Second National Communication on Climate Change

Saint Vincent and the Grenadines

Prepared by: Noretta John
Prepared for: Ministry of Health, Wellness and the Environment
2015

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ACKNOWLEDGEMENT

The completion of this Second National Communication (SNC) would not have been possible without the assistance of key individuals and agencies. With this in mind, the Ministry of Health, Wellness and the Environment extends its sincere appreciation to the following:

- The Global Environment Facility (GEF) for funding the project
- The United Nations Development Programme (UNDP) for the support provided as the implementation agency
- The UNDP- National Communications Support Programme for reviewing several components of the document and providing valuable comments
- The Environmental Management Department, for serving as focal point and ensuring the implementations of activities to develop the SNC.
- To the project team (Project Coordinator, Administrative Assistant, Public Education Officer), contributors to the various chapters, the editors and compiler of the report.
- To the persons who provided data and participated in the consultations and training sessions
- To the media, for extending the reach of the project to the public by honouring invitations and disseminating information through news items

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LIST OF ACRONYMS

ACCC: Adaptation to Climate Change in the Caribbean

ACs: air conditioners

AIDS: Acquired Immune Deficiency Syndrome

AWMS: Animal Waste Management Systems

BAU: Business-as-usual

CAFE: corporate average fuel efficiency

CAFÉ: Corporate Average Fuel Efficiency

CARDI: Caribbean Agriculture Research and Development Institute

CARICOM: Caribbean Community Common Market

CCCCC: Caribbean Community Climate Change Centre

CCCDF: Canadian Climate Change Development Fund

CIDA: Canadian International Development Agency

CNCDs: Chronic Non-Communicable Diseases

COP: Conference of Parties

CPACC: Caribbean Planning for Adaptation to Climate Change

CWSA: Central Water and Sewerage Authority

DF: Dengue Fever

DHF: Dengue Haemorrhagic Fever

DOC: Degradable Organic Carbon

ECCB: Eastern Caribbean Central Bank

ECGC: East Caribbean Group of Companies

EIA: Environmental Impact Assessment

EMD: Environmental Management Department

ENSO: El Niño Southern Oscillation

ESE: East South East

FAO: Food and Agriculture Organisation

GCM: Global Circulation Model

GDP: Gross Domestic Product

GEF: Global Environment Facility

GHG: Greenhouse gas

GIS: Geographic information system

GoSVG: Government of Saint Vincent and the Grenadines

GPG: Good Practice Guidance

GWP: Global Warming Potential

HFCs: Fluorinated Hydrocarbons

HIV: Human Immunodeficiency Virus

IMF: International Monetary Fund

IMP: Integrated Pest Management

INC: Initial National Communication

INDC: Intended Nationally Determined Contributions

IPCC: Inter-governmental Panel on Climate Change

IPP: Independent power producer

ITCZ: Inter Tropical Conversion Zone

KAP: knowledge Attitude and Practice

LEAP: Long-range Energy Alternatives Planning System

LEED: Leadership in Energy and Environmental Design

LPG: Liquefied petroleum gas

LUCF: Land use change and forestry

MA: Mitigation Assessment

MACC: Mainstreaming Adaptation to Climate Change

MAFF: Ministry of Agriculture, Forestry and Fisheries

MARTIFF: Ministry of Agriculture, Rural Transformation, Industry, Forestry and Fisheries

MCF: Methane Correction Factor

MEAs: Multilateral Environmental Agreements

MOHE: Ministry of Health and Environment

MOHWE: Ministry of Health, Wellness and the Environment

MRV: Measurement, Reporting, and Verification

MSW: Municipal Solid Waste

NAMAs: Nationally Appropriate Mitigation Actions

NAO: North Atlantic Oscillation

NAP: National Action Programme

NCSA: National Capacity Self-Assessment

NEMS: National Environment Management Strategy

NGOs: Non-Governmental Organisation

OECS: Organisation of East Caribbean States

PAHO: Pan American Health Organisation

PV: Photovoltaic

RCM: Regional Circulation Model

SIDS: Small Island Developing State

SNC: Second National Communication

SPACC: Special Programme on Adaptation to Climate Change

SRES: Special Report on Emissions Scenario

SVG: Saint Vincent and the Grenadines

SVGMET: Saint Vincent and the Grenadines Meteorological Office

SWDSs: Solid Waste Disposal Sites

SWMU: Solid Waste Management Unit

UNCBD: United Nations Convention on Biological Diversity

UNCCD: United Nations Convention to Combat Desertification

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

US EPA: United States Environmental Protection agency

USA: United States America

USD: United States Dollars

V&A: Vulnerability and Assessment

VINLEC: St. Vincent Electricity Services Ltd

VOC: Volatile Organic Compound

WHO: World Health Organisation

XCD: East Caribbean Dollar

Units

cm: centimetre

Gg: gigagrams

GJ:gigajoules

ha: hectares

Kcal: kilocalorie

km: kilometre

kt: Kilotonne

KW: Kilowatt

kWh: kilowatt hour

M: Millon

mm: Milimetres

TJ: Terajoules

Ton: Tonne

Gases

C: Carbon

CH_4: Methane

CO: Carbon monoxide

CO_2: Carbon dioxide

CO_2e: Carbon dioxide equivalent

HFC: Hydrofluoro Carbon

N_2O: Nitrous oxide

NMVOC: Non-methane volatile organic compound

NO_x: Nitrogen Oxides

O_3: Ozone

SO_2: Sulphur Dioxide

GLOSSARY

Activity data: According to the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, are defined as data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time.

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Biomass: Materials that are biological in origin, including organic material (both living and dead) from above and below ground, for example, trees, crops, grasses, tree litter, roots, and animals and animal waste.

Bunker fuels: A term used to refer to fuels consumed for international marine and air transport.

Census division: The largest geographic areas into which St Vincent and the Grenadines is divided for the purpose of the census administration.

Climate change: According to the UNFCCC, this refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Climate change projections: model-derived estimates of future climate.

Climate Model: A quantitative way of representing the interactions of the atmosphere, oceans, land surface, and ice

Conference of the Parties (COP): The supreme body of the Convention. It currently meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association". The "Conference" meets in sessional periods, for example, the "fourth session of the Conference of the Parties."

Emission categories: Emission estimates are presented in accordance with the categories of the Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas

Inventories (1996). The category "National Total" does not include emissions resulting from fuel sold for use in ships or aircraft engaged in international transport (international bunker fuel emissions).

Emission factors: An emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity.

Emissions: The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Global warming potential (GWP): An index representing the combined effect of the differing times greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

Greenhouse gas: Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. E.g Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Gross domestic product: According to the World Bank, gross domestic product (GDP) is defined as the measure of the total output of goods and services for final use occurring within the domestic territory of a given country, regardless of the allocation to domestic and foreign claims.

Implementation: Actions (legislation or regulations, judicial decrees, or other actions) that governments take to translate international accords into domestic law and policy.

Intergovernmental Panel on Climate Change (IPCC): Established in 1988 by the World Meteorological Organization and the UN Environment Programme, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.

International Bunkers: Emissions resulting from fuel use in ships or aircraft engaged in international transport.

Mitigation: In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere.

National communication: A document submitted in accordance with the Convention (and the Protocol) by which a Party informs other Parties of activities undertaken to address climate change. Most developed countries have now submitted their fifth national communications; most developing countries have completed their first national communication and are in the process of preparing their second.

Party: A state (or regional economic integration organization such as the European Union) that agrees to be bound by a treaty and for which the treaty has entered into force.

Ratification: Formal approval, often by a Parliament or other national legislature, of a convention, protocol, or treaty, enabling a country to become a Party.

Reference approach: a top-down approach, using a country's energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuel

Scenarios: A plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships.

Sink: Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

Uncertainty: An expression of the degree to which a value (e.g. the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in

the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g. a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgement of a team of experts).

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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PREFACE

It is said that necessity unites, a proverb that was clearly demonstrated in 1992 in Rio de Janiero when birth was given to the United Nations Framework Convention on Climate Change (UNFCCC). This Convention seeks to stabilise greenhouse gas (GHG) concentrations at a level that would prevent dangerous anthropogenic or human induced interference with the climate system. Recognizing its vulnerability and the benefits to be derived from collective global responsibility and action, Saint Vincent and the Grenadines ratified the convention on the 5th of September 1996. By so doing, the country has committed to develop, periodically update, publish and make available to the Conference of the Parties (COP) national inventories of anthropogenic emissions by source and removal by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change.

Therefore, the preparation of this this Second National Communication (SNC) allows Saint Vincent and the Grenadines to fulfill this commitment. Additionally, it will build upon lessons learnt, skills developed and progress made in adapting to climate variability and change during the preparation of the Initial National Communication (INC). The INC was submitted in 2000.

The development of the report was financed by Global Environment Facility (GEF), implemented by the United Nations Development Programme (UNDP) and Executed by the Ministry of Health, Wellness and the Environment. The process required the involvement of international and local consultants, government employees and civil society for traditional knowledge, data collection and writing of chapters amongst other things. The assistance of the UNDP- National Communications Support Programme was solicited for the review of the document. Moreover, a public education and awareness campaign was also built in to the project to inform the populace of its progress, the issue of climate change and its effects to facilitate public participation in developing adequate response.

The SNC will report on National Circumstances; GHG Inventory, Mitigation Assessment, Vulnerability Assessment, Other Information Considered Relevant to the Achievement of the

Objective of the Convention, and Constraints and Gaps, and Related Financial, Technical and Capacity Needs.

The SNC process is expected to enhance Saint Vincent and the Grenadines awareness and knowledge of climate change related issues and strengthen its mainstreaming into the national planning and development framework. Additionally, it is expected to contribute to the global objective of stabilizing GHG concentration in the atmosphere by providing greater understanding of sources and sinks.

EXECUTIVE SUMMARY

Saint Vincent and the Grenadines is an archipelagic state in the south eastern Caribbean consisting of 32 islets and cays. It has a population of 109,188 (Preliminary Census report, 2012) occupying a total land area of 359 square kilometers. The main island, St. Vincent, lies at latitude 13^{o} 15' N and longitude 61^{o} 15' whilst the other islands, called the Grenadines (low-lying with no point higher than 304.8 metres (m), stretch a distance of 72 kilometeres (km) to the southwest. There are eight inhabited islands in the Grenadines: Young Island, Bequia, Mustique, Union, Canouan, Mayreau, Palm Island, and Petit St. Vincent.

Saint Vincent and the Grenadines experiences two distinct rainfall periods - the wet season and the dry season. The former occurs from June to November, which coincides with the Atlantic hurricane season, while the latter occurs between December and May. On average, the main island, St Vincent, receives 219 cm of rainfall per year, making it one of the wetter islands of the Eastern Caribbean while the Grenadines receive an estimated 100 cm.

Saint Vincent and the Grenadines has a tropical climate with an average monthly temperature of 27^{0}C with little diurnal variation. Temperature peaks in the rainy season between May and October where it can reach a high of 31^{0}C, and it can get as low as 23^{0} C in February during the dry season. Noteworthy are recent claims by residents of some unusually hot (hotter than usual) days. Empirical data from the Meteorological Office seems to support this claim as they have shown a warming trend over the past 22 years for both the maximum and minimum temperatures. However, the trend is not statistically significant at the 95 per cent level.

Relative humidity is high throughout the year (above 70 per cent) and predictably highest during the rainy period. The evaporation rate is highest during the late dry season and into the early wet season. This is consistent with lowest relative humidity, which increases further into the rainy season. Several weather systems affect Saint Vincent and the Grenadines annually and include: the tropical Atlantic high pressure system which brings most of the rain, the Inter-Tropical Conversion Zone (I.T.C.Z) and the El Nino Southern Oscillation (ENSO).

The soils of Saint Vincent and the Grenadines are considered to be fertile, highly permeable and

susceptible to erosion. They are grouped into five categories: shoal; alluvial; recent volcanic ash; yellow earth; and central mountain. Additionally, forest covers approximately 29 - 35 per cent of the country. Most of it consists of natural forests concentrated in the central mountain region of St. Vincent. The combination of natural vegetation, mountainous terrain, and climate gives rise to a network of streams which provides the main source of potable water on the main island. Three rivers are used to produce approximately 20 per cent of the nation's electricity. Conversely, the main sources of fresh water in the Grenadines come from harvested rainwater from house roofs, concrete communal rainwater catchment systems, and desalination plants. To a lesser extent, groundwater is sourced from wells and rainwater collected in ponds for construction and livestock production.

The country has a small open economy which is highly susceptible to external shocks and natural disasters. Production is focused on a narrow range of goods and services, most of which are exported while relying heavily on imports to satisfy local demand for consumer and producer goods. During the period 2000 to 2013, the economy grew by a real annual average of 2.48 per cent. Furthermore, the real growth of the economy ranged from weak to relatively strong, ranging from a low of – 3.36 per cent in 2010 to a high of 7.69 per cent in 2003.

Given the need to protect its fragile environment, Saint Vincent and the Grenadines has signed and/or ratified several Multilateral Environmental Agreements (MEAs) including the United Nations Convention on Biological Diversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC). The island ratified the UNFCCC on December 2, 1996.

As a Party to the UNFCCC, the Country has committed to develop, periodically update, publish and make available to the Conference of Parties (COP), national inventories of anthropogenic emissions by source and removal by sinks of all Green House Gas (GHG) not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to the adverse impacts of climate change. This is done via national communications. To fulfil its obligations under the Convention, the island submitted its Initial National Communication (INC) to the sixth COP in The Hague in November 2000.

This Second National Communication (SNC) reports GHG emissions and removals by sinks for the years 2000 and 2004 and revised emissions in the INC. The inventory was conducted for the years 2000 and 2004 in six sectors: Energy; Industrial Processes; Solvents and Product Use; Agriculture; Land Use; Land Use Change and Forestry (LUCF) and Waste. It took into consideration direct GHGs - *Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O) and partially Fluorinated Hydrocarbons (HFCs)* and indirect GHGs that contribute to tropospheric ozone (O_3) formation - *Carbon Monoxide (CO*), *Non-Methane Volatile Organic Compounds (NMVOC), and Nitrogen Oxides (NO_x).*

The Revised 1996 Inter-governmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Volumes 1, 2 and 3) along with the accompanying software in Microsoft Excel were used as the basis to undertake the required calculations for GHG emissions and removal. In addition, the IPCC Good Practice Guidance (GPG) complementary to the Revised 1996 Guidelines, was used to update emission factors or other default conversions factors where enough data was available. CO_2 emissions from International Bunkers and burning of biomass were calculated and reported separately from the national totals as memo items. Moreover, a Tier 1 uncertainty assessment was also conducted base on guidance provided in the Revised 1996 IPCC Guidelines and the IPCC GPG 2000 Guidelines.

The revision of emissions in the INC was based on the recommendations of the IPCC to make use of more accurate activity data and emission factors. This was done for reference years 1990, 1994 and 1997. A notable change in the revision of the inventory is the LUCF sector which moved from acting as a significant sink to being a significant source of emissions. The reason for this difference is attributed the fact that forests in Saint Vincent and the Grenadines were classified as regenerating forests which sequester large amounts of carbon when in reality these forests, overtime, have had little change to their carbon stocks.

The results of the 2000, 2004 inventory showed that the energy, LUCF and waste sectors contributed to either CO_2 emissions or removal with the energy sector presenting a significant increase in CO_2 emissions. In addition, there was an increase in the net sink of emissions in the LUCF sector due to a slower rate of deforestation and natural regeneration of biomass in managed forests. Generally, there was an increase in net emissions of CO_2 from 1994 to 2004 by

approximately 78 per cent.

In terms of non-CO_2 emissions, the major source of CH_4 was from landfills in the waste sector while the major source of N_2O emissions was from the agricultural sector, especially the use of manure as a fertiliser. The major source of NO_X, CO, NMVOC and SO_2 emissions was the energy sector. The Solvents and Product Use and the Industrial Processes sectors were also significant contributors to NMVOC. The only source of HFCs came from the Industrial Processes sector.

A comparison of non-CO_2 emissions from 1994 to 2000 and 2004 shows an increase in emissions for CH_4, N_2O, CO, NMVOC, and SO_2 and a decrease in emissions for NO_x. The increase in CH_4 emissions is attributed to an increase in the quantities of solid waste produced and sent to the landfill. The increase in CO and SO_2 emissions is due to an increase in the quantities of diesel fuel used for electricity generation and transportation, and the increase in N_2O emissions is linked to the increased application of synthetic nitrogen fertilizers in agriculture. Conversely, a reduction in the practice of field burning of agricultural residues has led to a decline in NO_x emissions.

HFCs were not included in the 1994 inventory, however, an increase in emissions was noted between 2000 and 2004 due to the increased importation of HFC-containing products. It is worth noting that there are substantial uncertainties (uncertainty analysis suggests: 2004 is ±30 per cent) related to GHG emissions and removals because of the lack of data and use of assumptions.

Similar to other small island developing states (SIDS), Saint Vincent and the Grenadines' contribution to global CO_2 is minimal. Nevertheless, in the global fight against the negative effects of climate change, every action counts. A mitigation assessment (MA) was conducted in 2011 to evaluate the potential impacts of various technologies and practices which can mitigate climate change, while also supporting sustainable development in Saint Vincent and the Grenadines. The assessment used 2010 as the base year and was done up to 2025 for six sectors: Transport, Residential, Commercial-Tourism, Waste, Agriculture, and Industrial Processes.

The assessment was based on the UNFCCC guidance which involves two major steps: (1)

development of a baseline scenario, which projects GHG emissions assuming no additional emission reduction measures (i.e. a "business-as-usual" (BAU) scenario); and (2) development of mitigation scenarios, which project GHG emissions assuming additional defined emission reduction measures. The Long-range Energy Alternatives Planning System (LEAP), a flexible "bottom up" modelling framework was used to prepare the scenarios because it was proven advantageous to developing island states.

The BAU baseline scenario was developed using three main steps:

- Step 1 - GHG emissions for year 2010 were estimated for the main economic sectors based on the existing year 2004 Saint Vincent and the Grenadines GHG Inventory developed for the SNC along with additional data.
- Step 2 - Emissions and energy consumption were allocated to sector end-uses based on available data and reasonable assumptions.
- Step 3 - Future GHG emissions were estimated based on forecasts of growth as well as historical trends and assumptions regarding technology adoption.

After establishing the baseline, two mitigation scenarios were developed and analysed. The process involved the following steps:

- Step 1 – The selection of the measures to be analysed through a stakeholder process.
- Step 2 – Individual analysis of the measures.
- Step 3 – Analysis of the combined effect of the measures (Mitigation Scenario #1 and then for Mitigation Scenario #2).

Mitigation Scenario #1 includes nine measures: adopt standards and guidelines for the construction of energy efficient buildings; set energy performance standards for the importation and sale of major energy consuming equipment and appliances; revise the car taxation system to provide incentives for the purchase and use of fuel-efficient passenger cars and other vehicles; provide information to the public on the fuel consumption of different vehicle models that are

commonly imported; implement programmes of reforestation and agroforestry; implement programmes for the reduction of deforestation; introduce a composting programme for the commercial sector; implement a program for the installation of grid-connected wind and PV power systems; and, implement energy related education and training from primary to tertiary level, and implement public awareness campaigns to promote energy conservation and waste reduction.

Mitigation Scenario #2 includes twelve measures which, in addition to the nine in mitigation scenario # 1, includes: waste reduction across all sectors; undertake sustainable development of geothermal resources in the Soufriere Resource Area; and, support the development of innovative financing mechanisms for the deployment of solar water heaters.

The results of the baseline scenario projects an overall 65 per cent increase in GHG emissions for the period between 2010 and 2025, or an average annual increase of 3.4 per cent. That is, emissions are projected to rise from 407,199 tonnes (tons) in 2010 to 673,738 tons in 2025. Results from the sectors for the forecast period indicate the residential, transport, and commercial – tourism sectors are all projected to have increasing emissions, with commercial – tourism having the fastest growing emissions. On the other hand, the industry, waste, agriculture, forestry, and fishing sectors are all projected to have decreasing emissions.

The results also revealed that except for Measure #11, geothermal power, no single measure will generate large, economy wide emission reductions. Therefore, achieving significant national emission reductions will need a diverse range of mitigation measures, addressing the full range of sectors and emission sources. Notwithstanding this general observation, certain sectors present opportunities for relatively larger emission reductions, when compared against other measures. Among the measures considered, the largest emission reductions were generated by new building standards and guidelines and by changes to the vehicle taxation system. Emission reductions generated by these measures would continue to grow after 2025, particularly in the case of buildings, vehicles, and equipment with a long service life.

Besides GHG emission reduction, the measures also offer a wide range of important co-benefits. Similarly to the GHG inventory, there are uncertainties in the emissions projected for both

scenarios since they only give an indication of what emissions might be, based on a defined set of future events and plausible assumptions.

With this in mind, to adequately address climate change, one needs to go beyond mitigation to adaptation. As a result, using literature review, traditional knowledge, climate models and expert judgment, a vulnerability and adaptation assessment was conducted in five sectors: agriculture, coastal zone, health, water and tourism.

According to the vulnerability assessment, the agricultural system in Saint Vincent and the Grenadines is based on the production of crops and animals. The former relies on the rainy season for planting making the sector vulnerable to changes in climatic patterns; livestock production is also vulnerable to climate change as increased heat can affect the body temperature of animals and their functioning. In addition, grazing is affected during the dry season as pastures are void of grass.

The coastal zone is also threatened by climate change since more than 90 per cent of the critical infrastructural development lies on a narrow coastal belt less than eight metres (m) above sea-level. Any disruption at this zone such as storm damage or shoreline inundation would therefore be catastrophic to the economy and social dynamics. Moreover, most of the marine support structures — mangroves and reefs — have been severely affected by higher than normal sea surface temperatures and droughts followed by massive storm surges.

Like other sectors, the Health sector is affected by a change in climate. There is the burden of climate sensitive diseases or other related conditions resulting from climate change such as temperature-related morbidity and mortality although some causes of death have been exacerbated by heat. Moreover, too little or too much water can facilitate the spread of water and vector borne diseases such as Malaria, Dengue and Leptospirosis. Leptospirosis has shown an upward trend in the past 12 years. Noteworthy is that during the years 2002, 2004, 2005 and 2007, when there were tropical storms or hurricanes (which also resulted in some flooding) the rates of infection were high.

The Water sector is also subject to the negative effects of climate change since the country depends heavily on rainfall to supply its network of rivers and for water harvesting. It is worth

mentioning that despite the apparent abundance of surface water in St Vincent, the country experiences water shortage during the dry season and occasionally reverts to rationing of potable water.

Saint Vincent and the Grenadines is shifting its economy towards tourism. This industry interacts with, and is supported by, other sectors such as: energy, health, agriculture, social development, housing and the environment. Thus, the impacts of climate change on tourism are, therefore, the cumulative impacts on these sectors. With this in mind, the estimated impact of climate change on the tourism product of small island states and by extension Saint Vincent and the Grenadines is expected to be strongly negative.

Given the sectors' current vulnerabilities, rainfall and temperature were projected for Saint Vincent and the Grenadines through the end of the century. This was done using a consensus of an ensemble of 15 General Circulation Model (GCMs) for the 2030s, 2060s, and 2090s. The data used are compiled in United Nations Development Programme (UNDP) Climate Change Country Profile report and represent future change under three GHG emission scenarios: AIBI (medium emissions), A2 (high emissions) and B1 (lower emissions).

According to the models, mean temperature is expected to increase by 0.15^0 C per decade over the next century. A similar warming trend was projected for seasonal changes. In addition, the frequency of hot[1] days and nights is also expected to increase by the end of the century while cold[2] days and nights show significant decline, almost reaching nonexistence by the 2060s.

Furthermore, most models point to a reduction in rainfall with negative median values ranging from 10 per cent to 22 per cent annually by 2090s. They also suggest drying in the wet season from June to November, with the greatest seasonal change seen in the summer months (7.1 per cent per decade). A reduction in the rainy season will significantly affect water availability.

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[1] *'Hot' day or 'hot' night is defined by the temperature exceeded on 10% of days or nights in current climate of that region and season*

[2] *'Cold' days or 'cold' nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season.*

According to predictions from the IPCC, the future hurricanes of the north tropical Atlantic will likely become more intense, with larger peak wind speeds and heavier near storm precipitation. Similar to projections for hurricanes, the IPCC's projections were relied on to estimate sea level rise. It is estimated that changes in the Caribbean are expected to be near the global mean. What's more is that all models show continued ENSO inter-annual variability.

The adaptation assessment showed Saint Vincent and the Grenadines is already adapting to the adverse impacts of climate change albeit on a low level and without consciously associating their implementation to addressing the issues of climate change. Some of the adaptive measures include: (a) soil conservation measures to deal with run-offs, especially on hillside farms; (b) control and restriction of sand mining; (c) a national solid waste management program which prohibits open burning; (d) renewable energy and energy efficient programs in the Hotel sector; and, (e) ground water exploitation and protection of water catchment areas. It is expected to see new areas of adaptation as the need arises. Therefore, it will be imperative to mainstream climate change adaptation into the national development process as it ensures effective adaptation and gives climate change more prominence at the national level.

Additionally, several actions have been undertaken nationally towards the achievement of the objective of the Convention and forming linkages with others. On the local level, these include integrating climate change consideration into some policies and legal instruments which govern some sectors. Regionally, Saint Vincent and the Grenadines is signatory to the *St George's Declaration of Principles for Environmental Sustainability*, the overarching environmental policy of Eastern Caribbean States. Moreover, Saint Vincent and the Grenadines has participated in other regional initiatives/actions which address climate change such as: the Caribbean Planning for Adaptation to Climate Change (CPACC) Project; and the Special Programme on Adaptation to Climate Change (SPACC) Project.

There were public awareness and education components built into these projects to increase awareness and understanding of climate change in the Vincentian population. There are also on-going, though limited initiatives, being undertaken by the Ministry of Health and the Environment, several non-governmental Organisation (NGOs) and minimal private sector involvement.

Saint Vincent and the Grenadines faces several challenges in implementing its obligations under the UNFCCC. During the SNC process they included administrative delays, slow response time from resource persons to deliver relevant information and technological failure. Additionally, there were gaps and constraints which can be summarized as follows: the absence of adequate financial resources to undertake climate change activities; inadequate levels of human resources; lack of requisite data, limited impact of the public awareness and education of the threat of climate change and the actions which can be taken to mitigate and adapt to the adverse impacts; and insufficient institutional coordination amongst the relevant departments/agencies.

Therefore, if Saint Vincent and the Grenadines is to effectively mitigate and/or adapt to the adverse impacts of climate change and meet its future obligation to the UNFCCC, there is a need for targeted actions. These actions include, but not limited too: capacity building, systematic observation and research and data collection; development and implementation of climate change related policies and strategy documents; increased public awareness initiatives, including strengthening community-based natural resource management programmes; engendering a cooperative approach to policy implementation among stakeholders; and, establishing a national climate change committee or other coordinating body for climate change. This could lead to more access to funds from donor agencies, more informed decision making at the level of policy makers and engender a sustained national effort to implement measures to mitigate and adapt to the adverse effects of climate change.

Chapter 1: National Circumstances

1.1 Location and Size

Saint Vincent and the Grenadines also known as 'Hairoun (a)', is an archipelagic state comprising 32 islets and cays in the Lesser Antilles, in the south eastern Caribbean. Saint Vincent, where Kingstown, the capital is located, is the largest of the islands with a size of 344.5 square kilometres (km^2). It is located at 13° 15' N, 61° 12' W with its closest neighbours being Grenada, 120 kilometres (km) to the south, St. Lucia 40 km to the north and Barbados 160 km to the east as seen in *Figure 1*. The Grenadines, which extends 1.6 km to the southwest of the mainland, Saint Vincent, covers a land area of approximately 44 km^2. However, only eight islands of the Grenadines are inhabited: Young Island, Bequia, Mustique, Canouan, Mayreau, Union Island, Palm Island, and Petit St. Vincent. The other islets, rocks and cays that make up Saint Vincent and the Grenadines are mostly uninhabited, volcanic, rugged in terrain and difficult to access in many areas.

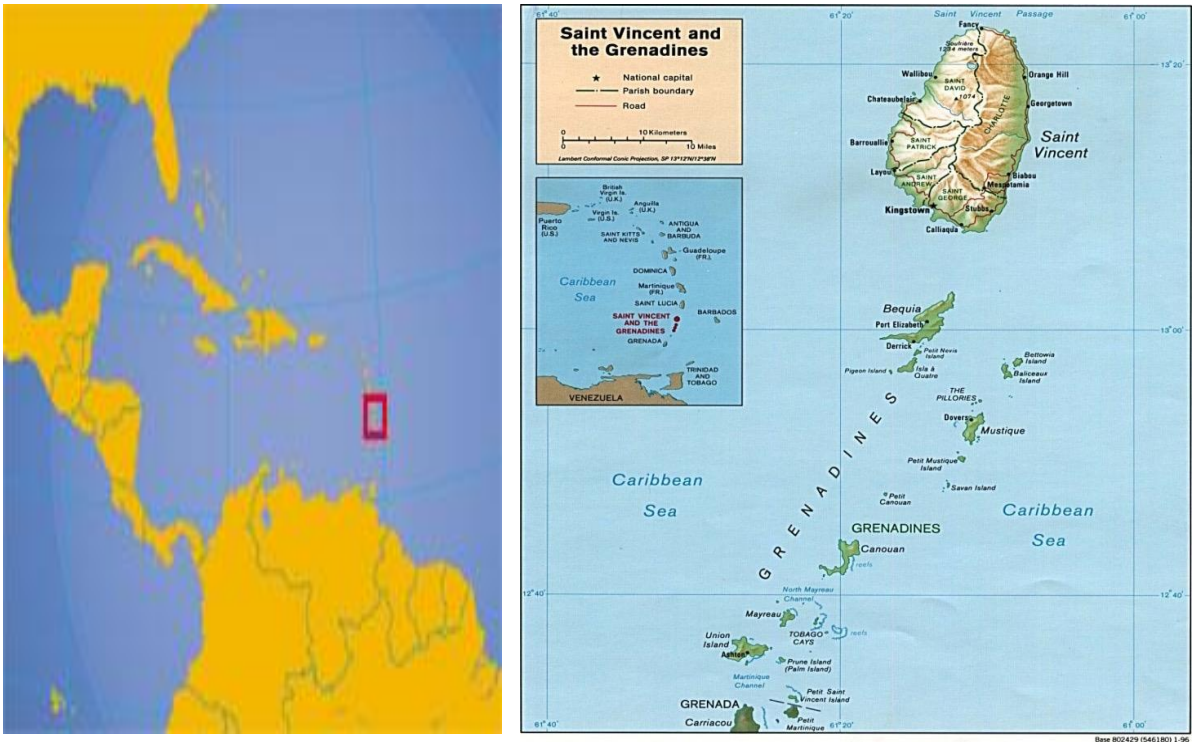


Figure 1: Location Map of St Vincent and the Grenadines. Source: Google Earth

As part of the Caribbean, its geographical coordinates places it in the Caribbean Hurricane Belt[3]. This makes it susceptible to hurricanes during the Atlantic hurricane season which commences on the first of June and ends on the thirtieth of November, annually. In addition, climate change projections predict that the region will be affected negatively by sea level rise, increase intensity of hurricane, decrease in precipitation and temperature rise. If these projections hold true, Saint Vincent and the Grenadines need to make sure that measures are put in place to adequately adapt to the impact of climate change.

1.2 Topography

Saint Vincent is of volcanic origin and mountainous in nature; the central mountain range that stretches from north to south along the entire length of the island is considered to be the island's main topological feature. The northern most part of the range is home to the island's active volcano, the La Soufriere, which is the highest point on the island at approximately 1233.8m above mean sea level. On the other hand, the southernmost part of the range consists of several noteworthy elevations namely Richmond Peak (1073.8m), Mt. Brisbane (932.1m), Grand Bonhomme (969.6m), Petit Bonhomme (756.2m), and Mt. St. Andrew (735.5m).

The range is characterised by lateral spurs which radiate outwardly to the east and west, giving rise to deep narrow stream filled valleys that drain unto predominantly black sand beaches. On the eastern (windward) side of the island the relief is gently rolling with a somewhat straight coast line. In contrast, the western (leeward) side is characterised by steep ridges and deep narrow valleys, extending down the sheltered coast.

Similar to the mainland, the Grenadines are volcanic in origin, however, they are low-lying with no point higher than 304.8m. In addition, there are coral formations on these islands that give rise to white or beige sand beaches. The low-lying nature of the islands makes them vulnerable to the expected effects of sea level rise.

[3] *Caribbean Hurricane Belt is an area in the Atlantic, including the Caribbean Sea and Gulf of Mexico that has a high level tendency to get hit by a hurricane. (Source: Caribbean Hurricane Belt, 2014)*

1.3 Soils

The soils of Saint Vincent and the Grenadines were affected by the eruptions of the island's Volcano which recorded five (5) major eruptions over the last 300 years (1717, 1812, 1902, 1971- 1972 and 1979). They are grouped into (5) five major categories which include:

1. High-level yellow earth: soils that have been rejuvenated by falling ash from volcanic eruptions. These occur above the 182.9m contour elevation.

2. The recent volcanic ash: soils which are unconsolidated, coarse-textured porous soil covering the northern third of the island.

3. The alluvial: soils deposited by streams flowing out of the mountains hence they are found in the valley bottoms mainly in the south west of the island.

4. Shoal: soil occurring in coastal areas along the south and southwest of the island and

5. The central mountain: soils which occur in high rainfall areas on approximately 20 per cent of the island. These soils are very vulnerable to sheet erosion.

1.4 Water Resources

The terrain on St. Vincent has given rise to a dense river network consisting of small, relatively short and straight rivers. There are, however, several large rivers including: Colonaire, Richmond, Yambou, Buccament and Wallilabou Rivers. Although most of these rivers flow year round, there are some seasonal ones located mainly in the north of the island, including the famed Rabacca River commonly called the "dry river". This river has a large base flow even during the dry season but is normally dry at its mouth because of the high permeability of the river bed material. Historically, high intensity rainfall will cause the flow to increase to a volume that would impede traffic beyond the river. Persons living to the north of the river would be "cut off" from the rest of the island until the river has subsided. However, residents in the area claim such occurrence is decreasing with time.

The rivers on the island are the main source of water supply. The Central Water and Sewerage

Authority (CWSA), the lone provider of water, uses a gravity-fed system to supply potable water to domestic, industrial and business consumers. Hydroelectricity is generated from three large rivers (Cumberland, South Rivers and Richmond) by the island's lone electricity provider – the St Vincent Electricity Services Limited (VINLEC). This production contributes to approximately 20 per cent of the national electricity supplied. On the north eastern side of the country, five irrigation schemes were commissioned to supply water to about 445.2 hectares of agricultural land to the north western side of the island.

Additionally, a few natural springs indicate the presence of ground water, however, little is known about the quantity of this water source as the main island's water demand is met by the rivers. The country rarely experiences severe supply constraints, although there have been occasional periods of moderate water shortage during the dry season. Noteworthy is the drought of 2000 where severe drought conditions were experienced for five of the six months in dry season. Notwithstanding this, anecdotal evidence points to deteriorating stream flow which has implications for future water supply.

In the Grenadines, the land masses are too small and impermeable to support stream dynamics, therefore, the situation regarding water supply differ significantly from the mainland. The main sources of fresh water in these islands come from rainwater harvesting systems, concrete communal rainwater catchment systems and desalination plants. To a lesser extent, groundwater is also sourced from wells and rainwater collected in ponds. Water from these two sources is used for construction and livestock. These islands are, therefore, highly stressed for water especially during the dry season.

1.5 Climate

Saint Vincent and the Grenadines enjoys a tropical climate with an annual mean temperature of 27^0C. On the main island, St Vincent, rainfall occurs in a concentric pattern with annual rainfall ranging from 1,700 mm in coastal areas and increasing inward to the central mountain range to about 7,000 mm (*see Figure 2).* However, most of the rainfall occurs on the windward (eastern) side of the central mountain range due to orographic uplift. St Vincent receives on average 219 cm of rainfall per year, making it one of the wetter islands of the Eastern Caribbean while that

for the Grenadines is estimated at 100 cm. The island experiences two distinct rainfall periods - the wet season and the dry season. The wet season occurs from June to November, coinciding with the region's hurricane season; lower rainfall is experienced during the dry season which begins in December and ends in May. The island receives about 70 per cent of its total annual rainfall during the rainy season (June to November). This season coincides with the period of highest tropical storm activity in the Caribbean and peaks in September to November where it receives 40 per cent of the total rainfall. It is during this period that the country experiences severe land and coastal erosion from landslides associated with torrential rains and storm surges as a result of tropical waves, depressions, storms or even hurricanes. The island also suffers infrastructural damage and crop loss due to high winds.

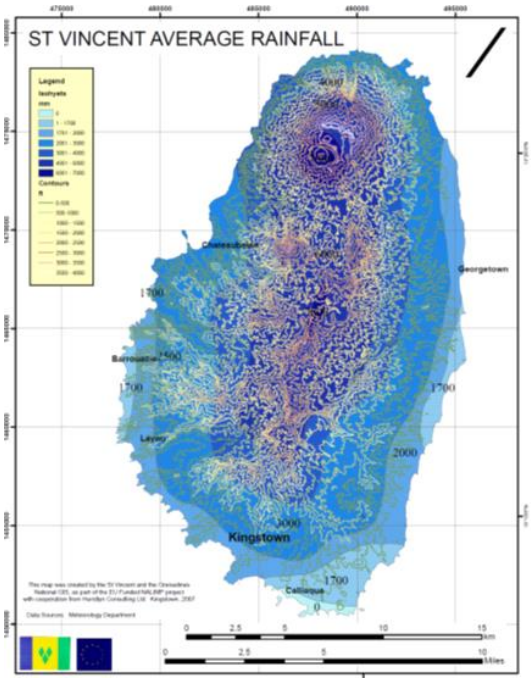


Figure 2: Saint Vincent's Rainfall Map. Source: Physical Planning Unit

In addition, calculated rainfall indices show an increase in the number of heavy rainfall events which occur in a year. This is reflected in the increase in the number of days with rainfall between 10-20 mm (R10) and the number of consecutive wet days. This trend is also reflected in the increase in some rainfall intensity indices e.g. daily intensity, maximum consecutive five day rainfall, and maximum one day rainfall. However, extremely wet days (days with rainfall

occurring at levels higher than the 99th percentile, R99) occur with less frequency as the historical record progresses.

Mean temperatures vary by 2^0C throughout the year. Similarly to rainfall, it peaks in the rainy season between June and October. During these months maximum temperatures can reach a high of 31^0C, while minimum temperatures can be as low 23^0C in February. The island's highest temperatures on record were experienced in 1998 during a major El Niño event. There have also been complaints by citizens of some unusually hot day. Empirical data obtained from the Meteorological Office at the E. T. Joshua Airport appears to support this claim as it has shown a warming trend over the past 22 years for both the maximum and minimum temperature. The trend is however not statistically significant at the 95 per cent level. This warming is consistent with the rest of the Caribbean (Akhtar et al. 2007) and the globe (Alexander et al. 2006). In keeping with global averages, maximum temperatures for St. Vincent and the Grenadines are increasing at a slightly faster rate (0.2° C/decade) than minimum temperatures (0.15°C/decade) as seen in *Figure 3.*

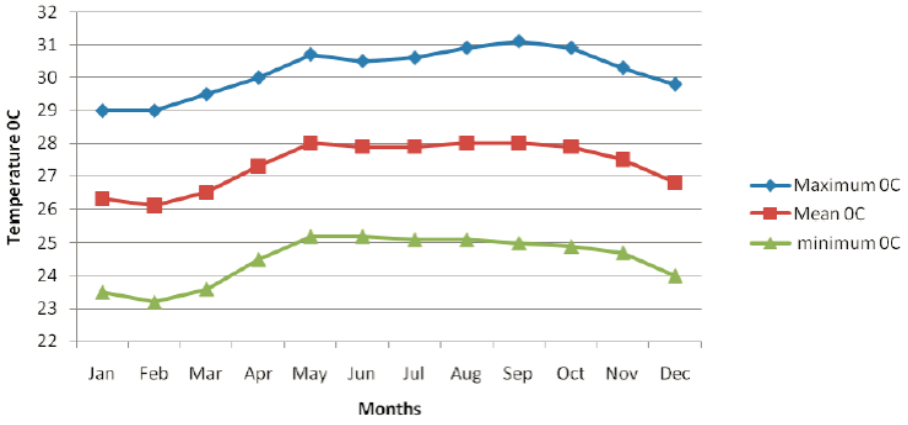


Figure 3: The climatology of minimum, maximum and mean temperatures for Saint Vincent. Source: ET Joshua Airport 1987-2008

Additionally, temperature indices support the conclusion that warm days (TX9O) and nights have increased over the last two decades (*Figure 4*) and cool days (TX1O) and nights have decreased *(Figure 5*).

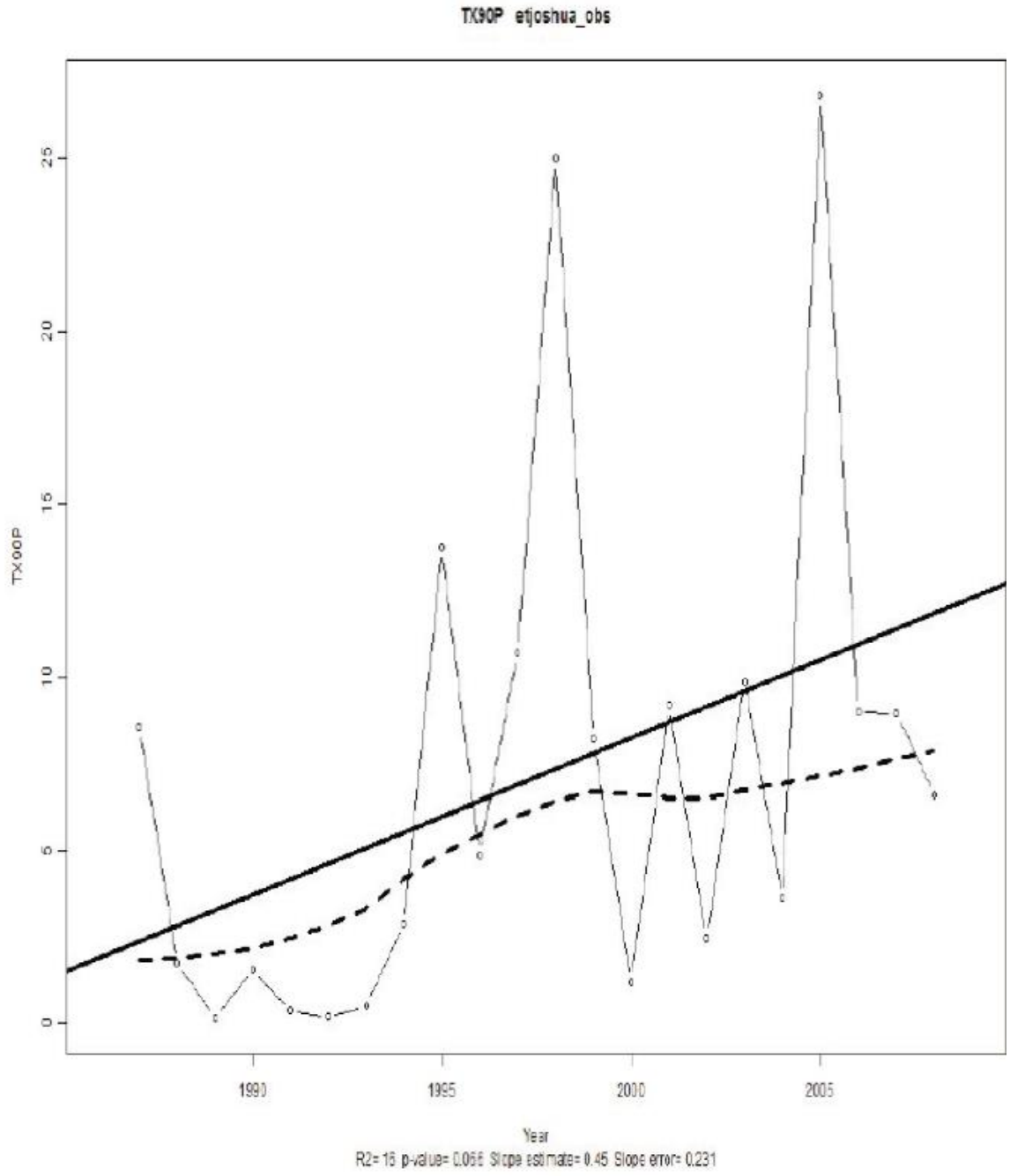


Figure 4: Temperature Indices Supporting Increase in Warm Days (TX9O) and Nights

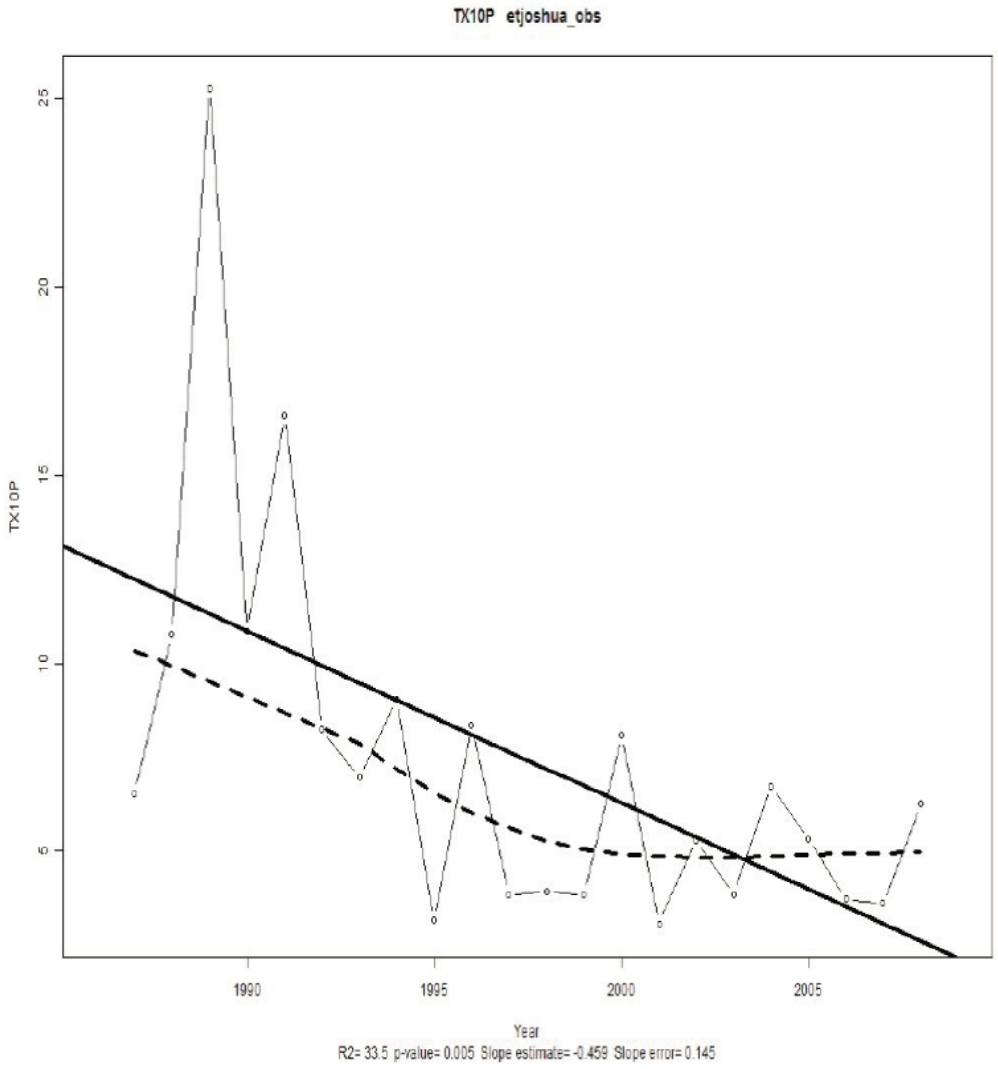


Figure 5: Temperature Indices Supporting Decrease in Warm Days (TX9O) and Nights

Relative humidity across the country is generally high throughout the year (above 70 per cent) and predictably highest during the main rainfall period. Winds are generally East to East South East and wind speed is strongest (>9 metres per second) through the dry period to the start of the rainy period (December-June). During this period the North Atlantic high pressure is a persistent and dominant influence on the region. Notwithstanding, strong winds are also common from June to November during the passage of tropical waves, depressions, storms or hurricanes.

Evaporation rate is highest during the late dry season and into the early wet season. This is consistent with lowest relative humidity, which increases further into the rainy season.

In general, several weather systems affect Saint Vincent and the Grenadines annually. These include tropical Atlantic high pressure system that brings most of the rain, the Inter-Tropical Conversion Zone (ITCZ) and the El Nino Southern Oscillation (ENSO). The El Niño phenomenon has become more frequent, persistent and intense during the last 20-30 years. It is uncertain whether this is due to natural variation or the effect of increasing greenhouse gases. According to Giannini et al, 2001, other global phenomenon e.g. the North Atlantic Oscillation (NAO) can also modulate El Niño's impact on the Caribbean region. More so, during the drier months, upper level troughs and the remnants of the cold fronts from the Eastern sea border of the United States of America (USA) contribute to the rainfall in St. Vincent and Grenadines. The islands enjoy the cooling effect of the north east trade winds which can be gusty at times.

Furthermore, deep surface swells from the Atlantic (often called ground swells) occasionally cause severe coastal erosion and infrastructural damage particularly on the north eastern side of St. Vincent. Noteworthy, are the almost annual effects of tropical storms which cause coastal flooding, high winds, storm waves, river flooding and landslides. The impact of such occurrence is damage to property, loss of life and severe soil erosion.

1.6 Population size, growth and density

According to the 2012 Population and Housing Census Preliminary report, the population in that year stood at 109,188. This represents an increase in the population by 0.89 per cent when compared to the 2001 figure of 106,253 (*see Table 1*). Of the population, 98,954 (90.6 per cent) lives in St. Vincent mainly in the census divisions of Kingstown (12,712), Kingstown suburbs (13,782) and Calliaqua (23,908) while 10,234 (9.4 per cent) resides in the Grenadines. The Grenadines population represents the largest percentage increase in population (16.7) with the southern Grenadines registering a 20.8 per cent increase

Consistent with the increase in the population, the population density saw an increase from 707 in 2001 to 732 in 2012. The Kingstown district recorded the highest density of 6,794 although it saw a reduction of 499 persons per square miles from the 2001 census. Other highly populated

census divisions are Calliaqua and the suburbs of Kingstown. These three census divisions located on the southerly part of the mainland, accounts for 46 per cent of the total population. The Chateaubelair district remains the district with the lowest population density of 186 (*See Table 2).*

Table 1: Population Size and Growth from 1871-2012. (Source: Population and Housing Census Preliminary Report 2012)

Date of Census	Male	Female	Total	Sex Ratio	Average Annual Increase
1871	16,865	18,823	35,688	0.90	
1881	19,047	21,501	40,548	0.89	486
1891	18,780	22,274	41,054	0.84	51
02-Apr 1911	18,345	23,532	41,877	0.78	82
24-Apr 1921	19,155	25,292	44,447	0.76	257
26-Apr 1946	21,208	26,753	47,961	0.79	351
09-Apr 1946	27,901	33,746	61,647	0.83	1,369
07-Apr 1960	37,561	42,387	79,948	0.89	1,830
07-Apr 1970	41,150	45,794	86,944	0.90	700
12-May 1980	47,409	50,436	97,845	0.94	1,090
12-May 1991	53,165	53,334	106,499	1.00	787
12-Jun 2001	53,626	52,627	106,253	1.02	252
12- June 2012	55,835	53,353	109,188	1.05	88

Table 2: Saint Vincent and the Grenadines Population Density -1991, 2001 and 2012 (Source: Population and Housing Preliminary Census Report 2012)

CENSUS DIVISION	Area Sq. Miles	POPULATION			DENSITY		
		1991	2001	2012	1991	2001	2012
Kingstown	1.9	15,466	13,212	12,909	8,140	6,954	6794
Kingstown Suburbs	6.4	10,757	12,508	13,812	1,681	1,954	2158
Calliaqua	11.8	20,290	22,095	24,205	1,719	1,872	2051
Marriaqua	9.4	8,864	8,145	7,798	943	866	830
Bridgetown	7.2	7,532	6,754	6,568	1,046	938	912
Colonaire	13.4	7,890	7,482	6,849	589	558	511
Georgetown	22.2	7,303	6,914	7061	329	311	318
Sandy Bay	5.3	2,793	2,716	2576	527	512	486
Layou	11.1	5,993	6,303	6339	540	568	571
Barrouallie	14.2	5,199	5,422	5884	366	382	414
Chateaubelair	30.9	6,045	6,087	5756	196	197	186
Total Mainland	**133.8**	**98,132**	**97,638**	**98954**	**733**	**730**	**746**
Northern Grenadines	9	5,514	5,389	6184	613	599	687
Southern Grenadines	7.5	2,853	3,226	4050	380	430	540
Total Grenadines	**16.5**	**8,367**	**8,615**	**10234**	**507**	**522**	**620**
Total Saint Vincent and	**150.3**	**106,499**	**106,253**	**109,188**	**709**	**707**	**732**

CENSUS DIVISION	Area Sq.	POPULATION			DENSITY		
the Grenadines							

1.7 The Economy

Saint Vincent and the Grenadines has a small open economy that is highly susceptible to external shocks and natural disasters. The country's production is focused on a narrow range of goods and services mainly for export. Moreover, it relies heavily on imports to satisfy the local demand for consumer and producer goods. Globalisation, changes in international trade regimes, trade liberalization and erosion of market preferences and shares have had a disproportionate impact on the local economy with marked negative effects on the banana industry. The domestic economy has experienced significant shifts with regards to services – i.e tourism, communications, wholesale and retail trade and construction - becoming an important economic contributor, cushioning the impacts of the challenges facing agriculture. Even in the face of this, the agricultural sector remains a central component of the domestic economy.

1.7.1 Gross Domestic Product

Figure 6 depicts total Gross Domestic Product (GDP) in constant prices for the period 2000 – 2013. During the period 2000-2008, total GDP increased steadily from XCD 1,232.18M in 2000 to a period peak of XCD 1,731.59M in 2008. This was followed by relative and steady falls in economic outputs for the periods 2009, 2010 and 2011. However, the years 2012 and 2013 recorded reversals in this trend with GDPs of XCD 1,653.84M and XCD 1,693.28M respectively.

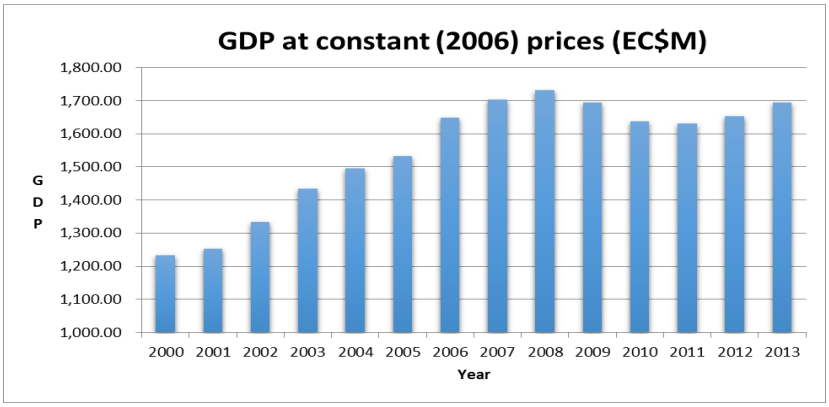


Figure 6: Total Gross Domestic Product in Constant Prices for the Period 2000 -2013 (XCD Million).Source: St. Vincent & the Grenadines Statistical Office /ECCB

1.7.2 Real growth rates

The economy of Saint Vincent and the Grenadines grew by a real annual average of 2.48 percent during the period 2000 to 2013 However, during this same period, the real growth of the economy ranged from weak to relatively strong .This is depicted by a period low of negative real growth or a contraction in the country's economy of 3.36[4] percent in 2010 and a period peak of 7.69 percent real growth in 2003 (*See Figure 7*). Fundamentally, the economies of the Caribbean are small and open. These characteristics, among others, form the foundation for the vulnerability of these economies, the reality of which was brought to life in light of the 2008-2009 global recession. More specifically, 2006 and 2007 recorded strong (7.68 percent) and moderate (3.28 percent) real rates of growth which may be attributed to corresponding growths in the construction sector, however, after 2008 the economy of Saint Vincent and the Grenadines experienced three (3) consecutive years of contractions (2009, 2010 and 2011) before recording marginal rates of real growths of 1.39 and 2.38 percent in 2012 and 2013 respectively.

[4] *The annual rate of growth was therefore -3.36 percent*

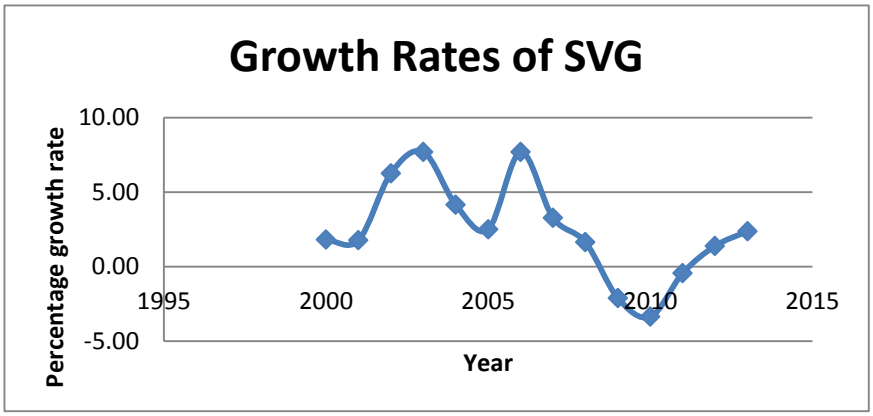


Figure 7: Annual real growth rates of Saint Vincent and the Grenadinesfor the period 2000-2013. Source: St. Vincent & the Grenadines Statistical Office /ECCB

1.7.3 GDP by Economic Activity

Table 3 shows GDP by economic activity in constant (2006) prices for the period 2000-201

Table 3: Sector Contribution to GDP. Source: Saint Vincent and the Grenadines Statistical Office /ECCB

Sector	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, Hunting and Forestry	80.31	74.66	84.94	79.15	76.06	77.60	80.54	88.47	87.74	99.50	81.56	81.61	83.41	88.25
Fishing	6.17	5.92	4.92	6.17	6.08	6.37	6.38	8.13	5.31	7.47	6.34	6.15	5.23	5.58
Mining & Quarrying	2.10	2.17	2.09	2.37	3.85	3.98	4.18	4.76	5.00	5.13	4.01	3.02	2.28	2.03
Manufacturing	68.93	66.11	64.31	69.36	67.48	72.43	72.17	67.82	69.60	63.94	60.79	63.78	61.02	58.91
Electricity & Water	42.44	45.47	46.72	49.30	51.92	55.49	56.78	59.03	58.10	59.98	57.25	56.00	58.72	58.46
Construction	85.20	88.13	96.15	116.00	127.55	127.09	137.99	155.98	139.89	128.27	124.27	120.08	115.84	123.48
Wholesale & Retail Trade	155.56	161.46	167.14	180.14	195.70	205.23	215.42	234.84	243.94	224.10	222.06	210.94	217.87	224.16
Hotels & Restaurants	26.67	25.43	24.44	32.27	36.65	39.56	49.45	49.33	46.62	38.23	32.81	34.15	34.21	34.18
Transport, Storage and Communications	123.92	124.44	152.65	184.56	194.18	197.57	218.00	214.18	217.04	213.27	209.91	210.47	209.97	208.57
Financial Intermediation	87.33	89.41	96.56	100.08	105.50	104.99	110.04	105.76	104.36	101.93	95.51	98.97	99.10	101.84
Real Estate, Renting and Business Services	198.08	203.57	205.89	207.53	212.72	215.81	227.52	229.16	233.98	230.15	229.51	230.20	231.56	235.27
Public Administration, Defence & Compulsory Social Security	82.94	86.95	89.59	91.85	95.58	98.81	105.65	112.19	121.48	132.73	144.16	151.10	159.10	168.25
Education	69.32	69.39	72.44	74.89	77.99	80.31	78.18	76.06	60.58	62.33	61.56	63.03	66.16	67.94
Health and Social Work	32.07	31.70	33.89	34.89	34.08	36.26	36.68	38.49	40.58	39.54	40.26	42.82	44.87	44.20
Other Community, Social & Personal Services	17.18	21.86	21.06	19.30	19.71	22.61	26.11	24.88	29.42	27.92	30.71	30.83	32.17	30.09
Private Households with employed persons	2.45	2.68	3.08	3.34	3.25	3.28	3.35	3.06	3.35	3.11	3.16	3.21	3.41	3.50
GDP at Market Prices	**1,232.15**	**1,253.22**	**1,332.50**	**1,434.91**	**1,494.47**	**1,531.83**	**1,649.42**	**1,703.59**	**1,731.59**	**1,695.18**	**1,638.26**	**1,631.24**	**1,653.84**	**1,693.28**

The 'Real Estate, Renting and Business Services' and 'Wholesale & Retail Trade' sectors have consistently remained the two biggest sectoral contributors to GDP over the period, with period-average contributions of 16.78 and 15.38 percent respectively. Real GDP for the period 2000-2013 saw a continuing shift away from traditional sectors such as Agriculture and Manufacturing, with agricultural contribution to GDP falling from 7.52 percent in 2000 to 6.13 percent in 2013 and manufacturing contribution to GDP falling from 6.48 percent at the beginning of the period to 4.09 percent at the end of the period. On the other hand, the Construction sector's contribution to GDP grew from 7.98 percent in 2000 rising to a period peak of 10.72 percent in 2007 before settling at 8.57 percent in 2013. Similarly, the 'Public Administration, Defense and Compulsory Social Security' sector has grown consistently with its contribution to GDP moving from 7.77 percent in 2000 to 11.68 percent in 2013. Agriculture, Wholesale and Retail Trade, Construction and Public Administration are among the only sectors that grew in 2013.

1.7.4 Trade Statistics

Trade statistics for Saint Vincent and the Grenadines continue to reveal a widening commodity trade deficit as shown in ***Error! Reference source not found.***, where the trade balances (total exports minus total imports) are in general increasingly negative for the period 2005-2013. The most significant categories of imports for the country are food and live animals, machinery and transport equipment and mineral fuels and related materials. Finally, tourism, though not identified as a distinct sector, is growing in importance and is the largest source of foreign exchange.

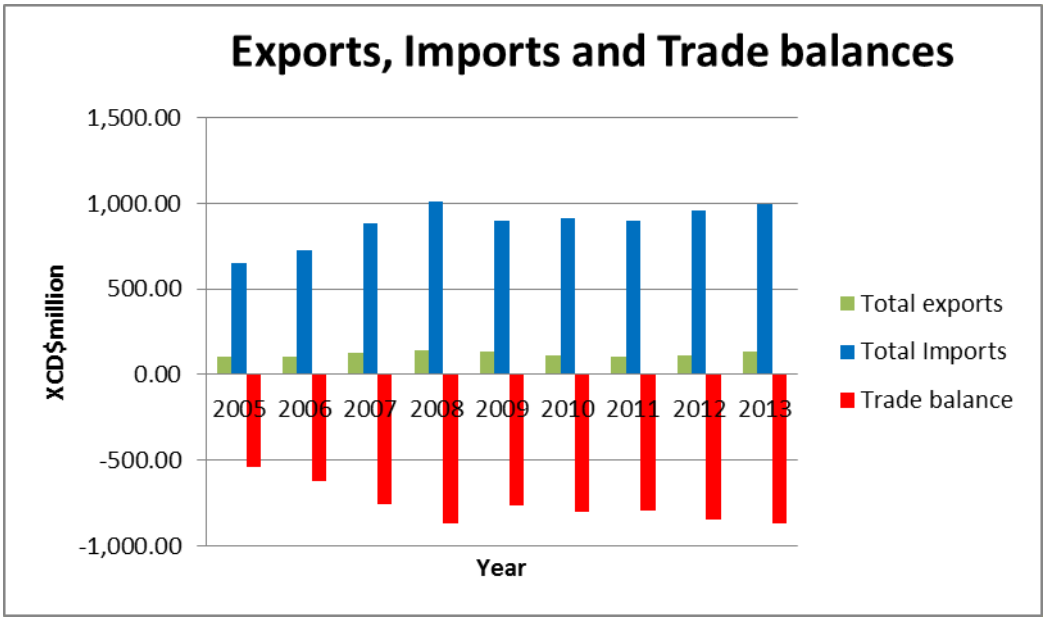


Figure 8: Total exports, imports and trade balances for Saint Vincent and the Grenadines for the period 2005-2013. Source: Central Statistical Office, Saint Vincent and the Grenadines

1.7.5 Inflation rate

In General, point to point inflation rate in Saint Vincent and the Grenadines has increased over the period 2000-2013 as shown in (*See* ***Error! Reference source not found.***). However, it remained between zero and 3.5 percent for all years except 2007 and 2008. Additionally, for this period, the rate ranged from a low of 0.1 percent in 2003 to a peak of 10.1 percent in 2008. Saint Vincent and the Grenadines, as a small open economy with heavy dependence on the importation of crude oil to satisfy its energy needs would like many countries have much of its inflation being imported inflation. This is particularly important in understanding what was happening to the general price level in the country in 2008 since crude oil in this year traded on the market for per barrel prices well in excess of US $100.

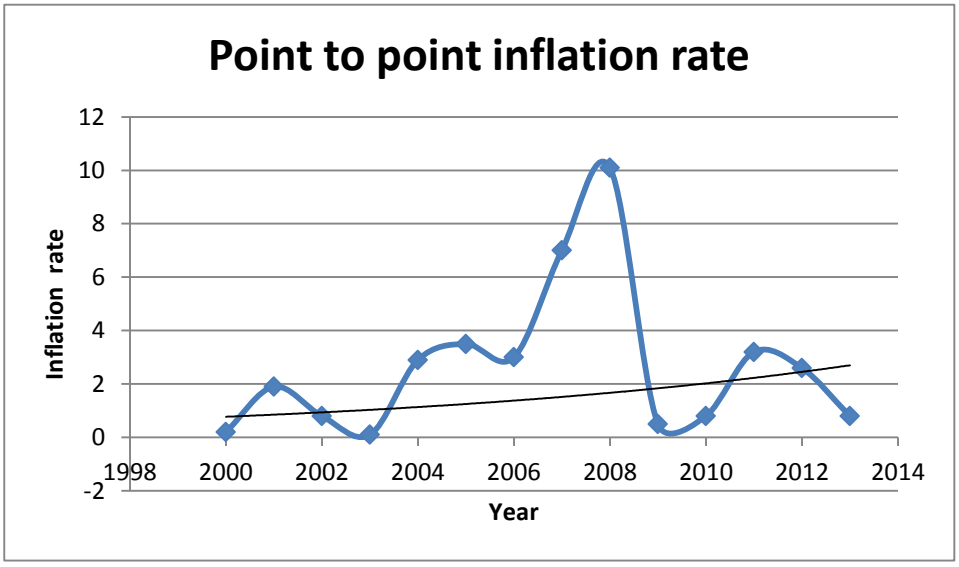


Figure 9: Point to point inflation rate in Saint Vincent and the Grenadines for the period 2000-2013. Source: Central Statistical Office, Saint Vincent and the Grenadines

1.8 Energy

Approximately 80 per cent of the electrical energy generated in Saint Vincent and the Grenadines comes from fossil fuel. The other twenty per cent is renewable energy generated by three hydro-electricity plants at Cumberland, Richmond and South Rivers. However, the electricity company, VINLEC, has reported reductions in its hydro-electricity supply during the dry season due to reduce stream flow which prompted the upgrade of the diesel plants to meet demand. In 2007, the Lowmans Bay Power Plant, the Company's modern state of the art facility was commissioned. It has a capacity of 17.4 Mega Watts and provides approximately 60% of all power generated on the mainland. Currently, the government is reviewing its legislation governing energy to encourage private generation of renewable energy. It is worth mentioning that studies conducted at La-Soufriere suggest that the potential for geo-thermal exploitation is high. The government intends to tap into to this potential to reduce Saint Vincent And The Grenadines' dependence on fossil fuel.

In 2010, installed generating capacity for the island was 40,357 Kilowatt (kW) on mainland with an additional 7,467kW on the Grenadine Islands of Bequia, Union Island, Canouan and Mayreau. During this same year, a new peak load of 21,120MW was recorded on the mainland.

The main consumers of this electricity are the domestic sector (48.9 per cent), commercial sector (43.2per cent), industry (5.5 per cent) and street lighting (2.4 per cent). Less than 0.1 per cent of Vincentian homes use a form of renewable energy (wind, or solar).

1.9 Transport

Accessibility, especially by air is seen as a major challenge to the development of Saint Vincent and the Grenadines. The real challenge is the number of flights and airlines available to the country. Despite the presence of six small airport covering Saint Vincent and the Grenadines only 91,193 persons arrived in the island by air during 1995. Furthermore, the transport system of the country is less than adequate to meet the current needs and demands of an expanding economy and society. There are approximately 680 miles of motorable road way and over 12,000 motor vehicles. In addition, this sector uses a large amount of fossil fuel. In 2002, of the 100 kilotonnes of fossil fuel imported into the country, approximately 40 per cent was delivered to the pump to service motor vehicle while the rest went to service light aircrafts, small boats, the food industry (cooking) and the electricity company.

There are five marine terminals in the country including the main deep water port at Kingstown. The terminal in Kingstown is comprised of a 274.3m long deep water pier, an 800 feet long cruise ship terminal, a 76.2m long schooner facility and a 76.2m pier that serves the ferries which services the Grenadines. There is a container port at Campden Park with a storage capacity of 540 containers. There are also several smaller ports and jetties scattered around the island.

1.10 Industry

Similar to most Small Island developing states (SIDS), there are no major manufacturing industries in Saint Vincent and the Grenadines. The word industry is generally used loosely to include activities relating to tourism, agriculture, housing, mining and manufacture. Agriculture and tourism are dealt with as separate themes in this report; this section speaks only to manufacturing and mining.

Manufacturing is not projected to play a major role in the country's economy in the near future

given the absence of mineral, the population, market size and the high cost of energy. These factors along with the absence of an international airport have reduced the competitiveness of Saint Vincent and the Grenadines as an investment destination. Despite these challenges, the government proposed in 1999, the provision of factory space and or land and ancillary services for lease or sale to private entrepreneurs. These sites are the Campden Park Industrial Estate and the Diamond Industrial Estate. Rice and wheat imported from Guyana and Canada respectively are milled and packaged at a small plant at the Campden Park Estate while arrowroot rhizome are processed into starch at Owia on the north eastern side of the island.

St. Vincent and the Grenadines is endowed with large quantities of volcanic deposits in the form of igneous rocks. A number of quarries are set up to mine these rocks for construction purposes. Another mining venture that supports local construction is the mining of the beaches for sand. This practice increases the vulnerability of coastal areas to storm surges, a growing feature attributed to climate change.

1.11 Tourism

Saint Vincent and the Grenadines tourism industry is seen as the economic earner because of the downfall of the agricultural industry. The industry has proven to be a significant driver of economic activity, foreign exchange earner and employment creator. This sector contributed 2.23 per cent to the country's GDP in 2004. Estimated earnings rose from XCD189.09 million in 1997 to XCD217.17 million in 2005. Currently, Saint Vincent and the Grenadines is diversifying its tourism product into eco- and sport-tourism, as well as to improve the accommodation sector. This is seen as a gateway to investment opportunities which would create a stronger infrastructure system which would support this sector.

The diversification process would pay particular attention to promoting Saint Vincent and the Grenadines as a scuba diving destination. Additionally, the government plans "to position Saint Vincent and the Grenadines as a diverse, globally competitive destination" through effective planning, management and sustainable use of the cultural and natural resources of the country, while facilitating the preservation of the local heritage.

1.12 Agriculture

Agriculture in Saint Vincent and the Grenadines is predominantly practised on the mainland with some subsistence farming on the larger islets of the Grenadines. As previously mentioned, the economy of Saint Vincent and the Grenadines was based primarily on agriculture; first sugar – which persisted into the twentieth century – then a combination of crops including cotton, arrowroot and bananas. These crops dominated agriculture during their heyday to the point where they were mono-crops. Their market was in England and until the middle of the twentieth century they were produced on plantations.

Bananas dominated the agricultural scene throughout the second half of the twentieth century until the loss of preferential trade agreements with Europe and competition from the mega-producers in Central and South America. This decline in the banana industry saw St. Vincent and the Grenadines moving from being a net exporter of food crops to a net importer.

Agriculture is still practiced in the traditional way by older, experienced farmers (traditional knowledge) using manual labour and simple tools such as fork, cutlass and hoe. Additionally, large quantities of chemical fertilisers are used to increase production but usually only succeed in maintaining the existing production levels. Moreover, pesticide use has become widespread to control the increase in pests associated with mono-cropping under tropical conditions. Further to this, there has been a gradual decline in the acreage of land under permanent crop cultivation as shown in *Figure 10*. The figure also shows fluctuations in the acreage under temporary crops. There is a concern that agricultural lands are being converted for residential construction. The more suitable the land is for agriculture – flat or gentle slopes with deep soil and few stones – the higher is the demand for it to be used for housing. A national land management plan to control the rate of conversion of lands zoned for agriculture being converted to land for housing now appears to be necessary if St. Vincent is to maintain, and even increase, its current level of food production. Failure to institute zoning laws could result in significant loss of agriculture lands and the consequent inability of the country to feed itself.

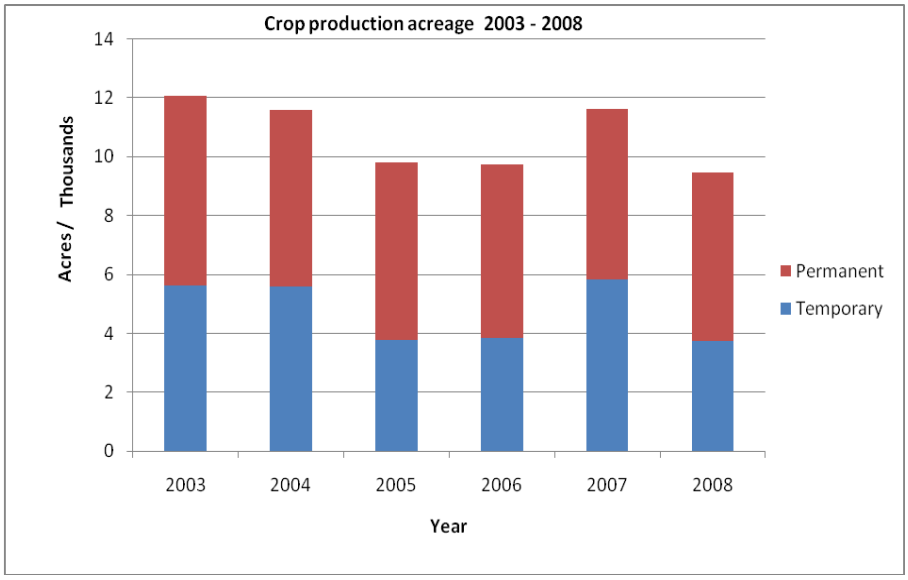


Figure 10: Land Utilization for Crop Production for the Period 2003 To 2008.Source: Statistical Unit MAFF

Livestock - largely sheep, goats, cattle and pigs - are raised by farmers in small family holdings. With the growing number of fast food outlets, the demand for poultry and poultry products are increasing. Most of the products from the livestock industry are consumed locally.

Agriculture and climate change

Given the geography, topography and current land use patterns in St. Vincent and the Grenadines, a climate change scenario that brings increased rainfall could devastate the agriculture sector through floods, landslides, accelerated loss of top soil, loss of crops and livestock, loss of agricultural infrastructure and even human lives. A scenario with decreased rainfall would be no less catastrophic; droughts would destroy the land, the animals and the vegetation cover. In the meantime, high level discussions are taking place regarding adaptation to the adverse impacts of the climate change in the agricultural sector, but no definitive actions could be identified which would signal real commitment to the cause. There is awareness of the potential negative impact of climate change on agriculture but adaptation measures are not commensurate with the potential consequences.

The resources available to tackle climate change are woefully inadequate. While there are

academically qualified staffs in the Ministry of Agriculture there is no adaptation agenda with which to engage. This is due in part to the lack of finance to support technological innovations and partly to the fragmented nature of the institution.

1.13 Health

The Government of Saint Vincent and the Grenadines has sought to deliver proper health care base on the needs of its citizens. To achieve this goal, the Ministry of Health, Wellness and the Environment is pursuing preventive medicine through public education. The country is divided into nine health districts served by one general hospital, one mental hospital, five district hospitals, two nursing homes, and forty health centres (outpatient clinics). Additionally, there is one private hospital that works in tandem with the state facilities to deliver what the Pan American Health Organisation (PAHO) considers adequate health coverage for the country.

Mortality Profile

Statistical data show that the crude mortality rates for the population of Saint Vincent and the Grenadines have been consistently high when compared to World Health Organisation (WHO) Regions standards (above 60 per 10,000). This is illustrated in *Figure 11* which shows a rate of gradual increase during 2000-2007 where it peaked in 2005 with a crude mortality rate of 81 per 10,000. However, the data shows slight decreases in the rate for consecutive years, 2006 and 2007. The elevated crude mortality rates are as a direct result of the unvarying elevated chronic non-communicable diseases (CNCDs). The CNCDs (cancers, diabetes mellitus, diseases of the circulatory system-ischemic heart disease, cerebrovascular disease and all external injuries - injuries and violence) caused 61-71 per cent of deaths from 2000-2007 (*See Figure 12*). On the other hand, communicable diseases, such as Human Immunodeficiency Virus (HIV)/ Acquired Immune Deficiency Syndrome (AIDS), Tuberculosis, etc. did not impact heavily on the crude mortality rates.

CNCDs have primarily affected the mortality rates for the over 65 and 45-64 year old age group *(See Figure 13)*. Mortality among males dominated that late age group. However, the main causes of mortality among the age groups 15-24 and 25-44 year olds are as a result of injuries and violence and, to a lesser extent, the onset of other CNCDs. Generally, infant mortality (under

1) is greatly influenced by perinatal mortality with the main underlying cause of mortality in the under one year olds being prematurity of the neonate.

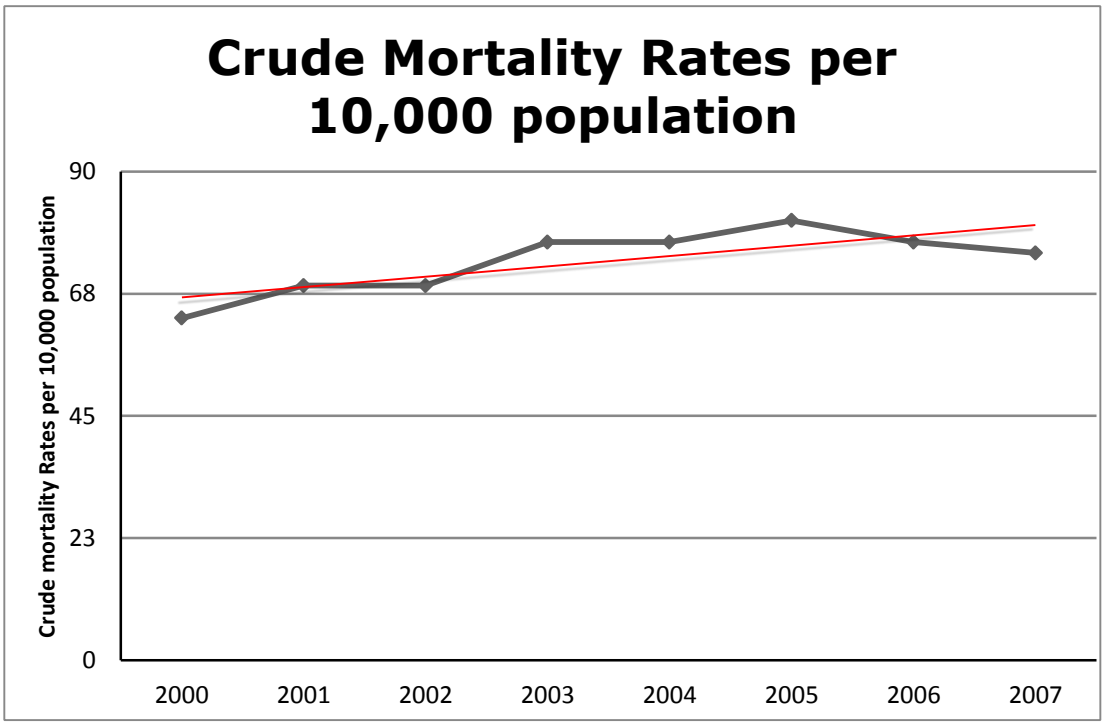


Figure 11: Graph showing Crude Mortality Rates per 10,000 population from 2000-2007.Source: Ministry of Health and the Environment, Planning Unit

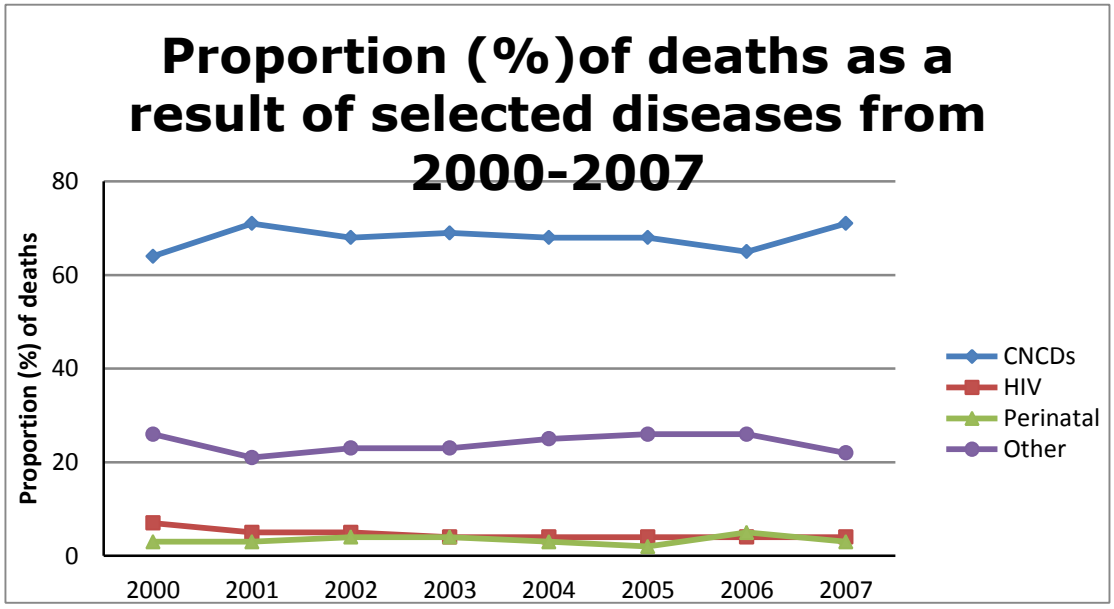


Figure 12: Graph Showing Proportion of Deaths as a Result of Selected Diseases from 2000 – 2007. Source: Ministry of Health and the Environment, Planning Unit

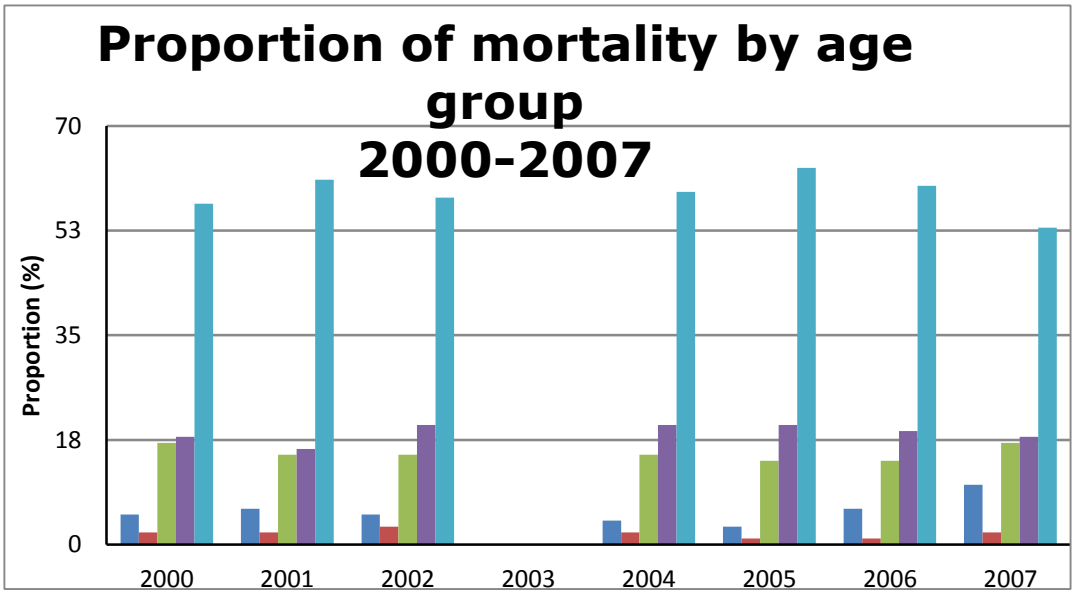


Figure 13: Graph Showing Proportion of Mortality by Age Groups from 2000-2007

****2003 data not available by age group***

1.14 Education

In the education system, teachers and students are specifically encouraged to take ownership of the physical structures as well the services provided. Recently, primary, secondary and post-secondary schools throughout Saint Vincent and the Grenadines were refurbished, resulting in enhanced ethos of most schools. In the last five (5) years, there education revolution which introduced the notion that no-child must be left behind. As a result, the government constructed additional schools both at the primary and secondary level. Currently there are 69 primary schools, 26 secondary schools and approximately five (5) tertiary institutions throughout the island state.

As it relates to enrolment, during 2003 - 2008, primary school enrolment decreased significantly (-18.4 per cent) while secondary school enrolment increased substantially (32.4 per cent) as shown in *Figure 14*. This was due to an increase in the number of secondary schools and the conversion of all age elementary schools (schools for ages 5 to 15) to junior elementary schools (school for ages 5 to 11 years). This change in school structure allowed all children over eleven years to enter secondary school, thus, addressing one element of the no-child left behind principle. It was also noted that more males attend primary school while more females attend secondary school *(Table 4*). In addition, the completion rate moved from 51.8 per cent in 2003 to a healthier 68.7 per cent in 2007.

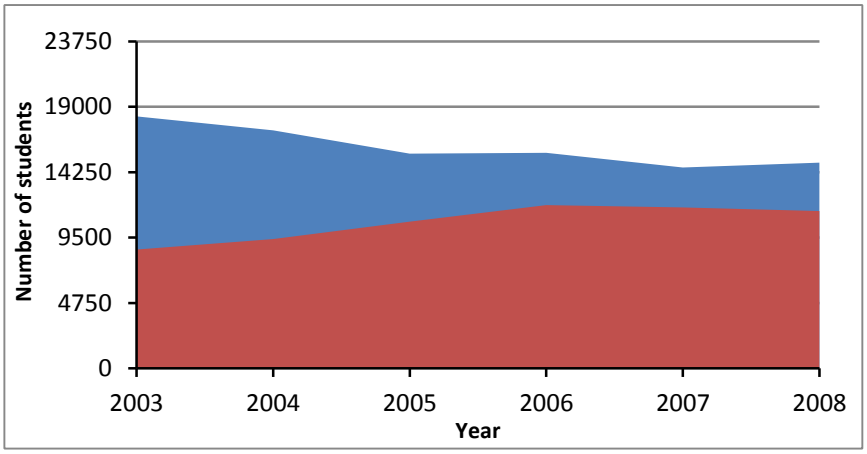


Figure 14: Total Enrolment in both Primary and Secondary Schools during the Period 2003 – 2008. Source: Ministry of Education.

Table 4: Female to Male Ratios in Primary and Secondary Schools in Saint Vincent and the Grenadines from 2003 -2008.Source: Statistical Unit, Ministry of Education

Year	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Primary	0.89	0.89	0.92	0.92	0.9	0.91
Secondary	1.16	1.28	1.14	1.04	1.09	1.04

Similarly to the attendance in secondary school, the number of persons seeking university education and the number of university graduates returning to the island after training is increasing. Statistics revealed the number of graduates returning to the Government Service has been increasing annually since 2003 where only 37 returned compared to the end of 2008 when 87 returned.

1.15 Institutional arrangements for the preparation of the national communication

The primary responsibility for the preparation Second National Communication (SNC) rests with the Ministry of Health, Wellness and the Environment (Ministry of Health and the Environment) which houses the Environmental Management Department. The objectives of the Department include, inter alia: to effectively monitor all national environmental activities; to provide technical support to sustainable development initiatives; and, to coordinate local, regional and international activities relating to environmental Conventions, Agreements and/or Protocols. As a result, it is the National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC) and its sister Conventions - the United Nations Convention to Combat Desertification (UNCCD) and United Nations Convention on Biological Diversity (UNCBD). This role allows for a synergistic approach in implementing these Conventions and other multilateral environmental agreement (MEAs).

The preparation of the SNC is overseen by the National Focal Point of the UNFCCC and managed by a Coordinator who maintains contact with the United Nations Development Programme (UNDP) Barbados Office. The Coordinator receives guidance from a steering committee comprising representatives from the different agencies with responsibility for the environmental and natural resource management and at least one NGO representative. These

agencies include, but are not limited to: the Ministry of Agriculture, Industry, Forestry, Fisheries and Rural Transformation; National Parks, Rivers and Beaches Authority; Physical Planning Department; Central Planning Division; Legal Affairs Department; EMD and CWSA. It is worth mentioning that these same agencies and it is sometimes the same individual who sits on steering committees for the UNCCD and UNCBD projects, thus, becoming intimately involve with the work of implementing the Conventions which enhance their knowledge base to make informed decisions and to promote synergy. A local consultant was hired to perform the role of coordinator due to limited human resource which existed in the Department. There were instances where the staff attempted to undertake the role of coordinator but the project suffered at the expense of competing work assignment. During these periods, the project activities made little or no progress as opposed to when there was a coordinator dedicated to the execution of the project.

Consultants were contracted to develop the chapters (local and international) because of limited local capacity. Workshops were conducted to develop local capacity to assist in the preparation of future national communications. Additionally, consultations were held to engender public participation and to confirm the findings. Upon the completion of the national communication, it must be endorsed by Cabinet before submission to the UNFCCC Secretariat.

1.16 Summary of National Circumstance

Table 5 provides a summary of Saint Vincent and the Grenadines' national circumstances.

Table 5: Summary of National Circumstances

	National Circumstances
Capital	Kingstown
Location	13° 15' N, 61° 12' W (Caribbean)
Size	150 sq miles (St. Vincent 133,Grenadines17)
Population	109,188
Population density	732 (2012)
Climate	Tropical

Mean annual temperature	27^0C
Average annual Rainfall	St. Vincent: 219cm; Grenadine: approx..100cm
Seasons	Wet: June – November; Dry: December - May
Topography	Mountainous/ Rugged
Soil	High-level yellow earth, recent volcanic ash, alluvial ,Shoal and Central mountain
Main source of water	St. Vincent: rivers; Grenadines: rainwater harvesting
Economy	Small open economy
Natural disasters	Droughts, hurricanes, storms, floods, etc
GDP	XCD 1,693.28M (2013)
Institution responsible for SNC	Ministry of Health, Wellness and the Environment (Ministry of Health and the Environment)

Chapter 2: Green House Gas Inventory

This chapter responds to Article 4.1 (a) of the UNFCCC which requested all Parties to update and report on their inventory of anthropogenic emissions and removals of Green House Gases (GHG) not controlled by the Montreal Protocol. As a result, for this report, Saint Vincent and the Grenadines undertook a GHG inventory for the years 2000 and 2004 in seven sectors: Energy; Industrial Processes; Solvents and Product Use; Agriculture; Land Use; Land Use Change and Forestry (LUCF) and Waste. The inventory took into consideration direct GHGs (Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O) and partially Fluorinated Hydrocarbons (HFCs)) and indirect GHGs that contribute to tropospheric ozone (O_3) formation, (Non-Methane Volatile Organic Compounds (NMVOC), Carbon Monoxide (CO) and Nitrogen Oxides (NOx)). The Revised 1996 Inter-governmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Volumes 1, 2 and 3) along with the accompanying software in Microsoft Excel were used as the basis to undertake the required calculations for GHG emissions and removal. In addition, the IPCC Good Practice Guidance (GPG) complementary to the Revised 1996 Guidelines was used to update emission factors or other default conversions factors where sufficient data was available. CO_2 emissions from International Bunkers and burning of biomass were calculated and reported separately from the national totals as Memo items. A Tier 1 uncertainty assessment was also conducted base on guidance provided in the Revised1996 IPCC Guidelines and the IPCC GPG 2000 Guidelines.

Additionally, this inventory also reports the revised GHG inventory for the Initial National Communication (INC) which was prepared for the reference year 1990, 1994 and 1997. This was done on the recommendation of the IPCC to make use of more accurate activity data and emission factors. This use of the Revised 1996 Guidelines for the years 1990, 1994, 1997, 2000 and 2004 facilitated Saint Vincent and the Grenadines to fulfill the aim of the Conference of the Parties (COP) for the use of comparable methodologies.

2.1 Review of 1990, 1994, 1997 Inventories

The review of the GHG inventory from the INC for the years 1990, 1994 and 1997 for the major

IPCC source/sink categories was challenging due to the unavailability of the spread sheets used to calculate the emission inventories and all detailed calculations. In most cases, supporting information was used to estimate if the 1990, 1994 and 1997 GHG emissions are reasonable for each IPCC source and sink category. Despite these limitations, the 1994 emission inventory was reproduced and several potential corrections/changes were identified. They impacted four of the six source/sink categories that are identified in the Revised 1996 IPCC Guidelines: Industrial Processes; Solvents and Other Product Use; Agriculture; and LUCF. Some of the corrections/changes could cause substantial differences in the overall emissions from these sectors; in particular, the Waste and LUCF sectors. The potential changes, corrections, justifications for the changes and an indication of the impact if the changes were made are summarised in *Table 6.*

2.2 CO_2 Emissions

The Energy and LUCF sectors are the only two IPCC source/sink categories in the 1994 Inventory with substantial CO_2 emissions or sinks. A notable change as a result of revisions to the inventory is the LUCF sector moves from a significant sink to a significant source of emissions (*see Figure 15*). The reason for this difference is stated in *Table 6* where forests in Saint Vincent and the Grenadines were classified as regenerating forests which sequester large amounts of carbon, whereas in reality, these forests have had few changes to their carbon stocks overtime.

2.3 Non-CO_2 Emissions

In the 1994 inventory, non-CO^2 emissions saw significant changes (*see Figure 16*) based on the following:

1. Overestimation of CH_4 produced by enteric fermentation and manure management for poultry. In accordance with the default emission factors from the Revised 1996 IPCC Guidelines that were used, the CH_4 generated by 270,000 poultry reported in the inventory should have been 0.0062 gigagram (Gg) as opposed to the reported 0.168 Gg;

2. Overestimation with regards to field burning of agricultural residues. The data presented

in the INC is equivalent to an estimated 480,000 tons of agricultural residues being burned.

Table 6: Summary of Recommended Changes to Saint Vincent and the Grenadines 1994 GHG Inventory

IPCC Source/sink Categories	**Potential Change**	**Reason for Changing Parameter**	**Relative Impact** [1]
Industrial Processes	NMVOC Emissions for road paving are indicated at 52.22 Gg in inventory	This is equivalent to emissions to pave 1.64 million square metres or approximately 205,000 km of roadway and is clearly an overestimate	↓↓
Solvent and Product Use	Inventory does not include solvent and product use. Recommend adding general household solvents use to inventory	Emissions from household solvents were not included in the 1994 inventory, but to be consistent with future inventories it should be added.	↑
Agriculture	There appears to be an error in the calculation of methane emissions from enteric fermentation and manure management of poultry	The total methane emissions from enteric fermentation and manure management of poultry should be decreased from 0.168 Gg to 0.0062Gg.	↓
	Emissions from field burning of agricultural residue seem greatly overestimated (60 per cent of total CO_2e GHG emissions in the inventory). By our estimation emissions equivalent to 480,000 tons of agricultural residue being burned.	The total crop production in 1995 was reported to be approximately 16,000 tons (FAO, 2007). Agricultural residue are not likely to exceed double this value	↓↓
	Nitrous oxide emissions from agricultural soil seems underestimated based on manure nitrogen available	Fraction of manure nitrogen per animal waste system should be increased.	↑
LUCF	Annual biomass growth rates for forest are representative of new plantation forest, not mature forest	It is likely that the removal (sequestration) of carbon is several fold lower than estimated, resulting in much higher total GHG emissions	↑↑

[1] ↑ indicates an increase in emissions relative to the INC inventory. ↓ indicates a decrease in emissions relative to the INC inventory. Changes that resulted in a large change in overall emissions are indicated by double arrows ↓↓

The resulting CH_4 and N_2O emissions represent 60 per cent of the total CO_2 emissions in 1994. This figure is deemed to be erroneous as it is nearly 30 times the value of the total agricultural production of 16,062 tons in the year 1995 (FAO, 2007). Furthermore, the residue to crop ratio is

unlikely to exceed approximately 2:1 (IPCC Guidelines, 1996) for any types of crop. Based on this crop residue ratio, the total residue for Saint Vincent and the Grenadines could not exceed 32,000 tons. Revising the 1994 inventory based on the practice that 100 per cent of available crop residues are burned would cause a reduction in CH_4 and N_2O emissions from field burning of agricultural residues of 15 fold. Due to limited information on the likely practice of residue crop burning in 1994, the estimates were revised based on this maximum potential value.

3. Overestimation of NMVOC emissions. Road paving emissions were adjusted to reflect the imported amount of bitumen recorded in 1994 and NMVOC emissions from the use of household products was added to be consistent with 2000 and 2004 inventories. Moreover, changes to agricultural methane from enteric fermentation and manure management of poultry had only a small impact on total methane emissions.

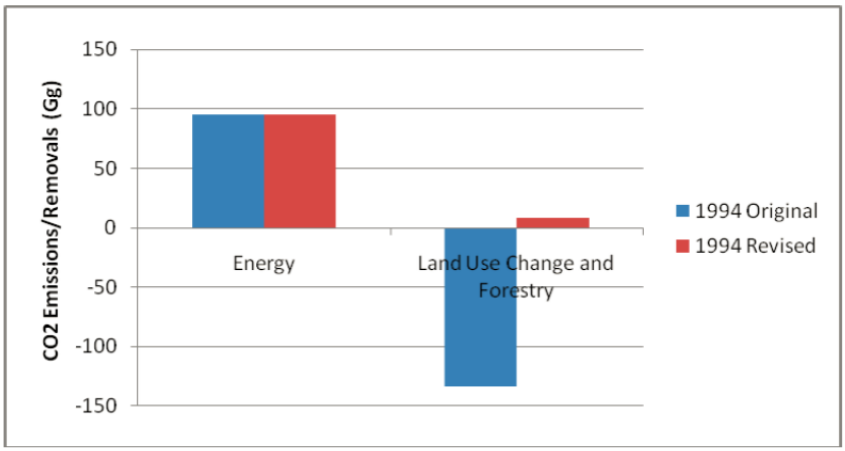


Figure 15: Summary of Changes to CO_2 Emission in Saint Vincent and the Grenadines 1994 GHG Inventory

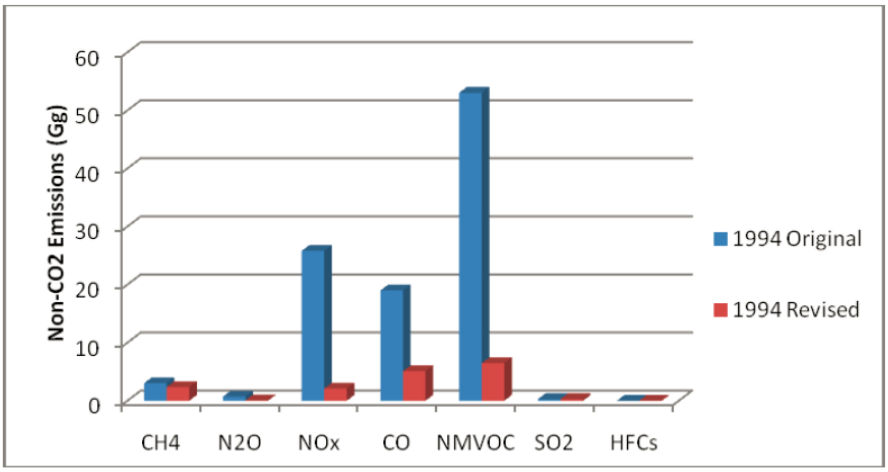


Figure 16: Summary of Changes to Non-CO_2 Emissions in Saint Vincent and the Grenadines1994 GHG Inventory

2.4 Greenhouse Gas Inventory for 2000 and 2004 by Sectors

2.4.1 Energy

Saint Vincent and the Grenadines is not a producer of primary or secondary fuel, therefore, it is heavily dependent on the importation of fossil fuel to supply the production, transformation, handling, and consumption of energy commodities. In the island, fuel is used for various means; however, it is mainly used in the transport and energy sectors

Methodology

The GHG Inventory for the energy sector was calculated using both the aggregate fuels supply-based top-down Reference Approach and the policy-oriented source categories bottom-up Sectoral Approach. Local activity data for fuels imported as well as changes to local stocks in the years 2000 and 2004 were used to estimate the consumption of fuels in metric tons. In addition, default IPCC emission factors (kt of emissions/TJ) were used to convert energy consumption into emissions. The default IPCC carbon oxidation factors were used to calculate carbon dioxide emissions while the UNFCCC's Non-Annex National Greenhouse Gas Inventory Software (version 1.3.2) was used to aid in the calculation of emissions.

Energy Activity Data

The GHG emissions were calculated for imported liquid fuels including gasoline, jet kerosene, gas oil and fuel oil using consumption data provided by the Statistical Office. Calculations were also done for charcoal and firewood use for energy in the residential sector. The level of consumption of charcoal was determined based on typical energy use for cooking (6,000 kcal/person/day or 9.16 GJ/person/y), the conversion efficiency for charcoal to wood (23per cent) (Amous, 1999) and interpolation of Saint Vincent and the Grenadines census data.

CO_2 Emissions

In Saint Vincent and the Grenadines, combustion of fossil fuels in the energy sector is the main source of CO_2 emissions. In 2000, CO_2 emissions stood at 154 Gg which were within 1 per cent for the aggregate Reference and differential Sectoral approaches. This percentage is a good indication of the accuracy and consistency of the data and the calculations. In 2004, CO_2 emissions totaled 217 Gg and 218 Gg for the Reference and Sectoral approach respectively. Although 2004 recorded an increase in emission when compared to 2000, difference between the two approaches is considered to be negligible (less that 1 per cent).

Of the fossil fuels imported and consumed in Saint Vincent and the Grenadines, the greatest proportions of CO_2 emissions resulted from the combustion of gas/diesel oil (61 per cent in 2000 and 68 per cent in 2004), and from gasoline (32 per cent in 2000 and 27 per cent in 2004), used mainly for vehicular road transport. Smaller amounts of CO_2 emissions also result from liquefied petroleum gas (LPG) use in the residential and commercial/institutional sectors as seen in *Figure 17.*

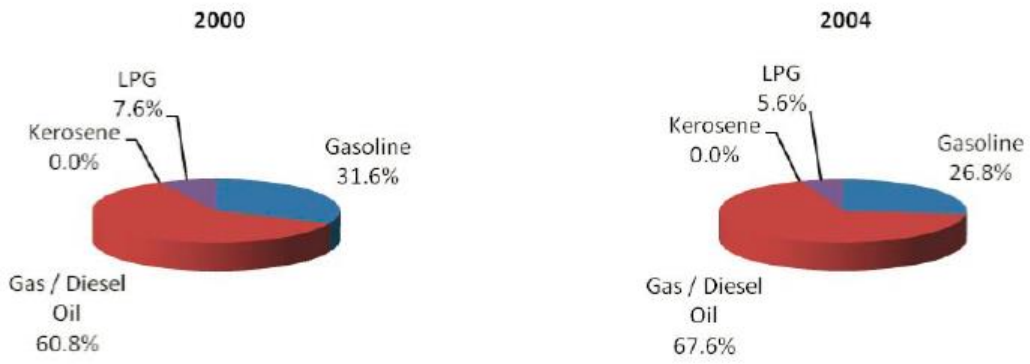


Figure 17: CO2 Emissions from different fossil fuel for 2000 and 2004

In 2004, within the energy sector, CO_2 emissions from the transport sector totaled 108 Gg of CO_2. This accounted for nearly 50 per cent of the total CO_2 emissions and an increase in emissions of over 200 per cent from the year 1994. The energy industries sector was also a significant contributor to CO_2 emissions, totaling 94 Gg of CO_2 and representing 43 per cent of total CO_2 emissions in the energy sector in the year 2004 *(see Figure 18*).

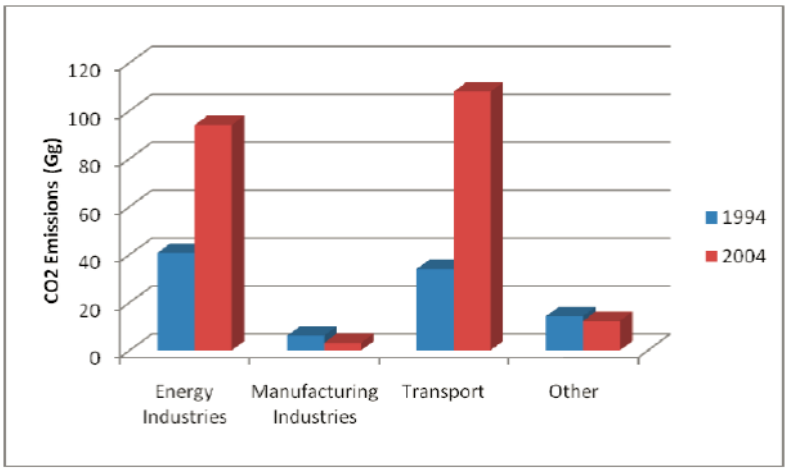


Figure 18: Emission from the energy sector in 1994 compared to 2004

Non-CO_2 Emissions

Emissions from non-CO_2 gases (*Methane (CH_4), Nitrous Oxide (N_2O), Nitrogen Oxides (NO_x), NMVOC, carbon monoxide (CO), and sulphur dioxide (SO_2)*) recorded an increase in 2004 over 1994 primarily as a result of increased fuel usage (*See Figure 19*). Despite rising fuel use, the level of increase in SO_2 emissions was less than the other non-CO_2 emissions (55 per cent compared to a range of 115 per cent to 258 per cent for the other non-CO_2 emissions). This was because imported fuels in 2004 had lower sulphur content than fuels imported in 1994.

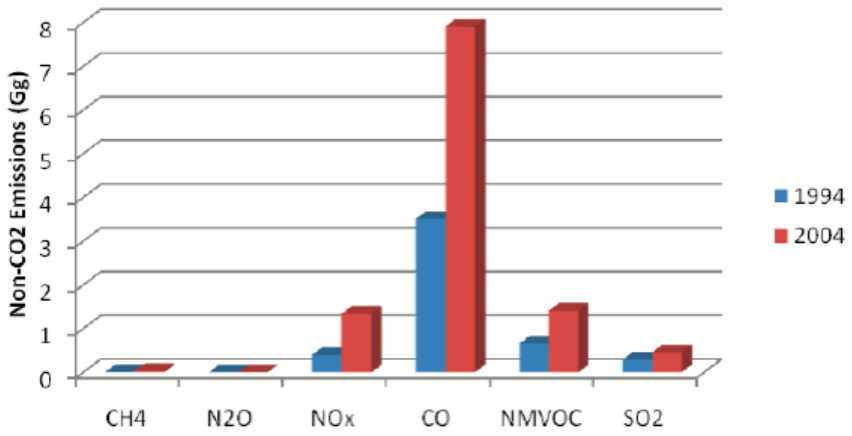


Figure 19: Comparison of non CO2 emissions from Fuel Combustion (1994 and 2004)

2.4.2 Memo Items

2.4.2.1 International Bunker Fuels

Aviation gasoline and jet fuels are considered to be international bunker fuels and emissions are not reported as part of the domestic inventory as recommended in the guidelines. In Saint Vincent and the Grenadines, there are international flights to and from the E.T. Joshua Airport on Mainland, Saint Vincent; as well as significant traffic of small aircraft between the Grenadines islands of Canouan, Bequia, Mustique and Union Island.

Methodology

Aviation gasoline and jet fuel consumed at airports in Saint Vincent and the Grenadines were

collected. In addition, data was gathered for the total number of landings and departures for all airports in Saint Vincent and the Grenadines along with the total number of landings by aircraft type for the E.T. Joshua airport for June 2004 to September 2009. However, the data collected was not detailed enough to distinguish between domestic and international flights by aircraft type. As a result, it was assumed that all aviation gasoline fuel was used for domestic flights and all jet fuel used as international bunkers. Unfortunately, international bunker marine fuel usage could not be estimated as insufficient data was available from major fuel distributors to determine fuel usage.

CO_2 Emissions

CO_2 emissions from international bunker fuels decreased since 1994 as shown in *Table 7*. This occurred despite air traffic recording an increase over time. Unfortunately, it is difficult to make comparisons because the methodology used to determine the 1994 emissions was not fully documented. Nevertheless, a possible explanation is that aircraft flying into Saint Vincent and the Grenadines from international destinations may be refueling less often in the island than in previous years.

Non-CO_2 Emissions

Non-CO_2 emissions from international bunker fuels were not provided in the INC. Therefore,

International Bunker Categories	**CO_2 Emissions**			
	1994 (Gg)	2000 (Gg)	2004 (Gg)	per cent change (1994 -2004)
Aviation	1.38	0.87	0.72	-48 per cent
Other	1.35	0	0	-1005
Total	**2.73**	**0.87**	**0.72**	**-74 per cent**

Table 8 presents non-CO_2 emissions from international bunker fuels for 2000 and 2004.

Table 7: Comparison of CO_2 emissions from international bunker fuels between 1994, 2000 and 2004

International Bunker Categories	**CO_2 Emissions**			
	1994 (Gg)	2000 (Gg)	2004 (Gg)	per cent change (1994 -2004)
Aviation	1.38	0.87	0.72	-48 per cent
Other	1.35	0	0	-1005
Total	**2.73**	**0.87**	**0.72**	**-74 per cent**

Table 8: Non-CO_2 Emissions from International Bunker fuels for 2000 and 2004

International Bunker	**2000 (Gg)**	**2004 (Gg)**
CH_4	$6.13*10^{-6}$	$5.1*10^{-6}$
N_2O	$2.45*10^{-5}$	$2.04*10^{-5}$
NO_x	0.0037	0.0031
CO	0.0012	0.001
NMVOC	0.0006	0.0005
SO_2	0	0

2.4.2.2 CO_2 Emissions from Biomass Fuels

In Saint Vincent and the Grenadines, biomass fuels that are burned for energy are primarily firewood and charcoal. The figures depicted in *Table 9* reveals that, CO_2 emissions from biomass fuels decreased by 66 per cent to 7.5 Gg between 1994 and 2004.

Methodology

To estimated CO_2 emissions, an IPCC default emission factor (tC/TJ) was used to convert terajoules of biomass into tons of carbon. Subsequently, conversion factors (e.g., oxidation factor and molecular weight factor) were utilised to convert total carbon into CO_2.

Table 9: Comparison of CO_2 Emission for biomass for 1994, 2000 and 2004

CO_2 Emissions from Biomass	**1994 (Gg)**	**2000 (Gg)**	**2004 (Gg)**	**per cent change (1994 -2004)**
Biomass	21.8	8.8	7.5	-66 per cent

Source of uncertainty

Generally, there is a low degree of uncertainty for CO_2 emissions associated with the energy sector since fuel usage in Saint Vincent and the Grenadines is tracked through import data. This fact is supported by the high level of correspondence between the Reference Approach and Sectoral Approach used to calculate emissions. On the other hand, there is a high degree of uncertainty in the data set for biomass, as the activity data were only available for 200l and the use of non-country specific estimates of the energy use for cooking.

Likewise, Non-CO_2 emissions ($C0_2$, CH_4, N_20, NO_x, CO, NMVOC) have a greater degree of uncertainty since emission factors used to calculate these emissions have a much greater range of variability than CO_2 emission factors. Only IPCC default values were used since country-specific measurements were not available.

2.4.3 Industrial Processes

The Manufacturing and Industrial sector in Saint Vincent and the Grenadines is very small and contributes a relatively insignificant proportion of GHG emissions. Substantial emissions result from the Food and Beverage industry and road paving with asphalt. In addition, some HFCs are released from the consumption and use of halocarbons for air-conditioning and refrigeration.

Methodology

Industrial activity in Saint Vincent and the Grenadines was reviewed to identify the industrial processes that could lead to emissions of GHG. Specifically identified were emissions of NMVOC from bitumen used in road paving asphalt; the manufacture of alcoholic beverages (rum and beer); food production (primarily bread and cakes) and meat processing. In addition, HFC emissions (not reported under the Montreal Protocol) from the import and consumption of halocarbons, including leakage and disposal, in refrigeration and air-conditioning activities were

identified.

Country specific production statistics and import data were obtained from the Government of Saint Vincent and the Grenadines, Customs and Excise Department; and specific industries and associations. Subsequently, default IPCC emission factors based on production levels or on import data were then used to estimate emission based on the *Revised 1996 IPCC Guidelines*.

Owing to limited data, the *Revised 1996 IPCC Guidelines* Tier 1 methodology was used to estimate the potential emissions of HFCs. The calculation formula for the Tier 1 methodology is:

Potential emissions = Production + Imports - Exports —Destruction.

Where:

- *Potential emissions are equal to the imports because Saint Vincent and the Grenadines does not produce, export or destroy HFCs.*

Imports were approximated based on Customs data of the number of products imported for the years 2000 and 2004 that was likely to contain HFCs, including refrigerators and motor vehicles. What is more, IPCC defaults were used to estimate the quantity of HFC material in each product as well as potential losses. Additionally, *UNFCCC's Non-Annex I National Greenhouse Gas Inventory Software (version 1.3.2)* was used to assist with the calculation of emissions.

Activity Data

Activity data to estimate emissions from road paving were derived from estimates of the Bitumen imported by asphalt plants. There is no domestic production of bitumen and its use outside of road pavement is limited, hence it was assumed that all imported bitumen was to be used in asphalt production. Another assumption made is that domestic asphalt production has 10 per cent bitumen content. This was done in order to estimate the total production of asphalt paving material.

In relation to the production of alcoholic beverage, data was gathered directly from the St. Vincent Brewery Ltd and St Vincent Distillers Ltd, for the years 2000 and 2004.

The data for bread production was provided by the East Caribbean Group of Companies (ECGC) based on the number of sacks of flour that was sold to bakeries; data was also provided on animal feed production by way of the Animal Feed Production Division. Data for meat and poultry production for 2000 and 2004 was obtained from the Statistical Unit in the Ministry of Agriculture, Rural Transformation ,Industry, Forestry and Fisheries and -MARTIFF (Ministry of Agriculture, Forestry and Fisheries- MAFF), while estimates of the fish landed and marketed for the same period was obtained from the Fisheries Division within the same Ministry.

The potential release of HFCs was based on Customs import data for products that contain HFCs (household refrigerators, window air conditioners (ACs), vehicles with ACs, commercial AC Units) and the charge per unit. This was assumed to be HFC134a. Detailed information on the individual charge of HFC per unit, especially for the commercial display units, was not available and the charge per unit selected is subject to considerable uncertainty. The Tier 1 methodology used assumes that all HFC for products imported in that year are released in the same year as it assumes that this would be roughly equivalent to total stock releases. No data was provided for bulk imports of HFCs.

CO_2 Emissions

No industrial processes were identified that directly released CO_2 emissions on the island since emissions related to fuel combustion are reported in the energy sector.

Non-CO_2 Emissions

Unlike CO2 emissions, NMVOC emissions recorded a 13.9 per cent increase in 2004 compared to 1994 as depicted in Figure 20. This was due to an increase in the estimate of asphalt used for road paving. Similarly, NMVOC emissions from industrial processes recorded an increase as reported in

Table *10*. There are no estimates of HFC emissions in 1994, however, estimated HFC emissions in 2000 and 2004 are 0.0245 Gg and 0.0372 Gg respectively.

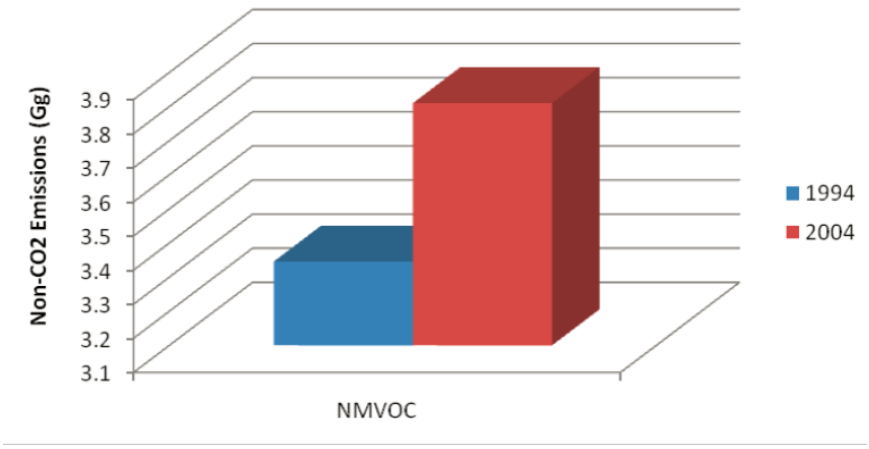


Figure 20: Comparison of Non-CO_2 (NMVOC) emission form Industrial process in 1994 and 2004

Table 10: NMVOC emissions from industrial process in 2000 and 2004

NMVOC Emissions by Sector	**Gg**	
	2000	2004
Road Paving with Asphalt	0.029	3.67
Production of Alcoholic Beverages	0.079	0.080
Production of Food	0.062	0.067
TOTAL	**0.170**	**3.81**

Source of uncertainty

Uncertainty arises as it relates to the collection of all relevant data. In the case of activity data for road paving which was based on bitumen import data and asphalt production, the data was collected for 2000 and 2004 directly from asphalt plants. However, import data was not available for bitumen to confirm the accuracy of the data collected, thus, creating a high degree of uncertainty on whether all the data was captured.

Uncertainties associated with the data for alcoholic beverages and food production are low. This

is because activity data was obtained directly from manufacturers for the corresponding years. There may be some level of uncertainty with NMVOC emission as emissions factors used to estimate emissions from road paving and alcoholic beverages are based on the IPCC default values. This may be somewhat unrepresentative based on the age and condition of the factories. In addition, country specific conversion factors are not available.

A high degree of uncertainty is associated with the estimated HFC emissions because estimates of the charge mass of HFC and type of HFC in refrigeration and air conditioning units were assumed based on representative values from other countries it is also unclear how accurately the Custom Department is able to track the import of products containing HFCs.

2.4.4 Solvent and other product use

Emissions from solvent and product use were not calculated in the INC 1994 inventory because specific IPCC methodologies was not provided in the guidance documents and the UNFCCC software did not have a module to handle these emissions. Although specific guidance from IPCC still was not provided for this sector, the 2000 and 2004 inventories include estimates of emissions from solvents and other products use. This was done as they can lead to significant sources of emissions of NMVOCs. In addition, NO_x is released in certain medical applications such as anesthetics.

Methodology

A consumption-based approach was used to estimate the emissions from solvents and other product use for the years 2000 and 2000. As a complement, the United States Environmental Protection Agency (USEPA) solvent content limits were used to estimate the volatile organic compound (VOC) content from different types of paints, varnishes and thinners. It was assumed that 100 per cent of the solvent content was released upon application.

Total NMVOC emissions from household product use were determined by multiplying the emission factor by the population of Saint Vincent and the Grenadines in the years 2000 and 2004. No data was available to determine a country-specific emission factor, therefore, NMVOC emissions from household product use were estimated based on average per capita emission factors published by the US EPA.

NMVOC emissions from Spraytex (a pesticide used in banana cultivation) were estimated based on 2000 and 2004 import data from the Customs Department as well as information on its physical properties (solvent percentage and density) as reported by the Windward Islands Banana Development and Exporting Company Ltd. These parameters allowed the total emissions to be calculated assuming that all solvents were released to the atmosphere.

Emissions of N_2O were estimated based on the total quantity of bulk nitrous oxide imported with the assumption that all N_2O that was used was released to the atmosphere.

Activity Data

The activity data for this sector came primarily from Saint Vincent and the Grenadines Statistical Office.

Non-CO_2 Emissions

NMVOC emissions increased marginally by less than 1 per cent from 2000 to 2004. This increase is a result of increased use of paints. N_20 emissions increased by 25 per cent over the same period as illustrated in *Table 11*.

Table 11: Non-CO_2 emissions from solvent and product use for 2000 and 2004

Non-CO_2 Emissions	**2000 (Gg)**	**2004 (Gg)**	**per cent change (1994 -2004)**
NMVOC	0.950	0.965	1.6 per cent
N_2O	0.004	0.005	25 per cent

Source of uncertainty

A high degree of uncertainty accompanies NMVOC emissions due to the method used to

estimate emissions from household products. The average per capita emissions used was for American consumers. As a result, the data is not country specific and emissions may be overestimated or underestimated depending on the national product usage pattern. It is likely that per capita usage of household products is less in Saint Vincent and the Grenadines. Still, it is also possible that the VOC content of the products may be higher as there are fewer regulations that govern the VOC content of these products than in the United States.

In addition, country specific VOC content for paints was unavailable since it was not possible to match the VOC contents of paints provided to the type of solvents that were reported by Customs Department. As a result, NMVOC emission factors for paints (flat coatings, non-flat coatings, quick dry enamel, varnishes and thinners) were based on VOC emission limits from US EPA and, therefore, have a high degree of uncertainty.

2.4.5 Agriculture

The Agriculture sector of Saint Vincent and the Grenadines comprises of crop production and the livestock industry. The former is mainly focused on the production of banana (primarily for export markets) as well as a variety of other crops (roots and tubers, vegetables, spices and fruit) which are primarily used for local consumption. Statistical data revealed an approximately 20 per cent decrease in the total value of crop production from 1994. Likewise, the number of dairy cattle, pigs and poultry has decreased significantly while the number of sheep and goats has increased.

In Saint Vincent and the Grenadines, CH_4 and N_2O are the only significant GHG emitted by the Agriculture sector. CH_4 emissions are limited to enteric fermentation and manure management emissions associated with animal livestock; N_2O emissions arise from fertilizer application to cultivated soils, excretion from grazing animals, atmospheric deposition of NH_3 and NO_x, and from leaching of agricultural soils.

Methodology

A Tier 1 simplified approach was used to calculate enteric fermentation and manure management emissions. This was based on regional default IPCC emission factors and on the population of each category of livestock.

The amount of nitrogen input from synthetic fertilizers, animal waste, nitrogen fixing crops and crop residues was estimated to calculate N_2O emissions from soils, animal production and from the application of fertilizers. Subsequently, default IPCC emission factors were then used to estimate direct and indirect N_2O releases.

Activity Data

Activity data on animal population according to livestock and types of Animal Waste Management Systems (AWMS) used in the island for different livestock was obtained from the MARTIFF (MAFF) a based on data collected as part of the Agricultural Census 2000. Synthetic fertilizer use was also sourced from the MARTIFF (MAFF). Crop production data were collected from the Food and Agriculture Organisation (FAO) data estimates for Saint Vincent and the Grenadines for the year 2000.

CO_2 Emissions

No CO_2 emissions were released from the Agriculture sector. Emissions related to fuel combustion are reported in the energy sector.

Non-CO_2 Emissions

CH_4 Emissions: A comparison of CH_4 emissions between 1994 and the years 2000 and 2004 revealed that total annual CH_4 emissions diminished by approximately 50 per cent from the year 1994 *(See Table 12*).This is mainly due to a slight reduction in the number of cattle, a reduction in enteric emissions and non-report of field burning for 2000 and 2004. In general, enteric emissions accounted for over 90 per cent of total CH_4 emitted from the Agricultural sector.

N_2O Emissions

According to calculations, N_2O emissions increased by over 200 per cent between the years 1994 and 2000 (*Table 13).* This increase was attributed to an increased application of animal waste, crop residues and synthetic nitrogen fertilizers to soils.

Table 12: CH_4 emission from the agriculture sector for 1994, 2000 and 2004

Agriculture Sub-Sector	**CH_4 Emissions**		
	1994 (Gg)	**2000 and 2004 (Gg)**	**per cent change (1994 -2000)**
Enteric Emission	0.420	0.224	-47 per cent
Manure Management Systems	0.036	0.019	-47 per cent
Field Burning Residues	0.038	0	-100 per cent
Total	**0.494**	**0.243**	**-51 per cent**

Table 13: N_2O Emission for the Agriculture Sector for 1994, 2000 And 2004

Agriculture Sub-Sector	**N_2O Emissions**			**percent change (1994-2004)**
	1994 (Gg)	**2000 (Gg)**	**2004 (Gg)**	
Manure Management systems		0.012	0.012	-
Cultivation of Agricultural Soils		0.074	0.093	-
Grazing Animals	0.0084	0.011	0.011	-
Atmospheric Deposition		0.007	0.008	-
Leaching		0.041	0.059	-
Field Burning of Residues	0.0469	0	0	-100 per cent
TOTAL	**0.0553**	**0.145**	**0.179**	**224 per cent**

Source of uncertainty

The main area of uncertainty in the Agricultural sector is related to the types of AWMS that are present and the methane emissions generated by these systems.

In addition, a high degree of uncertainty arises from the use of regional default IPCC emissions factors which were based on studies conducted in Latin America and used to estimate methane emissions from enteric fermentation.

2.4.6 Land Use Change and Forestry (LUCF)

Human activity that changes the way in which land is used or which affects the amount of biomass in existing biomass stocks give rise to emissions of CO_2, CH_4 and N_2O. Other GHGs such as NO_x, CO and NMVOCs are emitted especially when land is burned. In contrast, primary forests which are devoid of human activities are considered to be in equilibrium with respect to changes in CO_2.

Methodology

Due to insufficiently detailed land use data, it was impossible to utilise the most recent *Good Practice Guidance methodology (2003),* therefore, the methodology used draws primarily on the 1996 methodology, incorporating where appropriate, *Good Practice Guidance or emission factors from the 2006 IPCC Guidelines*.

Changes in forest and land-use that affect biomass stocks (harvesting of wood, establishing plantations and converting forested areas to other uses such as agriculture or urban development) were accounted for by estimating the net change in biomass over a l0 year time frame by considering both the growth and loss of biomass. Charcoal and fuel wood data are also used in the estimation of changes in biomass stocks but emissions from the combustion of these fuels are not included in the inventory except as memo item.

The growth rate of biomass for different forests was estimated by applying the IPCC default emission factors. Additionally, Conversion and Emission factors relating to Carbon Fraction, Biomass Conversion/Expansion and Fraction of Biomass Oxidized were taken as default values from the IPCC Workbooks.

Unfortunately, data was not available for the land use management practices by soil type, hence, no estimates were made for emissions due to possible changes in soil carbon due to land management practices.

In regards to CO_2 emissions, the *Revised 1996 IPCC Guidelines* Tier 1 methodologies were used to estimate emissions from LUCF. The estimates were based on a FAO Global Forest Resources Country Report for Saint Vincent and the Grenadines (FAO, 2005). Furthermore, the *UNFCCC's*

Non-Annex I National Greenhouse Gas Inventory Software (version 1.3.2) was used to assist in the calculation of emissions.

Activity Data

Land use data were obtained from the FAO report which included estimates of forest cover for the years 2000 and 2005 based on interpolation and extrapolation of original data obtained in 1984 and 1993 along with data on forest plantations for 1994 to 1999. These data were interpolated to derive land use data for 1994 (in order to revise the estimates in the INC) and 2004.Estimates from the INC put the annual average rate of deforestation in 1994 at 250 ha per year, but recent data indicates a deforestation rate of 139 ha per year. The required annual changes were derived from changes in land use between 1990 and 2000.

The amount of charcoal and the equivalent amount of wood used to make charcoal for 1994, 2000 and 2004 were estimated using the typical energy use for cooking (6,000 kcal/person/day or 9.16 GJ/person/y), the conversion efficiency for charcoal to wood (23 per cent) (Amous, 1999), and interpolation of Saint Vincent and the Grenadines census data. The estimates of charcoal use and the equivalent amount of wood were based on the percentage of households using charcoal.

CO_2 Emissions

There was no data available to evaluate soil carbon change and there was no report of liming of the soil. Therefore, CO_2 emissions and removals from the LUCF sector were derived primarily from carbon uptake due to biomass accumulation in forests, emissions from forest conversion, and from burning and decay of biomass (*See Table 14*).

As was previously mentioned, the data reported in the INC indicated that the LUCF Sector in 1994 had a net removal (i.e., a sink) of 134 Gg. However, the recalculated estimates show net emissions of 8 Gg. The recalculation of the 1994 data was done using the FAO data, the same emission factors used in the 2000 and 2004 inventory and estimates for charcoal use. The main reasons for the difference are the area assigned to forests, the emission factors (i.e., growth rates) used, and the inclusion of estimates for charcoal use (*Figure 21*)

Table 14: Sub-sector that lead to emission and removals of CO_2 in the LUCF sector for 2000 and 2004

Saint Vincent and the Grenadines Land Use Category	**2000**			**2004**		
	$C0_2$ Removals/Emissions			**CO_2 Removals/Emissions**		
	Removals (Gg)	**Emissions (Gg)**	**Net sink (Gg)**	**Removals (Gg)**	**Emissions (Gg)**	**Net Sink (Gg)**
Changes in Forest and Biomass Stocks	-49.4	-	-49.4	-55.6	-	-55.6
Forest and Grassland Conversion	-	20.9	20.9	-	20.9	20.9
Abandonment of Managed lands	-	-	-	-	-	-
CO_2 emissions and removals from soil	-	-	-	-	-	-
TOTAL	**-49.4**	**20.9**	**-28.5**	**-55.6**	**20.9**	**-34.7**

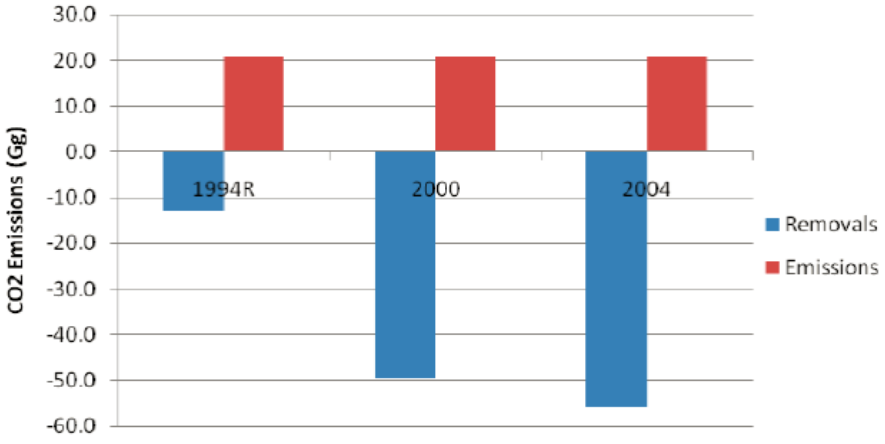


Figure 21: Comparison of CO_2 emission for LUCF sector 1994, 2000 and 2004

Non-CO_2 Emissions

Non-CO_2 emissions from the LUCF Sector are small. The emissions in 1994, 2000 and 2004 are summarised in *Figure 22*. The decrease in emissions from 1994 to 2000/2004 is primarily a result of the decrease in the burning of biomass that occurs during land clearing.

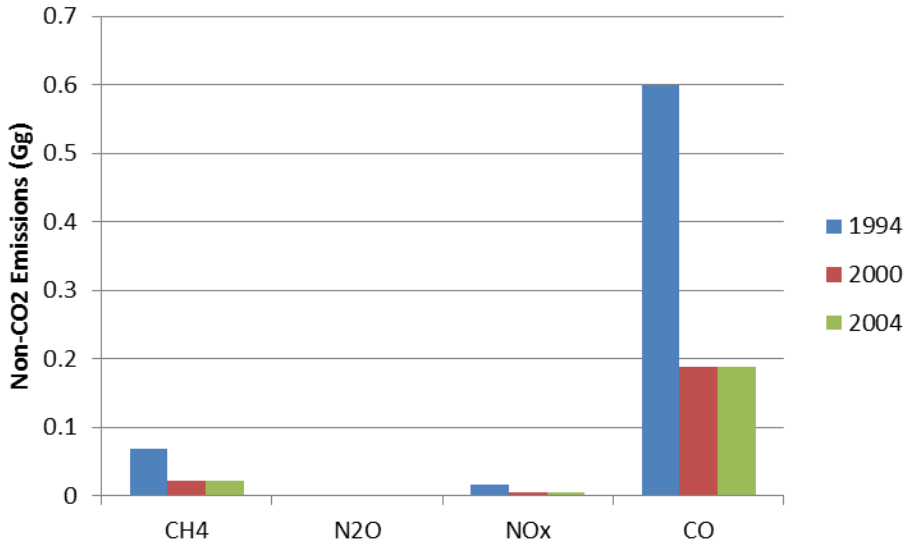


Figure 22: Comparison of Non-CO_2 Emissions for LUCF Sectors for 1994, 2000 And 2004

Source of uncertainty

Land-use information was available from the 2005 Saint Vincent Land Cover Map provided by the MARTIFF (MAFF). However, there were no similar data to estimate long-term trends before the year 2000. Additional land use data were obtained from the FAO to estimate land-use changes based on interpolation and extrapolation of original data obtained in 1984 and 1993 and data on forest plantations for 1994 to 1999.

These data were also interpolated to derive land use data for 1994 (in order to revise the estimates in the INC) and 2004. It is likely that these estimates are improved over previous estimates that relied on default FAO data published in the Revised 1996 IPCC Guidelines. There, however, remains a fair degree of uncertainty associated with this data. A forestry expert noted at the stakeholder workshop that the data trend that shows a net increase in forest cover between 2000 and 2004 is opposite to what he would have expected, and deforestation in this period may have occurred, however, there was no additional data available to verify this trend.

Uncertainty also arose from estimates for timber harvest, fuel wood harvesting and charcoal

production that led to removals in biomass which were approximated based on country specific census data of the number of households using wood and charcoal. In order to determine the amount of wood required for heating and cooking it was necessary to make assumptions in regards to household energy requirements for cooking. There is considerable uncertainty in these estimates. Charcoal consumption data were collected for the inventory but it was determined that this data most likely underestimated overall charcoal usage. Industry experts at the stakeholder workshop also indicated that some charcoal is also imported into the island but was not included in the consumption data provided.

With regard to biomass conversion factors, such as annual growth rate of forests, IPCC default values were used but actual values may be quite different. This could mean significant uncertainty in the GHG emissions and removals calculations for this sector.

2.4.7 Waste

In Saint Vincent and the Grenadines, solid waste disposal is limited to a small number of landfills. Open burning of waste is prohibted, but it estimated that approximately 15 per cent of waste is disposed at unmanaged dump sites (SWMU, 2002).

The disposal and treatment of industrial and municipal wastes by landfilling, recycling, incineration or waste-to-energy can produce emissions of most of the important GHG. These include CH_4 (the most important gas produced), CO_2 and NMVOCs; however, these emissions are small and not accounted for in the national inventory. Indirect N_2O emissions can also result from the treatment of sewage sludge and incineration of medical wastes.

Methodology

The mass balance approach from the default IPCC methodology was used to estimate methane emission. This approach involves estimating the degradable organic carbon (DOC) content of the solid waste (i.e., the organic carbon that is accessible to biochemical decomposition), and using this estimate to calculate the amount of CH_4 that can be generated by the waste from the total volume of waste generated. IPCC default emission factors were used for the fraction of DOC that degrades and the fraction of carbon released as methane.

The DOC content of the waste was estimated from surveys conducted on the composition of waste being sent to all landfills as recorded in the Saint Vincent and the Grenadines Solid Waste Characterization Study (SWMU, 2002).

Indirect N_2O emissions from human sludge were estimated from the N content of human sludge based on the per capita protein consumption of an average person in Saint Vincent and the Grenadines (FAO, 2009) and by applying a default IPCC emission factor (kg N20/kg human Sludge N).

Activity Data

Country-specific data pertaining to Municipal Solid Waste (MSW) disposed to Solid Waste Disposal Sites (SWDSs) were obtained from the Saint Vincent and the Grenadines Solid Waste Management Unit (SWMU) for the year 2002. It was estimated that 15 per cent of the total waste produced (includes waste generated from both urban and rural populations) was not sent to SWDSs. Moreover, the volume of Waste for 2000 and 2004 were assumed to be the same as the estimated waste disposed in 2002 as population levels were nearly the same in these years.

The DOC content of the waste is based on the fraction of organic materials in MSW (SWMU, 2002) and the per cent degradable Carbon (C) of each organic material.

In order to estimate N_2O emissions from wastewater handling operations, the per capita protein consumption by Vincentians was estimated based on data published by the FAO of the United Nations (FAO, 2009) for Saint Vincent and the Grenadines.

Industrial wastewaters in Saint Vincent and the Grenadines are generally untreated and all other wastewater treatment systems are aerobic. Therefore, industrial wastewater emission were not calculated and reported.

CO_2 Emissions

In Saint Vincent and the Grenadines, CO_2 emissions stem from the incineration of medical wastes. These emissions are included as they result primarily from non-biological and inorganic waste sources. Rough calculations of the per capita generation of incinerated medical wastes

were based on a presentation prepared by the Solid Waste Management Unit (SWMU, 2002). Total emissions in 2000 and 2004 were estimated to be less than 0.04 Gg, however, emissions related to fuel combustion are reported in the energy sector.

Non-CO_2 Emissions

Methane emissions from the Waste Sector are a very significant contributor to Saint Vincent and the Grenadines GHG inventory and increased by approximately 64 per cent from 1994 to 2004.The increase was due to the increase in waste reported going to SWDS/landfills. Total methane emissions in 2004 were estimated to be 2.9 Gg. Conversely, N_2O emissions from waste water handling were negligible as illustrated in *Figure 23* which compares non-CO_2 emissions from the Waste Sector in 1994, 2000 and 2004.

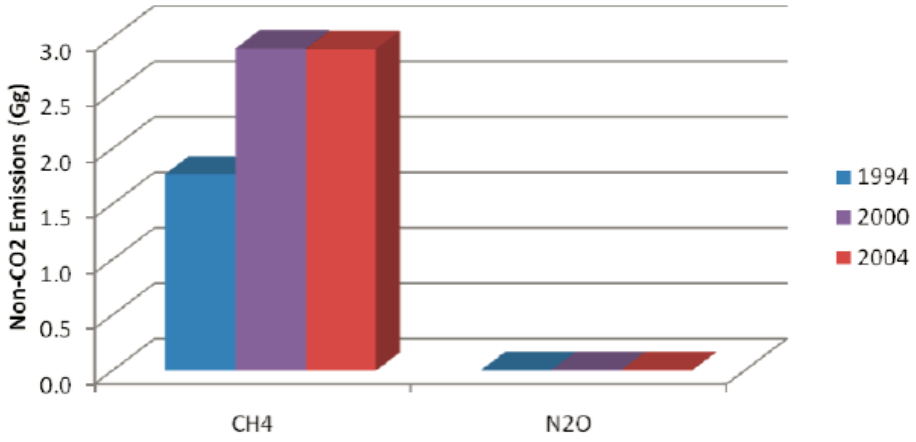


Figure 23: Non-CO2 Emission for Waste Sector for 1994, 2000 And 2004

Source of uncertainty

A low degree of uncertainty is attributed to the estimates due to the availability of reliable activity data on the amount of waste sent to solid waste disposal. In addition, there is a low degree of uncertainty for DOC of waste. This is a major factor in estimating methane emissions and is based on country specific waste composition.

There is also a high degree of certainty with the estimates of emissions arising from the incineration of wastes and estimate of methane emissions from the domestic and commercial wastewater which was based on country specific data.

There may be uncertainty associated with N_2O emissions from human sewage, since the IPCC default values were used along with per capita protein consumption values reported by the FAO. However, the highest degree of uncertainty is associated with the default values for the Methane Correction Factor (MCF).

2.5 Global Warming Potential (CO_2e Emissions)

Amongst the most important direct GHG are CO_2**,** CH_4, HFC and N_2O. Emissions of these gases can be expressed as an equivalent amount of carbon dioxide (CO_2e) that would have the same global warming potential (GWP) when measured over a specified timescale (generally, 100 years). In order to convert the various GHG emissions to CO_2e they must be multiplied by their GWP.

Total CO_2e emissions are 274Gg for 2000 and 358Gg for 2004 which represents a 60 per cent and 109 per cent increase respectively in total emissions from the year 1994 (See *Figure 24*).

The key source category analysis was a useful tool to identify key areas where resources can be spent on improving the emission inventory. Specifically because it is known that the uncertainty associated with methane emissions from landfills and CO_2 emissions from conversion of forests to other land-uses is high, improvements to emission estimation methodologies (e.g., using a Tier 1 versus a Tier 2 methodology) and improving activity data and/or emissions factors is a priority for these categories.

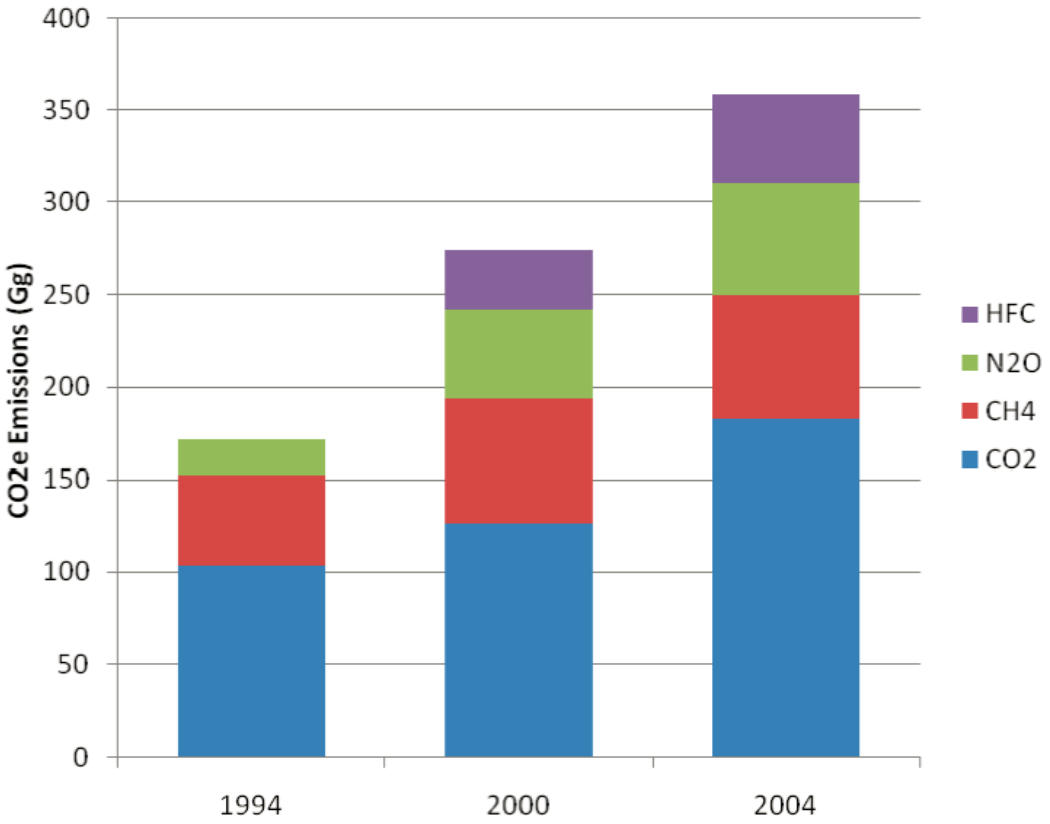


Figure 24: Comparison of Total GHG Emissions (CO_2e) for Saint Vincent and the Grenadines (1994, 2000, 2004)

Table 15 indicates the key source categories that were identified using the Key Source Category Tool in the *UNFCCC Software v.1.3.2*. The analysis indicates that CO_2 emissions from transportation sources in 2004 were the largest overall contributor to emissions. The second and third largest sources in 2004 were CO_2 emissions from stationary combustion in the energy sector and then CH_4 emissions from solid waste disposal. In the year 2000, CO_2 emissions from stationary combustion in the energy sector were larger than emissions from transportation sources.

Emissions of GHG from the energy sector accounted for more than 55 per cent of total emissions in 2004. While there is reasonable confidence in the overall value and in the level of emissions from stationary combustion, the resolution of the other energy key source categories (e.g., transportation, residential and manufacturing) is poor because a sectoral energy balance for Saint

Vincent and the Grenadines was not available. Therefore, the uncertainties in the energy key source categories in *Table 15* are moderate.

Table 15: Comparison of Total Greenhouse Gas Emissions (CO_2e) for Saint Vincent and the Grenadines (2000, 2004)

Sector	**Key Source Categories**	**Applicable GHG**	**Level Assessment excluding LULUCF (per cent)**	
			2000	**2004**
Energy	Mobile Combustion: Road Vehicles	CO_2	22.1	27.4
Energy	Emission from Stationary Combustion Diesel	CO_2	25.1	24.0
Waste	Emission from Solid Waste Disposal Sites	CH_4	18.3	14.0
Agriculture	(Direct and Indirect) Emissions from Agricultural soils	N_2O	13.6	13.2
Industrial Processes	Consumption of Halocarbons	HFC	10.6	12.3
Energy	Other Sectors: Residential	CO_2	3.5	2.8
Waste	Emissions from Wastewater Handling	CH_4	2.0	1.5

2.6 National GHG Summary Report

The 2000 and 2004 GHG Emission Inventory Summaries from the UNFCCC software are presented in

Table 16, *Table 17*, *Table 18* and *Table 19.*

Table 16: Summary of 2000 National GHG Inventory of Anthropogenic Emissions by Sources and Removals by Sink of all GHG not controlled by the Montreal Protocol and GHG Precursors

GREEN HOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 Emissions (Gg)**	**CO_2 Removals (Gg)**	**CH_4 (Gg)**	**N_2O (Gg)**	**NO_2 (Gg)**	**CO (Gg)**	**NMVOC (Gg)**	**SO_2 (Gg)**
Total National Emission and Removals	**155.15**	**-28.51**	**3.202**	**0.156**	**0.867**	**6.659**	**2.241**	**0.298**
1 Energy	**155.11**	**0.00**	**0.037**	**0.001**	**0.862**	**6.471**	**1.122**	**0.293**
A fuel Combustion (Sectoral Approach)	155.11		0.037	0.01	0.862	6.471	1.122	0.293
1 Energy Industries	75.56		0.003	0.001	0.207	0.016	0.005	0.235
2 Manufacturing Industries and Construction	1.04							
3 Transport	66.79		0.000	0.000	0.011	0.001	0.000	0.003
4 Other Sectors	11.72		0.015	0.001	0.617	5.888	1.107	0.055
5 Other (please specify)	NE		0.018	0.000	0.027	0.567	0.009	0.000
B Fugitive Emissions from Fuels	NE		NE		NE	NE	NE	NE
1 solid Fuels			NO		NO	NO	NO	NO
2 Oil and Natural Gas			NO		NO	NO	NO	NO
2 Industrial Processes	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
A Mineral Products	NO					0.00	0.03	0.00
B Chemical Industry	NO		NO	NO	NO	NO	NO	NO
C Metal Production	NO		NO	NO	NO	NO	NO	NO
D Other Production	NO				NO	NO	0.146	NO
E Production of halocarbons and sulphur hexafluoride	NO		NO	NO	NO	NO	NO	NO
FConsumption of halocarbons and sulphur hexafluoride	NO		NO	NO	NO	NO	NO	NO
G Other(please specify)	NE		NE	NE	NE	NE	NE	NE
3 Solvent and Other Product Use	**0.000**			**0.004**			**0.950**	
4 Agriculture			0.243	0.145	0.000	0.000		

GREEN HOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_2 (Gg)	CO (Gg)	NMVOC (Gg)	SO_2 (Gg)
A Enteric Fermentation			0.224					
B Manure Management			0.019	0.012				
C Rice cultivation			NO					
D Agriculture Soils				0.133				
E Prescribed Burning of Savannas			NO	NO	NO	NO		
F Field Burning of Agricultural Residues			NO	NO	NO	NO		
G Other (please specify)			NE	NE				
5 Land-Use Change & Forestry	**0.000**	**-28.515**	**0.022**	**0.000**	**0.005**	**0.188**		
A Change in Forest and Other Woody Biomass Stock	0.000	-49.403						
B Forest and Grassland Conversion	20.888		0.022	0.000	0.005	0.188		
C Abandonment of Managed Lands		NE						
D CO_2 Emissions and Removals from soil	NO	NO						
E Other (please specify)	NE	NE	NE	NE	NE	NE		
6 Waste	0.037		2.902	0.006	0.000	0.000	0.000	0.000
A Solid Waste Disposal on Land			2.620					
B Wastewater Handling			0.282	0.006				
C Waste Incineration	0.037		0.000	0.000				
D Others (please specify)			0.000	0.000				
7 Other9please specify)								
Memo Items								
International Bunkers	**0.87**		**0.000**	**0.000**	**0.004**	**0.001**	**0.001**	**0.000**
Aviation	0.87		0.00	0.00	0.004	0.001	0.001	0.000
Marine	NE		NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass	8.82							

Table 17: Summary of 2000 National GHG Inventory of Anthropogenic Emissions of Hfcs,Pfcs and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC_S (Gg)			PFC_S (Gg)			SF_6(Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
Total National Emission and Removals	**0**	**0.0245**	**0**	**NO**	**NO**	**NO**	**NO**
1 Energy							
A fuel Combustion (Sectoral Approach)							
1 Energy Industries							
2 Manufacturing Industries and Construction							
3 Transport							
4 Other Sectors							
5 Other (please specify)							
B Fugitive Emissions from Fuels							
1 solid Fuels							
2 Oil and Natural Gas							
2 Industrial Processes	**0**	**0.0245**	**0**	**NO**	**NO**	**NO**	**NO**
A Mineral Products							
B Chemical Industry							
C Metal Production	NO	NO	NO	NO	NO	NO	NO
D Other Production							
E Production of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO
F Consumption of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO
G Other(please specify)							
3 Solvent and Other Product Use							
4 Agriculture							
A Enteric Fermentation							

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC_S (Gg)			PFC_S (Gg)			SF_6(Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
B Manure Management							
C Rice cultivation							
D Agriculture Soils							
E Prescribed Burning of Savannas							
F Field Burning of Agricultural Residues							
G Other (please specify)							
5 Land-Use Change & Forestry							
A Change in Forest and Other Woody Biomass Stock							
B Forest and Grassland Conversion							
C Abandonment of Managed Lands							
D CO_2 Emissions and Removals from soil							
E Other (please specify)							
6 Waste							
A Solid Waste Disposal on Land							
B Wastewater Handling							
C Waste Incineration							
D Others (please specify)							
7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo Items							
International Bunkers							
Aviation							
Marine							
CO_2 Emissions from Biomass							

Table 18: 2004 National GHG Inventory of Anthropogenic Emission by Source and Removals By Sinks of all GHG not controlled by the Montreal Protocol and GHG Precursors

GREEN HOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_2 (Gg)	CO (Gg)	NMVOC (Gg)	SO_2 (Gg)
Total National Emission and Removals	**217.414**	**-34.731**	**3.201**	**0.193**	**1.352**	**8.091**	**6.188**	**0.456**
1 Energy	217.377	0.000	0.040	0.002	1.346	7.903	1.410	0.456
A fuel Combustion (Sectoral Approach)	217.377		0.040	0.002	2.346	7.903	1.410	0.456
1 Energy Industries	94.057		0.004	0.001	0.257	0.019	0.006	0.292
2Manufacturing Industries and Construction								
3 Transport	3.150		0.000	0.000	0.018	0.001	0.000	0.010
4 Other Sectors	107.936		0.020	0.001	1.045	7.398	1.396	0.154
5 Other (please specify)	12.234		0.016	0.000	0.026	0.485	0.008	0.000
B Fugitive Emissions from Fuels	NE		NE		NE	NE	NE	NE
1 Solid Fuels			NO		NO	NO	NO	NO
2 Oil and Natural Gas			NO		NO	NO	NO	NO
2 Industrial Processes	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.812**	**NO**
A Mineral Products	NO					NO	3.666	NO
B Chemical Industry	NO		NO	NO	NO	NO	NO	NO
C Metal Production	NO		NO	NO	NO	NO	NO	NO
D Other Production	0.000				NO	NO	0.146	NO
E Production of halocarbons and sulphur hexafluoride								
F Consumption of halocarbons and sulphur hexafluoride								
G Other(please specify)	NE		NE	NE	NE	NE	NE	NE
3 Solvent and Other Product Use	0.000			0.005			0.965	
4 Agriculture			0.243	0.179	0.000	0.000		
A Enteric Fermentation			0.224					

GREEN HOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_2 (Gg)	CO (Gg)	NMVOC (Gg)	SO_2 (Gg)
B Manure Management			0.019	0.012				
C Rice cultivation			NO					
D Agriculture Soils				0.167				
E Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F Field Burning of Agricultural Residues			NO	NO	NO	NO	NO	
G Other (please specify)			NE	NE	NE	NE	NE	
5 Land-Use Change & Forestry	**0.000**	**-34.731**	**0.022**	**0.000**	**0.005**	**0.188**		
A Change in Forest and Other Woody Biomass Stock	0.000	-55.619						
B Forest and Grassland Conversion	20.888		0.022	0.000	0.005	0.188		
C Abandonment of Managed Lands		NE						
D CO_2 Emissions and Removals from soil	NO	NO						
E Other (please specify)	NE	NE	NE	NE	NE	NE		
6 Waste	**0.037**		**2.896**	**0.007**	**0.000**	**0.000**	**0.000**	**0.000**
A Solid Waste Disposal on Land			2.620					
B Wastewater Handling			0.277	0.007				
C Waste Incineration	0.037		0.000	0.000				
D Others (please specify)			NE	NE				
7 Other (please specify)	NE	NE	NE	NE	NE	NE	NE	NE
Memo Items								
International Bunkers	**0.723**		**0.000**	**0.000**	**0.003**	**0.001**	**0.001**	**0.000**
Aviation	0.723		0.000	0.000	0.003	0.001	0.001	0.000
Marine	NE		NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass	7.53							

Table 19: Summary of 2004 National GHG Inventory of Anthropogenic Emissions of Hfcs, Pfcs and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC_S (Gg)			PFC_S (Gg)			SF_6(Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
Total National Emission and Removals	**0**	**0.037**	**0**	**NO**	**NO**	**NO**	**NO**
1 Energy							
A fuel Combustion (Sectoral Approach)							
1 Energy Industries							
2 Manufacturing Industries and Construction							
3 Transport							
4 Other Sectors							
5 Other (please specify)							
B Fugitive Emissions from Fuels							
1 solid Fuels							
2 Oil and Natural Gas							
2 Industrial Processes	**0**	**0.037**	**0**	**NO**	**NO**	**NO**	**NO**
A Mineral Products							
B Chemical Industry							
C Metal Production	NO	NO	NO	NO	NO	NO	NO
D Other Production							
E Production of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO
F Consumption of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO
G Other(please specify)							
3 Solvent and Other Product Use							
4 Agriculture							
A Enteric Fermentation							

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC_S (Gg)			PFC_S (Gg)			SF_6(Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
B Manure Management							
C Rice cultivation							
D Agriculture Soils							
E Prescribed Burning of Savannas							
F Field Burning of Agricultural Residues							
G Other (please specify)							
5 Land-Use Change & Forestry							
A Change in Forest and Other Woody Biomass Stock							
B Forest and Grassland Conversion							
C Abandonment of Managed Lands							
D CO_2 Emissions and Removals from soil							
E Other (please specify)							
6 Waste							
A Solid Waste Disposal on Land							
B Wastewater Handling							
C Waste Incineration							
D Others (please specify)							
7 Other(please specify)	NO	NO	NO	NO	NO	NO	NO
Memo Items							
International Bunkers							
Aviation							
Marine							
CO_2 Emissions from Biomass							

Chapter 3: Mitigation Assessment

The Mitigation Assessment (MA) includes an analysis of the potential impacts of various technologies and practices that can mitigate climate change, while also supporting sustainable development in Saint Vincent and the Grenadines. The assessment was done for 6 sectors: Transport, Residential, Commercial _Tourism, Waste, Agriculture, and Industrial Processes. Although the GHG inventory was done for the year 2000 and 2004, neither was used as the base year since the selection of the base year should reflect the most current data available. Consequently, 2010 was selected and new inventory data was gathered to establish this more current base year. The MA was conducted in 2011 and considered over a relatively short term to 2025. This is in keeping with the UNFCCC document which concludes that nearer term assessments (10-20 years) based on national plans and sectoral assessments are generally the most practical for most developing countries.

The Long-range Energy Alternatives Planning System (LEAP), a flexible "bottom up" modelling framework was used to prepared the baseline and mitigation scenarios. LEAP was chosen because it provides several advantages which includes: a comprehensive and integrated system covering energy supply-side and demand-side mitigation options; it is relatively easy to use; it can be applied in situations where there are data limitations; the depth of analysis can be tailored to the needs of the user and it is available free of charge to users in developing countries[5].

3.1 Methodology

The methodology used to execute the MA involved two major steps:

(1) Development of a Baseline Scenario, which projects GHG emissions assuming no additional emission reduction measures (i.e. a "business-as-usual" scenario); and

(2) Development of Mitigation Scenarios, which project GHG emissions assuming additional

[5] *Information regarding LEAP is available on the SEl website (http://www.sei-us.orq/leap). Further information is available here: http://www.energycommunity.org/default.asp?action47, including the application to receive a LEAP license free of charge.)*

defined emission reduction measures.

3.1.1 Baseline Scenario Methodology

In a MA, it is critical to establish a baseline from which to critically analyse possible mitigation scenarios and evaluate their potential impact. In this case, the baseline will represent a plausible and consistent description of how GHG emissions in Saint Vincent and the Grenadines might evolve into the future in the absence of explicit new GHG mitigation policies. Therefore, providing a reasonable baseline is vital since mitigation measures must be largely judged on the incremental costs and benefits relative to this baseline.

With this in mind, a business – as - usual (BAU) approach was used to develop a single baseline for the analysis of the mitigation scenarios. This approach is based on using current socio-economic trends to project future energy demand or emissions while also trying to consider the evolution of technologies, practices and structural shifts in the economy. The BAU scenarios were developed by undertaking three steps:

Step 1: Estimating Emissions from 2004 to 2010

GHG emissions for the year 2010 were estimated for the main economic sectors based on the 2004 GHG Inventory. Activity data and energy use data were collected to make new emission estimates for 2010 by entering the new activity data into the UNFCCC GHG Inventory Software[6] and estimating new GHG emission levels. In addition, a 2010 energy balance was developed to determine sectoral fossil fuel consumption. It included the main imported fuels (gasoline, diesel, kerosene, LPG and aviation gas) and was primarily based on import data available from the Customs and Excise Department along with diesel consumption data from VINLEC. This data set was used to generate sector estimates based on sectoral distributions of the year 2004 energy balance. With regard to the non-energy related sectors, data was gathered to estimate the change in emissions between 2004 and 2010. The specific data sources and assumptions for this and the other two steps are

[6] *UNFCC GHG Inventory Software was used to develop the 2000 and 2004 emission inventory of the Second National Communication and is available at: http://unfccc.int/resource/cd romsìnal/ghq inventories/index.htm*

summarized in .

Table 20.

Step 2: Allocation of Emissions and Energy-Use to Sector End-Uses

Emissions and energy consumption were allocated to sector end-uses based on available data and reasonable assumptions. The LEAP model was applied in this process. The model requires, as a minimum, fuel usage by end-use to consider the potential effects of mitigation measures. The model input was generated by allocating the total sectoral emissions and energy consumption gathered in the first step to sector end-uses (e.g., residential appliances, vehicles, air conditioning units). Many different sources of information were gathered from publically available documentation and from national consultants between January 2012 and May 2012 to establish this allocation. In most cases a "top down" approach was used and the energy demand by sector and of end-uses was based on available socio economic data, regional studies, and reasonable assumptions.

Step 3: Future GHG Emissions and Energy Consumption

Growth rates for energy use and GHG emissions were estimated based on population, historical growth in the sector, and the projections stated in the *Energy Action Plan for Saint Vincent and the Grenadines (First Edition, January 2010).* Data was also collected to assess how technology changes and stock turnover would affect end-use energy efficiency and emissions.

The future population was projected by estimating the current population that represented the end-use in the LEAP model (e.g., number of vehicle kilometers travelled, number of air conditioners, number of households) to grow by the estimated sector growth rates. The LEAP model was also used to project adaption to technology as it contains factors that would account for any anticipated changes in end-use energy efficiency (e.g., vehicle fuel efficiency) based on technology changes. Conversely, non-energy sector emissions were typically based only on historical trends.

3.1.2 Mitigation Scenario Methodology

In this assessment, two Mitigation Scenarios were developed for analysis:

1. Mitigation Scenario #1- includes 9 measures; and
2. Mitigation Scenario #2 - twelve measures (measures in mitigation scenario # 1 plus 3 additional ones).

The measures included in the scenarios are potential policies, programs, or projects that are designed to reduce GHG emissions. The process of selecting the measures to include in the scenarios, and then analysing the emission impacts of the scenarios, involved the following steps:

Step 1: Selection of Measures

A list of potential mitigation measures that could be implemented in Saint Vincent and the Grenadines was identified (*See Annex 1*). The list was developed by the consulting firm, ICF Marbek, based primarily on measures described in existing policy documents including:

- *Sustainable Energy for Saint Vincent and the Grenadines: The Government's National Energy Policy, February 2009*
- *Energy Action Plan for Saint Vincent and the Grenadines, First Edition, January 2010*
- *Initial National Communication on Climate Change: Saint Vincent and the Grenadines, November 2000*
- *St. Vincent and the Grenadines Top-up Activity for Climate Change, Final Report (Draft),July 2005*
- *Saint Vincent and the Grenadines Top-up Activity for Climate Change: Monitoring and Evaluation Report, by Carol James, September 2005*
- *Climate Change and the Caribbean: A Regional Framework for Achieving*

Development Resilient to Climate Change (2009-2015), CCCCC, July 2009

- *Status of Renewable Energy and Energy Efficiency in the Caribbean (2010-2011), Low- Carbon Communities in the Caribbean, Draft February 201 1*
- *Technology Needs Assessment Workshop Report, Saint Vincent and the Grenadines, July 2004*
- *Powerline, January — June 2010, VINLEC*
- *Saint Vincent and the Grenadines Baseline Scenario Workshop Documents — Workshop Exercise (inputs from participants)*

The list was screened to identify the most promising options for further analysis. The screening process resulted in a list of nine measures which formed the basis for Mitigation Scenario #1 and an additional three measures to form Mitigation Scenario #2. This was undertaken by stakeholders at a workshop, which took place February 29, 2012 using the following criteria:

1. Potential GHG impact (Yes/No)
2. Consistency with national development goals (Yes/No)
3. Sustainability (weight: high)
4. Institutional considerations such as institutional capacity needed, political feasibility, replicability (weight: high)
5. Consistency with national environmental goals (weight: high)
6. Potential effectiveness of implementation policies (weight: high)
7. Expected cost e.g. cost per ton of carbon (weight: medium)

Step 2: Analysis of the Individual Measures

The selected mitigation measures were first analysed individually and then collectively to

determine their standalone and combined impacts respectively. The assessment of GHG impact of each measure must be based on two key variables- the technical potential of the measure and, the expected penetration rate. Due to data limitations, a full analysis of all these factors was well beyond the available resources for this project. Nevertheless, the LEAP model was used to analysis the approximate GHG impact of each individual measure. This was done using a combination of available relevant data, indicative international reference data within the LEAP, international "rules of thumb" and assumptions made based on the professional judgment of the consultant team and the MOHWE (MOHE).

Step 3: Analysis of Mitigation Scenarios #1 and #2

Upon completion of the assessment of the individual measures, the combined emissions impact of the selected measures was determined using the LEAP model, first for Scenario #1 and then for Scenario #2.

It must be noted that the emission impacts of the individual measures are not necessarily fully additive - in that, a measure that reduces emissions through reduced energy use in the Residential sector would be fully additive with a measure that reduced emissions in the Transportation sector. However, two measures that both reduce residential sector emissions may or may not be additive depending on whether or not they target the same emission sources.

This step resulted in the estimated emission reductions that would be generated by the two Mitigation Scenarios, relative to the Baseline Scenario. The results of which are presented in Section 3.4.

3.2 Data

Data collection for the development of the scenarios was a crucial activity that required the participation of a large number of organizations and government departments. As a consequence, the data collection was a two-step process:

(1) Data to update the inventory to the current year and to allocate the emissions and energy consumption to sector end-uses; and

(2) Data to project emissions into the future based on socio-economic forecasts of growth, historical trends, and assumptions regarding technology adoption.

This data was gathered from various sources such as:

- Official government publications;
- Directly from government agencies, energy utilities/suppliers, and others;
- Informed estimates with assistance from agencies, utilities, and others; and,
- Default (international) inputs.

Data Limitations and Key Assumptions

Data limitations affected the accuracy of the sector and end-use energy demand, GHG emission projections and, to some extent, the base year GHG emissions. Some of the key data limitations, impacts, and subsequent assumptions are highlighted in .

Table 20 and further detailed by sector in Section 3.4.

Table 20: Key Data Limitation, Impact and Assumptions

Data Limitation	**Impact**	**Assumptions**
No GDP projections available	Although GDP is not always the best indicator to project future growth or decline of a sector, for some cases it can be and for others, it serves as an important cross-check for growth assumptions based on other indicators.	Other indicators to estimate growth in individual sectors were extracted from the *Energy Action Plan for Saint Vincent and the Grenadines (First Edition, January 2010).*The Energy Action Plan was used to project the electricity growth rate in the following sectors: residential, commercial and tourism, industry, and street lighting. The Energy Action Plan was also used to project gasoline and diesel consumption for transportation out to 2015. Avgas was projected to grow in correlation with increased tourism. Population growth/decline was used as a proxy for the remaining fuels (i.e LPG, charcoal) that did not have available growth rates in the

Data Limitation	Impact	Assumptions
		following sectors: residential, commercial. Population growth/decline was also used to project change in the agriculture, forestry and fishing sector, as well as the waste sector.
No sectoral breakdown of electricity consumption	Impacts the accuracy of the sectoral baseline and projections	IMF Country Report No. 09/119[5] provided a breakdown by sector for 2004 data. It was assumed that this breakdown was unchanged between 2004 and 2010.
No sectoral breakdown of imported fuel consumption	Impacts the accuracy of the sectoral baseline and projects	To remain consistent, the assumptions used to estimate the fuel consumption by sector in the 2000 and 2004 inventory, were again applied to the total fuel import data for 2010
No information on energy demand by end-use in any sector	Impacts the accuracy and level of detail available to model and apply mitigation scenarios	Some of the mitigation measures are specific to end-use equipment. For modelling assumptions are made on the share of each end-use of the total electricity/fuel consumption
No recent data available in certain sectors (e.g LUCF, agriculture)	Depending on the sector, this could have a large or small impact. For example, LUCF can be a significant GHG source or sink; however, in the absence of data, this cannot be determined. In contrast, the agricultural sector is one of the smaller overall contributors to total emissions, so limited data does not have as big an impact.	From 1994 to 2005 the inventory results for the LUCF sector showed net removal of GHGs. However, there is no evidence to suggest that this pattern has continued or not continued beyond 2005, and there ¡s no basis for assuming that past trends will continue. In the absence of land-use area and forest land-use data for a recent year, LUCE emissions/sinks have not been estimated in the Baseline Scenario. This is quantitatively equivalent to an assumption that there will be no net LUCE emissions or removals, It can be expected that the

Data Limitation	Impact	Assumptions
		actual situation will involve some positive or negative land use change, but it is not possible to estimate what that change will be. In the absence of data, there is no way to know whether it would be a net positive or net negative change. In the absence of updated animal population data, the most recent data was applied, which in this case was from the 2002 census.

NB: Per cent change in population was used as a proxy to project growth in certain sectors. The annual population growth rate (2009 est.) was assumed to be -0.34 per cent[7]

3.3 Baseline Scenario

The GHG inventory presented emissions under the following source/sink categories: Energy; Industrial Processes; Solvents and Other Product Use; Agriculture; Land Use Change and Forestry; and, Waste. For this assessment, where necessary, each of these was further broken down. Consequently, the baseline scenario is presented by economic sectors where the brackets indicate the associated sector(s) in the GHG inventory.

3.3.1 Residential (Energy)

Current Allocation of Emissions and Energy Use

The residential sector includes emissions from energy sources, including electricity, LPG, and charcoal[8]. Apart from available data, key assumptions (see *Table 21*) were used to determine overall emissions and energy demand in this sector between 2004 and 2010 as well as their allocation to sector end-uses.

Table 21: Key assumptions and data source for allocating energy demand and emissions in the residential

[7] *U.S. Department of State, Bureau of Public Affairs: Electronic Information Publications, Background Notes, Saint Vincent and the Grenadines (http://www.state.qov/r/pa/ei/bqn/2345.htm - date accessed: February 2012).*

[8] *CO_2 emissions are not included for emissions from charcoal combustion.CO_2 emissions associated with the combustion of charcoal are considered to be biogenic in origin. These types of emissions are reported separately in GHG inventories, as memo items. However, other gas emissions, such as CH_4 and N_2O are not considered biogenic and therefore included in the total emissions.*

sector

Data Variable	**Assumption/ data Source**
Total Direct Household Energy Use (not including electricity)	Total fuel consumption provided by Customs and Excise. Of all fuels provided, the residential sector is assumed to use only LPG and charcoal. It was assumed that the residential sector used 90 per cent of the total imported LPG and 100 per cent of the charcoal.
Total Indirect Household Energy Use (i.e., electricity)	Total electricity generation provided by VINLEC. IMF Country Report No. 09/1197 provided a breakdown by sector for 2004 data. It was assumed that this breakdown was unchanged between 2004 and 2010. Therefore, 2004 sectoral ratio applied to 2010 data to determine electricity consumption in the residential sector.
Number of households	The number of households was estimated based on the total population and the assumed number of people living in one household.

Sector Growth Rate from 2010 to 2025

The majority of emissions from the residential sector are attributable to electricity consumption. However, there were no forecasts available to project how the residential sector might fare in the future. The Energy Action Plan for Saint Vincent and the Grenadines stated that electricity demand has grown annually by 5.4 per cent in the residential sector between 1998 and 2007.Therefore; it was assumed that the growth rate for electricity demand will continue at 5.4 per cent per year until 2025. It was noted that energy demand in this sector has increased despite a decline in population which can be attributed to greater energy intensity per household. It was also assumed that LPG and charcoal consumption will follow the trend in population declining at 0.34 per cent per year until 2015

Baseline Residential GHG Emissions

Baseline GHG emissions in the residential sector are expected to rise 101 per cent from 56,730 tons in 2010 to 113,801 tons in 2025, as shown in *Figure 25*. The cooking end use (including LPG and charcoal cooking, but excluding electric cooking) would account for 9 per cent of emissions in 2025 and the other end uses (including LPG for domestic hot water heating and electricity for all other end uses - primarily air conditioning, lighting, refrigeration, and electric cooking), which depend entirely on electricity except for LPG domestic hot water, would account for 91 per cent of emissions in 2025.

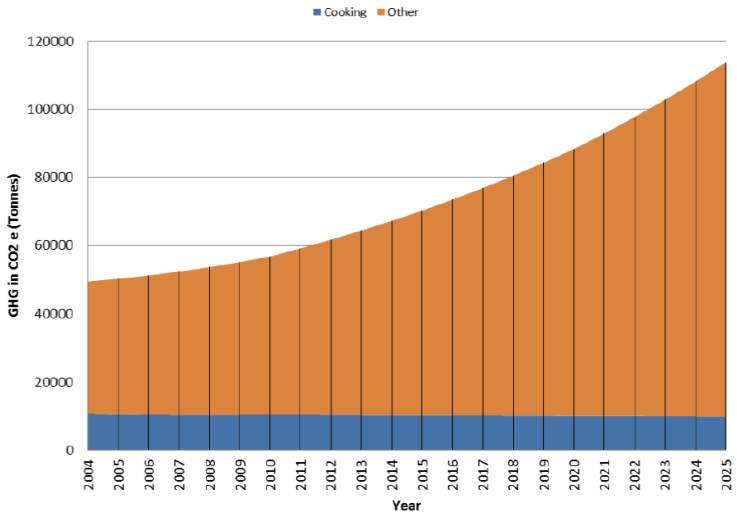


Figure 25: Residential Sector GHG Emissions (t CO_2e)

3.3.2 Industry (Energy; Industrial Processes; Solvents)

Current Allocation of Emissions and Energy-Use

The industry sector comprises emissions from energy sources, including electricity used in industrial processes, and diesel consumption from manufacturing and construction. It also takes into account emissions from non-energy sources, including emissions from road paving, food and beverage production, consumption of HFCs, use of solvents, and use of lubricants for the energy industry. *Table 22* reports the assumptions and data used to determine overall emissions and energy demand in the industrial sector between 2004 and 2010 and allocate them to sector end-uses.

Table 22: Assumptions and Data Source for Allocating Energy Demand and Emissions in the Industry Sector

Data Variable	**Assumption/Data Source**
Total Direct Energy Use (not including electricity)	Total fuel consumption provided by Customs and Excise. The industrial sector was assumed to consume diesel oil. To be consistent with the 2004 GHG inventory, it was assumed that the industry sector consumed 2 per cent of the total diesel imported to St. Vincent.

Total Indirect Energy Use (i.e., electricity)	Total electricity generation provided by VINLEC. IMF Country Report No. 09/119 provided a breakdown by sector for 2004 data. It was assumed that this breakdown was unchanged between 2004 and 2010. Therefore, 2004 sectoral ratio applied to 2010 data to determine electricity consumption in the industrial sector.
Activity Data	Import data for 2010 provided by Customs and Excise for bitumen, equipment containing HFCs, lubricants, and solvents. Bitumen was converted to asphalt based on a ratio of 10 per cent. Note that the amount of bitumen imports reported for 2010 was significantly less than those reported in 2004. Beer and black wine production provided by industry. Annual rum production assumed to increase by the average increase of beer and black wine. Flour production / sales data was provided for 2010. It was assumed that 5 per cent of flour was used for cakes and 95 per cent for bread. Production data for meat, fish, poultry, and animal feed was provided by ECGC and the Ministry of Agriculture for 2010. For solvents, product use was estimated for 2010 based on default factors for per capita consumption and the 2010 population. Note there was no import of Spraytex reported for 2010.

Sector Growth Rate from 2010 to 2025

It was not possible to project how this sector might fare in the future. As a result, the following were assumed:

- An annual growth of 1.1 per cent in electricity demand will continue to 2025. This was based on information in the *Energy Action Plan for Saint Vincent and the Grenadines, 2010*, which stated that the electricity demand grew at 1.1 per cent annually in the industrial sector between 1998 and 2007.

- A decline in emissions from non-energy industrial sources at 0.34 per cent per year until 2025. This was based on the assumption that emissions from non-energy industrial sources followed the trend in population and are assumed to decline at 0.34 per cent per year until 2025. The larger contributors in this sector are the non-energy sources (e.g., NMVOCs from road paving and from food and beverage manufacturing, and HFCs from consumption of halocarbons).

- A decline in diesel consumption at 0.34 per cent per year until 2025. With diesel being the second largest contributor to industrial emissions, it was assumed its consumption will follow population trend.

Baseline Industrial GHG Emissions

Baseline GHG emissions in the industrial sector are expected to decrease by 2 per cent from 57,494 tons in 2010 to 56,182 tons in 2025, as shown in Figure 26. The largest contribution in this sector would come from industrial processes (91 per cent in 2025). This includes electricity used in industry and non-energy emissions from industrial processes (e.g. NMVOCs from road paving and from food and beverage manufacturing, HFCs from consumption of halocarbons, and use of lubricants). Manufacturing and construction represents the diesel use in industry and would be the second largest contributor (7 per cent in 2025). NMVOC and N_2O emissions from solvent use are the smallest contributor (at 2 per cent in 2025) to total industrial GHG emissions and comprise the consumption of solvents by industry as well as minor solvent used in residence.

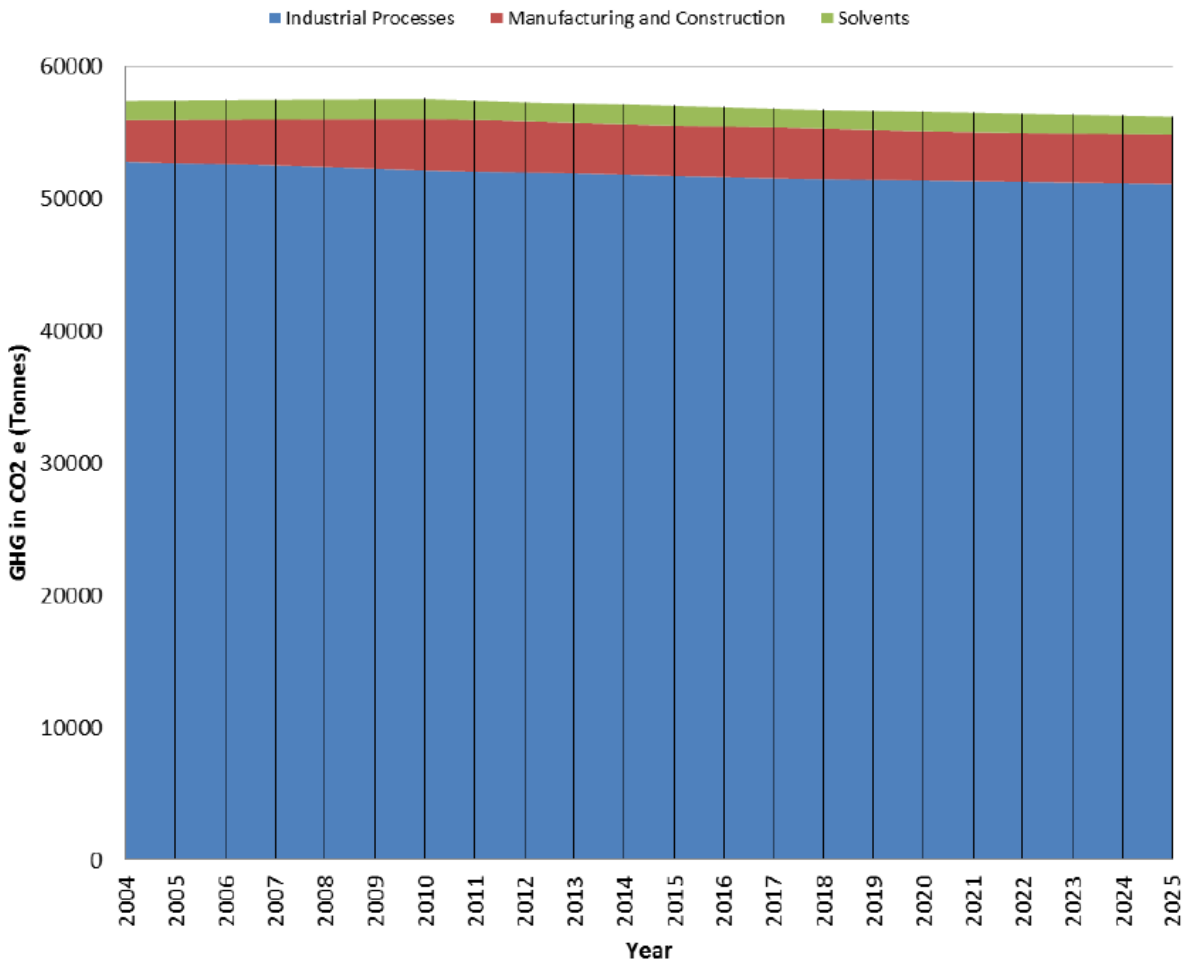


Figure 26: Industry Sector GHG Emissions (T CO_2e)

3.3.3 Commercial and Tourism (Energy)

Current Allocation of Emissions and Energy-Use

The commercial and tourism sector includes emissions from energy sources, including electricity and LPG. The overall emissions and energy demand in this sector between 2004 and 2010 and the allocation to sector end uses were determined using the key assumptions laid out in

Table 23.

Table 23: Key Assumptions and Data Sources for Allocating Energy Demand and Emissions in the Commercial and Tourism Sector

Data Variable	Assumption/Data Source
Total Direct Energy Use (not including electricity)	Total fuel consumption provided by Customs and Excise. Of all fuels provided, the commercial sector is assumed to use only LPG. To be consistent with the 2004 GHG inventory, it was assumed that the commercial and tourism sector consumed 10 per cent of the total imported LPG.
Total Indirect Energy Use (i.e., electricity)	Total electricity generation provided by VINLEC. IMF Country Report No. 09/119 provided a breakdown by sector for 2004 data. It was assumed that this breakdown was unchanged between 2004 and 2010. Therefore, 2004 sectoral ratio applied to 2010 data to determine electricity consumption in the commercial sector.

Sector Growth Rate from 2010 to 2025

Due to a lack of forecasts of the future of this sector, information from the *Energy Action Plan for Saint Vincent and the Grenadines, 2010* was used to make key assumptions. According to the Plan, Saint Vincent and the Grenadines' electricity demand has grown annually by 7.7 and 4 per cent in the commercial sector and for street lighting respectively between 1998 and 2007. Therefore, it was assumed that this annual growth rate for electricity demand and street lighting will continue to 2025.

Whilst the majority of emissions from the commercial and tourism sector are attributable to electricity consumption; it was also necessary to account for growth in use of other fuel (LPG) used in the sector. The Ministry of Tourism and the Physical Planning within the Ministry of Housing, Informal Human Settlements, Lands and Surveys and Physical Planning provided an estimated increase in tourist visitations of 3.66 per cent resulting from the construction of the new international airport. It was assumed that with increased visitors would result in increased use of LPG for cooking and domestic hot water. Consequently, the projected annual growth in LPG use is assumed to be 3.66 per cent until 2025.

Baseline Commercial and Tourism Sector GHG Emissions

Baseline GHG emissions in the commercial and tourism sector are expected to rise by 201 per

cent from 47,937 tons in 2010 to 144,101 tons in 2025, as *shown in Figure 27*. Electricity demand end-uses, such as air conditioning, lighting, refrigeration, and cooking, account for the majority of total energy demand (91 per cent in 2025) and for the large expected increase. Street lighting and LPG end uses make up the remainder, contributing 7 per cent and 2 per cent, respectively to total emissions in 2025.

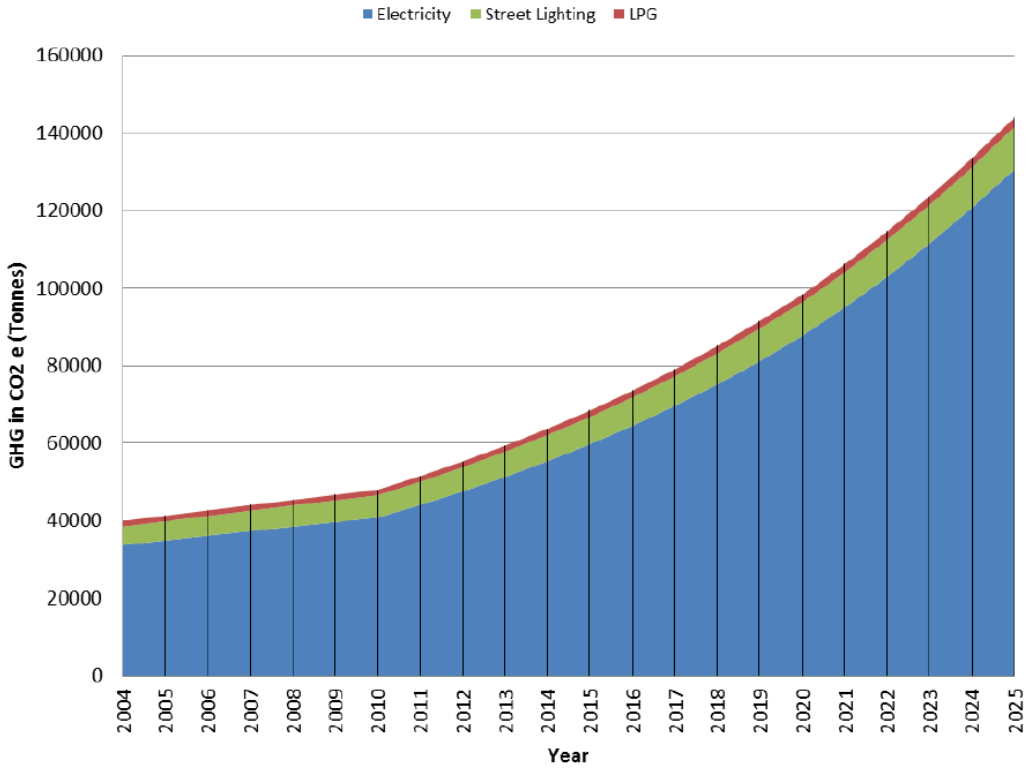


Figure 27: GHG Emissions (t CO_2 e) for the Commercial and Tourism Sector

3.3.4 Agriculture, Forestry and Fishing (Agriculture; LUCF)

Current Allocation of Emissions and Energy-Use

The agriculture, forestry and fishing sector includes emissions from non-energy sources, including emissions from enteric fermentation, manure waste management, and the application of nitrogen fertilizer. Due to the absence of data for land-use area and forest land-use for a

current/recent year, it is assumed that there was no change (i.e., that the forest was in a steady state beyond 2005) and therefore there are no emissions and no removals from forestry associated with this sector beyond 2005. The key assumptions used to determine the historical growth rate in this sector between 2004 and 2010 and allocate them to sector end-uses are reported in *Table 24.*

Table 24: Key Assumptions and Data Sources for Allocating Energy Demand and Emissions in the Agriculture, Forestry and Fishing Sector

Data Variable	**Assumption/Data Source**
Total Energy Use (Direct and Indirect)	No fuel consumption was attributed to the agricultural sector. Fuel used or transport by vehicles within this sector is captured in the transportation sector. No electricity use was attributed to the agricultural sector.
LUCF Emissions	For the 2004 inventory, updated land-use area and forest land-use data was provided (for year 2005) and compared to the 1994 inventory. The data for the period 1994 to 2005 showed a net sink (i.e. net removal of GHGs). However, there is no evidence to suggest that this pattern has continued or not continued beyond 2005, and there is no basis for assuming that past trends continued to 2010. As such and as noted above, emissions/removals from LUCF have not been estimated. This is quantitatively equivalent to an assumption that there were no net LUCF emissions or removals during the 2004 to 2010 period. It can be expected that the actual situation did involve some positive or negative land use change, but it is not possible to estimate what that change was. In the absence of data, there is no way to know whether it was a net positive or net negative change.
Agriculture Enteric Fermentation, Manure Management and Nitrogen Fertilizer Emissions	Livestock populations for 2002 were used to calculate emissions (as in the 2004 inventory). Although the source was stated to be the same, the number of cattle increased, and the population of sheep, goats, and pigs remained the same. Data for horses, mules, and poultry were not provided, so 2004 inventory data was applied. All cattle were assumed to be non-dairy. As this sector is in a continual state of flux, no attempt was made to revise livestock population figures based on socio economic data (i.e. it is assumed that there was no change in livestock population during this period, except for the noted cattle change). Crop production data for 2010 was provided by the Agriculture Statistics Unit. Nitrogen fertilizer application data was provided for the year 2010

	(note that the amount of fertilizer reported decreased significantly from 2004 to 2010).

Sector Growth Rate from 2010 to 2025

In comparison to other sectors, this sector is more vulnerable to external factors such as severe weather events and pest infestations. As such, it was more difficult to establish a growth trend in this sector. Statistical data indicated that the total yield and value of crop production has fluctuated between 2006 and 2010. Like the other sectors, no forecasts were available to project how these sectors might fare in the future. Thus, it was assumed that they will decline with population, at a rate of 0.34 per cent per year. Due to a lack of data, projections to 2025 were not made for land use change and forestry.

Baseline Agriculture, Forestry and Fishing Sector GHG Emissions

Baseline GHG emissions in the agriculture, forestry and fishing sector are expected to decrease by 5 per cent from 29,319 tons in 2010 to 27,859 tons in 2025, as shown in *Figure 28*. Emissions in this sector are generally dominated by enteric fermentation, manure waste management and the application of nitrogen fertilizer which are projected to make up 100 per cent of the emissions in 2025. The reasons being that the 2004 inventory determined LUCF was a sink and the absence of land-use area and forest land-use data for current/recent year hindered estimation for 2025.

3.3.5 Transport (Energy)

Current Allocation of Emissions and Energy-Use

The transport sector includes emissions from energy sources, including gasoline, diesel, and avgas plus lubricants (used domestically). *Table 25* contains the assumptions used to determine overall emissions and energy demand in the transport sector between 2004 and 2010 and allocate them to sector end-uses.

Sector Growth Rate from 2010 to 2025

The road transport sector has seen a fast growing demand for fuels even though the number of vehicles imported annually is not growing quickly. This may be a result of fewer vehicles being retired than imported each year, that the annual mileage driven is increasing, and possibly that the vehicles being imported have a lower fuel economy (e.g., increasing tendency to import large vehicles, such as SUVs, compared to smaller, light weight cars).

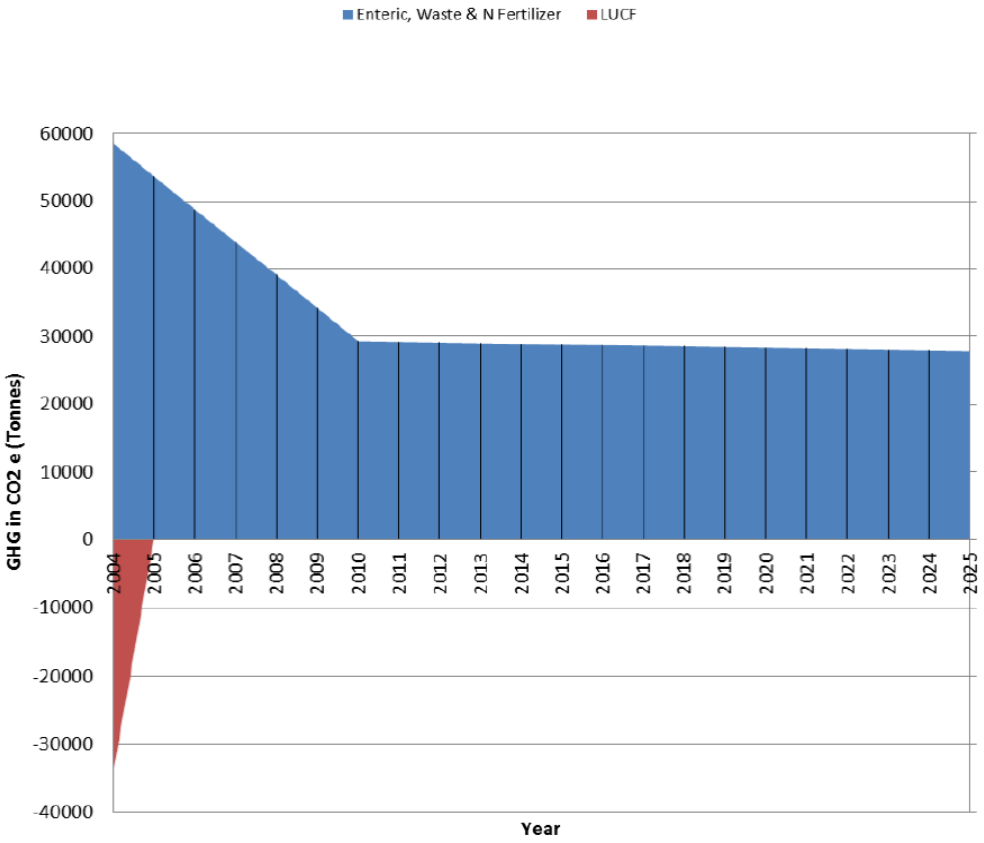


Figure 28: GHG Emissions (t CO_2 e) for the Agriculture, Forestry and Fishing sector

Table 25: Key Assumptions and Data Sources for Allocation Energy Demand and Emission in Transport Sector

Data Variable	**Assumption/Data Source**
Number and Types of Vehicles	Motor Vehicle Registration Statistics, 2010

Total Direct Energy Use	Total fuel consumption provided by Customs and Excise. The transport sector was assumed to consume diesel, gasoline, avgas and lubricants. To be consistent with the 2004 GHG inventory, it was assumed that the transport sector consumed 100 per cent of the total gasoline imported and the balance of diesel imported (i.e., the diesel not used by VINLEC for electricity generation or by the industry sector). This was 38 per cent of the total diesel imported to St. Vincent. It was assumed that all avgas imported to St. Vincent was used for domestic flights (note, all jet kerosene imported was assumed to be used for international flights and therefore not included in the emissions). Note that the amount of avgas reported for the year 2010 was significantly less than that reported for 2004. 50 per cent of lubricants imported to St Vincent are assumed to be used in the transport sector and are included along with the avgas energy use.

Based on the projected growth rates from the *2010 Energy Action Plan for Saint Vincent and the Grenadines*, a 15 per cent annual growth rate for gasoline consumption (assumed to be passenger vehicles) and a 10 per cent annual growth rate for diesel consumption (assumed to be freight vehicles) is assumed for the years 2010 to 2014 (inclusive). However, in 2015, this growth rate is assumed to decrease by half; therefore in 2015, the gasoline consumption would increase by 7.5 per cent and the diesel consumption would increase by 5 per cent. It was then assumed that saturation in the number of vehicles would be reached by the beginning of 2016. Therefore, from 2016 to 2025, fuel consumption in the transport sector is assumed to decrease due to older, less efficient vehicles being retired and replaced with newer, more efficient vehicles. Total energy demand decreases because of energy efficiency improvements to new vehicles. Since all vehicles are imported, improvements to fuel economy should remain in step with fleet-wide performance in jurisdictions from where vehicles are imported. Based on recent corporate average fuel efficiency (CAFE) standards passed into law in the US[9], the fleet-wide performance is expected to improve for new vehicles; even tighter standards exist for European and Japanese vehicles. The improvement in fuel efficiency in the United States fleet corresponds to an average increase in fuel efficiency of approximately 2 per cent per year between 2010 and 2016. By 2016, the US vehicle fleet fuel efficiency is expected to improve up to 4 per cent annually. As a result the baseline assumes, from 2010 to 2015, an annual decrease in fuel consumption of the sector of 2

[9] *United States, Energy Independence and Security Act of 2007*.

per cent, rising to 4 per cent for 2016 to 2025.

Based on an estimated increase in tourist visitations of 3.66 per cent; it is assumed that domestic flights will increase at the same rate as international, in order to keep up with demand. Therefore, Avgas demand in the transport sector will increase at 3.66 per cent per year until 2025. Lubricant use is assumed to increase by 10 per cent annually from 2010 to 2025.

Baseline Transport Sector GHG Emissions

Baseline GHG emissions in the transport sector are expected to rise 88 per cent from 137,034 tons in 2010 to 257,029 tons in 2025, as illustrated in *Figure 29*. These emissions would include only domestic transport. In 2025, 59 per cent of total transportation emissions would be contributed by on-road passenger travel (light duty gasoline vehicles) while on-road freight transportation (heavy duty diesel vehicles) would make up the remaining 41 per cent. The contribution of avgas, used domestically, minor and would account for only 0.03 per cent of total transport emissions in 2025.

In the absence of end-use data, it was assumed that all diesel imported for the transportation sector was used by road freight and all gasoline imported was used for on-road passenger transportation. It is understood that a portion of this gasoline and diesel would likely be used for domestic marine navigation (including passenger and freight travel). Generally, CO_2 emissions are dependent on the fuel type rather than the end-use, therefore fuel use in marine engines would produce the same CO_2 emissions as fuel use of the same type in on-road vehicles. However, differences were observed in CH_4 and N_2O emissions. Gasoline boats have a higher CH_4 emission factor (g/L fuel) and lower N_2O emission factor (g/L fuel) when compared to the assumed average light duty gasoline vehicle used in Saint Vincent and the Grenadines. Furthermore, diesel ships have a similar CH_4 emission factor (g/L fuel) and a higher N_2O emission factor (g/L fuel) when compared to the assumed average heavy duty diesel vehicle used in Saint Vincent and the Grenadines. Attributing all imported gasoline to passenger road transportation results in a higher estimate of GHG emissions, however, attributing all diesel imported for the transportation sector to road freight results in a lower estimate of GHG emissions. Therefore, not knowing the breakdown between marine and road transportation

within both fuel types; it is difficult to conclude on whether or not the transportation sector GHG emissions in the Baseline Scenario are over or under estimated.

3.3.6 Waste (Waste)

Current Allocation of Emissions and Energy-Use

The waste sector includes emissions from non-energy sources, including emissions from landfills and wastewater. The assumptions used to determine the historical growth rate in the waste sector between 2004 and 2010 are stated in *Table 26*.

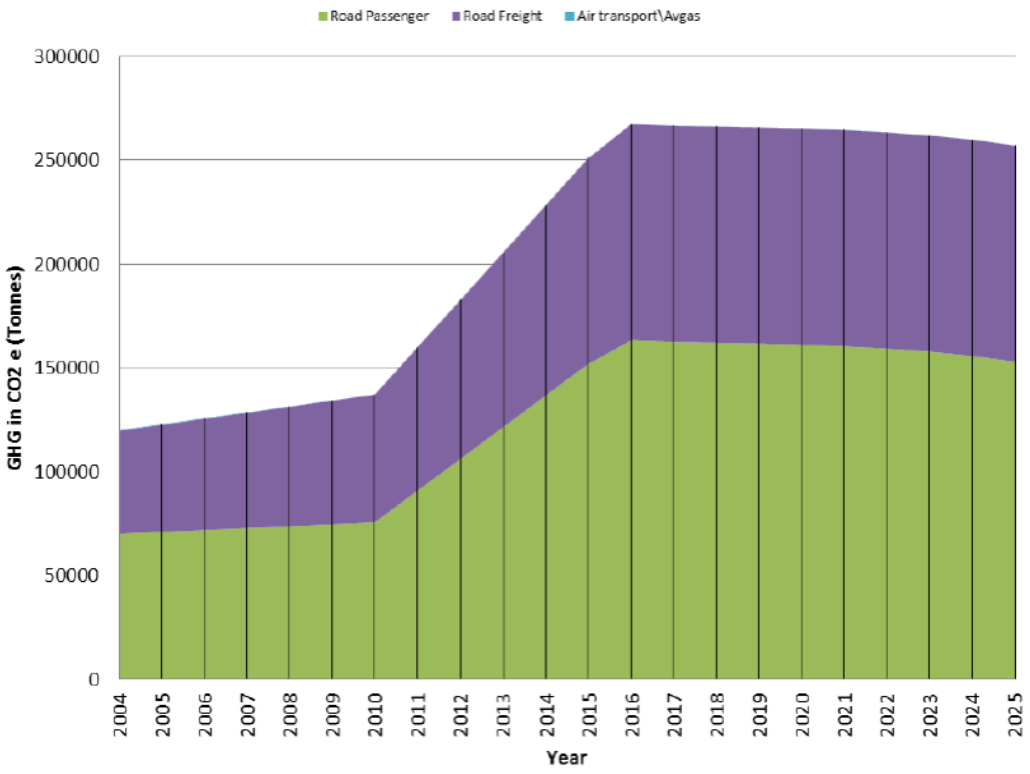


Figure 29: GHG Emission for the Transport Sector (t CO_2e)

Table 26: Key assumptions and data source for allocating energy demand and emissions in the waste sector

Data Variable	**Assumption/Data Source**
Total Waste Disposed	Waste data provided for 2010 was in cubic metres with no additional detail (compacted, un-compacted, density, etc.). Due to the uncertainty in converting the total volume to a total mass, the IPCC regional waste generation default for the Caribbean region (0.49 tons/capita/year) was applied. Note that data used in the 2004 inventory was sourced from *Solid Waste Characterization Studies in Saint Vincent and the Grenadines*, prepared by Esther Richards and O'Reilly Lewis, June 2002, with additional estimates made for MSW for the Union Island unmanaged site from 2008 data from CWSA. Given the increase seen from 2004 to the assumed total waste in 2010 (based on default factor), in addition to the declining population, it is possible that use of the regional default factor overestimates the total waste disposed for Saint Vincent and the Grenadines.
Nitrous Oxide Emissions from Wastewater	Nitrous oxide emissions are directly correlated to the amount of human waste disposed and the amount of protein consumed. Nitrous oxide emissions were assumed to decrease with the population change between 2004 and 2010 and the protein consumed (79 g/capita/day) as reported by the FAO (2007 data available). Note that the number and type of latrine systems (e.g., septic systems) was assumed to be the same the data used in the 2004 inventory (which was from 2001).

Sector Growth Rate from 2010 to 2025

No forecasts were available for future waste disposal rates. As a result, it was projected based on the population growth rate projections of -0.34 per cent since total waste disposed was determined using a tons per capita factor. The same assumption was applied to project wastewater handling.

Baseline Waste Sector GHG Emissions

Baseline GHG emissions in this sector are expected to decrease by 5 per cent from 78,685 tons in 2010 to 74,766 tons in 2025, as shown in *Figure 30.* Emissions from this sector are dominated by methane emissions from landfills and nitrous oxide emissions from wastewater.

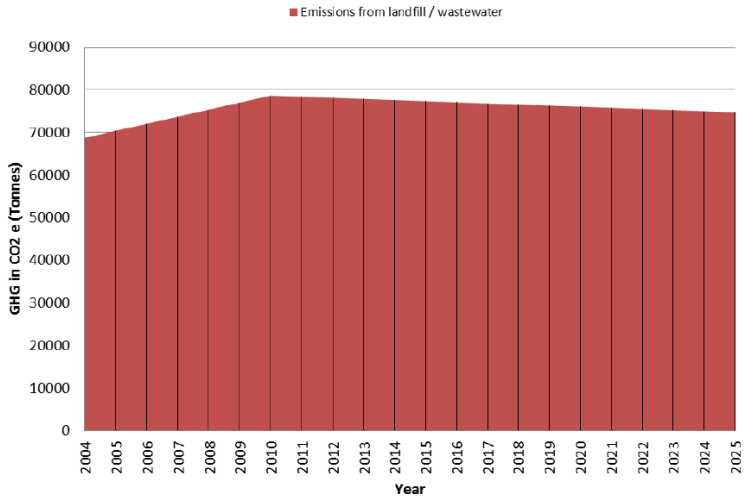


Figure 30: GHG Emission (t CO2 e) for the Waste Sector

3.4 Mitigation Scenarios

The measures included in Mitigation Scenario #1 are presented in *Table 27*. The measures included in Mitigation Scenario #2 comprise of the measures in Mitigation Scenario #1 plus the additional measures presented in

Table 28.

Table 27: Measures Included in Mitigation Scenario #1

No.	Measure	Description	Modelled?
RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS			
1	Adopt standards and guidelines for the construction of energy efficient buildings	Introduce guidelines and standards in the commercial and residential sectors relating to building design, insulation, ventilation, daylighting, use of efficient AC and appliances, and use of renewable energy sources (e.g., for water heating).	Yes
2	Set energy performance standards for importation and sales of major energy consuming equipment and appliances	Introduce minimum energy efficiency standards for selected types of appliances, used particularly in the residential and commercial sectors.	Yes
TRANSPORTATION SECTOR			

No.	Measure	Description	Modelled?
3	Revise the car taxation system to give incentives for the purchase and use of fuel-efficient passenger cars and other vehicles	Use import duties and/or excise taxes to provide incentives for the purchase of more fuel-efficient passenger cars and other vehicles.	Yes
4	Provide information to the public on fuel consumption of different car models that are commonly imported	Provide fuel consumption information for new and used vehicle models that are available for import in order to assist consumers in selecting more efficient vehicles with lower fuel costs.	No
AGRICULTURE,FORESTRY AND FISHING SECTOR			
5	Implement programmes of reforestation and agro-forestry	Increase the rate of tree-planting and reforestation through collaborative programmes involving local communities and the Ministry of Agriculture, Rural Transformation, Forestry and Fisheries.	No
6	Implement programmes for the reduction of deforestation	Promote the use of waste wood, including thinning debris, for crafts and furniture, as a means to combat deforestation. In subsequent years the programme would expand to include additional measures.	No
WASTE			
7	Introduce a composting programme for the commercial sector	Operate a central composting facility to handle organic waste, initially from the tourism sector. In subsequent years the programme would expand to include other parts of the commercial sector.	Yes
ELECTRICITY GENERATION			
8	Implement a program for the installation of grid-connected wind and PV power systems	Encourage production of electricity from renewable sources (wind and photovoltaic power) by independent power producers (IPPs).	Yes
CROSS-CUTTING MEASURES			
9	Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction	Provide education and awareness programmes promoting efficient energy use and waste reduction across all sectors of the economy. In addition, provide training for specialized expertise	No

No.	Measure	Description	Modelled?
		in relevant areas.	

Table 28: Measures for Mitigation Scenario #2

No.	Measure	Description	Modelled ?
10	Waste reduction across all sectors	Reduce waste to landfill through a Reduce, Reuse, Recycle programme. This measure applies to all sectors.	Yes
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	Assess the geothermal resource on St. Vincent, in order to establish the basis for possible development. Assuming viable results develop the resource for purposes of electricity generation.	Yes
12	Support the development of innovative financing mechanisms for the deployment of solar water heaters	Provide innovative financing mechanisms that encourage installation of solar water heaters in the commercial and residential sectors.	Yes

The reasons why some of the measures outlined in the above tables were not modelled are presented below in *Table 29*.

Table 29: Reasons for Unmodelled Measures

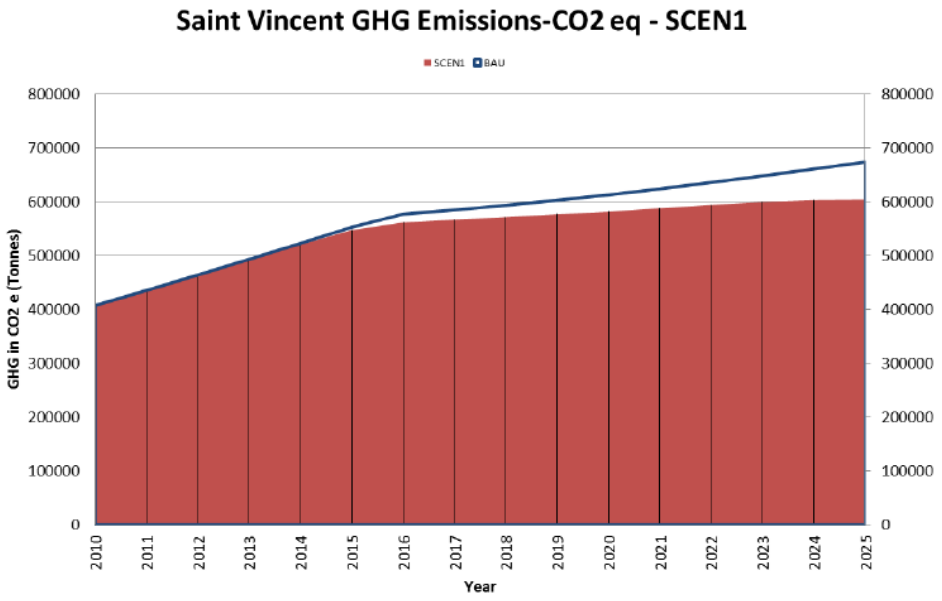
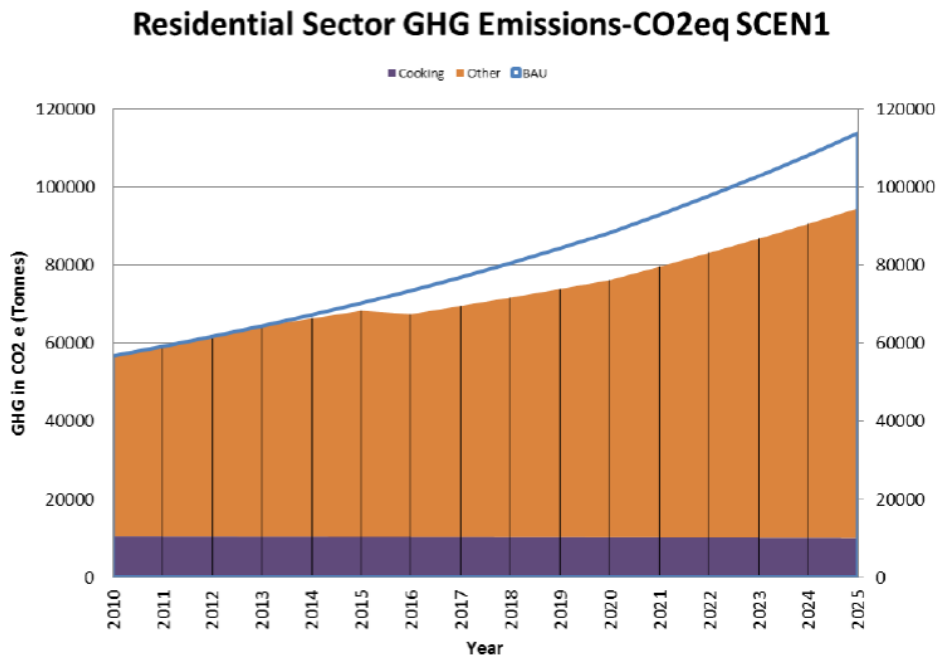
Measure not modelled	Reason
Measure #4: Provide information to the public on fuel consumption of different car models that are commonly imported	This measure is treated as a supportive measure that enhances the impact of Measure #3. As such, it is not modelled separately.

Measure #5: Implement programmes of reforestation and agro-forestry and Measure #6: Implement programmes for the reduction of deforestation	Measures #5 and #6 would have been integrated and the impacts of the two modelled together. However, because of data limitations, the baseline did not estimate emissions or sinks due to LUCF, and as a result it is inappropriate to include changes in LUCF generated by mitigation measures in the mitigation scenario. For example, assume that deforestation is occurring and that LUCF is a net source of emissions. These emissions are not included in the baseline due to lack of data. Mitigation Measures #5 and #6 would reduce these emissions, but to include this in the mitigation scenario is inappropriate, since the emissions being reduced were not included in the baseline. It is important to note that Measures #5 and #6 will reduce emissions or enhance sinks, and as such are worthwhile measures, even though they cannot be included in the mitigation scenario modelling.
Measure #9: Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction	This measure is cross-cutting in nature and is designed to support implementation of the other measures. The emission reduction benefit of this measure will be realized through the implementation of the other measures. In other words, achieving the expected emission reductions of the other measures will depend, in part, on the supportive contribution of this cross-cutting measure. Accordingly, it is not modelled separately.

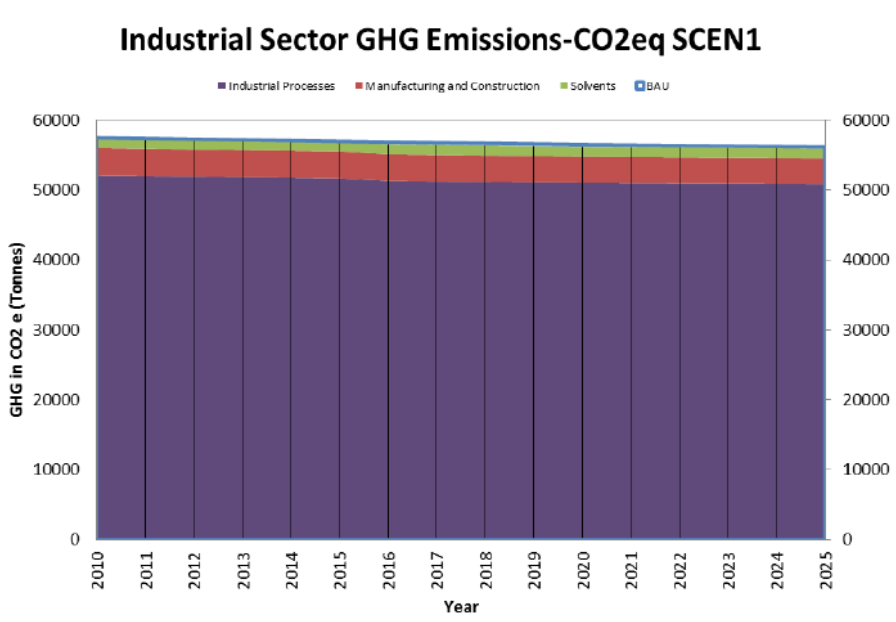
3.4.1 Mitigation Scenario #1: Summary of the Emissions Impact

Table 30 presents a summary of the emissions impact of Mitigation Scenario #1 relative to the Baseline Scenario (BAU), for the period to 2025. It includes results for Saint Vincent and the Grenadines as a whole, together with results by sector.

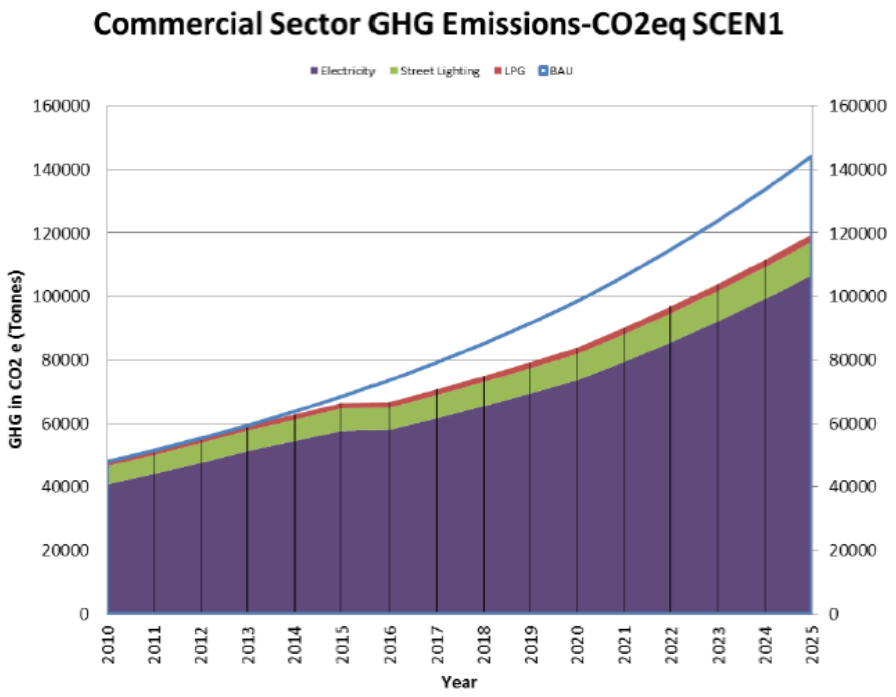
Table 30: Summary of Impact on Emissions as a Result of Mitigation Scenario #1.

Mitigation Scenario # 1
Impact of scenario on overall St. Vincent and the Grenadines GHG emissions ▪ 10% reduction in overall emissions relative to baseline by 2025 
Impact of scenario on sectoral GHG emissions ▪ 17% reduction in Residential Sector emissions relative to baseline by 2025 

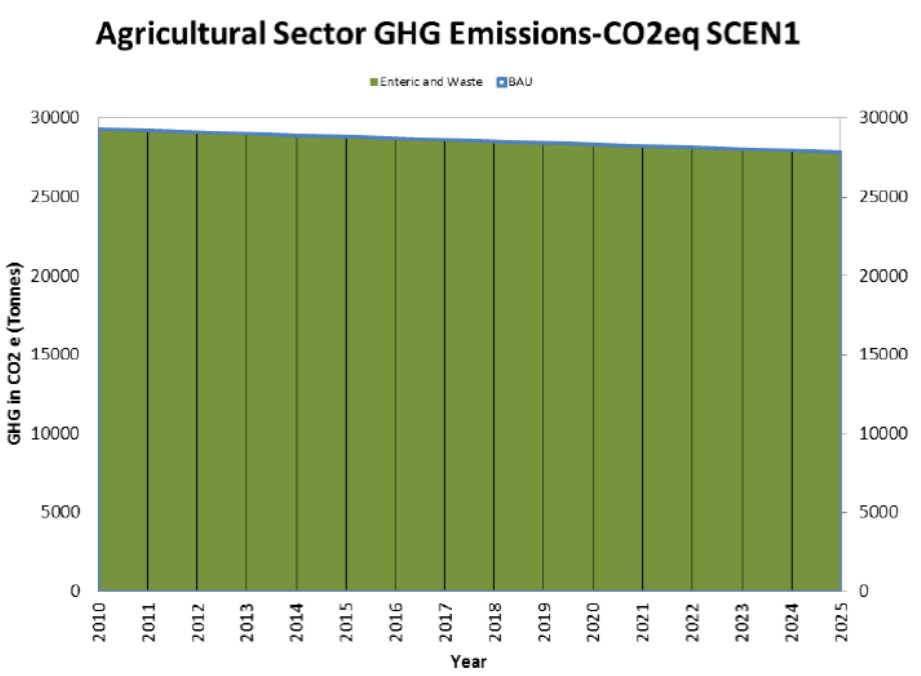
0.4% reduction in Industry Sector emissions relative to baseline by 2025



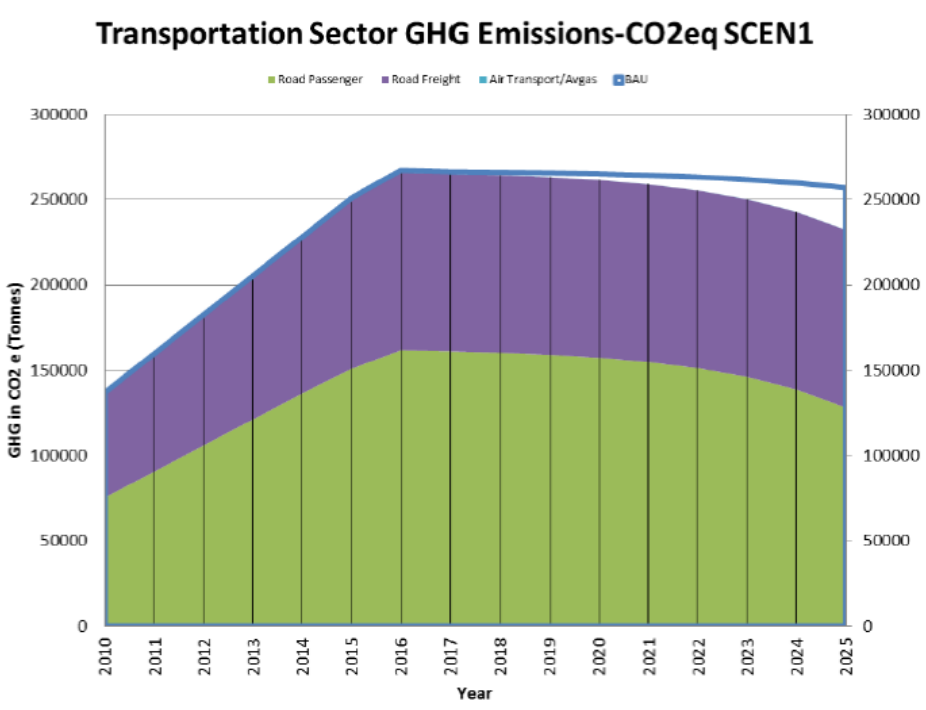
17% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



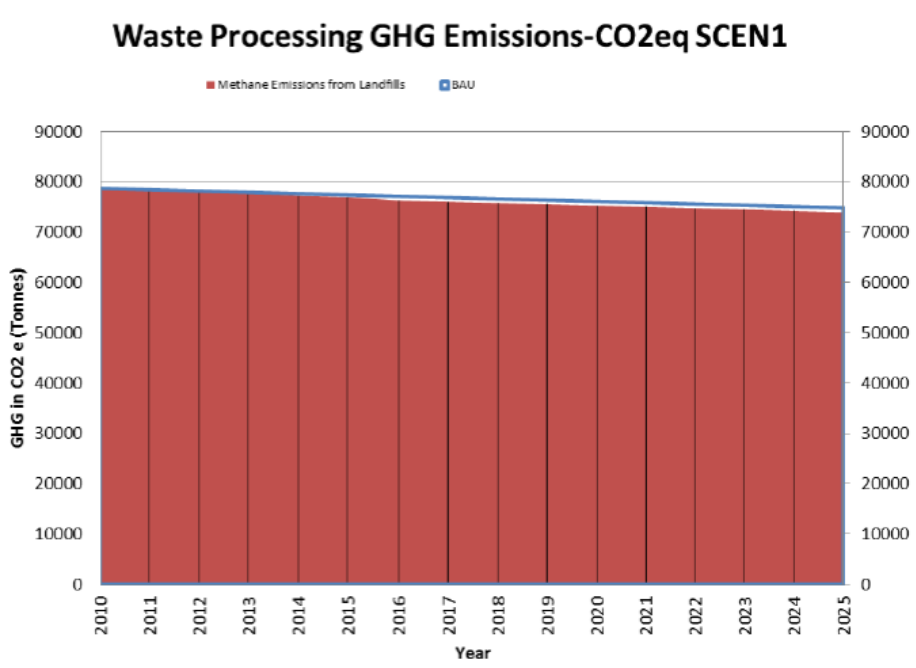
0% reduction in Agriculture, Forestry and Fishing Sector emissions relative to baseline by 2025



10% reduction in Transport Sector emissions relative to baseline by 2025



1% reduction in Waste Sector emissions relative to baseline by 2025



3.4.2 Mitigation Scenario #1: Emissions by Measure

A detailed summary of the emissions impact of each of the individual measures included in Mitigation Scenario #1 is presented below (tables and graphs). Specifically, for each measure it provides a description, assumptions concerning the physical impact of the measure, the impact of the measure on Saint Vincent and the Grenadines' GHG emissions, the impact of the measure on emissions from the sectors impacted by the measure, and in some cases additional pertinent information.

The results presented for each measure are a reflection of the assumed design of the measure and of the associated assumptions concerning its physical impacts. For any of these measures, a more or less aggressive design would produce greater or lesser emission reductions. Therefore, the results should be considered indicative rather than definitive.

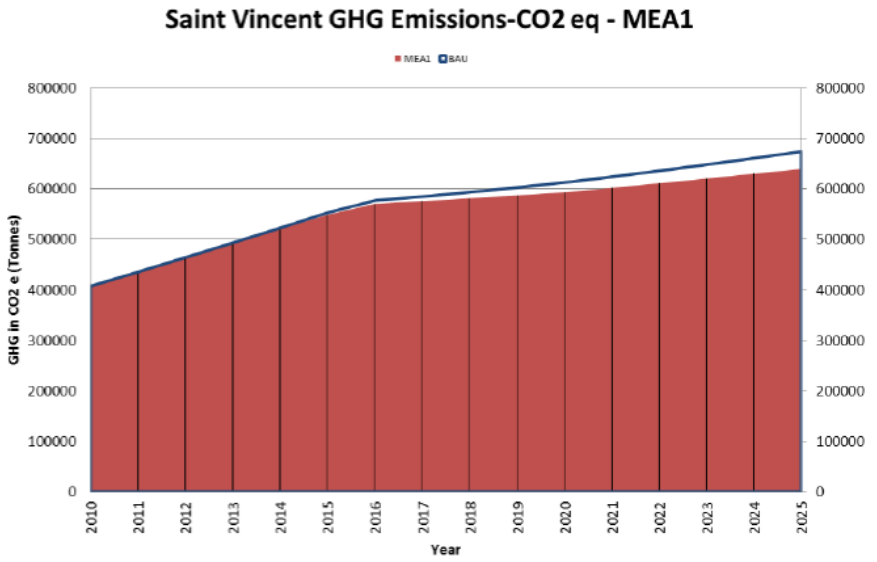
MEASURE #1:

MEASURE #1
Adopt standards and guidelines for the construction of energy efficient buildings
Description
This measure applies to residential and commercial (including tourism and institutional) buildings. It incorporates guidelines and standards relating to building design, insulation, ventilation, daylighting, use of efficient AC and appliances, and use of renewable energy sources (e.g., for water heating). For new buildings this measure would include a basic set of mandatory standards, and an additional set of voluntary guidelines. For existing buildings this measure would include a set of voluntary retrofit guidelines only. Government would provide public recognition for all new and existing buildings that comply with the voluntary guidelines. In addition. both the mandatory standards and the voluntary guidelines would be fully implemented in all new government buildings, and voluntary retrofit guidelines would be gradually introduced into all existing government buildings over a 10 year period.
Assumptions
The standards and guidelines will be implemented beginning in 2014. Revised and more stringent standards and guidelines will be implemented beginning in 2020. For new buildings, mandatory standards will include: (1) use of solar thermal for water heating in the commercial sector; and (2) use of efficient lighting (CFL or better). For all other end uses, voluntary guidelines apply. Together, it is assumed that all new buildings constructed will improve all electrical energy uses by 10 per cent in each year starting in 2014, then 15 per cent each year starting in 2020. This is in addition to improvements generated by Measure #2 (efficient equipment and appliances). For existing buildings. voluntary measures will apply, and are assumed to increase electrical energy efficiency of the existing building stock by 2 per cent per year, in addition to any improvements generated by Measure #2 (efficient equipment and appliances).This figures rises to 3 per cent in 2020.
Additional Information
None

RESULTS: Impact of measure #1 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #1 on overall St. Vincent and the Grenadines GHG emissions

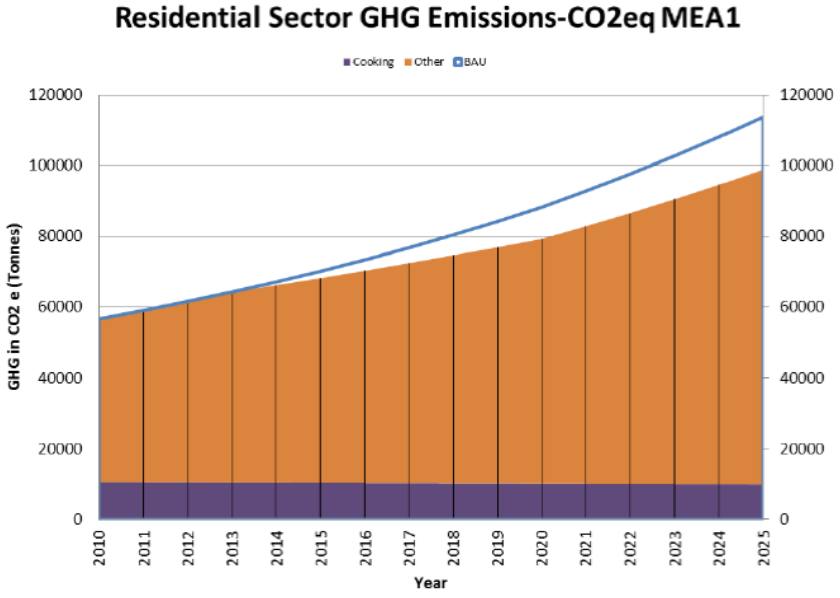
- 5% reduction in overall emissions relative to baseline by 2025



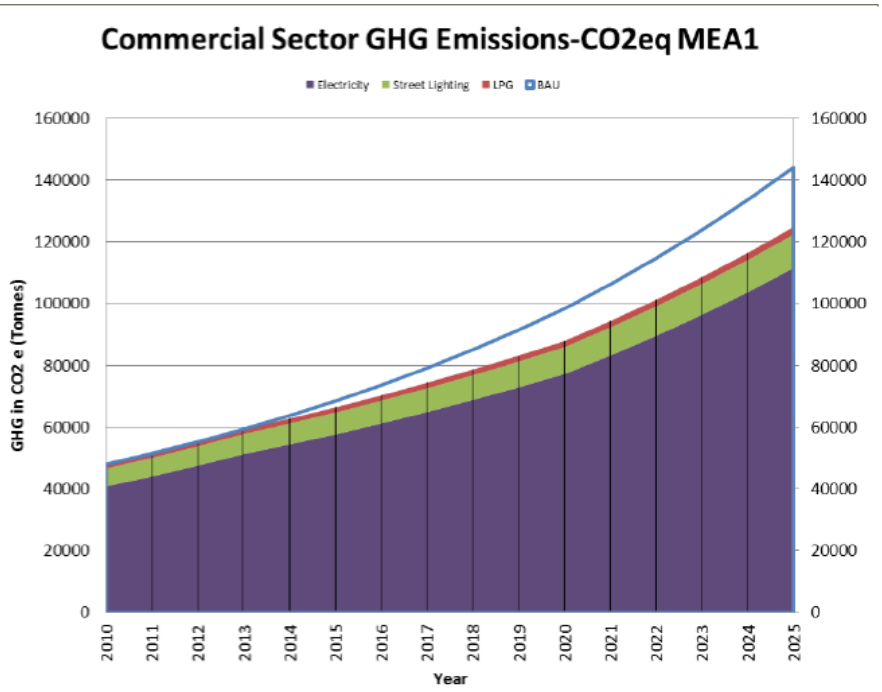
RESULTS: Impact of measure #1 on sectoral GHG emissions

Impact of measure #1 on sectoral GHG emissions

- 13% reduction in Residential Sector emissions relative to baseline by 2025



- 13% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



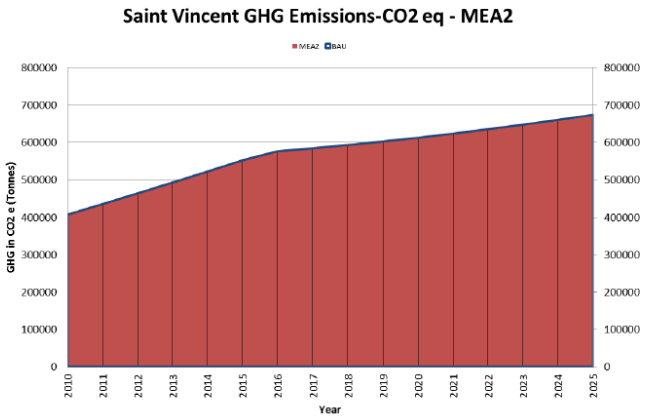
MEASURE #2:

MEASURE #2
Set energy performance standards for importation and sales of major energy consuming equipment and appliances
Description
Importation and sale of major energy using equipment and appliances Will be restricted to those meeting set energy performance standards. Specifically, for commercial (including tourism and institutional buildings) and residential air conditioning equipment and commercial and residential refrigerators and freezers, import will be restricted to appliances that are Energy Star labelled (or equivalent).
Assumption
This measure would take effect in 2013. It is assumed that by 2025, 25 per cent of all affected electrical equipment (i.e., air conditioners, refrigeration) within the commercial buildings and residential sector (all households) will be high energy efficiency. It is also assumed that change in penetration of energy efficient equipment is linear from 2013 to 2025 (0 per cent to 25 per cent).
Additional Information
The following is the modelled energy consumption by efficient equipment compared to standard equipment: air conditioning (86 per cent); and refrigeration (80 per cent).

RESULTS: Impact of measure #2 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #2 on overall St. Vincent and the Grenadines GHG emissions

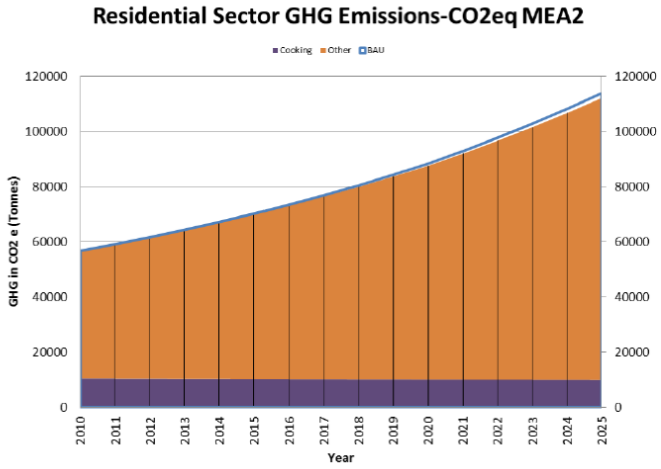
- 0.5% reduction in overall emissions relative to baseline by 2025



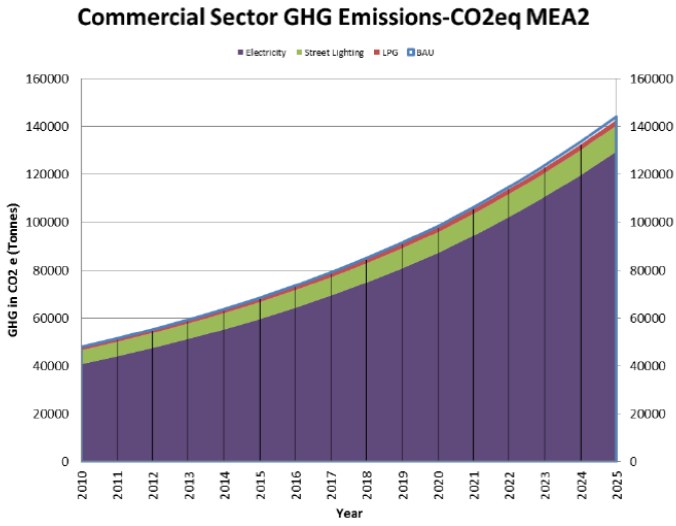
RESULTS: Impact of measure #2 on sectoral GHG emissions

Impact of measure #2 on sectoral GHG emissions

- 2% reduction in Residential Sector emissions relative to baseline by 2025



1% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



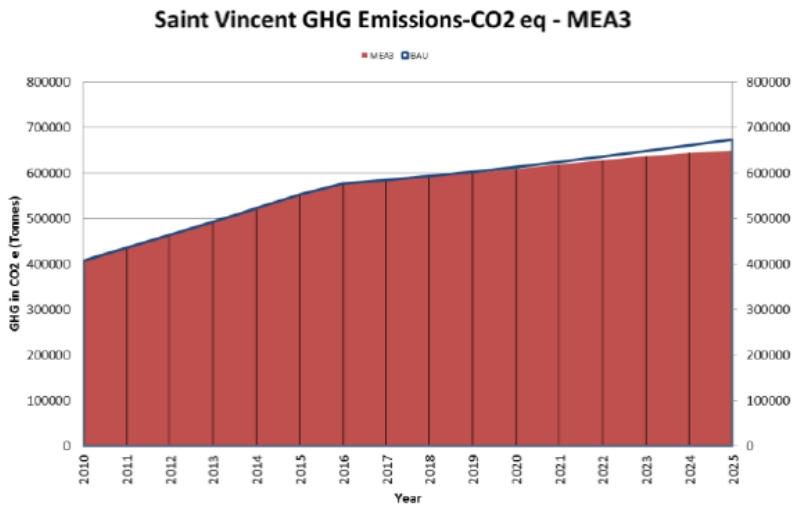
MEASURE #3:

MEASURE #3
Revise the car taxation system to give incentives for the purchase and Use of fuel-efficient passenger cars and other vehicles
Description
This measure involves use of import duties and/or excise taxes to provide incentives for the purchase of more fuel-efficient passenger cars and other vehicles. Within a given vehicle class, duties/taxes will be substantially higher on fuel inefficient vehicles, and substantially lower on fuel efficient vehicles. For the most efficient vehicles, duties or taxes could be set to zero, or rebates could be provided to buyers (financed by the incremental revenue produced by the higher duties/taxes collected for inefficient vehicles). In addition, hybrid vehicles could be specifically targeted by this measure.
Assumptions
This measure would come into effect in 2015 and apply to all vehicles imported into SAINT VINCENT AND THE GRENADINES. This measure does not affect the number of vehicles or the annual average kilometres travelled per vehicle. Emission reductions generated by this measure relate only to improvements in the average fuel efficiency of newly imported vehicles, relative to the average efficiency of newly imported vehicles in the business-as-usual (baseline) scenario. Specifically, this measure is expected to increase the average fuel efficiency of the vehicle imported each year relative to the baseline by 20 per cent. In addition, annual vehicle turnover is assumed to be 3 per cent beginning in 2016.
Additional Information
All passenger cars and light duty trucks sold in North America [and Japan] are rated for fuel efficiency using standardized tests, and the test results are published. This efficiency data would provide the basis for determining duty/tax treatment under this measure.
Additional Information
None

RESULTS: Impact of measure #3 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #3 on overall St. Vincent and the Grenadines GHG emissions

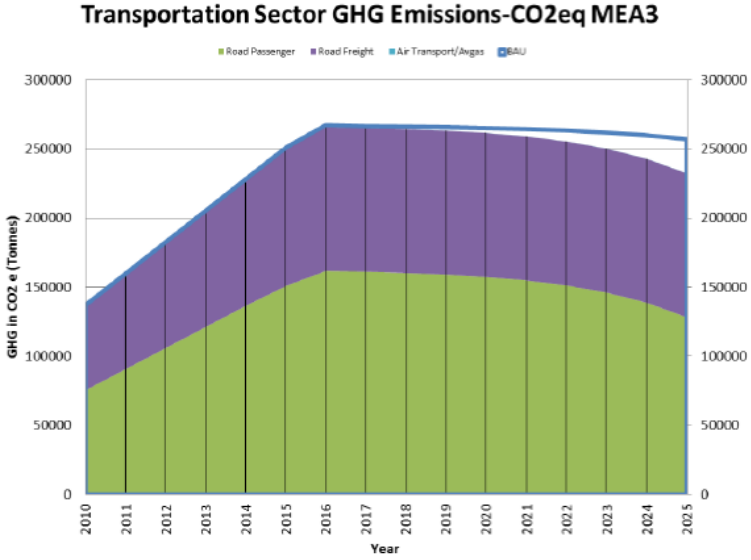
- 4% reduction in overall emissions relative to baseline by 2025



RESULTS: Impact of measure #3 on sectoral GHG emissions

Impact of measure #3 on sectoral GHG emissions

- 10% reduction in Transport Sector emissions relative to baseline by 2025



MEASURE #4:

MEASURE #4
Provide information to the public on fuel consumption of different car models that are commonly imported
Description
This measure provides fuel consumption information for new and used vehicle models that are available for import into Saint Vincent and the Grenadines. This information will assist consumers to select more efficient vehicles with lower fuel costs. As noted for Measure #3, all passenger cars and light duty trucks sold in North America [and Japan] are rated for fuel efficiency using standardized tests, and the test results are published and publicly available. However, consumers in Saint Vincent and the Grenadines may not be aware of this information, how to access it, and how to interpret it. This measure will provide a simple portal allowing consumers to access and use this information. This will provide consumers with the information they need to determine which vehicles are eligible for the available tax incentives, and will help them to make informed purchase decisions to take advantage of the Measure #3 incentives.
Assumptions
This measure is treated as a supportive measure that enhances the impact of Measure #3. As such, it is modelled separately.
Additional Information
None

MEASURE # 5:

MEASURE # 5
Implement programmes of reforestation and agro-forestry
Description
Reforestation of degraded lands and deforested areas contributes to climate change mitigation by sequestering carbon (i.e.enhancing carbon sinks). Reforestation also provides other significant co-benefits, including reduced vulnerability to the negative effects of climate change and renewed potential for environmentally sustainable harvesting of forest products. Agroforestry involves co-planting of tree species and crops to provide multiple benefits. When used to restore or increase the productivity of degraded lands, agroforestry can also enhance carbon sinks. This measure involves efforts to increase the rate of tree-planting and reforestation through collaborative programmes involving local communities and the Ministry of Agriculture. Rural Transformation, Forestry and Fisheries. This measure would include training to help ensure sustainable management of the re-planted areas.
Assumptions

This measure would have been integrated with Measure #6 and the impacts of the two modelled together. However, because of data limitations, the baseline did not estimate emissions or sinks due to LUCF, and as a result it is inappropriate to include changes in LUCF generated by mitigation measures in the mitigation scenario.
Additional Information
None

MEASURE #6:

MEASURE #6
Implement programmes for the reduction of deforestation
Description
This measure would initially encompass promotion of the use of waste wood, including thinning debris, for crafts and furniture, as a means to combat deforestation. In subsequent years the programme would expand to include additional measures. These measures are yet to be determined, but could include: (1) measures to eliminate illegal deforestation of watersheds; (2) social and economic incentives to encourage local partners and stakeholders to buy into the concept of forest protection; and (3) promotion of best practices for sustainable forest management, to reduce land and forest degradation.
Assumptions
This measure would have been integrated with Measure #5 and the impacts of the two modelled together. However, because of data limitations, the baseline did not estimate emissions or sinks due to LUCF, and as a result it is inappropriate to include changes in LUCF generated by mitigation measures in the mitigation scenario.
Additional Information
None

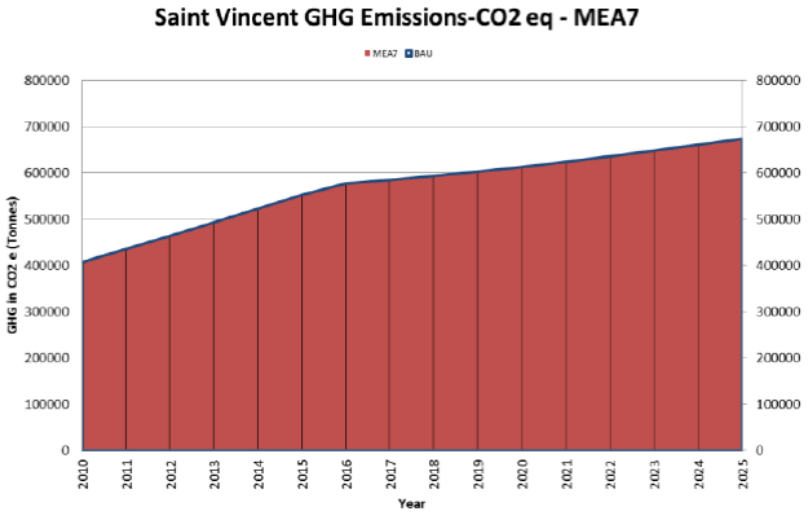
MEASURE # 7:

MEASURE # 7
Introduce a composting programme for the commercial sector
Description
This measure involves the operation of a central composting facility at one of the two waste disposal sites on St. Vincent. This site would receive and compost organic waste collected by private contractors serving the tourist sector initially, expanding subsequently to serve other parts of the commercial sector. The compost produced would be used as a soil conditioner and fertilizer in agriculture and other sectors. Expansion of the composting programme to handle waste generated in other sectors (e.g., the residential sector and food processing waste from the industrial sector) would be considered as a future option, but has not been included as part of the measure to be modeled for the mitigation scenario.
Assumptions
The programme would begin to serve tourism facilities (hotels, restaurants) in St. Vincent in 2014, expanding to other commercial sector facilities in St. Vincent in 2016. It is assumed that the programme will initially divert 20 per cent of organic waste from the commercial sector in 2014, rising to 40 per cent diversion in 2016.
Additional Information
It is assumed that only the commercial and residential sectors contribute degradable waste to the landfills. The commercial sector accounts for 20 per cent of the total waste generated by Saint Vincent and the Grenadines, but only 15 per cent of the degradable waste that is producing emissions. Of this 15 per cent, 19 per cent is organics waste and the remainder is paper and paper products.

RESULTS: Impact of measure #7 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #7 on overall St. Vincent and the Grenadines GHG emissions

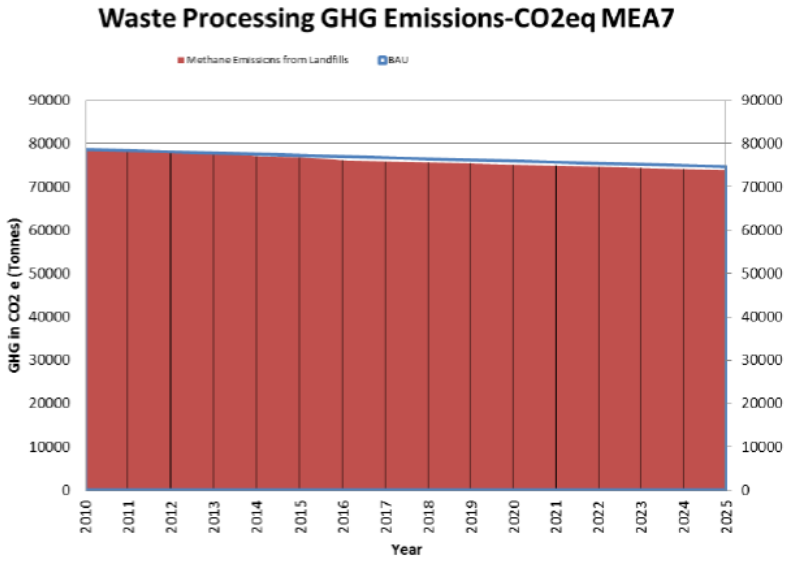
- 0.1% reduction in overall emissions relative to baseline by 2025



RESULTS: Impact of measure #7 on sectoral GHG emissions

Impact of measure #7 on sectoral GHG emissions

- 1% reduction in Waste Sector emissions relative to baseline by 2025



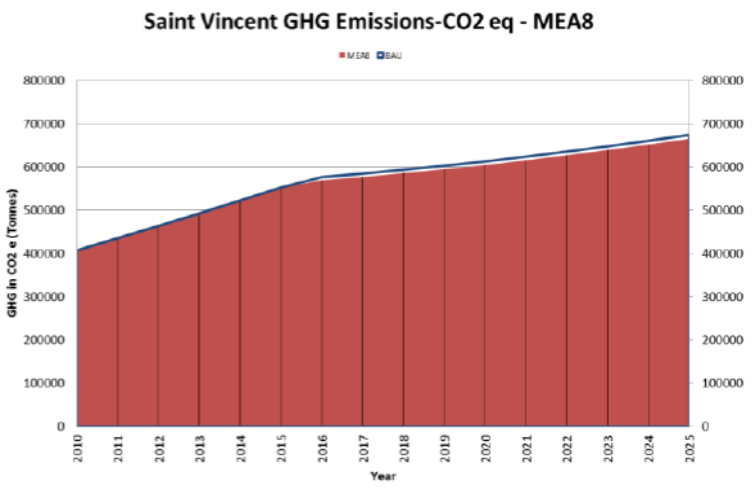
MEASURE #8:

MEASURE #8
Implement a program for the installation of grid-connected wind and PV power systems
Description
This measure is intended to encourage production of electricity from renewable sources. Specifically this measure is designed to stimulate production of wind and photovoltaic (PV) power by independent power producers (IPPs). Although the electricity generated could be used directly by the producer for their own purposes, the main focus of this measure is production of electricity to be fed into the power grid for sale to consumers. In part this measure involves ensuring that the legal and commercial framework exists to allow independent power production using renewable sources. In addition, this measure may involve financial support to encourage wind generation, if required to make the development financially viable. This financial support could take the form of, for instance, low cost leases on suitable sites for installation of wind turbines or PV panels, or power purchase agreements that incorporate a price incentive per kWh.
Assumptions
This measure assumes installation of 3MW of new capacity for wind and/or PV power production, with production beginning in 2016 and no change thereafter (i.e., installed capacity is 3MW in 2016 and does not grow in subsequent years). For purposes of modeling the emissions reduction impact of this measure, it will be assumed that the new renewable generation capacity will operate with a capacity factor of 35 per cent.
Additional Information
Hydropower remains part of the electricity mix and is assumed to be always available.

RESULTS: Impact of measure #8 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #8 on overall St. Vincent and the Grenadines GHG emissions

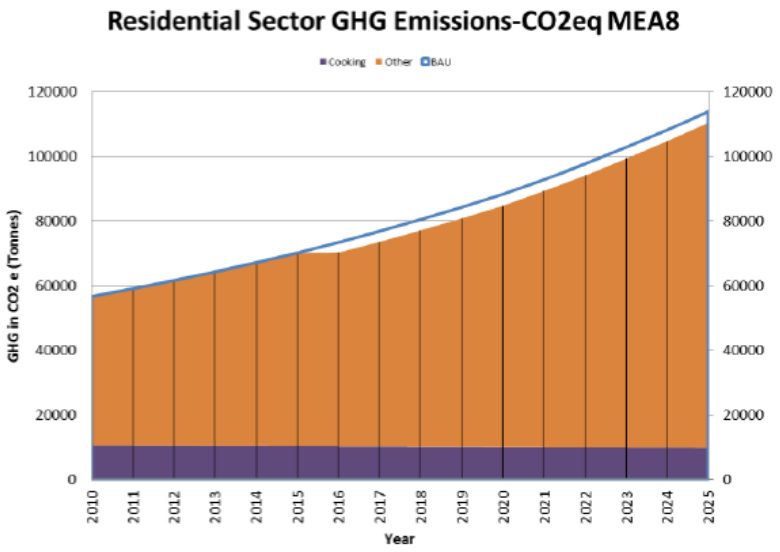
- 1% reduction in overall emissions relative to baseline by 2025



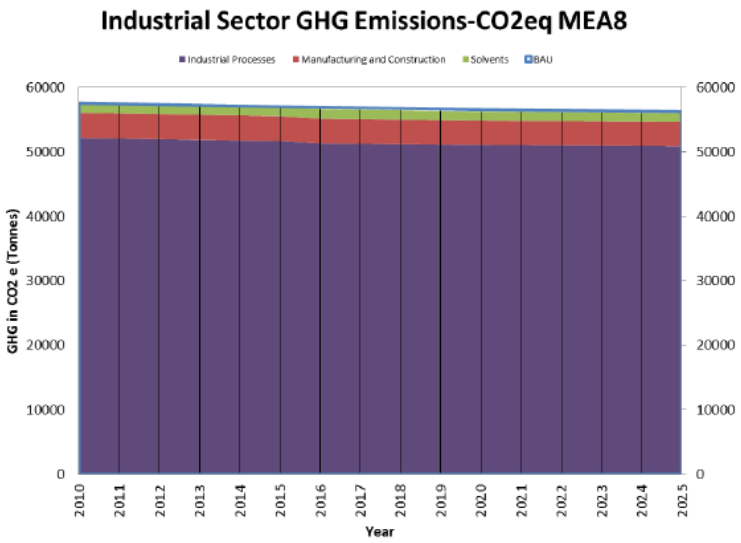
RESULTS: Impact of measure #8 on sectoral GHG emissions

Impact of measure #8 on sectoral GHG emissions

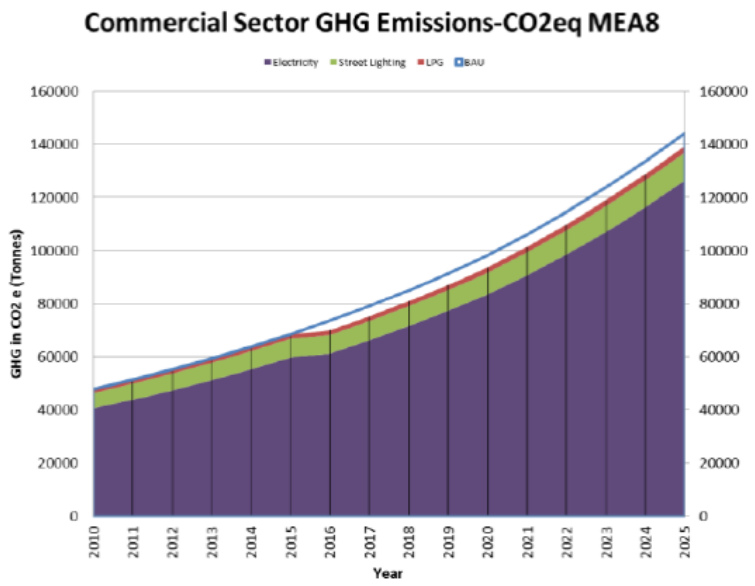
- 3% reduction in Residential Sector emissions relative to baseline by 2025



- 0.4% reduction in Industry Sector emissions relative to baseline by 2025



- 3% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



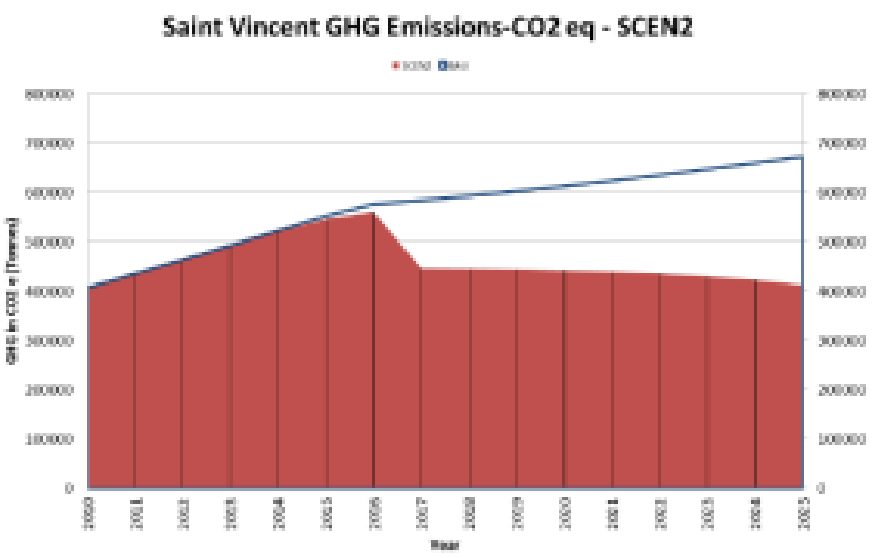
MEASURE #9:

MEASURE #9
Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction
Description
This measure involves education and awareness programmes promoting efficient energy use and waste reduction across all sectors of the economy. In addition this measure involves provision of training for specialized expertise that will be required for the measures included in this mitigation scenario (for instance, training relating to improved building practices associated with Measure #1).
Assumptions
This measure is cross-cutting in nature and is designed to support implementation of the other measures. The emission reduction benefit of this measure will be realized through the implementation of the other measures. In other words, achieving the expected emission reductions of the other measures will depend, in part, on the supportive contribution of this cross-cutting measure. Accordingly, it is not modeled separately.
Additional Information
None

3.4.3 Mitigation Scenario #2: Summary of the Emissions Impact

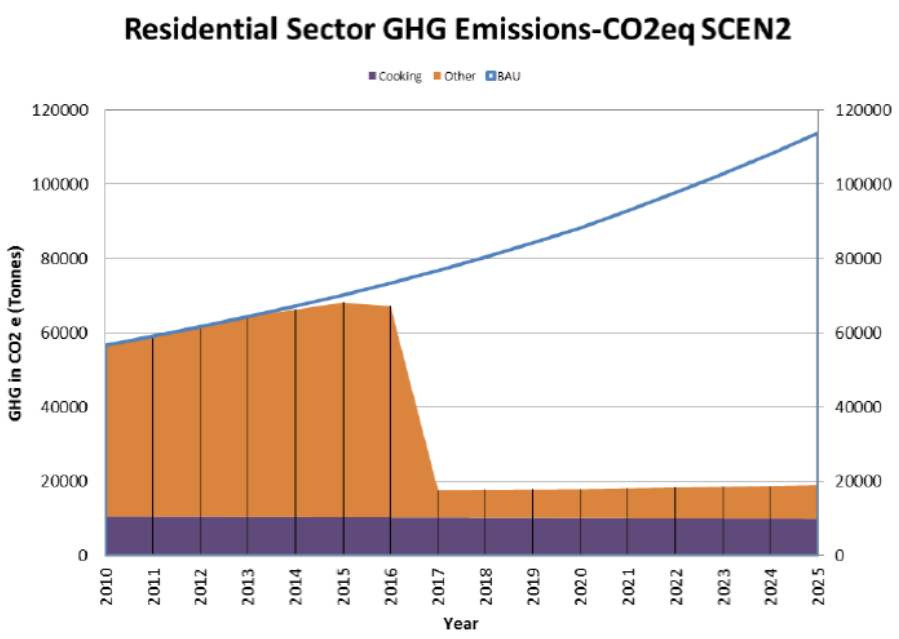
Table 31 presents a summary of the emissions impact of Mitigation Scenario #2 relative to the Baseline Scenario (BAU), for the period to 2025. The summary includes results for Saint Vincent and the Grenadines as a whole, together with results by sector.

Table 31: Summary of the Emission Impact of Mitigation Scenario # 2 Relative to the BAU for the Period 2025

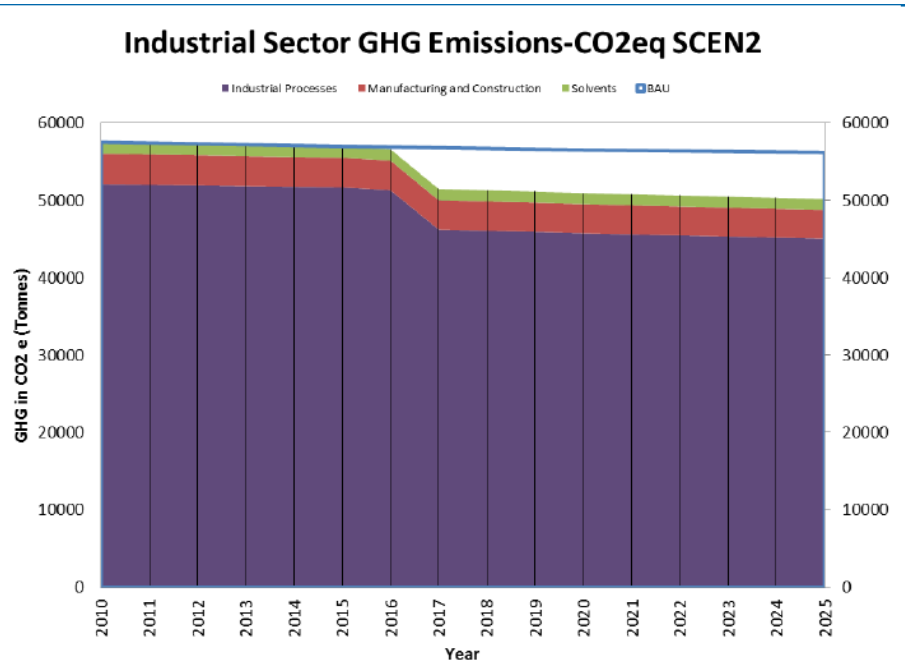
Mitigation Scenario # 2
Impact of scenario on overall St. Vincent and the Grenadines GHG emissions ▪ 39% reduction in overall emissions relative to baseline by 2025 

Impact of scenario on sectoral GHG emissions

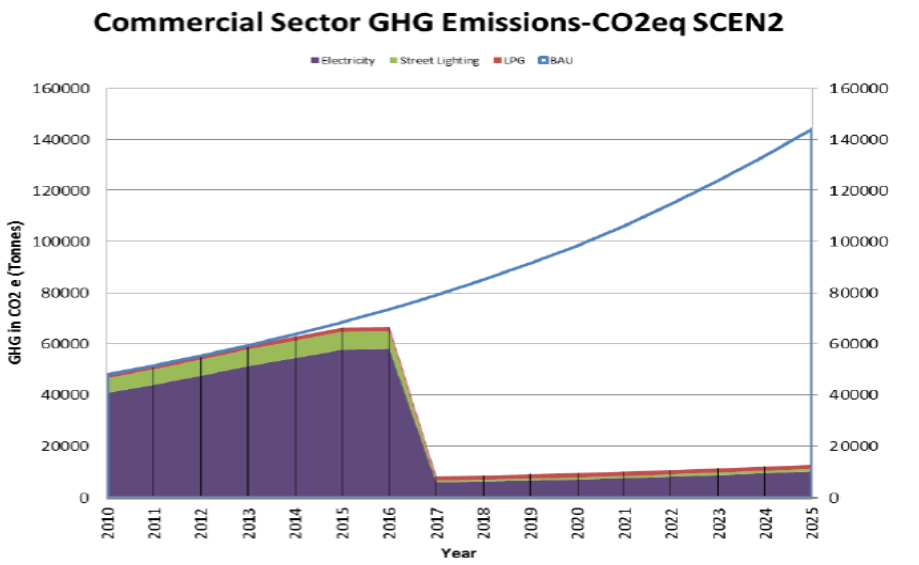
- 83% reduction in Residential Sector emissions relative to baseline by 2025



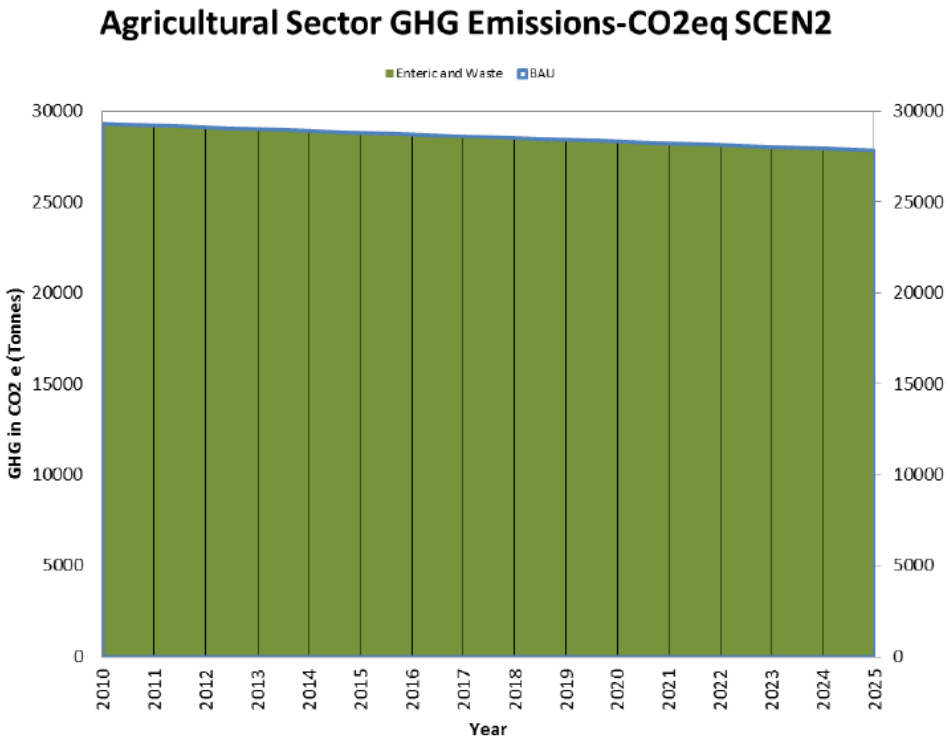
- 11% reduction in Industry Sector emissions relative to baseline by 2025



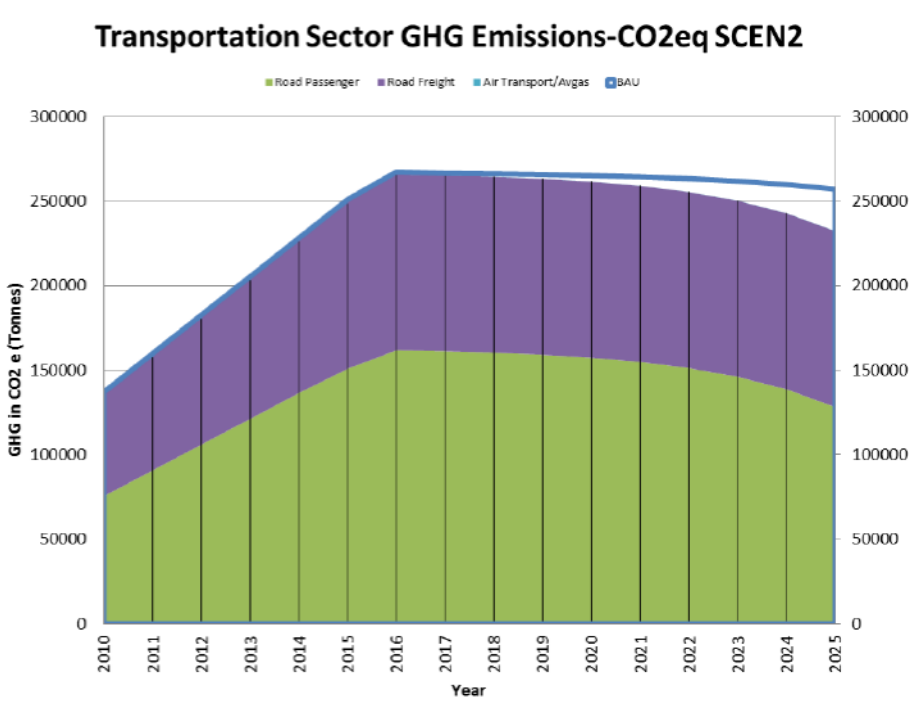
91% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



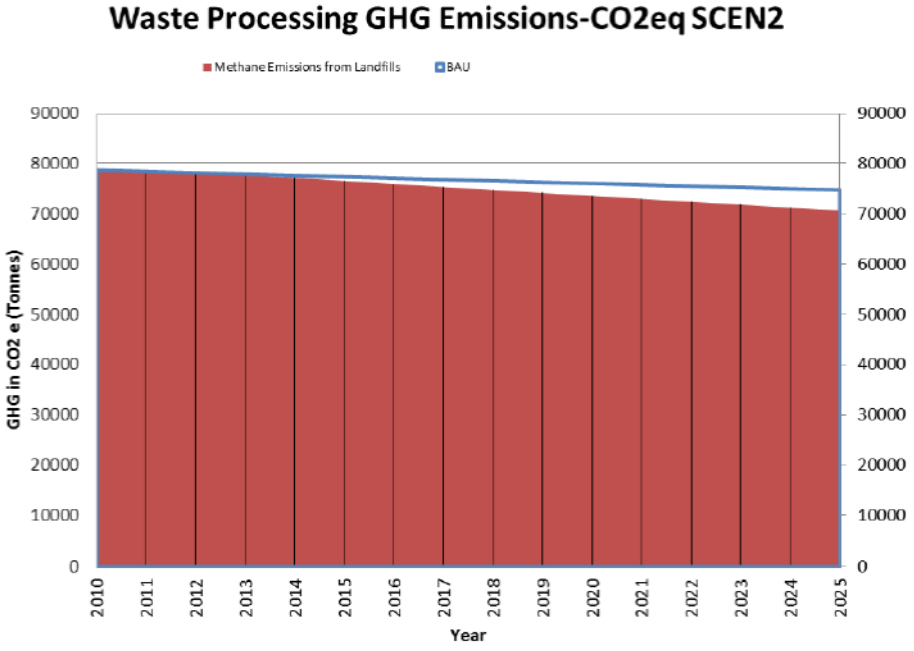
0% reduction in Agriculture, Forestry and Fishing Sector emissions relative to baseline by 2025



10% reduction in Transport Sector emissions relative to baseline by 2025



5% reduction in Waste Sector emissions relative to baseline by 2025



3.4.4 Mitigation Scenario #2: Emissions by Measure

Mitigation Scenario #2 includes all of the Scenario #1 measures, plus three additional measures.

A detailed summary of the emissions impact of these three additional individual measures in tabular form and their graphical representation is presented below.

Similar to Mitigation Scenario #1, the results presented for each measure are a reflection of the assumed design of the measure and of the associated assumptions concerning its physical impacts. For any of these measures, a more or less aggressive design would produce greater or lesser emission reductions. Thus, they should be considered indicative rather than definitive.

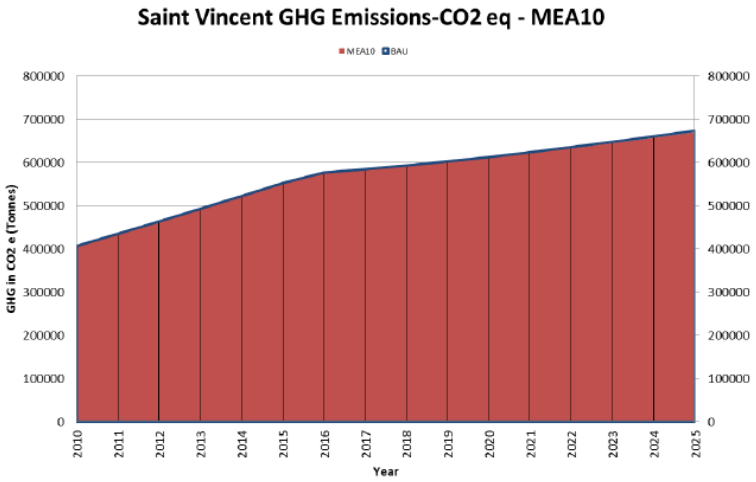
MEASURE #10:

MEASURE #10
Waste reduction across sectors
Description
This measure involves the reduction of waste to landfill through a **Reduce, Reuse, and Recycle** programme. This measure is a promotional program encouraging the reduction, reuse and recycling of waste, where possible, in all sectors. The program would encourage participation and provide residents, business owners, etc. with the information they need to assess waste reduction and management options. It will provide a better understanding of the impact of their waste management practices on the environment and would help them to make informed decisions on waste reduction, reuse, and recycling.
Assumptions
It is assumed that the promotional program would start immediately and that impacts would be realized beginning in 2013. The diversion rate would rise linearly from 0 per cent to a maximum of 15 per cent in 2025.
Additional Information
Emission reductions in this measure are generated from the diversion of degradable products only. In this program, degradable products would include paper and paper products (e.g., cardboard, newspaper, etc.). It is assumed that only the commercial and residential sectors contribute degradable waste to the landfills. The commercial sector accounts for 15 per cent of the degradable waste that is producing emissions, the residential sector accounts for the remaining 85 per cent. Of the commercial sectors' 15 per cent, 81 per cent is paper waste and of the residential sectors' 85 per cent, 21 per cent is paper waste.

RESULTS: Impact of measure #10 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #10 on overall St. Vincent and the Grenadines GHG emissions

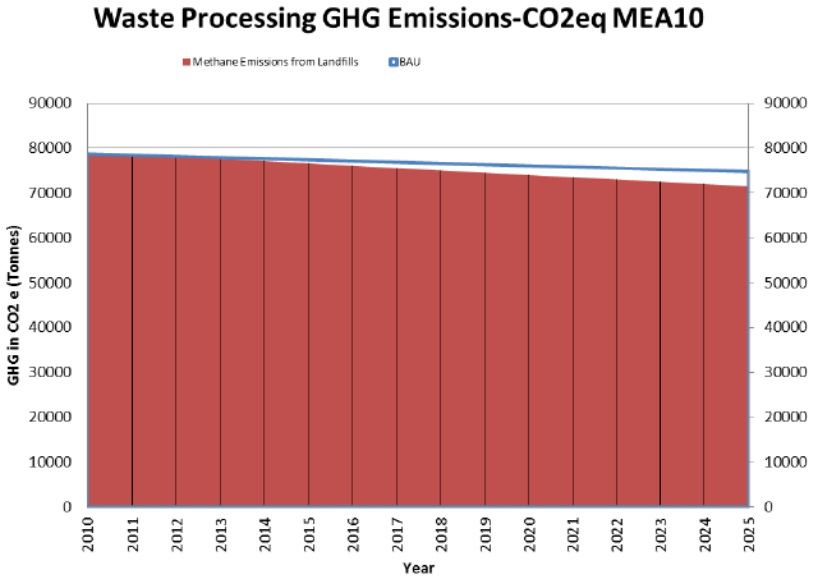
- 0.5% reduction in overall emissions relative to baseline by 2025



RESULTS: Impact of measure #10 on sectoral GHG emissions

Impact of measure #10 on sectoral GHG emissions

- 4% reduction in Waste Sector emissions relative to baseline by 2025



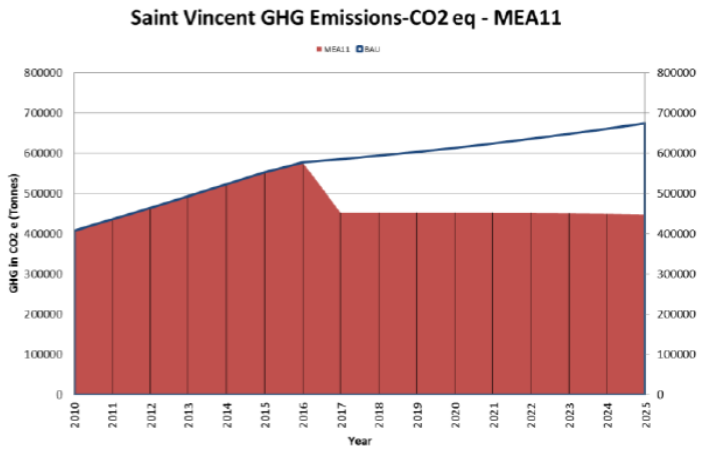
MEASURE #11:

MEASURE #11
Undertake sustainable development of geothermal resources in the Soufriere Resource Area
Description
This measure involves enhanced efforts to undertake assessment and development of the geothermal resource potential in the Soufriere Resource Area. The technical geothermal potential in St. Vincent far exceeds energy demand in the country, and could readily displace all diesel-based electricity generation on the island of St. Vincent. However, the economic potential of geothermal is unknown but much lower, as development costs are expected to be high relative to the market size. This measure therefore involves, initially, a commitment to do the required assessment of the geothermal resource, in order to establish the basis for possible development. Assuming viable results, this measure also includes development of the resource for purposes of electricity generation. It is likely that international financial resources will be required to support the assessment phase, and potentially to support incremental costs during the development phase.
Assumptions
This measure assumes development of St. Vincent's geothermal potential at a scale sufficient to displace all diesel-generated electricity on the island of St. Vincent. Because this measure will involve significant lead time, it is assumed that the system will not become operational until 2017.
Additional Information
As noted, in this measure geothermal displaces all diesel-generated electricity on the island of St. Vincent. Therefore, this measure is applied to 90 per cent of the total diesel used for electricity generation, as 10 per cent is used for electricity generation on the Grenadine islands. Given the lack of sectoral and end-use breakdowns, the remaining 10 per cent diesel is applied across all sectors.

RESULTS: Impact of measure #11 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #11 on overall St. Vincent and the Grenadines GHG emissions

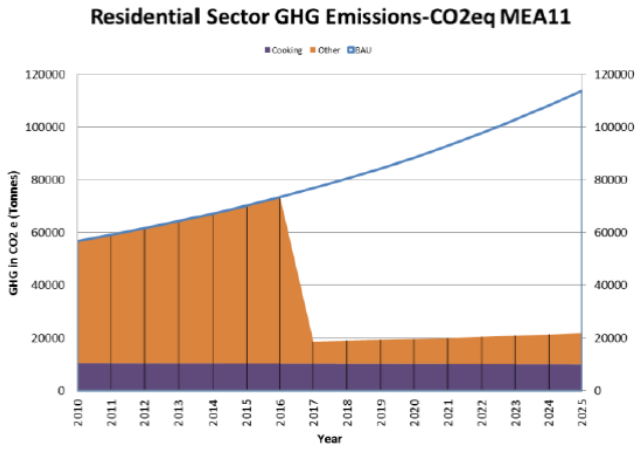
- 34% reduction in overall emissions relative to baseline by 2025



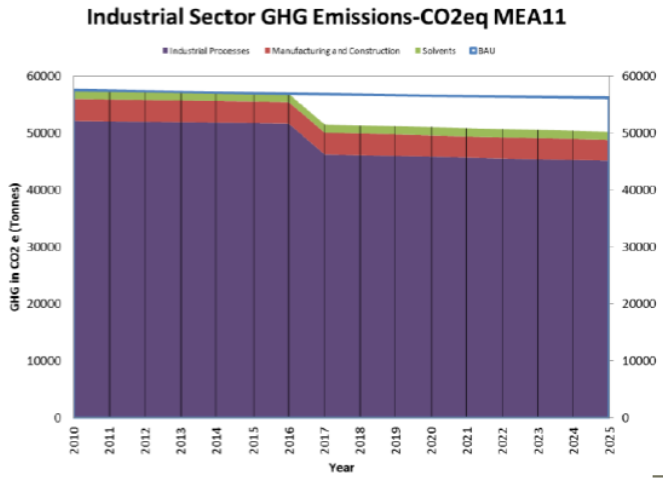
RESULTS: Impact of measure #11 on sectoral GHG emissions

Impact of measure #11 on sectoral GHG emissions

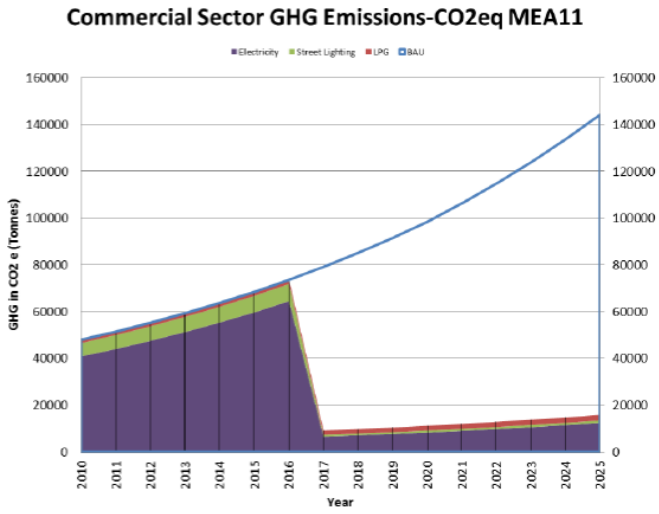
- 81% reduction in Residential Sector emissions relative to baseline by 2025



- 11% reduction in Industry Sector emissions relative to baseline by 2025



- 89% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



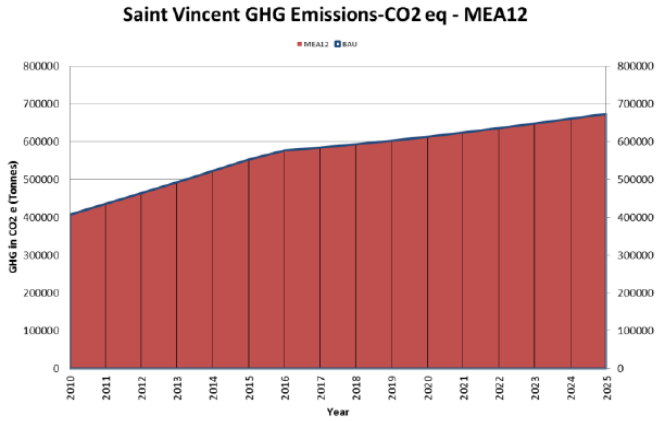
MEASURE #12:

MEASURE #12
Support the development of innovative financing mechanisms for the deployment of solar water heaters
Description
This measure involves provision of innovative financing mechanisms that encourage installation of solar water heaters in the commercial and residential sectors. The goal would be to increase the use of solar in new construction; to increase the use of solar when water heating is being installed for the first time in existing buildings; and to encourage installation of solar water heating to displace mainly existing LPG water heating. The choice of innovative financing mechanisms would be informed in part by a review of the successful Barbados program for the promotion of solar water heating. Measures could include exemptions from duties for the import of solar water heating equipment; imposition of higher duties on other types of water heaters; provision of capacity-development support to Saint Vincent and the Grenadines companies installing and servicing solar water heaters; and adoption of a government policy to install solar water heaters on government buildings, to create an additional market driver to help build the industry.
Assumptions
It is assumed that this measure starts in 2015 and linearly rises to 50 per cent penetration in both the commercial and residential sectors, by 2025 (i.e., 50 per cent of LPG use for hot water will be replaced with solar hot water by 2025).
Additional Information
Excluding existing solar hot water installations, it is assumed that all other water heating in the commercial and residential sectors is LPG.

RESULTS: Impact of measure #12 on overall St. Vincent & the Grenadines GHG emissions

Impact of measure #12 on overall St. Vincent and the Grenadines GHG emissions

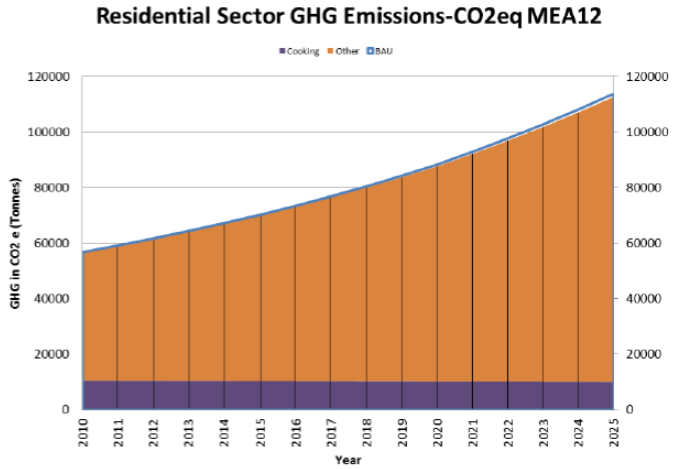
- 0.3% reduction in overall emissions relative to baseline by 2025



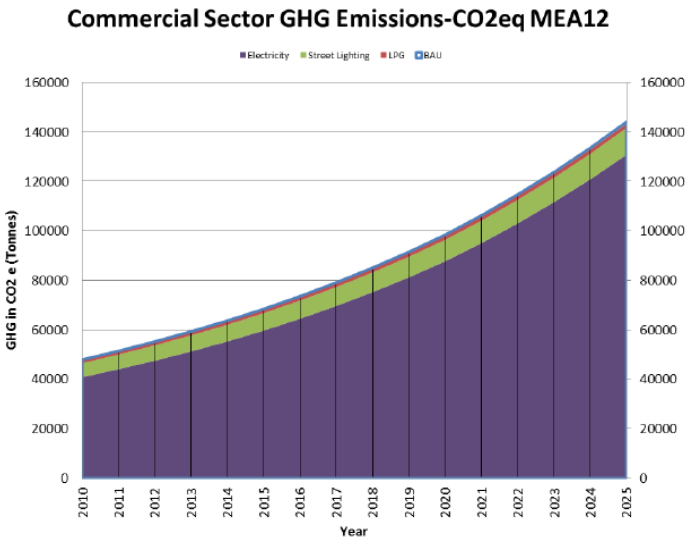
RESULTS: Impact of measure #12 on sectoral GHG emissions

Impact of measure #12 on sectoral GHG emissions

- 1% reduction in Residential Sector emissions relative to baseline by 2025



- 0.5% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025



3.4.5 Emissions Impact: Comparison of Mitigation Scenarios #1 and #2

Figure 31 provides a comparison of Mitigation Scenarios #1 and #2 relative to the Baseline. As illustrated, Scenario #2 provides a large incremental reduction relative to Scenario #1. Specifically:

- Scenario #1 generates a 10 per cent GHG emission reduction relative to the Baseline Scenario(604,205 tons vs. 673,738 tons)
- Scenario #2 generates a 39 per cent GHG emission reduction relative to the Baseline Scenario(412,849 tons vs. 673,738 tons)

The large difference between the two scenarios is a reasonable result, since Mitigation Scenario #2 includes one significant measure, namely displacing all diesel used to generate electricity on St. Vincent with geothermal energy.

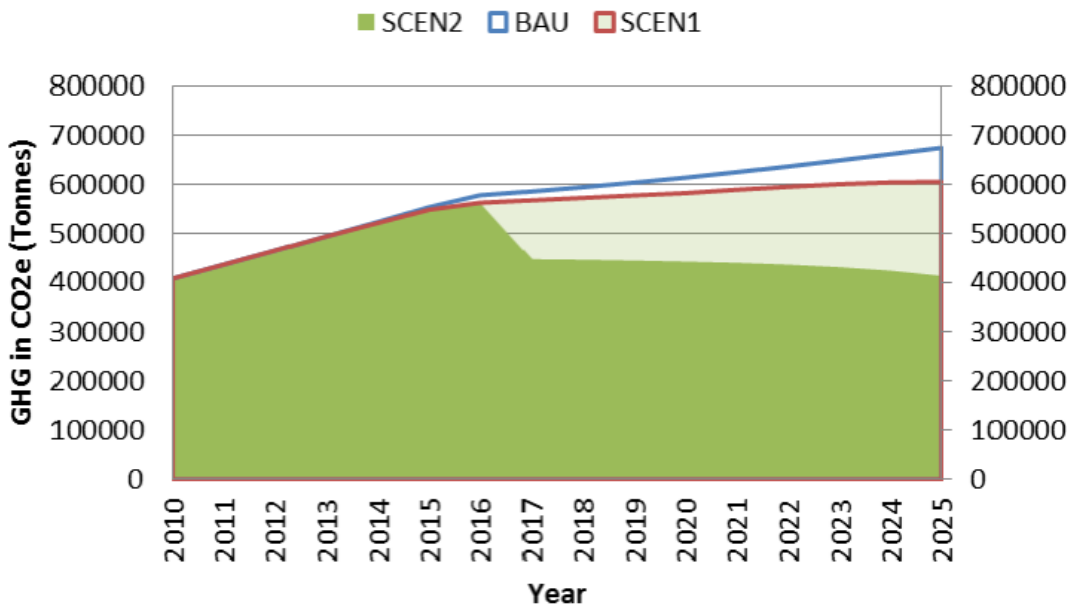


Figure 31: Comparison of Mitigation Scenario #1 and # 2 (t CO_2e)

3.4.6 Emission Impact: Comparison of the individual measures

Table 32 presents a comparison of the modeled impacts of the individual measures relative to the Baseline Scenarios[10].

Table 32: Comparison of Emission Reductions Relative to the Baseline Scenario

No.	**Measure**	Emissions Reduction (2025)
RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS		
1	Adopt standards and guidelines for the construction of energy efficient buildings	5 per cent
2	Set energy performance standards for importation and sales of major energy consuming equipment and appliances	0.5 per cent
TRANSPORTATION SECTOR		
3	Revise the car taxation system to give incentives for the purchase and use of fuel-efficient passenger cars and other vehicles	4 per cent
4	Provide information to the public on fuel consumption of different car models that are commonly imported	N/A
AGRICULTURE,FORESTRY AND FISHING SECTOR		
5	Implement programmes of reforestation and agro-forestry	N/A
6	Implement programmes for the reduction of deforestation	N/A
WASTE		
7	Introduce a composting programme for the commercial sector	0.1 per cent
	ELECTRICITY GENERATION	
8	Implement a program for the installation of grid-connected wind and PV power systems	1 per cent
CROSS-CUTTING MEASURES		

[10] *As noted previously in subsection 3.2.4, the emission impacts of the individual measures are not necessarily fully additive. A measure that reduces emissions through reduced energy use in the residential sector would be fully additive with a measure that reduced emissions in the transportation sector, for instance. But two measures that both reduce residential sector emissions may or may not be additive, depending on whether or not they target the same emission sources.*

9	Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction	N/A
ADDITIONAL MEASURES FOR SCENAROS #2		
10	Waste reduction across all sector	0.5 per cent
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	34 per cent
12	Support the development of innovative financing mechanism for the deployment of solar water heaters	0.3 per cent

The following were observed based on *Table 32*

- With the exception of Measure #11 (geothermal power), no single measure will generate large, economy wide emission reductions. Achieving significant national emission reductions will require a diverse range of mitigation measures, addressing the full range of sectors and emission sources.

- Certain sectors present opportunities for relatively larger emission reductions when compared against other measures. Among the measures considered, the largest emission reductions were generated by measures addressing the adoption of building standards and guidelines and the vehicle taxation system. Electricity generation related emissions also provide potential for GHG emission reduction because this sector is heavily dependent on fossil fuels, and because it plays a significant role in Saint Vincent and the Grenadines economy.

- Certain sectors present more limited opportunities. For example, the waste composting program generates only small reductions, because it is restricted to the commercial sector. Supporting integration of solar water heaters also produces limited benefit, due to the limited population of existing water heaters, most of which are non-electric (displacing LPG water heating generates lower GHG reductions than displacement of diesel electric water heating).

- Emissions impact is a function of design. Measure #2, for instance, could generate significantly greater reductions if it were applied to additional types of appliances and equipment (such as lighting).

- The impact of Measures #5 and #6 has not been estimated because LUCF emissions were not estimated in the baseline. However, these measures would produce emission reductions and/or increase carbon sinks. These could be included in future mitigation scenarios, once better LUCF data becomes available.

- Measures implemented in the coming years will generate emission reductions that will continue after 2025. For example, the expected lifespan of a solar PV system is 20 to 25 years, therefore, if Measure #8 (program for installation of grid-connected wind and PV power systems) is implemented in 2013, and PV systems are installed that same year, these would continue to generate emission reductions beyond 2033. For some measures, the emission reductions would even continue to grow. For example, Measure #1 (standards and guidelines) would generate emission reductions for each new building constructed to the revised standards and each existing building that undergoes energy retrofits. As an increasing number of buildings are either fully replaced or retrofitted, the emission reductions of the building stock as a whole are also increasing. The same is true for other measures that aim to turn over stock to more efficient units, such as vehicles and appliances.

3.5 Co-benefits of the Mitigation Measures

Besides a reduction in GHG emissions, there are a wide range of important co-benefits that can be derived from the proposed mitigation measures (*See Table 33*).

Table 33: Benefits and Co-Benefits of Energy Efficiency and Renewable Energy

Energy efficiency and renewable energy related benefits	**Other co-benefits**
Decrease dependence on imported fossil fuels, with positive economic benefits (e.g., improved balance of payments, improved energy security).	Increase life expectancy for existing waste disposal sites.

For energy end users: reduces costs, improves commercial and industrial competitiveness, and strengthens household finances.	New business opportunities and potential for economic development.
Significant environmental benefits (for instance, reduced air emissions).	Watershed protection and sustainable use of the forest resource

Costs

This study, based on available information and resources, has attempted to document in a qualitatively manner some of the costs associated with each measure. Therefore, the result as presented in *Table 34* is not intended to be a full costing but is rather to provide some initial insight into cost factors. It is worth mentioning, that in addition to the cost elements specified in table, most measures would also involve a program administration costs which must be considered. In most cases, it is incurred by government, however, many of the measures are closely related, which allows for coordinated or integrated program delivery arrangements and associated cost efficiencies.

Table 34: Indicative Cost Element for the Mitigation Measures

No	**Measure**	**Cost Elements (Indicative)**
1	Adopt standards and guidelines for the construction of energy efficient buildings	• Cost of developing standards and guidelines • Cost of implementation of the standards (cost depends on the degree of integration with existing standards e.g., an existing Building Code) • Incremental costs of more energy efficient buildings incurred by building owners should be recovered through energy savings, provided the measure focuses on the most cost-efficient options
2	Set energy performance standards for importation and sales of major energy consuming equipment and appliances	• Harmonization with established standards in other jurisdictions could reduce costs associated with implementing energy efficiency standards. • Incremental costs of efficient appliances and equipment incurred by residents and business owners should be recovered through energy savings, particularly in relation to highly inefficient units (often imported into unregulated markets)

No	Measure	Cost Elements (Indicative)
TRANSPORTATION SECTOR		
3	Revise the car taxation system to give incentives for the purchase and use of fuel-efficient passenger cars and other vehicles	• Cost of revising the import taxation system (depends on design, e.g., use of rebates, no or lower taxes for fuel efficient vehicles, etc.) • Costs could be financed by the incremental revenue produced by the higher duties/taxes collected for inefficient vehicles • Incremental costs of more fuel efficient vehicles incurred by the end users are recovered through reduced import taxes and fuel savings • Increased fuel efficiency is also available through cost-saving changes such as reduced vehicle size, reduced engine size, and other purchase choices
4	Provide information to the public on fuel consumption of different car models that are commonly imported	• Promotional (social marketing) costs • Ongoing costs depends on program design (e.g., website maintenance and updating of an information portal) • In general, these costs are dependent on measure design. The costs are "soft" costs (as opposed to hard infrastructure costs) and the specific activities to be undertaken are scalable with respect to level of effort, reach, and duration. This provides considerable flexibility in the measure design, and corresponding flexibility in measure cost.
5	Implement programmes of reforestation and agro-forestry	• Cost or measure depends on program design and approach adopted (training, technical support, incentives, promotional materials, planting material, site preparation, maintenance, etc.)
6	Implement programmes for the reduction of deforestation	•Cost or measure depends on program design and approach adopted (training, technical support, incentives, promotional materials, planting material, site preparation, maintenance, etc.)
WASTE		
7	Introduce a composting programme for the commercial sector	• Cost of composting services • Promotional (social marketing) costs • Some off-setting revenue will be generated from the sale of resulting compost and from reduced waste disposal costs
ELECTRICITY GENERATION		

No	Measure	Cost Elements (Indicative)
8	Implement a program for the installation of grid-connected wind and PV power systems	• Costs of developing legal (and commercial) framework to allow independent power production using renewable sources • Costs of fiscal incentives to encourage wind and PV power generation to make the development financially viable (e.g., low cost leases on suitable sites, power purchase agreements ($/kWh), rebates, etc.) • For the independent power producer (IPP), cost of grid-tied solar PV installation could vary from around $3,200 USD/kW to $5,400 USD/kW. Estimates for the capital cost for wind power also vary from around $800 USD/kW to $2,200 USD/kW, with additional operational costs that vary with size (e.g., $25/kW/year for 250 kW to $14/kW/year for 750 kW turbines) (cost figures gathered from Caribbean based studies and distributors). • For the IPP, revenue from sale of power would depend on negotiated Power Purchase Agreement with VINLEC.
CROSS-CUTTING MEASURES		
9	Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction	• Promotional (social marketing) costs • Cost of developing education and training materials (including costs of training trainers) • Cost of implementing program into existing curriculum • In general, these costs are dependent on measure design. The costs are "soft" costs (as opposed to hard infrastructure costs) and the specific activities to be undertaken are scalable with respect to level of effort, reach, and duration. This provides considerable flexibility in the measure design, and corresponding flexibility in measure cost.
ADDITIONAL MEASURES FOR SCENARIO #2		
10	Waste reduction across all sector	• Cost of recycling and composting services • Promotional (social marketing) costs • Some off-setting revenue will be generated from the sale of resulting compost and from reduced waste disposal costs
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	• Cost of assessment of the geothermal resource • Cost of resource development and associated infrastructure
12	Support the development of innovative financing mechanism for the deployment of solar water heaters	• Cost of fiscal incentives to encourage uptake of solar hot water (e.g., decreased/no duties on import of solar water heating equipment, rebates, etc.) • Promotional (social marketing) costs • Cost of capacity development support (e.g., training for

No	Measure	Cost Elements (Indicative)
		installation and servicing of solar hot water) • Cost of installation of solar hot water on government buildings (to create an addition market diver). • Some off-setting revenue could be generated from imposing higher duties on non-solar water heaters (e.g. LPG, electric) • Installation costs incurred by the end user are around $1,900 USD for a 246 L system, with maintenance costs of around $150 every 7 years. Costs would be partially offset by cost savings from other energy sources (e.g., LPG, electricity) (cost figures gathered from Caribbean based studies and distributors).

3.6 Barriers, Constraints, and Uncertainties

Barriers

Small countries such as Saint Vincent and the Grenadines face a particular set of implementation challenges that arise from inherent resource limitations. Therefore, the detailed design of the individual measures will need to consider options to overcome barriers that potentially reduce the effectiveness of the measures. The barrier to implementation of the aforementioned mitigation measures are divided as follows:

Technical barriers:

- Lack of mature technology and equipment to implement the measures
- Limited, and in some cases lack of, professional or technical service to support some of the measures and technologies
- Lack of infrastructure and support measures

***Economic and financial barriers**:*

- Some measures may exceed available financial resources, or present too large a financial risk. For example, it is expected that geothermal feasibility studies and implementation

would be a large capital cost that may prove challenging for the government to meet without external financing.

- Sourcing financing for unproven technology. These initial costs can be a substantial barrier on their own despite the fact that many of the measures (e.g., vehicle efficiency and building and appliance energy efficiency) would have financial paybacks over time (e.g., fuel cost savings and savings on electricity bills).

- Determining who will bear the cost. The entity incurring the initial costs (government, business, individual) may not be the one to directly benefit from the financial paybacks in the future. For example, the owner of a multi-family building who invests in energy efficiency retrofits may not be able to pass on the costs to the tenants, even though the tenants would directly benefit through lower electricity bills.

***Institutional barriers**:*

- Insufficient technical, financial, and management capabilities as well as insufficient human resources.

- Overlapping or unclear mandates between organizations that potentially deal with similar resources (such as the Energy Unit and VINLEC). This could present a barrier to successfully developing, implementing and running a program that impacts both organizations.

- Existing rules may pose a structural barrier; for example independent power production from renewable sources depends on regulations regarding market (and grid) access for the power producer.

3.7 Uncertainties

The uncertainties associated with the emissions projected for the Baseline and Mitigation Scenarios is significant due to the following:

- St. Vincent and the Grenadines significant data gaps

- Many of the demographic, economic, and technical variables that will affect future emissions are unknown and unknowable (at least with any precision).

- The results presented for each mitigation measure are a reflection of the assumed design of the measure. A more or less aggressive design would produce greater or lesser emission reductions. As such the modeling results should be considered indicative rather than definitive.

The interactive effect of varying the results for the Baseline and Mitigation Scenarios was tested because a conventional sensitivity analysis was beyond the scope of this study. It was done as follows:

- Varying GHG emissions growth in the Baseline Scenario by ±25 per cent

- Varying the aggressiveness of the Mitigation Scenarios by ±25 per cent

The emissions that would be expected under these modified sets of assumptions are presented in *Table 35.*

Table 35: Alternative Emissions Growth and Mitigation Scenario

GHG Emissions (tons CO_2e)			
	Lower Baseline Emissions Growth (-25 per cent)	**As Modelled**	**Higher Baseline Emissions Growth (+25 per cent)**
BASELINE SCENARIO			
2010	407,199	407,199	407,199
2015	607,103	673,738	740,373
MITIGATION SCENARIO #1 (2025)			
25 per cent Less Aggressive	560,111	621,588	683,065
As Modelled	544,447	604,205	663,963
25 per cent More Aggressive	528,783	586,822	644,860
MITIGATION SCENARIO #2 (2025)			

25 per cent Less Aggressive	430,789	478,071	525,354
As Modeled	372,017	412,849	453,681
25 per cent More Aggressive	313,245	347,627	382,008

The two extreme scenarios presented in the above table show the following results:

- Highest baseline emissions + least aggressive mitigation: 2025 emissions are 683,065 tons of CO_2e (68 per cent above 2010 levels)
- Lowest baseline emissions + most aggressive mitigation:2025 emissions are 313,245 tons of CO_2e (23 per cent below 2010 levels)

3.8 Implementation Priorities

Limited finances, amongst other factors, make it necessary to prioritise the implementation of the measures included in Mitigation Scenarios #1 and #2. With this is in mind, four screening criteria are proposed for use in identifying priority mitigation measures for early implementation:

• Potential GHG impact

• Sustainability

• Expected cost

• Feasibility of early implementation

The first three criteria are selected from the original screening criteria presented in (subsection 3.1.2 - Step 1: Selection of Measures) while the final criterion complements the first three by considering feasibility of early implementation.

A preliminary screening was conducted for Mitigation Scenario #1 and #2 measures. All the measures that achieved a 1 per cent reduction or more of GHG emissions were carried forward as possible priorities for early implementation. In addition, the supporting measures (Measures #4 and #9) were carried forward for evaluation against the remaining criteria.

The Measures carried forward include:

Measure #1: Adopt standards and guidelines for the construction of energy efficient buildings [5 per cent emissions reduction]

Measure #3: Revise the car taxation system to give incentives for the purchase and use of fuel-efficient passenger cars and other vehicles [4 per cent]

Measure #4: Provide information to the public on fuel consumption of different car models that are commonly imported [supporting measure]

Measure #8: Implement a program for the installation of grid-connected wind and PV power systems [1 per cent]

Measure #9: Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction [supporting measure]

Measure #11: Undertake sustainable development of geothermal resources in the Soufriere

Resource Area [34 per cent]

Subsequently, these measures were evaluated relative to the four screening criteria: potential GHG impact, sustainability, expected cost, and feasibility of early implementation. The results of this illustrative screening process are presented in

Table 36. It must be noted that the scores presented in the table are not absolute as the scoring was done informally on a relative scale. For example, in the case of the "potential GHG impact" criterion, measures with an impact of 5 per cent or higher were given an H (high) rating; all

below 5 per cent were given an M (medium) rating.

Table 36: Results of the Illustrative Screening Process

#	Measure	Potential GHG Impact	Sustainability	Expected cost	Feasibility of Early Implementation	Early Priority?
RESIDENTIAL, COMMERCIAL AND INDUSTRIL SECTORS						
1	Adopt standards and guidelines for the construction of energy efficient building	H	H	$$	H	Yes
TRANSPORTATION SECTOR						
3	Revise the car taxation system to give incentive for the purchase and use f fuel-efficient passenger cars and other vehicles	M	M	$$	M	Yes
4	Provide information to the public on fuel consumption of different car model that are commonly imported	N/A	H	$$	H	Yes
ELECTRIITY SECTOR						
8	Implement a program for the installation of grid-connected wind and PV power system	N/A	H	$$(wind)	H	Yes
CROSS-CUTTING MEASURES						
9	Implement energy related educated and training at all education levels from primary schools up to college courses, and implement public awareness campaign to promote energy conservation and waste reduction	N/A	H	$$	H	Yes
ADDITIONAL MEASURE FOR SCENARIOS #2						

11	Undertake sustainable development of geothermal resource in the Soufriere Resource Area	H	H	$$$$	L	?

All the measures score well against the defined criteria. However, despite the high cost and potentially lengthy implementation time, Measure #11 (geothermal resources) was carried throughout the screening process due to its potentially high impact on GHG emission reductions.

Based on the screening all measures involved would be candidates for priority focus and early implementation in Saint Vincent and the Grenadines, except for Measure #11 (lead time may be dependent on access to international funding and a full feasibility assessment). The other measures in Mitigation Scenarios #1 and #2 remain valid and potentially important, but would be considered as part of a second phase of implementation activity.

As noted above, the implementation priorities presented here are illustrative only. The priorities have not been reviewed by stakeholders in Saint Vincent and the Grenadines, and have not been subjected to critical review and evaluation.

Ongoing Mitigation Planning and Implementation

A mitigation assessment is a requirement for the Saint Vincent and the Grenadines' Second National Communication to the UNFCCC. However, this and future assessments can also contribute to the island's on-going mitigation planning and its implementation since it provides a solid foundation on which to develop a climate change mitigation strategy and implementation plan.

To use this groundwork to develop a climate change mitigation strategy and implementation plan, the following steps must be taken:

- Consult national experts and stakeholders to validate the findings of the Mitigation Assessment and to confirm implementation priorities.
- Conduct an analysis to develop each measure into a detailed design, to confirm

feasibility, determine implementation requirements, and identify financial requirements.(reread original and rewrite if necessary)

- Develop the implementation plan for consultations and review.
- Address the implementation requirements, identified earlier in the process, including establishing partnerships and securing financial commitments.
- Implement the plan

As a signatory to the UNFCCC, the concept of Nationally Appropriate Mitigation Actions (NAMAs) is relevant to Saint Vincent and the Grenadines. The measures included in the Mitigation Scenarios in this report are nationally appropriate for Saint Vincent and the Grenadines and suitable for consideration as NAMAs. Therefore, Saint Vincent and the Grenadines would be in a good position to seek support for these measures via the NAMAs mechanism. If Saint Vincent and the Grenadines is interested in pursuing international support for NAMAs, it would be critical to develop and implement a measurement, reporting, and verification (MRV) plan. This plan should be done and implemented as part of the climate change mitigation strategy and implementation plan.

Intended Nationally Determined Contributions

In an effort to fulfill its obligation as a Party to the UNFCCC and to publicly outlined climate actions it intends to undertake post 2020, Saint Vincent and the Grenadines developed it's Intended Nationally Determined Contribution (INDC) report in 2015. The report which takes into consideration the mitigation assessment in this SNC, strategic adaptation interventions and other factors states that Saint Vincent and the Grenadines intends to achieve an unconditional, economy-wide reduction in GHG emissions of 22 per cent compared to its BAU scenarios by 2025. Some of the intended measures identified falls into the area of renewable energy, energy efficiency, transport and land use, land use change and Forestry. It is expected that the proposed measures will result in a reduction in projected per capita emissions to 4.3 tonnes CO_2e in 2025, which is less than the global average of 5.3 tonnes CO_2e emissions per capita in 2025, the level required to be consistent with returning warming to below 1.5°C above pre-industrial levels.

Chapter 4: Vulnerability and Adaptation Assessment

This section of the report looks at the vulnerabilities in five key sectors: agriculture, coastal zone, water, health, and tourism. The report attempts to the present and future impacts on these sectors by the vagaries of global climate change and climate variability. It also provides the linkage between climate and the Vincentian society by highlighting the impact of drought spells on water availability and the sensitivity of the tourism and agricultural sectors to climate extremes. The linkage was extended to the vulnerability of important coastal infrastructure to storm and hurricane activity (particularly wind and storm surges). Furthermore, projection was done rainfall, temperature, climate variation, future storm activity and sea level rise to facilitate adaptation measures .Adaptation options were outlined for the aforementioned sectors. The chapter was developed using, extensive literature review, traditional knowledge, expert's judgment and Climate Modeling

4.1 Current Sector Vulnerability Assessment

4.1.1 Agriculture

Agricultural activities in Saint Vincent and the Grenadines are based on the production of vegetables, tree and root crops, and animals on small plots of land generally about a hectare or less. However, the island is known for the production of root crops such as sweet potato (*Ipomoea batatas*), dasheen (*Colocasia esculenta*), eddoe (*Colocasia antiquorum*), tannia (*Xanthosoma spp*.), yam (*Dioscorea spp*.), cassava (*Manihot esculenta*), ginger (*Zingiber officinale)* and arrowroot (*Maranta arundinacea*). The farming technique used with these crops is deep soil tilling often on slopes over 30^0 which are not conducive to mechanization. This practice leads to frequent occurrences of landslides during periods of heavy rain.

Apart from the soil erosion as a result of cultivation on slopes, the Vincentian agriculture system is vulnerable to a host of social, economic and environmental factors. Among these are fragmentation of farm lands, loss of farm lands to housing development, irrigation, outbreaks of plant diseases and the climatic conditions of the island. The latter is considered to be most critical because of the high dependence of plants on sunlight and rain for production.

The "planting season" in Saint Vincent and the Grenadines is influenced by the climate. Traditionally, it begins at the onset of the rainy season, around late May to early June. This reliance on the rainy season for planting makes the sector vulnerable to changes in climatic patterns. In that, a prolonged dry season will affect the beginning of the planting season, while at the same time affecting the crops under production in the dry season. With the exception of banana farms located on the north-eastern side of the island, most farms do not have on-farm irrigation, thus a prolonged dry season increases water stress and negatively affects the productive cycle of the crops. Conversely, an intense wet season, generally leads to water logging and the loss of vital soil nutrients which are necessary for optimum production. Landslides result in loss of soil along with crops. At the beginning of the rainy season, some of these landslides are triggered by exposed soil resulting from fires which occur during the dry season. Therefore, a very rainy season can lead to decreases production due to crop loss from landslides as well as from attacks from pests and diseases. The latter often occur because of the existence of favorable conditions for their development since the period of high temperature also occurs during this season.

Similarly, livestock production is characterized by small producers of ruminants through extensive grazing and the use of imported feed for non-ruminants. Most of the livestock activities are semi- commercial or backyard type operations carried out by small farmers many of whom are landless. Livestock production, especially ruminants, declined over the last decade due to loss of farm lands to housing, the increase in number of large dogs on the island and criminal activity.

Livestock production is vulnerable to climate change as the increase heat can affect the body temperature of the animal and consequently, their functioning. In addition, during the dry season, grazing is affected as pastures tend to be void of grass. Of interesting is the situation in Union island where the animals are let-go during the dry season to roam freely in search of food. This action subsequently causes the degradation of the land as it becomes exposed to the element of the weather. In addition, low rainfall affect the amount of water that becomes natural available to livestock.

Therefore, the Vincentian agriculture system is vulnerable to climate change as climatic

conditions directly or indirectly influence the production of crops and raring of animals. As a result, a change in one of the parameters would produce a subsequent change in the other.

4.1.2 Coastal Zone

More than 90 per cent of the infrastructural development in Saint Vincent and the Grenadines lies on a narrow coastal belt less than eight meters above sea-level making it vulnerable to the impacts of climate change. These include the island's main communication and emergency response structures - roads, airports, health services, telecommunications, financial, and technical support centres. Saint Vincent and the Grenadines' vulnerability is vividly depicted in the location of its capital, Kingstown, which is located on the coastal strip surrounding Kingstown Bay. This area is considered a hotspot for storm surge inundation. The bay is semi enclosed with well-developed rocky headlands. However, the shoreline was modified for the construction of the deep-water sea port with only a relatively small section at north western end remaining a narrow sandy beach. The maximum storm surge height for Kingstown Bay is estimated at 5 feet (SWIL 2006). However, a detailed analysis is required to determine the site specific storm surge elevations to be expected in this area since the Coastal Vulnerability Study, 2007 estimated a range of at least 12-15 feet. The city, over the years, has seen its fair share of damage from climatic events. Storm waves tend to break directly unto structures along the coastline and the roads running perpendicular to the coast form channels for the run-up as waves break. In addition, drainage channels overflowing unto the flood plain and impeded by the increased sea levels increases inundation of the flat lands adjacent to the coast. The combination of high inundation levels and the impact of high energy waves at the shoreline create conditions for extreme storm surge hazard. Noteworthy is the significant damage to the cruise ship berth and the deep water pier from storm surge from Hurricane Lenny in 1999. The port is the main point for trade between St Vincent and the Grenadines and the rest of the world. More than 90 per cent of the country's commerce and trade takes place at this port. Any disruption at this port, such as storm damage or shoreline inundation, would, therefore, be catastrophic to the economy and social dynamics of Saint Vincent and the Grenadines. Tourism, food imports and exports, medical supplies, motor vehicle and building material imports, among other things, would need to find alternative ports or come to a stop. This will affect employment and the circulation of capital across the country amongst others things.

Moreover, most of the marine support structures — mangroves and reefs — have been severely affected by higher than normal sea surface temperatures and droughts followed by massive storm surges. The result is that these ecosystems are dead, dying or have been removed. The *St. Vincent Coastal Vulnerability Assessment, 2007* revealed that coral reefs are patchy around the island. It went on to say that reef life has suffered from coral bleaching, polluted terrestrial runoff, boating, lobster trapping, and other overuse. The study used three segments (segments with peculiar characteristics related to storm surge and coastal erosion) of the Vincentian coast line as representative samples pointing to the vulnerability of the entire coast (*See Figure 32)*. The areas are as follows:

1. Questelles Point to Johnson's Point (*Section 1- Figure 32)*: This section, located on the south coast is somewhat protected and experiences a relatively mild wave climate, except for periods of south east trade wind dominance. The area is also impacted by two drainage basins with moderate runoff. Assessments have recommended that the area of sea between Villa Point and Johnsons Point be designated the South Coast Marine Park allowing for the protection of its environmental assets (eg. coral reef and limited wetland). There is also a healthy coral reef associated with Milikin Bay that warrants protection given the large coastal community in the area and their increasing use of the marine resources for economic and recreational purposes.

   In the community of Calliaqua, an area of land less than 2 m above sea level, is seen as an area of concern in terms of vulnerability to climate change. The concern of the impact of sea level has led to the installation of a sea-level rise monitor along the southern coastline in this community near the Coast Guard Station on December 4, 1998. The monitoring system was part of Saint Vincent and the Grenadines' involvement in Component I of the Caribbean Planning for Adaptation to Climate Change (CPACCs) regional initiative to establish baseline conditions and to monitor change in sea level over time. It was upgraded by the Caribbean Community Climate Change Centre (CCCCC).

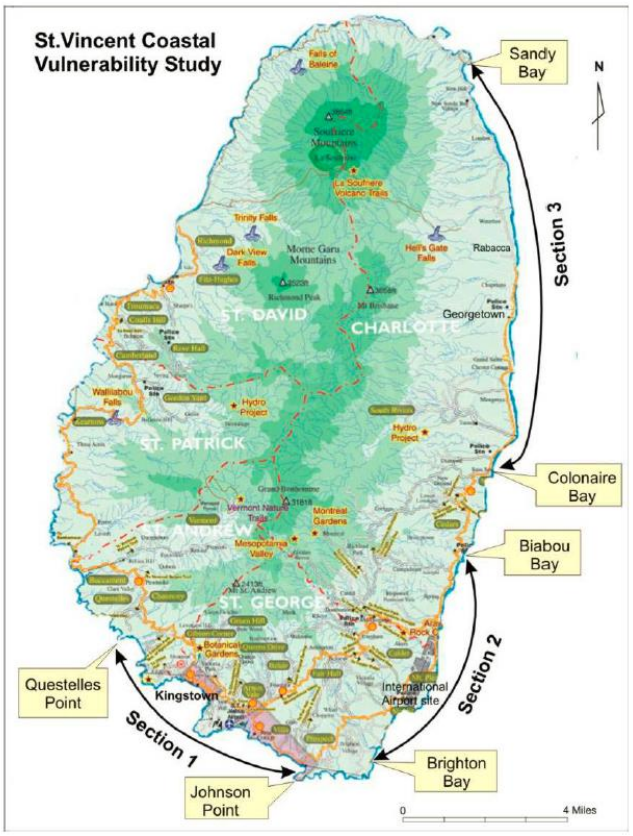


Figure 32: The study area. Source: St. Vincent Coastal Vulnerability Assessment, 2007

2. Brighton Bay to Biabou Bay *(Section 2- Figure 32)*: the area is oriented southeast and unprotected to waves generated by the trade wind as well as hurricane. The area is characterised by a narrow, low-lying, and gently sloping sand terrace with some mangrove. Diamond, located within the area, has been the main sand minding site on the island. The resource has been overexploited, where parts of the area were mined below mean sea level. In addition, along a considerable stretch of the beach, the protective sand dune has been completely removed, making it even more vulnerable to the impact of storm waves and erosion. Moreover, sand dunes, a natural coastal defence, in the Brighton area are targeted for mining. Thus, it is imperative that mitigation measures with regards to risk reduction and disaster management be implemented. Failure to address this issue will result in the loss of the protective services of the dunes, the destruction of turtle nesting sites, fishing banks and the beach area resulting in a more vulnerable community

physically, socially and economically.

Furthermore, the lush and extensive mangrove communities in the vicinity of the Brighton Salt Pond have been greatly reduced. This is due to harvesting of the mangroves for firewood, increased pollution loadings and habitat degradation. The Grenadine Islands, they destroyed for Marina development and other coastal developments.

3. Colonaire Bay to Sandy Bay (*Section 3- Figure 32*): This high energy area includes the Georgetown and the Rabacca River floodplain. It is exposed to wind generated swells, waves and storm generated seas. Steep slopes characterised the coastline with only narrow coastal corridors allowing for north-south traffic movement in some sections. There are major rivers which empty into this section and flooding is a serious problem. Coral Reefs are located at Biabou and Colonaire, but the form and health of the reefs are unknown.

4.1.3 Health

Health is an important sector in any society and like other sectors it's affected by a change in climate. In Saint Vincent and the Grenadines, a reduction in the burden of climate sensitive diseases or other related conditions resulting from climate change and variability does not appear to be a deliberate agenda issue. To date, data published by the health sector in Saint Vincent and the Grenadines does not report directly on temperature-related morbidity and mortality although some causes of death have been exacerbated by heat. These conditions include ischemic heart disease, diabetes, stroke, and respiratory diseases (Geehin and Mirabelli,2001)

Work is being done in this regard through public health programmes undertaken by the Ministry of Health, Wellness and the Environment (Ministry of Health and the Environment). The programs are geared towards the prevention and control of communicable diseases such as small pox and yellow fever. While not expressly targeting climate sensitive diseases, these programs are effective measures in reducing both the incidence and burden of these diseases. Additionally, a giant stride was made with the establishment of the Environmental Services Unit (1987/88) whose mandate is to guide national development along the "green' path to a sustainable future through sound environmental health practices,' green' production, and the sustainable management of natural resources.

Moreover, some of the air quality challenges faced By Saint Vincent and the Grenadines over the past decades are thought to be climate related. These air quality issues are likely to have health implications especially for respiratory diseases such as asthma. Air quality challenges are linked to the presence of Sahara dust originated from Africa, allergenic pollen and the increased in fossil fuel usage especially in the transportation sector. Gyan (11) et al points to increased amounts of Saharan dust being transported across the Atlantic to the Americas since the mid 1960's. Since then there has been an increase number of patients presenting with asthma in the region.

Furthermore, many of the enteric diseases that are under epidemiological surveillance on the island show a seasonal pattern (WHO 2003) suggesting sensitivity to climate. Consistent with the public health literature, research confirm that there is a peak in the incidence of diarrheal diseases during the rainy season (May –Nov). However, increase surveillance and aggressive prophylactic treatment by the MOHWE (MOHE) has resulted in a decrease in the number of cases over the last five years.

According to Chen et al, 2007, changes in climatic parameter are known to have influence the increased in severity and frequency of dengue fever outbreaks throughout the Caribbean region. While there is no clear pattern established in Saint Vincent and the Grenadines between the annual dengue fever (DF) /dengue haemorrhagic fever (DHF) cases and total annual total rainfall *(Figure 33),* this tendency was observed 1998. In this year, there was a noticeable increase in both variables, with DF/DHF numbers being at an all-time high of 205 cases and rainfall also at an all-time high of 2941.72 mm.

Akhtar et al 2007, supports the theory that diseases transmitted by rodents are likely to increase during period of heavy rainfall and flooding. In Saint Vincent and the Grenadines, the rodent borne disease of public health importance is Leptospirosis which has shown an upward trend in the past 12 years as illustrated by the solid black line in graph *Figure 34*. Noteworthy is that during the years 2002, 2004, 2005 and 2007, when there were tropical storms or hurricanes (which also resulted in some flooding) the rate of infection were high.

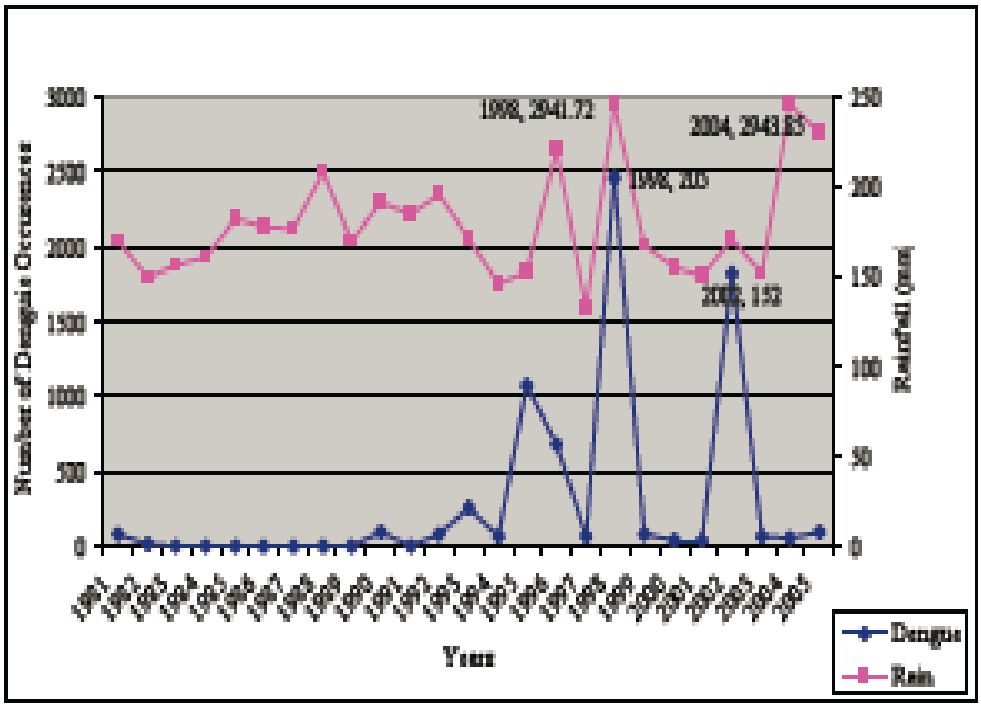


Figure 33: Number of Dengue Cases 1981-2005.Source: Saint Vincent and the Grenadines Meteorological Office, 2009 & CAREC, 2009

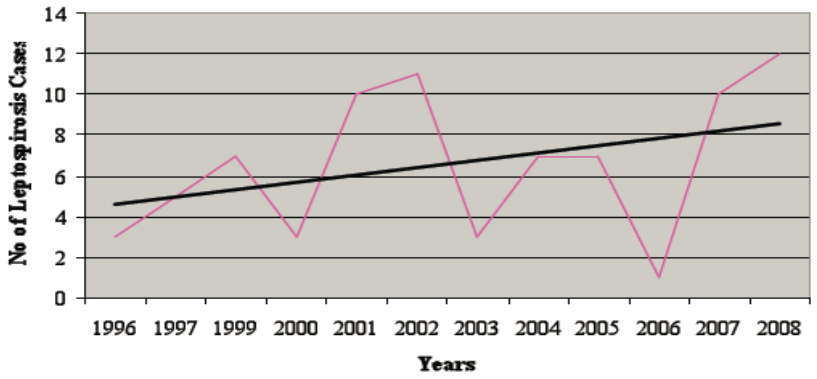


Figure 34: Annual Leptospirosis Cases in Saint Vincent and the Grenadines during the Period 1996 - 2008.Source: Ministry of Health and the Environment, 2009

What's more, the aforementioned diseases (asthma, dengue fever and leptospirosis) have shown seasonal fluctuations associated with weather conditions. Using these as proxy indicators, it is safe to say that climate change will affect the health of the Vincentian population which in turn

will affect the labour force and the economy.

4.1.4 Water

There is a claim that there is an abundance of water to meet the needs of the populace. Water, that comes from the network of rivers and spring within the island's 16 watersheds. This water is used for three main purposes:

1. Potable water-collected at higher elevations ;
2. Irrigation - taken in the lower elevations where most of the agriculture occurs and;
3. Hydro-electricity- captured for normally from midstream in rivers not tapped for potable consumption where the volume and velocity are sufficiently great to facilitate the generation process.

Furthermore, the total water demand on the island can be viewed from a sectoral perspective:

Domestic and Tourism: Domestic demands for freshwater is increasing with the changes in life style and housing patterns. Larger modern homes with multiply bathrooms, frequent showers in hot weather, lawns to be watered and cars to be washed all add up to force the CWSA to improve is collection, treatment and distribution capacity. *Figure 35* illustrates an increase in potable water for domestic consumption; where it is approximately seven time that for commercial (tourism, industry) and government institutions (schools, hospitals, fire service). A small volume (around 5 million gallons per year) is supplied to ships. As the tourism sector develops so too will the demand for high quality potable water. It is well known that the per capita demand for fresh water by the tourism sector is about four times of that demanded by the local population.

Industrial: This includes water for hydro-electricity generation (untreated), production of beverages and bottled water. In an attempt to address the growing cost of electricity occasioned by the ever increasing price of oil, about 25 per cent of the nation's electricity is generation from hydro. However, this source of electricity is subject to the impacts of climate change and climate variability. This was clearly seen during the period 2008 – 2010 where Saint Vincent and the Grenadines generated 28.21 per cent and 8.17 per cent of its electricity in 2008 and February

2010 respectively[11]. This was attributed to the prolonged dry period experienced in the Caribbean from November 2009 to May 2010.

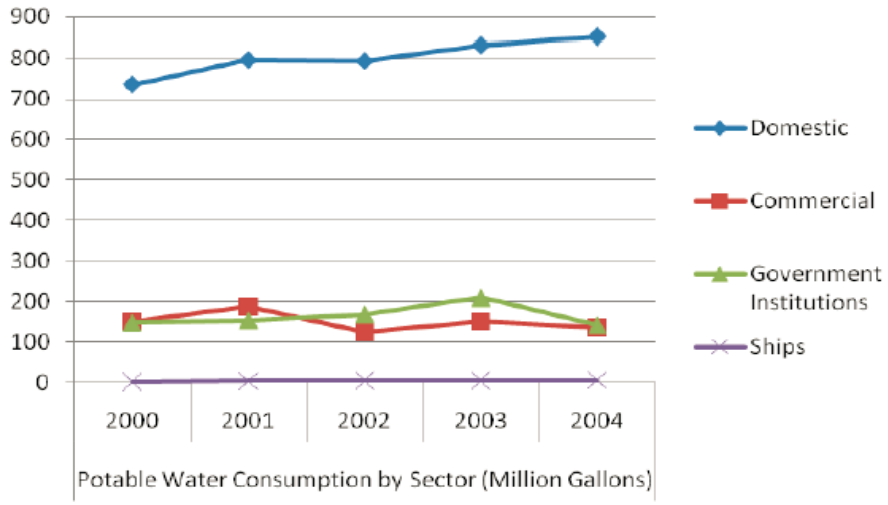


Figure 35: Potable Water Consumption in St. Vincent

As it relates to bottled water, increased demand for this commodity has resulted in the formation of at least three companies exporting bottled water. If the predictions of decreased precipitation for the Caribbean region holds, then one can expect increase upstream abstraction and more stress for downstream users and ecosystems.

Watershed in St. Vincent is synonymous with forest reserve. Thus, any impact on forest affects the watershed. In 1986, figure for forest cover was reported at 35 per cent but in 2007 the Forestry Department reported it at 29 per cent. This represents a decrease of approximately 6 per cent in 20 years due mainly to farming and housing encroachment. Such decline in forest cover will reduce rainwater percolation and subsequently stream flow.

This data seems to support the claims by Murray 1993 and Bishop 1998 who reported a slow but

[11] *SVG Today. Press Conference by Dr. Vaughn Lewis, Manager of Engineering, VINLEC, March 11th 2010*

steady decline in flow volume of many rivers in St. Vincent. In addition, anecdotal evidence indicates a considerably decreased dry season flow than that in the wet season. Notwithstanding, greater flow rates in some of the major perennial rivers (Richmond, Cumberland, Buccament, Yambou and Colonarie) have been attributed to high rainfall in these upper catchments and the likelihood of them being fed by groundwater with base-flow from the coarse, weathered rock debris beneath. Some of the smaller rivers, particularly on the west coast, are intermittent.

Besides, the country occasionally experiences water shortages during the dry season which leads to rationing of potable water. This seasonal shortage coupled with the increase in demands caused the government to invest in a ground water resource assessment and monitoring in 2007. During the process, 14 boreholes were drilled on Saint Vincent, Bequia and Union Island. Additionally, 40 wells were identified in Bequia, six in Union Island and one in St. Vincent. 26 springs were found on St. Vincent with the major ones being used by the CWSA for supply of potable water. These includes Montreal and Layou-Palmistie (used year round); and Greggs and South Rivers (used during the dry season in support to the Jennings system). The study revealed that there is a considerable amount of ground water with good harvesting potential in Saint Vincent and the Grenadines.

Agriculture: Most of the agriculture done in Saint Vincent and the Grenadines is rain fed. However, over 315 ha of the agricultural lands are currently irrigated utilizing approximately 12.5 per cent of the estimated quantity of water available for abstraction. It is assumed that any expansion of the irrigation system beyond the current level will depend on the findings of the current hydrological study.

4.1.5 Tourism

Saint Vincent and the Grenadines is currently diversifying its economy towards tourism. This industry interacts with, and is supported by, various other sectors such as: energy, health, agricultural, social development, housing and the environment. Thus, the impacts of climate change on tourism are, therefore, the cumulative impacts of these sectors. With this in mind, the estimated impact of climate change on the tourism product of small island states and by extension Saint Vincent and the Grenadines is expected to be strongly negative. As was previously mentioned, most of the critical infrastructure is located within a few meters of the

coastline inclusive of most hotels, resorts and restaurants. This proximity and heavy reliance on the beaches increases the vulnerability to climate change impacts - coastal erosion, salt water intrusion into wells, the impacts of storm surges and sea-level rise.

Additionally, much underwater damage including damage to coral reefs, seagrass beds and various types of beach vegetation, including but not limited to mangroves results from extreme events. For example, in September, 2002, after tropical storm Lilli, there was a significant decrease in the height and width of the beaches on the east and south east of St Vincent. It is estimated that average beach height fell from 1.4 m to less than 0.5m.

More so, water is an important resource for the tourism sector. The seeming decline in surface water in St Vincent may limit the number of visitors to the island unless alternative sources are found. The Grenadines where the Tobago Cays are located and where tourism is concentrated are already plagued by a shortage of potable water. The availability of an adequate supply of water combined with the coastal resources (coral reefs, fish stock and white sand), the main assets, are likely to be most severely affected by climatic impacts in this sector.

Furthermore, the numerous opportunities for the locals to be employed in the service sector would also be affected. The primary and secondary groups that are anticipated to be vulnerable to impacts on climate change are shown in *Table 37*. This will have repercussions for the nation's economy. In 2008, the Tobago Cays alone generated approximately US$215,644.00 from 58,224 visitors. Climate change impacts could destroy the reefs and the ecosystem that make up this tourism product. What's more, over the past decade, the south eastern coast of St Vincent, where the majority of hotels are located have lost significant proportion of its beaches to storm surges. The decline in the beaches produced a consequent decline in the value and rating of the hotels in the market place.

Other tourism products that stand to be affected include trails, wild life and waterfalls. These will be negatively affected due to decrease in precipitation and increase in temperature as predicted for St Vincent.

Table 37: Primary and Secondary Vulnerable Groups Affected by Climate Change

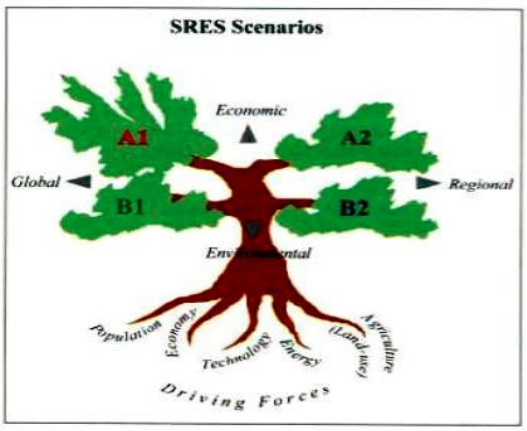
Primary Vulnerable Groups	**Secondary Vulnerable Groups**
Taxi driver	Souvenir Vendors
Vendors	Market Vendors
Shop attendants	Food and Beverage suppliers
Store clerks	Farmers
Construction workers	Fishermen
Entertainment staff (performers)	
Activities staff (water sports, dive staff)	

4.2 Projection of future climate

The projections of rainfall and temperature for Saint Vincent and the Grenadines through the end of the century are obtained, from a consensus of an ensemble of 15 Global Circulation Model (GCMs), Regional Climate Model (RCM) and downscaling techniques. The data used are compiled in the UNDP Climate Change Country Profile: St Vincent and the Grenadines. The models were run using the Special Report Emission Scenarios (SRES) where each scenario is a possible storyline of the future world. They explore pathways of future GHG emissions, derived from self-consistent sets of assumptions about energy use, population growth, economic development and other factors. However, global policy to reduce emissions to avoid climate change is absent. The scenarios are grouped into families according to the similarities of their storylines (*see Figure 36*). Since there is an equal probability of each storyline becoming the future, three scenarios were used, namely A2, B1 and A1B. A2 and B1 are representative of high and low emissions scenarios respectively, while A1B is seen as a compromise between the two. This scenario is characterised by a rise in CO_2 emissions through mid-century followed by a decline.

The future climate of Saint Vincent and the Grenadines is presented as absolute or percentage

deviations from the present day climate which is represented by averaging over a 30 year period (1970-1999). The results are presented for 10 year average time slices for the 2030s, 2060s, and 2090s (GCM data) and for the end of the century (2070-2100) (RCM data).



- A1 storyline and scenario family: a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and rapid introduction of new and more efficient technologies.
- A2 storyline and scenario family: a very heterogeneous world with continuously increasing global population and regionally oriented economic growth that is more fragmented and slower than in other storylines.
- B1 storyline and scenario family: a convergent world with the same global population as in the A1 storyline but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies.
- B2 storyline and scenario family: a world in which the emphasis is on local solutions to economic, social, and environmental sustainability, with continuously increasing population (lower than A2) and intermediate economic development.

Figure 36: Special Report on Emission Scenarios (SRES) schematic and storyline

4.3 Future Climate: Results

4.3.1 Temperature

The mean temperature is expected to increase by 0.15^0 C per decade over the next century. Under the A2 scenario (high emissions), GCMs project maximum temperature changes of up to 4^0 C by the end of the century, with median annual increase of up to 1.0° C by the 2030s,1.8 °C by the 2060s, and 2° C by the 2090s. This increase is consistent with IPCC projections for the Caribbean where mean annual temperatures are estimated to increase by 1.4°C to 3.2°C, with a median increase of 2.0°C by 2100. Projection for seasonal changes also showed a similar warming trend throughout the century. By the end of the century, under the highest emission scenario, GCMs project the greatest seasonal warming will occur in December, January and February while the months of June to November showed the fastest average rates of decadal change.

In keeping with trends from historical data, the frequency of hot[12] days and nights is also expected to increase by the end of the century. Annual percentage frequency approaches 75 per cent and 66 per cent of hot night and days by the 2060s, increasing up to 99 per cent by the end of the century according to GCMs. Cold[13] days and nights show marked decrease under all models and all scenarios, almost reaching nonexistence by the 2060s.

4.3.2 Rainfall

Regarding rainfall, most models point to a drying throughout the year with negative median values range from 10 per cent to 22 per cent annually by 2090s. The maximum possible changes indicate up to 24 per cent less annual rainfall by 2030s, 41 per cent by 2060s and 58 per cent by 2090s. The results from the models also suggest drying in the wet season from June to November, with the greatest seasonal change seen in the summer months (7.1 per cent per decade). Decreased rainfall in the rainy season will significantly affect water availability for Saint Vincent and the Grenadines whose water source currently is from surface streams. The dry months early in the year are less severely affected in the median, but still show similar downward trends.

Moreover, the proportion of total rainfall occurring in 'heavy' events shows the greatest change in March, April and May, with a decrease of up to 30 per cent under A2. However, the B1 (low emissions) scenario shows the possibility of an increase by up to 13 per cent by end of century. Most scenarios, however, indicate a slight decrease in maximum 1- day rainfall, but up to 7 mm decrease in maximum 5-day rainfall by the end of the century.

4.3.3 Hurricanes

The IPCC's projections were relied upon to project hurricane since the models examined do not explicitly model hurricanes. According to predictions from the IPCC, the future hurricanes of the north tropical Atlantic will likely to become more intense, with larger peak wind speeds and

[12] *'Hot' day or 'hot' night is defined by the temperature exceeded on 10 per cent of days or nights in current climate of that region and season*

[13] *'Cold' days or 'cold' nights are defined as the temperature below which 10 per cent of days or nights are recorded in current climate of that region or season.*

heavier near storm precipitation. Stronger hurricanes are anticipated to result from on-going and projected increases in tropical ocean temperatures (from surface through 450 m) and atmospheric water vapour content (Barnett et al.2005, Anthes et al. 2006)

4.3.4 Sea level Rise

Ocean expansion (due to warming) and the inflow of water from melting glaciers have raised the global sea level over the last decade. Large deviations among the limited set of models addressing the issue, however, make future estimates of sea level change uncertain, including those for the Caribbean. Similar to projections for hurricanes, it is the IPCC's projections which are relied upon to estimate sea level rise. Whereas it is not presently possible to project sea level rise for Saint Vincent and the Grenadines, changes in the Caribbean are expected to be near the global mean. Under the A1B scenario, sea level rise within the Caribbean is expected to be between 0.17 m and 0.24 m by 2050 (IPCC 2007). For comparison, global sea level rise is expected to average 0.35 m (0.21 to 0.48 m) under the same scenario by the end of the century (relative to the period 1980-1999). It is important to note, however, that changes in ocean density and circulation will ensure that the distribution of sea level rise will not be uniform across the region.

4.3.5 Temperatures and ENSO:

All models show continued ENSO interannual variability in the future. However, there is no consistent indication of discernible changes in projected ENSO amplitude and frequency in the 21st century (IPCC 2007).

According to the aforementioned projections, one can expect a drier, hotter Saint Vincent and the Grenadines with less natural coastal defence structures (mangroves, coral reefs, sand dunes) to buffer more intense and more frequent storm systems.

4.4 Adaptation Assessment

Saint Vincent and the Grenadines is already adapting to climate change on a low level. However, these measures were put in place seemingly without consciously associating their implementation with addressing the issues of climate change. Most of these measures are funded by annual government budget allocation to the various line Ministries with some responsibility

for environmental protection. In cases where activities were geared towards adapting to the adverse impacts of climate change, they were mainly project based financed by grant funds. *Table 38* summarised some of the adaptations measures that have been and can be implemented.

It is expected to see new areas of adaptation as the need arises in the future. This can include: a modified and improved agriculture system with technological support for new plant and possible animal species capable of existing under the new and harsh climatic conditions; a more responsive, technically equipped medical system with appropriate human resource; communication infrastructure to battle new and emerging diseases (DHF, Asthma, Flus); water exploration technology; renewable energy development; and, new housing structures.

However, it will be imperative to mainstream climate change adaptation into the national development process as it ensures effective adaptation and gives climate change more prominence at the national level. The issues should also be mainstreamed into the national planning frameworks to engender national participation in its various phases of implementation.

Adaptation will continue to be a normal part of the government's agenda. However, it must be taken to a level beyond the current level through mainstreaming for it to be adequate and effective.

Table 38: Compilation of Adaptation Efforts Implemented in Saint Vincent and the Grenadines

Sector	**Adaptation Strategies**
Agriculture	Sensitization seminars and education about climate change and its impact designed to help in building a resilient society.
	Improved rainwater harvesting for irrigation purposes.
	Development of stress tolerance varieties of common agricultural plants through genomics and molecular biology. This can be done utilising technical assistance from regional and international agencies and countries like Caribbean Agriculture Research and Development Institute (CARDI), FAO and the Taiwanese.
	Adaptive measures to control pest. For example, consumer education relative to the ecological principles of the Integrated Pest Management (IMP), Seasonal planting of crops that provide substrate for some pest.
	Use of technologies by Port Health authorities to provides quarantine facilities for both import and export of biological material
	Adapting livestock to increased heat stress by using the following measures: Provision of shade in pastures through physical structures, Education of heat production through rumination by enhanced nutrition and feeding programme, Breeding programmes that improve the animals' abilities to withstand heat.
	Identification of crops that are productive under emerging climatic conditions and for which there is a ready market.
	Adaptation measures for soil and water use in agriculture include: Soil conservation measures to deal with run-offs, especially on hillside farming, Construction of retaining walls to lessen the risks of landslides, Increase the allocation of ground water recharge areas on the islands to support the irrigation programme.

Sector	Adaptation Strategies
	Adaptation measures for Hurricanes: Crop insurance like WINCROP to provide start-up funds for farmers after storm damage as well as compensation for damage to crops. Introduction of shorter species of Plantains (specie of bananas). Mix farming using a combination of tree crops and vegetable or root crops.
Coastal Zone	Hazard assessment of the coast to determine priority for action on the coast.
	Movement of settlement from coast to inland
	Construction of retaining walls in areas where old settlements have high commercial value. e.g Layou, Barrouallie and Chateaubelair
	Control and restriction of sand mining is now controlled and restricted at a few sites. Sand for construction is now imported from countries with stocks of inland sand often from mines.
	Building codes and land use plans are slowly evolving and gaining legal status
	A sea level monitor station was established at the coast guard base on the south of the island in 1996. This has been since updated to give real time reaching of sea surface changes.
	Storm surge maps developed under the coastal vulnerability assessment will allow St. Vincent to put in place early warning systems to coastal settlement and activities.
Health	A vector control program with surveillance for dengue and other forms of vector borne diseases that are climate sensitive.
	A water quality monitoring program that take cognizance of floods, droughts and waste disposal into water bodies
	The national Solid waste management program that prohibits open burning.
	Community Health services that are equipped with trained staff and equipment to perform primary health care and some degree of hospitalization for asthma patients and persons suffering from heat stress

Sector	**Adaptation Strategies**
	There is an evolving 'roving health clinic" that can also treat emergency cases while transporting the victim to an appropriate treatment center.
Tourism	Promotion of small group tourism that fits well into the carrying capacity of the island amenity sites.
	Renewable energy and energy efficient programs in the hotel sector
	Development of water management strategies in line with government policies.
	The establishment of a National parks, Rivers and beach Authority to support management of the tourism product.
	The promotion of regional tourism tied to cultural and island specific events.
Water	Policy options like water pricing and the development of water user groups.
	Ground water exploitation and protection of water catchment areas.
	Support to irrigation for agricultural diversification.
	The use of green house for vegetable farming

Chapter 5: Other Information Relevant to the Achievement of the Objective of the Convention

This section highlights the activities which are "*relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication…".* The information herein was collected using literature review using unpublished and published documents - national, regional and international, email communication, web-based information, etc; compilation and inventory of relevant climate change meetings; and projects. The information is presented as follows: Steps taken to integrate climate change considerations into national development and policy formulation; Information on climate change education, training, and public awareness; Capacity building activities and priorities; and The way forward.

Steps Taken to Integrate Climate Change Considerations

To address the issue of climate change, a number of actions have been undertaken nationally. This was done by integrating climate change consideration into policies and legal instruments which governs a number of sectors. These sectors fall under the jurisdiction of several government and quasi-government agencies for whom climate change consideration was not a part of their regular routine. The policies and legal instruments include:

- ✓ St Vincent and the Grenadines Environmental Management Strategy and Action Plan 2004 - 2006
- ✓ Sustainable Energy for Saint Vincent and the Grenadines: The Government's National Energy Policy, March 2009
- ✓ Energy Action Plan for St Vincent and the Grenadines, January 2010
- ✓ Draft Environmental Management Bill
- ✓ National Disaster Plan, 2005 (addresses the response to the impacts of climate change)
- ✓ National Emergency and Disaster Management Act, 2006
- ✓ Comprehensive National Disaster Management Plan

- ✓ Forest management policy documents
- ✓ Biodiversity-related policy documents
- ✓ Land degradation-related documents

Regionally, Saint Vincent and the Grenadines is signatory to the *St George's Declaration of Principles for Environmental Sustainability* in the Organisation of East Caribbean States (OECS) which is the overarching environmental policy for the sub-region. To monitor progress all signatories are required to report biennial on its implementation through the National Environment Strategy (NEMS). The Declaration enables Saint Vincent and the Grenadines to achieve the objection of the Convention since it addresses climate change issues in a number of the Principles namely:

- ✓ ***Principle 2***: Integrate social, economic and environmental considerations into national development policies, plans and programmes
- ✓ ***Principle 3***: Improve on legal and institutional frameworks
- ✓ ***Principle 6***: Use economic instruments for sustainable environmental management
- ✓ ***Principle 7***: Foster broad-based environmental education, training and awareness
- ✓ ***Principle 8***: Address the causes and impacts of climate change
- ✓ ***Principle 9***: Prevent and manage the causes and impact of disasters
- ✓ ***Principle 15***: Promote cooperation in science and technology
- ✓ ***Principle 16***: Manage and conserve energy

Additionally, Saint Vincent and the Grenadines have participated in other regional initiatives/action that addresses climate change. These include:

- **Climate Change and the Caribbean: A Regional Framework for Achieving Development Resilient to Climate Change (2009 - 2015):** This was prepared by the CCCCCC at the request of the Caribbean Community Common Market (CARICOM)

Heads of Government in consultation with technical officers from countries. It was done in an effort to lay the ground for a "regional society and economy that is resilient to climate change" (CCCCC, 2009)

- **Caribbean Planning for Adaptation to Climate Change Project (CPACC):** The goal of this project was *"build capacity in the Caribbean region for the adaptation to climate change impacts, particularly sea level rise*." Under this project, Saint Vincent and the Grenadines received support to complete its INC to the UNFCCC amongst other things.

- **Adaptation to Climate Change in the Caribbean (ACCC):** This project, funded by the Canadian International Development Agency (CIDA) through the Canadian Climate Change Development Fund (CCCDF), ran from 2001 to 2004. It built on the work done by the CPACC project and served as a bridge between that project and the Mainstreaming Adaptation to Climate Change (MACC) Projects (CIDA, 2005). The ACCC project consisted of nine components intended to *"…sustain activities initiated under CPACC and to address issues of adaptation and capacity building not undertaken by CPACC…"*

- **Mainstreaming Adaptation to Climate Change (MACC) Project**: This project was funded by the Global Environment Facility (GEF)-World Bank and implemented in the English-speaking CARICOM countries from 2004 to 2008. This project with its five components intended to build capacity in the Small Island and low-lying coastal states of the Caribbean as well as build their resilience to climate change risks through the identification and implementation of feasible adaptation measures.

- **Special Programme on Adaptation to Climate Change (SPACC) Project**: This project was funded by the GEF-World Bank spanned from 2008 to 2012. The participating islands were: Saint Vincent and the Grenadines, St Lucia and Dominica. In Saint Vincent and the Grenadines one pilot project was implemented in Paget Farm, Bequia which aimed at exploring an integrated, sustainable solution to address the issue of limited water resources in that community. The community relied exclusively on rain water harvesting as the source of potable domestic water. Therefore, the project provided the combination of a renewable, carbon-free energy generation source (photovoltaic system), with a reverse osmosis desalination plant. The 70 kW photovoltaic systems was installed on the

roof of the hangar at the Bequia Airport and connected to the national electricity grid, which then powers the desalination plant.

Climate Change Education, Training and Public Awareness

There are on-going although limited initiatives, to increase awareness and understanding of climate change issues carried out by the MOHWE (MOHE), few Non-Governmental Organisation (NGOs) and minimal private sector involvement. Furthermore, the previously mentioned climate change projects each contained a public awareness and education component. Some of the activities conducted include:

- Advertisements on radio and television
- Contributions to the print media.
- Distribution of pamphlet
- Education sessions conducted at primary, secondary and tertiary education schools - i.e. 5 to 18 years old
- Presentations at summer programs, both secular and religious.
- An annual School Environmental Competition of which climate change consideration was a component
- Exhibitions and other open-air events (usually on United Nations -designated environmental days), in conjunction with other agencies which play a part in environmental management.
- Sponsorship of a Carnival J'ouvert band which portrayed aspects of climate change as part of their presentation.
- A one-day workshop with members of the Insurance Association.

As part of the Second National Communication process, several workshops were held:

- GHG Inventory workshops: participants were trained to identify sources of GHG, assess the quantities of gases discharged and the identification of sinks.
- Vulnerability and Adaptation workshops: Participants were provided with information about latest findings related to climate change trends in St Vincent and the Grenadines specifically, and the Caribbean amongst other things
- Mitigation Assessment workshops: were also conducted to provide training in understanding and generating baseline scenarios with a view to enhancing national capacity to undertaking future assessments.

Capacity building activities and priorities

Capacity building needs and priorities has been identified in several reports, including the INC and the National Capacity Self-Assessment (NCSA).

Table 39 below provides a summary of the capacity building needs which have been identified in key areas.

Table 39: Capacity Building Needs in Key Areas Related to Climate Change

Key Area	Strategies and Actions
Climate change coordination	Formation of a national climate change committee
Climate change education and awareness	Development and implementation of an integrated and sustained climate change education and awareness programme Establishment of a climate change information storage and exchange mechanism
Incorporation of climate change considerations into the national development planning process	Training activities in areas related to planning Development of a national climate change framework as part of a larger national planning framework
Management of coastal and marine resources	Review of existing coastal monitoring and data collection systems Development and implementation of integrated coastal zone management plan

Key Area	Strategies and Actions
Human settlements	Development and implementation of a national physical development plan
Freshwater resources	Inventory of freshwater resources, and development and implementation of a National Water Resources Management Plan
Tourism	Development/Improvement of a regulatory framework with emphasis on enforcement
National communication process	Enhance data collection, management and processing Building capacity to resolve issues regarding emissions factors and to better address LULUCF computations Establishing systems for enhanced exchange of information

Chapter 6: Constraints and Gaps, and Related Financial, Technical and Capacity Building Needs

Saint Vincent and the Grenadines faces a number of challenges in implementing its obligations under the UNFCCC. These challenges include a lack of resources – human, technical, physical and financial – to institute adequate measures to mitigate and, more importantly, to adapt to the consequences of climate change.

This chapter seeks to outline the constraints and gaps associated with the implementation of activities, measures and programmes under the Convention, and with the preparation of National Communications.

The NCSA 2005 identified constraints and issues relative to the implementation of the UNFCCC *(see Table 40).* During the development of this report many of the gaps relative to the implementation of the Convention were found to be consistent with those identified in the NCSA.

Table 40: Key Capacity Constraints and Opportunities for Integrated Capacity-Building across Thematic Areas

Cross-cutting Capacity Constraint	**Thematic Areas**			
	Biodiversity(UNCBD)	**Climate Change (UNFCCC)**	**Land Degradation(UNCCD)**	**Opportunities for cross-cutting capacity building**
1Information management	There is a biodiversity clearing house with potential to host other thematic areas	There is a wealth of information collected periodically relating to GHG	Need for building indicators and following trends in Biodiversity development and GHG emission	Data collection and management Training for individuals and groups
2 Institutional mandate; cooperation between stakeholders	The MAFF has some responsibility in all areas And a large extension team	The MOHE, as focal point for the GEF liaises with MAFF through the National Environmental Advisory Board	The emerging NAP is multidisciplinary thus there is a need to link with other disciplines	Co- management opportunities Implementation of joint work programmes and training for individuals

3 Resource mobilization	The link between agriculture, land and water allows for joint mobilization of resources	The development of financial instruments like the green funds	The emerging NAP calls for resources allocation to address land degradation	Need to improve negotiation skill and skills in resource mobilization
4 Mobilisation of science to support decision-making	Biodiversity studies to select resistant species and minimize threats to species	Determining which crops grow under conditions of reduced or increased precipitation and carbon dioxide levels	Land stabilisation techniques, including biodiversity conservation	Making science a tool for decision-making
5 Incentive systems and market instrument	Development economic valuation models	Carbon trading and clean development mechanism require pricing structure	Valuing non-agricultural lands, wetlands and slopes	Training in environmental economics and valuing the environment
6 Individual skills and motivation	Tracking biodiversity	Establishing indicator species	Understanding population shift	Training in biodiversity mapping and monitoring
7 development and implementation of policies	Existence of conservation legislation and areas	Need for policies on setbacks and buffer-zones	There are areas prone to movement that are not restricted	Need for training in GIS mapping and land policy formulation
8 Creating links between national and global priorities	Identifying and conserving nationally and globally significant biodiversity	Need for renewable energy policies and technologies	Reducing erosion that impact upon aquatic and marine environment	Need for policy and technology that addresses the convention while meeting national needs
9 Engaging civil society	Involving non-state actors in biodiversity conservation and food security issues	Developing appropriate technology to reduce carbon dioxide emissions	Local area soil and water conservation	Forest conservation strategies development of appropriate technology

The gaps and constraints identified during the preparation of the SNC can be summarized as follows:

- The absence of adequate financial resources to undertake climate change activities

- High cost of mitigation and adaptation technologies
- Inadequate levels of human resources, including specialist skilled resources.
- Lack of requisite data
- Lack of a system to collect and report on data necessary to develop the GHG inventory
- Absence of a clearing house mechanism to facilitate the exchange of information on climate change
- Insufficient institutional coordination.
- Loss institutional memory and data
- Weak institutional capacity and lack of local consultants to conduct research, data collection and analyses required for the development of the GHG inventory
- Limited availability of skilled staff necessary to :
    - Implement adaptation actions and monitor progress,
    - Undertake and interpret regional climate change projections
    - Conduct research on the vulnerability of key sectors and communities to the impacts of climate change
- Limited public awareness and education of the threat of climate change and the actions that may be taken to mitigate and adapt to the adverse impacts.
- Lack of nation-wide hydro metrological monitoring network to increase the accuracy of forecasting
- Climate change mitigation and adaptation not sufficiently mainstream into key sectors
- No agency has been tasked with the responsibility for research coordination

As a result of the gaps and constraints highlighted above, it is difficult to accurately quantify all areas of vulnerability and potential impacts of climate change on the sectors. It will be necessary for the Third National Communication to undertake a more thorough analysis of the sectors to determine specifically to determine areas of vulnerability which may be possible obstacles to development growth in the country.

CONCLUSIONS

Saint Vincent and the Grenadines as a party to the UNFCCC is obligated to develop national communications as part of its commitment to the Convention. The SNC is financed by the GEF, implemented by the UNDP and executed by the Ministry of the Health, Wellness and the Environment. The development of the SNC emphasized the country's vulnerability to the negative effects of climate change due to its size and location.

Cognizant of its vulnerability, Saint Vincent and the Grenadines instituted measures to adapt to and, to a lesser extent, mitigate climate change. This tends to be in sync with the belief that SIDS should not concentrate on mitigation measures as our GHG emissions are low. The mitigation scenarios demonstrated that with one exception, the introduction of geothermal energy, no single measure would generate large, economy wide emission reductions. Therefore, achieving significant national emission reductions will need a diverse range of mitigation measures, addressing the full range of sectors and emission sources. With this in mind, the country should continue on its path to adaptation to the adverse impacts of climate change as projections predict a drier, hotter Saint Vincent and the Grenadines with less natural coastal defence structures (mangroves, coral reefs, sand dunes) to buffer against more intense and frequent storm systems. Mainstreaming climate change will become vital as the impacts are expected to be physical, social and economic.

Like other SIDS, Saint Vincent and the Grenadines also faces challenges to implementing the Convention; chief among these challenges are the lack of relevant data and limited resources – human, technical, physical and financial. For example, one could think of the loss of information for the SNC due to technological failure that took months to be redone due to limited human and financial resources.

Therefore, if Saint Vincent and the Grenadines is to effectively mitigate and/or adapt to the adverse impacts of climate change and meet its future obligation to the UNFCCC, it is incumbent that data collection of the relevant data be strengthened. More importantly, efforts must be placed on sustained public awareness, education and capacity building at all levels of society. This could lead to more access to funds from donor agencies, more informed decision making at

the level of policy makers and engender national action/effort/support to implement measures to mitigate and adapt to the adverse effects of climate change.

RECOMMENDATIONS

Green House Gas Inventory

Capacity Building

There is a strong need for institutional capacity building and training of government staff and local consultants to do the research, data collection and analyses required to reduce inventory uncertainties and improve the quality of activity data and emission. This can be done by training sector leads from each of the six major sink/source categories - Energy, Industrial Processes, Solvents and Product Use, Agriculture, LUCF, and Waste.

At the beginning of the development of future inventories, responsibilities, roles, and resources, including the time to conduct the inventory and training for sectoral teams should be clearly identified.

Data Research and Collecting

Establish a data repository to store the inventory, information and data sources with the software workbook sheets, detail notes on assumptions and methodologies for future reference.

Develop surveys to estimate the amount of biomass removed (tons of dry biomass) for both charcoal production and fuel wood consumption.

All importers and fuel distributors should be required to report (for example quarterly) sales of fuels by sector (Transportation, Industry, Commercial, Residential, Agriculture, International bunkers, etc.) to the Statistical Office. This would allow the preparation of a national energy balance, to be updated yearly.

Develop a national land classification system applicable to the six land-use categories (Forest, Land, Cropland, Grassland, Wetland, Settlements and Other Land). This would require processing of existing Geographic information system (GIS) data with future GIS data to develop integrated maps of land-use subdivided by ecological region (type) (e.g., forest types) and soil types to accurately identify changes in land-use categories. These maps should extend

back to the year 1990 and be updated a minimum of every 5 years.

Evaluate CO_2 emissions and removals from managed forests using a Tier 2 (This would require the development of country or Caribbean region specific emission factors for biomass growth rates).

Develop surveys to estimate the average quantity of household solvents consumed per capita, to develop country specific emission factors.

Integration with Other Planning Processes

Sector teams and leads from different government departments should establish clear linkages with other aspects of the national communications namely the vulnerability, adaptation and mitigation components since such interaction will assist in identifying appropriate and consistent measures and policies.

Government departments should collaborate to establish a system and/or mechanisms to collect and report data annually to support institutional and GHG needs.

Develop an annual national energy balance which will satisfy or complement many competing information demands including; forecasting energy supply, infrastructure and community planning, energy conservation programs, projecting the balance of trade, and predicting emerging technology markets and opportunities.

Expand the data collection requirements for the agricultural census. The census could be expanded to also identify what type of animal waste management system and the data requirements for projecting LUCF emissions.

Methodologies for Future Inventories

Training, research and planning initiatives to develop future inventories should be based on new guidance that is provided in 2006 IPCC Guidelines.

Mitigation Assessment

Build internal capacity to support future efforts in preparing Mitigation Assessments base on the

following:

Knowledge based resources: This includes expanding the training of government staff and local consultants in research, data collection and analyses. This will improve the availability and quality of input data, plus decrease uncertainties in the baseline and mitigation scenarios. Besides specific training, priority should be given to their continuous engagement

Technical capacity: A data repository and archiving system (Data, information sources, assumptions, and methodologies for the mitigation assessment) should be established and housed at the EMD of the MOHWE. In addition, the key data gaps identified in the Mitigation Assessment should be explicitly addressed.

Frequent update of the GHG emission inventory, baseline and mitigation scenarios more frequently (e.g., every three years). This would improve understanding, participation, data collection, and results. It would also feed into any on-going mitigation planning.

Vulnerability and adaptation

Update and implement or enforce draft climate change related policy and strategy documents such as the draft Climate Change Strategy document, a draft National Action Plan (NAP), a Biodiversity Strategy and Action Plan, a draft Tourism Plan and a draft Water User Plan.

Promote public awareness initiatives, including the strengthening of community-based natural resource management programmes.

Research should be accompanied by a systematic monitoring programme. Civil society groups and non state actors need to be involved in these processes since government alone cannot effectively manage all national resource.

Strengthen soil conservation strategies to enhance the carbon sequestration function as well as reduce erosion.

Promote water conservation technology.

Put in the public domain the draft National Physical Development Plan, Zoning Regulations and the National Building Code.

Increase the participation of the public in the Environmental Impact Assessment (EIA) review process.

Regional cooperation should be a central theme in the country's development to take advantage of the many agreements and treaties, Institutions, programmes and access to resources regionally.

Develop early warning system with seasonal forecast for climate sensitive diseases

Up—grade of the current health management information system to a level that will allow for easy retrieval of climate sensitive disease data.

Other Information Relevant to the Achievement of the Objective of the Convention

Engender a cooperative approach to policy implementation among stakeholders where climate change considerations were integrated into their policy and/or legal instrument.

Strengthen/develop policy and legislation intended to encourage meaningful participation by all in climate change activities.

Establish a national climate change committee or other coordination body for climate change.

Strengthen inter-agency collaboration and coordination between lead agencies on climate change and other related agencies.

Establish a repository for all relevant policy documents and strengthen existing databases and networks.

Support non-governmental entities to encourage civil society and other entities to participate in climate change education and awareness activities.

A continuous monitoring and evaluation programme to review capacity building needs, adjusting accordingly and undertaking periodic knowledge Attitude and Practice (KAP) surveys to identify

emerging needs.

Develop and implement communication strategies, methods and tools.

Ensure availability of adequate resources for climate change activities.

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ANNEXES

Annex 1: List of potential mitigation measures that could be implemented in Saint Vincent and the Grenadines

TRANSPORTATION	
Modal Shift	• **Subsidize the public transport sector** as to stimulate the use of low consuming vehicles • **Provide incentives for improvements of the public transport system** as alternative to individual vehicle use
Vehicle Purchase and Use	• **Advise the public on fuel consumption** of different car models that are commonly imported • **Apply environmental tax on purchase of vehicles over 5 years old,** or other measures to curb the emissions of private vehicles currently being purchased (large number of second hand cars coming into the country) • **Revise the car taxation system** to give incentives for the use of fuel-efficient passenger cars and other vehicles
Vehicle Maintenance	• **Introduce regular motor check-ups** to avoid unnecessary emissions and limit the fuel consumption to the lowest possible level. • **Include emission standard/compliance testing** in annual vehicular inspection
Urban Planning and Traffic Management	• **Develop a comprehensive long term transport strategy** • **Improve road conditions and traffic management** as to avoid congestions and prioritize public transport buses.
Marine Transportation	• **Improve fuel conservation and efficiency for marine transport sectors** (ferries, cargo. fishing vessels)
Other	• **Study the potential of introducing electric vehicles** in the island. • **Study the options to either produce biofuels or import biofuels** from countries such as Brazil. • **Investigate GHG costs and benefits of substituting LPG for gasoline in taxis** • **Apply energy efficiency measures in the public transportation system.**
COMMERCIAL (Including Tourism and Institutional)	
Building codes	• **Publish guidelines and standards for the construction of energy efficient buildings and for retrofitting existing buildings** (including building design, insulation, ventilation, day lighting, use of efficient AC and appliances. etc.) • **Disseminate this information** to architects, civil engineers, construction companies, and the public, and encourage adoption of energy-efficient building technologies • Note: additional detail in Energy Action Plan.
Energy audits	• **Offer low- or no-cost services for energy audits to major electricity consumers**. Set up an information and advisory centre and elaborate publications for smart and cost-saving energy use. • **Promote energy audits for key energy consuming sectors**, such as industries, hotels, restaurants and public buildings.
Efficiency standards for equipment & appliances	• **Set energy performance standards for importing and sales of major domestic appliances**

Government buildings	• **Ensure that the new International Airport on St. Vincent is built in the most energy efficient manner possible.** • **Implement the results of a comprehensive energy study of the highest energy consuming Government owned/operated buildings**, to reduce the energy consumption of these buildings, and also evaluate the use of renewable energy technology for these buildings (refers to EU SFA funded study). • **Implement the Energy Conservation Education and Awareness Programme developed** to raise awareness and promote energy efficient behaviours among government employees in their workplace (refers to same study). • **Apply VINLEC's Own Use Reduction Programme** model (or similar program) to all government buildings. • **Set rules for the procurement of energy efficient goods and equipment**, including as much electricity and fuel possible from indigenous renewable sources.
Tourism sector	• **Provide fiscal incentives for the import of energy-efficient appliances**
Other	• Note: Additional cross-cutting renewable energy measures are considered below
RESIDENTIAL	
New buildings	• **Publish guidelines and standards for the construction of energy efficient buildings and for retrofitting existing buildings**
Retrofit	• **Provide incentives for retrofitting of built infrastructure** (tax write-offs, zero rated duties on imported materials, etc.)
Efficient lighting and appliances	• **Support households to switch from incandescent light bulbs to compact fluorescent light bulbs** by improving current VAT and excise tax exemptions and embarking on public awareness campaigns. • **Set energy performance standards for importing and sales of major domestic appliances**. Appliances will require energy labeling, using the rules of the European Appliance Label or US Energy Star programs. • **Provide fiscal incentives for the import of energy-efficient appliances (and equipment)** (duty free concession on energy efficient appliances)
Education	• **Introduce public awareness activities supported by incentives to implement energy-conservation measures** (awareness alone has limited influence if not associated with the appropriate marketplace signals.
Other	• Note: Additional cross-cutting renewable energy measures are considered below
INDUSTRIAL	
Energy audits	• **Offer low- or no-cost services for energy audits to major electricity consumers**. Set up an information and advisory centre and elaborate publications for smart and cost-saving energy use.
Standards	• **Publish guidelines and standards for the construction of energy efficient buildings and for retrofitting existing buildings**
Other	• Note: No refrigerant (HFC) measures were identified in the source documents
AGRICULTURE /FORESTRY/FISHING	
Agriculture non-energy emissions	• **Encourage cocoa production** (for carbon sequestration) • **Encourage minimum tillage practices** (for carbon sequestration) • **Adopt policies to encourage move away from traditional fertilizers** to environmentally friendly alternatives (including composting). • **Encourage use of methane from farm waste to energy**
Land use	• **Implement integrated land-use planning** • **Implement Sustainable Land Management (SLM) Project**

	• **Upgrade the National Physical Development Plan** to consider climate change, conservation of biodiversity, and allow for better land zoning.
Forestry	• **Identify measures to eliminate illegal deforestation of watersheds** (e.g., b marijuana planters) • **Promote use of waste wood, including thinning debris, for crafts and furniture**, as a means to combat deforestation • **Implement programmes of reforestation and agro-forestry** • **Promote the adoption of best practices for sustainable forest management**, to reduce land and forest degradation, reversing vegetation and forest cover loss • **Provide local partners and stakeholders with social and economic incentives to buy into the concept of forest protection**
Fishing	• Note: No measures related to agricultural energy emissions were identified in the source documents • Note: No measures related to fishing were identified in the source documents
WASTE	
Waste reduction	• **Introduce source reduction programme** (possibly including incentives) • **Introduce composting programme** for hotels, for home owners
Other	• Note: No landfill gas recommendations were identified in the source documents
ELECTRICITY GENERATION	
Self-generation and independent power	• **Establish mechanisms that allow for fair access to the transmission/ distribution grid** and provide the basis for a stronger involvement of the private sector in renewable electricity generation and cogeneration. • **Support efforts by private power operators to replace diesel fuel with alternative renewable energy sources.** Encourage private sector participation in the development, financing and management of renewable energy projects • **Analyse market potentials for the application of solar electric systems in all consumption sectors**. Install a pilot photovoltaic plant and publish technical guidelines for the interconnection of small grid-connected RE systems.
Renewables policy and programming	• **Remove legal barriers and introduce legislation supportive of non-traditional energy development, coupled with fiscal incentives.** • **Provide financial and fiscal incentives that allow renewable energy technologies to be market competitive** (e.g. import duties, low-interest loans, tax credits) • **Demonstrate pilot projects of various renewable energy systems.** • **Small hydro:** Provide the financial means for rehabilitation of the hydro power plants at South River and Richmond and for installation of new small hydro plants. Start with a long-term gauging programme. • **PV and wind**: Investigate opportunities for the installation of stand-alone PV and wind power systems (VIN LEO). • **Geothermal**: Ensure sustainable development of geothermal resources in the Soufriere Resource Area • **Organic Waste**: Analyse the potentials of energy production from organic waste material from the agricultural, forestry and food processing sector. • OTEC: Assess the Economic Viability of shore-based Ocean Thermal Energy Conversion (OTEC) Plants.
Efficiency	• **Improve the efficiency of existing power production, transmission** and distribution to optimise costs and fuel consumption.

	• **Investigate opportunities for electrical interconnection** between different islands of the country and with neighbouring states. • **Establish guidelines for any new energy project**, including requirements and standards of Environmental Impact Assessment (EIA).
Other	• **Study opportunities for demand management in the short term.**
CROSS-CUTTING MEASURES	
Energy efficiency	• **Set up a fund in support of small-scale pilot and demonstration projects that showcase new ways to enhance energy efficiency.** • **Implement energy efficient bulb replacement program**
Renewable energy	• **Support the development of innovative financing mechanisms for the deployment of solar water heaters** • **Consider the mandatory installation of solar thermal collectors for all major users of hot water** • **Assess the feasibility of converting waste to energy**, including production of biodiesel from waste oils and fats; production of biogas and fertilizer from agriculture residues; and production of fuels for power generation from solid waste.
Public awareness	• **Implement energy related training** at all education levels from primary schools up to college courses, and implement general public awareness campaigns to promote energy conservation.
Other	• **Examine opportunities for participation in the Clean Development Mechanism** • **Report biannually on the status and results of meeting goals of EAP**