manufacturing industries	biomass	N_2O	0	0	60	150	161,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.3	transport	-	CO_2	69,00737826	98,1702937	10	5	11,2	3,7	0,1	0,3	0,6	4,0	4,0
1.A.3	transport	-	CH_4	0,35552657	0,233062047	10	50	51,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.3	transport	-	N_2O	1,594620838	2,040424494	10	380	380,1	2,6	0,0	0,0	0,7	0,1	0,8
1.A.4	commercial, resid., agriculture…	liquid fuels	CO_2	12,58829599	7,037510556	20	7	21,2	0,5	0,0	0,0	-0,1	0,6	0,6
1.A.4	commercial, resid., agriculture…	liquid fuels	CH_4	0,032963897	0,017954727	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	liquid fuels	N_2O	0,010855993	0,005544904	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A	commerci	solid	CO	0	0	2	7	21,	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
.4	al, resid., agriculture…	fuels	2			0		2						
1.A.4	commercial, resid., agriculture…	solid fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	solid fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	gaseous fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	gaseous fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	gaseous fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A	commerci	other	CO	0	0	6	7	60,	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
.4	al, resid., agriculture…	fossil fuels	2			0		4						
1.A.4	commercial, resid., agriculture…	other fossil fuels	CH_4	0	0	60	100	116,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	other fossil fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	biomass	CH_4	0,007357025	0,009354308	60	100	116,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	biomass	N_2O	0,000468988	0,000585934	60	150	161,6	0,0	0,0	0,0	0,0	0,0	0,0
1.B.1	fugitive emissions / solid fuels	-	CO_2	0	0	0	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1.B	fugitive	-	CH	0	0	5	20	20,	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
.1	emissions / solid fuels		4					6						
1.B.1	fugitive emissions / oil & natural gas	-	N_2O	0	0	0	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1.B.2	fugitive emissions / oil & natural gas	-	CO_2	0,001348678	0,002288069	10	2	10,2	0,0	0,0	0,0	0,0	0,0	0,0
1.B.2	fugitive emissions / oil & natural gas	-	CH_4	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
1.B.2	fugitive emissions / oil & natural gas	-	N_2O	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
2.A	mineral	-	CO	0	0	2	2	2,8	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	industry		$_2$											
2.B	chemical industry	-	CO_2	0	0	5	6	7,8	0,0	0,0	0,0	0,0	0,0	0,0
2.B	chemical industry	-	CH_4	0	0	2	2	2,8	0,0	0,0	0,0	0,0	0,0	0,0
2.B	chemical industry	-	N_2O	0	0	2	40	40,0	0,0	0,0	0,0	0,0	0,0	0,0
2.C	metal industry	-	CO_2	0	0	10	25	26,9	0,0	0,0	0,0	0,0	0,0	0,0
2.C	metal industry	-	CH_4	0	0	10	25	26,9	0,0	0,0	0,0	0,0	0,0	0,0
2.C	metal industry	-	SF_6	0	0	20	5	20,6	0,0	0,0	0,0	0,0	0,0	0,0
2.D	non-energy products from fuels and solvent use	-	CO_2	0	0	15	50	52,2	0,0	0,0	0,0	0,0	0,0	0,0
2.F	product uses as substitutes for ODS	-	HFC	0	0	20	20	28,3	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
3.A	enteric fermentation	-	CH_4	14,952	5,169836	20	40	44,7	0,8	0,0	0,0	-0,9	0,4	1,0
3.B	manure management	-	CH_4	0,76384	0,63232456	20	30	36,1	0,1	0,0	0,0	0,0	0,1	0,1
3.B	manure management	-	N_2O	1,59819035	1,346237854	20	50	53,9	0,2	0,0	0,0	0,0	0,1	0,1
3.D.1	direct N2O emissions from managed soils	-	N_2O	2,484409873	1,794607812	5	300	300,0	1,8	0,0	0,0	-0,3	0,0	0,3
3.D.2	indirect N2O Emissions from managed soils	-	N_2O	0,63966953	0,499745552	5	300	300,0	0,5	0,0	0,0	0,0	0,0	0,0
3.F	field burning of agricultur	-	CH_4	0	0	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	al residues													
3.F	field burning of agricultural residues	-	N_2O	0	0	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,0
3.G	liming	-	CO_2	0,0055	0,005133333	20	20	28,3	0,0	0,0	0,0	0,0	0,0	0,0
3.H	urea application	-	CO_2	0,0055	0,005133333	5	50	50,2	0,0	0,0	0,0	0,0	0,0	0,0
5.A	solid waste disposal on Land	-	CH_4	35,84866125	45,90332946	77	65	100,8	15,6	0,0	0,1	2,9	3,4	4,5
5.C	incineration and open burning of waste		CO_2	0,027222465	0,029629533	30	40	50,0	0,0	0,0	0,0	0,0	0,0	0,0
5.C	incinerati		CH_4	0,082072187	0,089329182	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,00591

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	on and open burning of waste													
5.C	incineration and open burning of waste		N_2O	0,014877839	0,016069227	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,00103
5.D	wastewater treatment and discharge	-	CH_4	4,963181933	12,2123085	50	50	70,7	2,9	0,0	0,0	1,1	1,1	1,61935
5.D	wastewater treatment and discharge	-	N_2O	0,612685194	0,667413736	50	100	111,8	0,3	0,0	0,0	0,0	0,0	0,04745
		TOTAL		300,0	363,5				14,2					6,9

Table 8.9. Uncertainty assessment GHG Inventory for year 2018 – (with LULUCF)

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
1.A.1	energy industries	liquid fuels	CO_2	149,4808206	181,145091	5	7	8,6	6,2	0,1	0,8	0,6	5,5	5,5
1.A.1	energy industries	liquid fuels	CH_4	0,169451942	0,205346662	5	100	100,1	0,1	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	liquid fuels	N_2O	0,320748319	0,388691896	5	150	150,1	0,2	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	solid fuels	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	solid fuels	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	solid fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	gaseous fuels	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.	energy industries	gaseous	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
1		fuels												
1.A.1	energy industries	gaseous fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	other fossil fuels	CO_2	0	0	5	7	8,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	other fossil fuels	CH_4	0	0	5	100	100,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	other fossil fuels	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	biomass	CH_4	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.1	energy industries	biomass	N_2O	0	0	5	150	150,1	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	liquid fuels	CO_2	4,41205219	5,90039869	20	7	21,2	0,5	0,0	0,0	0,0	0,7	0,7
1.A.	manufacturing industries	liquid fuels	CH_4	0,005001517	0,006688711	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
2														
1.A.2	manufacturing industries	liquid fuels	N_2O	0,009467157	0,012660775	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	solid fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	solid fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	solid fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	gaseous fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.	manufacturing industries	other fossil	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
2		fuels												
1.A.2	manufacturing industries	other fossil fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	other fossil fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	biomass	CH_4	0	0	60	150	161,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.2	manufacturing industries	biomass	N_2O	0	0	60	150	161,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.3	transport	-	CO_2	69,00737826	98,1702937	10	5	11,2	4,4	0,1	0,4	0,5	5,9	6,0
1.A.3	transport	-	CH_4	0,35552657	0,233062047	10	50	51,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.3	transport	-	N_2O	1,594620838	2,040424494	10	380	380,1	3,1	0,0	0,0	0,5	0,1	0,6
1.A.	commercial, resid.,	liquid fuels	CO_2	12,58829599	7,037510556	20	7	21,2	0,6	0,0	0,0	-0,2	0,9	0,9

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
4	agriculture…													
1.A.4	commercial, resid., agriculture…	liquid fuels	CH_4	0,032963897	0,017954727	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	liquid fuels	N_2O	0,010855993	0,005544904	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	solid fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	solid fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	solid fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	gaseous fuels	CO_2	0	0	20	7	21,2	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	gaseous fuels	CH_4	0	0	20	100	102,0	0,0	0,0	0,0	0,0	0,0	0,0
1.A.	commercial, resid.,	gaseous	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
4	agriculture…	fuels												
1.A.4	commercial, resid., agriculture…	other fossil fuels	CO_2	0	0	60	7	60,4	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	other fossil fuels	CH_4	0	0	60	100	116,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	other fossil fuels	N_2O	0	0	20	150	151,3	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	biomass	CH_4	0,007357025	0,009354308	60	100	116,6	0,0	0,0	0,0	0,0	0,0	0,0
1.A.4	commercial, resid., agriculture…	biomass	N_2O	0,000468988	0,000585934	60	150	161,6	0,0	0,0	0,0	0,0	0,0	0,0
1.B.1	fugitive emissions / solid fuels	-	CO_2	0	0	0	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1.B.1	fugitive emissions / solid fuels	-	CH_4	0	0	5	20	20,6	0,0	0,0	0,0	0,0	0,0	0,0
1.B.1	fugitive emissions /	-	N_2O	0	0	0	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	solid fuels													
1.B.2	fugitive emissions / oil & natural gas	-	CO_2	0,001348678	0,000797739	10	2	10,2	0,0	0,0	0,0	0,0	0,0	0,0
1.B.2	fugitive emissions / oil & natural gas	-	CH_4	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
1.B.2	fugitive emissions / oil & natural gas	-	N_2O	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
2.A	mineral industry	-	CO_2	0	0	2	2	2,8	0,0	0,0	0,0	0,0	0,0	0,0
2.B	chemical industry	-	CO_2	0	0	5	6	7,8	0,0	0,0	0,0	0,0	0,0	0,0
2.B	chemical industry	-	CH_4	0	0	2	2	2,8	0,0	0,0	0,0	0,0	0,0	0,0
2.B	chemical industry	-	N_2O	0	0	2	40	40,0	0,0	0,0	0,0	0,0	0,0	0,0
2.C	metal industry	-	CO_2	0	0	10	25	26,9	0,0	0,0	0,0	0,0	0,0	0,0
2.C	metal	-	CH	0	0	10	25	26,9	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	industry		4											
2.C	metal industry	-	SF_6	0	0	20	5	20,6	0,0	0,0	0,0	0,0	0,0	0,0
2. D	non-energy products from fuels and solvent use	-	CO_2	0	0	15	50	52,2	0,0	0,0	0,0	0,0	0,0	0,0
2.F	product uses as substitutes for ODS	-	HFC	0	0	20	20	28,3	0,0	0,0	0,0	0,0	0,0	0,0
3. A	enteric fermentation	-	CH_4	14,952	5,169836	20	40	44,7	0,9	0,0	0,0	-1,8	0,6	2,0
3.B	manure management	-	CH_4	0,76384	0,63232456	20	30	36,1	0,1	0,0	0,0	0,0	0,1	0,1
3.B	manure management	-	N_2O	1,59819035	1,346237854	20	50	53,9	0,3	0,0	0,0	-0,1	0,2	0,2
3. D. 1	direct N2O emissions from managed soils	-	N_2O	2,484409873	1,794607812	5	300	300,0	2,1	0,0	0,0	-1,1	0,1	1,1
3. D.	indirect N2O emissions	-	N_2O	0,63966953	0,499745552	5	300	300,0	0,6	0,0	0,0	-0,2	0,0	0,2

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
2	from managed soils													
3.F	field burning of agricultural residues	-	CH_4	0	0	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,0
3.F	field burning of agricultural residues	-	N_2O	0	0	30	100	104,4	0,0	0,0	0,0	0,0	0,0	0,0
3.G	liming	-	CO_2	0,0055	0,005133333	20	20	28,3	0,0	0,0	0,0	0,0	0,0	0,0
3.H	urea application	-	CO_2	0,0055	0,005133333	5	50	50,2	0,0	0,0	0,0	0,0	0,0	0,0
5.A	solid waste disposal on land	-	CH_4	-130,0152678	-140,3424357	10	20	22,4	12,5	0,0	0,6	-0,1	8,5	8,5
5.C	incineration and open burning of waste		CO_2	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
5.C	incineration and open		CH_4	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0

CRF	Category	Fuel	Gas	Base year(2008)	Last year (2018)	AD_uncertainty_%	EF_uncertainty_%	Combined uncertainty (%)	Contribution to Variance by Category *incl. LULUCF* (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend introduced by EF (%)	Uncertainty in trend introduced by activity data (%)	Uncertainty in trend *incl. LULUCF* (%)
	burning of waste													
5.C	incineration and open burning of waste		N_2O	16,49191366	10,3275189	10	40	41,2	1,7	0,0	0,0	-1,2	0,6	1,4
5.D	wastewater treatment and discharge	-	CH_4	0	0	10	100	100,5	0,0	0,0	0,0	0,0	0,0	0,0
5.D	wastewater treatment and discharge	-	N_2O	20,83634444	13,72546259	10	50	51,0	2,8	0,0	0,1	-1,8	0,8	2,0
		TOTAL		234,1	250,4				24,4					15,0

Mitigation Assessment Data

Table 8.10. Data for Figure 3.2. Population (a) and household (b) trends to 2050

Year	Population (Thousand persons)
2020	53.19
2022	53.86
2024	54.47
2026	54.99
2028	55.44
2030	55.83
2032	56.15
2034	56.40
2036	56.57
2038	56.69
2040	56.73
2042	56.72
2044	56.67
2046	56.55
2048	56.38
2050	56.16

Table 8.11. Data for Figure 3.2. Population (a) and household (b) trends to 2050

Year	Households (Thousands)
2020	23.54
2022	24.48
2024	24.76
2026	24.99
2028	25.20
2030	25.38
2032	25.52
2034	25.64
2036	25.71
2038	25.77
2040	25.79
2042	25.78
2044	25.76
2046	25.71
2048	25.63
2050	25.53

Table 8.12. Data for Figure 3.3. GDP (a) and GDP per capita (b) trends to 2050

Year	GDP/Million EC$
2008	1,959.09
2011	1,902.49
2014	2,083.44
2017	2,209.01
2020	1,972.98
2023	2,257.66
2026	2,446.16
2029	2,649.69
2032	2,893.87
2035	3,154.30
2038	3,424.55
2041	3,704.36
2044	3,999.71
2047	4,297.67
2050	4,611.12

Table 8.13. Data for Figure 3.3. GDP (a) and GDP per capita (b) trends to 2050

Year	GDP per Capita EC$/Capita
2008	41.74
2011	40.31
2014	41.50
2017	42.45
2020	37.09
2023	41.67
2026	44.49
2029	47.61
2032	51.54
2035	55.84
2038	60.41
2041	65.29
2044	70.58
2047	76.10
2050	82.11

Table 8.14. Data for Figure 3.6. Projected GHG emissions in the baseline by sector

GHG Emissions/ kt CO_2eq	Ag and Fisheries {1A4c}	Agriculture	Electricity Generation	Fugitive Emissions	Industry {1A2}	LULUCF	Residential {1A4b}	Services {1A4a}	Transportation {1A3}	Waste	Total
2008	0.4	20.4	154.4	0.0	4.4	-65.8	4.2	8.1	70.5	41.5	238.3
2012	0.3	10.6	169.2	0.0	4.4	-90.5	4.4	3.3	56.1	51.8	209.7
2016	0.3	8.3	178.2	0.0	5.4	-113.1	4.6	1.8	88.3	56.7	230.5
2020	0.3	8.2	167.2	0.0	5.1	-113.1	4.9	1.7	107.1	59.8	241.1
2024	0.3	9.7	189.5	0.0	5.9	-113.1	4.9	1.6	125.9	61.2	285.8
2028	0.4	10.7	210.6	0.0	6.4	-113.1	4.8	1.4	140.0	62.3	323.5
2032	0.4	12.0	230.5	0.0	7.0	-113.1	4.6	1.2	157.0	63.1	362.9
2036	0.5	13.5	245.2	0.0	7.7	-113.1	4.5	1.1	175.8	63.6	398.7
2040	0.5	15.0	266.2	0.0	8.4	-113.1	4.3	1.0	195.8	63.7	442.0
2044	0.6	16.6	274.6	0.0	9.2	-113.1	4.1	0.9	216.9	63.7	473.4
2048	0.7	18.3	292.6	0.0	9.9	-113.1	3.9	0.8	238.8	63.3	515.1
2050	0.7	19.2	301.3	0.0	10.2	-113.1	3.8	0.7	250.1	63.1	536.1

Table 8.15. Data for Figure 3.7. Projected net GHG emissions in the baseline by gas

Year	Carbon Dioxide/ kt CO_2eq	Methane/ kt CO_2eq	Nitrous Oxide/ kt CO_2eq	Total/ kt CO_2eq
2008	174.20	56.94	7.11	238.25
2010	169.66	64.22	6.72	240.60
2012	145.46	59.18	5.02	209.66
2014	142.12	60.25	5.20	207.57
2016	163.07	62.11	5.35	230.53
2018	179.91	64.40	6.76	251.07
2020	170.22	64.50	6.34	241.06
2022	191.63	65.72	6.83	264.19
2024	211.66	66.85	7.32	285.82
2026	228.43	67.76	7.67	303.86
2028	246.80	68.63	8.05	323.48
2030	265.21	69.45	8.47	343.13
2032	283.70	70.25	8.93	362.88
2034	301.31	70.99	9.42	381.72
2036	317.20	71.65	9.89	398.74
2038	332.45	72.27	10.39	415.11
2040	358.23	72.82	10.92	441.97
2042	368.45	73.32	11.42	453.19
2044	387.68	73.79	11.97	473.44
2046	407.52	74.19	12.51	494.22
2048	427.47	74.55	13.08	515.10

2050	447.54	74.87	13.65	536.05

Table 8.16. Data for Figure 3.8. Projected total net emissions in St. Kitts and Nevis under three scenarios and Figure 3.14. Projected total net emissions in St. Kitts and Nevis under three scenarios by 2050

	Scenario			
Year	**Baseline/ kt CO_2eq**	**Current mitigation actions/ kt CO_2eq**	**Additional mitigation actions/ kt CO_2eq**	**Total/ kt CO_2eq**
2008	238.25	238.25	238.25	714.75
2010	240.60	240.60	240.60	240.60
2012	209.66	209.66	209.66	628.99
2016	230.53	230.53	230.53	691.59
2020	241.06	237.03	236.61	714.70
2024	285.82	255.99	253.92	795.73
2028	323.48	207.48	201.49	732.45
2030	343.13	159.37	148.66	651.16
2032	362.88	167.13	152.44	682.45
2036	398.74	138.70	104.77	642.21
2040	441.97	158.27	116.27	716.51
2044	473.44	175.14	107.75	756.33
2048	515.10	189.94	104.66	809.70
2050	536.05	198.57	103.85	838.48

Table 8.17. Data for Figure 3.9. Projected total net emissions by sector under three scenarios

Categories/kt CO_2eq	**Ag and Fisheries {1A4c}**	**Agriculture**	**Electricity Generation**	**Fugitive Emissions**	**Industry {1A2}**	**LULUCF**	**Residential {1A4b}**	**Services {1A4a}**	**Transportation {1A3}**	**Waste**	**Total**
2010 BAS	0.34	20.39	170.93	0.00	4.22	-65.84	4.34	5.11	52.26	48.85	240.60
2010 CMIT	0.34	20.39	170.93	0.00	4.22	-65.84	4.34	5.11	52.26	48.85	240.60
2010 AMB	0.34	20.39	170.93	0.00	4.22	-65.84	4.34	5.11	52.26	48.85	240.60
2020 BAS	0.30	8.21	167.16	0.00	5.09	-113.10	4.88	1.67	107.08	59.77	241.06
2020 CMIT	0.30	8.21	163.49	0.00	5.09	-113.10	4.88	1.67	106.72	59.77	237.03
2020 AMB	0.30	8.21	164.81	0.00	5.09	-113.10	4.88	1.67	104.98	59.77	236.61
2030 BAS	0.41	11.36	221.00	0.00	6.70	-113.10	4.71	1.31	148.00	62.73	343.13
2030 CMIT	0.41	11.36	46.21	0.00	6.70	-116.49	4.71	1.31	143.40	61.75	159.37
2030 AMB	0.41	11.36	54.03	0.00	6.70	-116.49	4.71	1.31	124.87	61.75	148.66
2035 BAS	0.47	13.13	243.00	0.00	7.55	-113.10	4.51	1.14	171.09	63.47	391.27
2035 CMIT	0.47	13.13	0.56	0.00	7.55	-116.49	4.51	1.14	160.92	62.48	134.28

2035 AMB	0.47	13.13	3.10	0.00	7.55	-116.49	4.51	1.14	127.05	62.48	102.95

Table 8.18. Data for Figure 3.10. Projected total net emissions by gas under three scenarios

GHG/kt CO_2eq	Carbon Dioxide	Methane	Nitrous Oxide	Total
2010 BAS	169.66	64.22	6.72	240.60
2010 CMIT	169.66	64.22	6.72	240.60
2010 AMB	169.66	64.22	6.72	240.60
2020 BAS	170.22	64.50	6.34	241.06
2020 CMIT	166.21	64.50	6.32	237.03
2020 AMB	165.85	64.50	6.27	236.61
2030 BAS	265.21	69.45	8.47	343.13
2030 CMIT	83.12	68.27	7.99	159.37
2030 AMB	72.81	68.25	7.60	148.66
2035 BAS	310.29	71.33	9.65	391.27
2035 CMIT	55.32	70.05	8.91	134.28
2035 AMB	24.76	70.00	8.19	102.95

Table 8.19. Data for Figure 3.12. Current and projected power generation capacity under three scenarios

Technology/MW	Solar	Wind	Geothermal	Thermal	Total
BAS 2020	0.50	1.93	-	70.40	72.83
BAS 2030	0.50	1.93	-	54.80	57.23
BAS 2035	0.50	1.93	-	58.80	61.23
BAS 2050	-	-	-	77.50	77.50
CMIT 2020	0.50	1.93	-	70.40	72.83
CMIT 2030	36.20	8.53	10.00	54.80	109.53
CMIT 2035	36.20	8.53	25.00	35.30	105.03
CMIT 2050	59.40	29.60	25.00	4.00	118.00
AMB 2020	0.50	1.93	-	70.40	72.83
AMB 2030	36.20	8.53	10.00	54.80	109.53
AMB 2035	36.20	8.53	25.00	35.30	105.03
AMB 2050	76.70	47.60	25.00	4.00	153.30

Table 8.20. Data for Figure 3.13. Current and projected power generation under three scenarios

Technology/GWh	Solar	Wind	Geothermal	Thermal	Total
BAS 2020	0.96	4.89	-	231.10	236.95
BAS 2030	0.96	4.89	-	290.81	296.66
BAS 2035	0.96	4.89	-	320.38	326.24
BAS 2050	-	-	-	416.58	416.58
CMIT 2020	0.96	4.89	-	226.02	231.88
CMIT 2030	69.51	21.63	70.14	63.89	225.17
CMIT 2035	69.45	21.62	131.12	0.77	222.97
CMIT 2050	99.06	71.70	109.43	1.98	282.17

AMB 2020	0.96	4.89	-	227.85	233.70
AMB 2030	69.73	21.65	72.61	74.70	238.68
AMB 2035	69.76	21.66	148.84	4.29	244.55
AMB 2050	113.92	111.24	103.09	2.54	330.79

Table 8.21. Data for Figure 3.11 Projected Emission Reductions by Sector in the Mitigation Scenario Compared to the Baseline.

Branch/kt CO_2eq	**Baseline**	**Ag and Fisheries {1A4c}**	**Agriculture**	**Electricity Generation**	**Fugitive Emissions**	**Industry {1A2}**	**LULUCF**	**Residential {1A4b}**	**Services {1A4a}**	**Transportation {1A3}**	**Waste**	**Total**
2008	238.25	-	-	-	-	-	-	-	-	-	-	238.25
2010	240.6	-	-	-	-	-	-	-	-	-	-	240.6
2011	221.25	-	-	-	-	-	-	-	-	-	-	221.25
2014	207.57	-	-	-	-	-	-	-	-	-	-	207.57
2017	240.17	-	-	-	-	-	-	-	-	-	-	240.17
2020	241.06	-	-	-3.67	-	-	-	-	-	-0.36	-	237.03
2023	277.98	-	-	-19.41	-	-	-0.75	-	-	-1.03	-0.21	256.57
2026	303.86	-	-	-93.29	-	-	-1.88	-	-	-2.31	-0.53	205.85
2029	332.7	-	-	-116.43	-	-	-3.02	-	-	-4	-0.87	208.38
2030	343.13	-	-	-174.78	-	-	-3.39	-	-	-4.6	-0.98	159.37
2032	362.88	-	-	-184.65	-	-	-3.39	-	-	-6.72	-0.98	167.13
2035	391.27	-	-	-242.44	-	-	-3.39	-	-	-10.17	-0.99	134.28
2038	415.11	-	-	-248.82	-	-	-3.39	-	-	-13.94	-0.99	147.96
2041	448.02	-	-	-262.29	-	-	-3.39	-	-	-18.11	-0.99	163.23
2044	473.44	-	-	-271.16	-	-	-3.39	-	-	-22.76	-0.99	175.14
2047	504.56	-	-	-286.91	-	-	-3.39	-	-	-27.77	-0.99	185.5
2050	536.05	-	-	-299.9	-	-	-3.39	-	-	-33.2	-0.98	198.57

Table 8.22. Data for Figure 3.11. Projected emission reductions by sector in the mitigation scenario with additional actions compared to the baseline Figure 3.13. Current and projected power generation under three scenarios

Branch/kt CO_2eq	Baseline	Ag and Fisheries {1A4c}	Agriculture	Electricity Generation	Fugitive Emissions	Industry {1A2}	LULUCF	Residential {1A4b}	Services {1A4a}	Transportation {1A3}	Waste	Total
2008	238.25	-	-	-	-	-	-	-	-	-	-	238.25
2012	209.66	-	-	-	-	-	-	-	-	-	-	209.66
2016	230.53	-	-	-	-	-	-	-	-	-	-	230.53
2020	241.06	-	-	-3.67	-	-	-	-	-	-0.36	-	237.03
2024	285.82	-	-	-27.12	-	-	-1.13	-	-	-1.27	-0.32	255.99
2028	323.48	-	-	-109.18	-	-	-2.64	-	-	-3.42	-0.75	207.48
2032	362.88	-	-	-184.65	-	-	-3.39	-	-	-6.72	-0.98	167.13
2036	398.74	-	-	-244.27	-	-	-3.39	-	-	-11.38	-0.99	138.7
2040	441.97	-	-	-262.66	-	-	-3.39	-	-	-16.66	-0.99	158.27
2044	473.44	-	-	-271.16	-	-	-3.39	-	-	-22.76	-0.99	175.14
2048	515.1	-	-	-291.25	-	-	-3.39	-	-	-29.54	-0.99	189.94
2050	536.05	-	-	-299.9	-	-	-3.39	-	-	-33.2	-0.98	198.57