St. Vincent and the Grenadines Mitigation Assessment

FINAL REPORT

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Submitted to:
Ministry of Health, Wellness and the Environment, Government of St. Vincent and the Grenadines

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Executive Summary

Introduction

In accordance with the reporting obligations to the United Nations Framework Convention on Climate Change (UNFCCC), St. Vincent and the Grenadines is preparing its Second National Communication (SNC). The Environmental Management Department of the Ministry of Health, Wellness and the Environment is responsible for preparation of the SNC.

The SNC includes a number of components including the *Greenhouse Gases Inventory* and the *Mitigation Assessment*, both of which were contracted to ICF Marbek of Canada. The Mitigation Assessment component includes analysis of the potential impacts of various technologies and practices that can mitigate climate change, while also supporting sustainable development in St. Vincent and the Grenadines.

Methodology

The methodology used to prepare this Mitigation Assessment is based on the UNFCCC guidance. It involves two major steps: (1) development of a Baseline Scenario, which projects greenhouse gas (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 defined emission reduction measures. The St. Vincent and the Grenadines Mitigation Assessment considers the period out to 2025.

Baseline Scenario Methodology:

Establishing a baseline from which to critically analyse possible mitigation scenarios and evaluate their potential impact is essential to the Mitigation Assessment. A baseline represents a plausible and consistent description of how GHG emissions in St. Vincent and the Grenadines might evolve into the future in the absence of explicit new GHG mitigation policies. Three main steps were undertaken to develop the business as usual (BAU) Baseline Scenario:

- Step 1 - GHG emissions for year 2010 were estimated for the main economic sectors based on the existing year 2004 St. Vincent and the Grenadines GHG Inventory developed for the Second National Communication 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.

Mitigation Scenario Methodology:

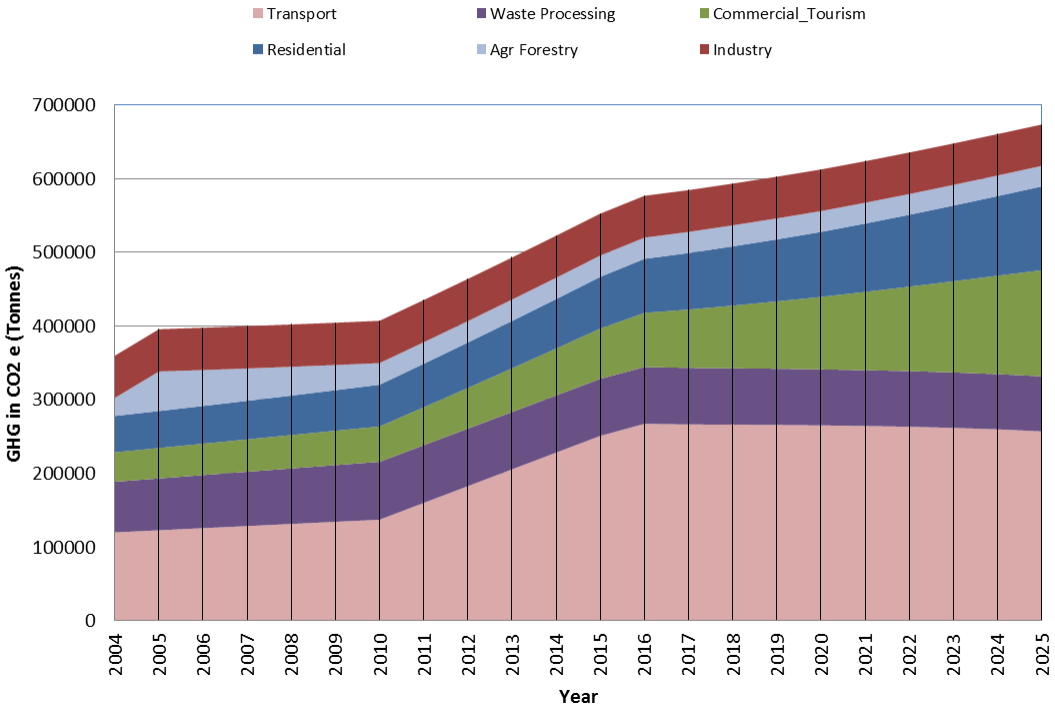
Mitigation Scenarios can be used to project GHG emissions in the future, assuming implementation of a set of defined emission reduction measures. By definition, the measures included in a Mitigation Scenario must go beyond what would be expected in the BAU case (represented by the Baseline Scenario). For the St. Vincent and the Grenadines Mitigation Assessment, two mitigation scenarios were developed and analysed. The process involved the following steps:

- Step 1 - The measures to be analysed were selected through a stakeholder process.
- Step 2 - These measures were analysed individually.
- Step 3 - The combined effect of the measures was analysed, first for Mitigation Scenario #1 and then for Mitigation Scenario #2.

Baseline Scenario Results

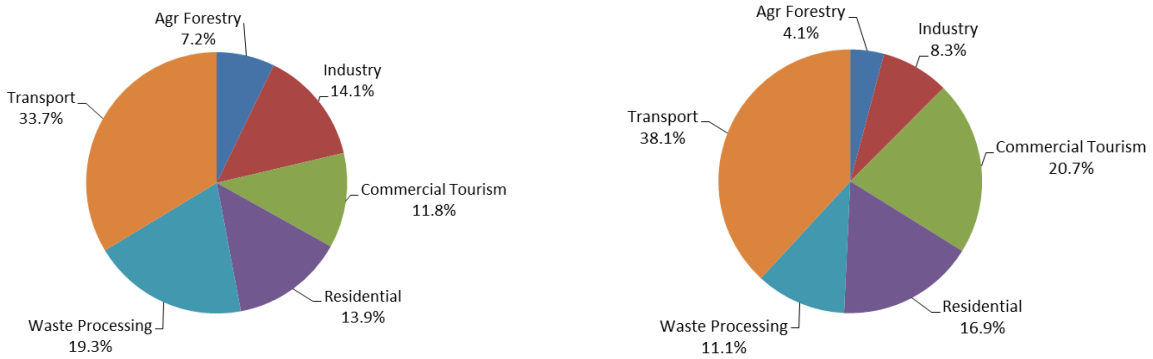
Total GHG emissions are projected to rise from 407,199 t in 2010 to 673,738 tonnes in 2025. This is an overall 65% increase in emissions for the period between 2010 and 2025, or an average annual increase of 3.4%. Exhibit 1 indicates the relative emission shares of each of the six economic sectors.

Exhibit 1 Total Baseline GHG Emissions by Sector (t CO_2e)



The sectoral breakdowns for 2010 and 2025 are presented in Exhibit 2 below. The residential, commercial and tourism, and transport sectors are all projected to have increasing emissions over the forecast time period, with the commercial and tourism sector having the fastest growing emissions. The industry, waste, and agriculture, forestry, and fishing sectors are all projected to have decreasing emissions over the forecast time period.

Exhibit 2 Sectoral Breakdown of GHG Emissions in 2010 and 2025 (t CO_2e)



Mitigation Scenario Results

Exhibit 3 presents the measures included in Mitigation Scenario #1. These measures are also included in Mitigation Scenario #2, along with the additional measures presented in Exhibit 4.

Exhibit 3 Measures Included in Mitigation Scenario #1

#	Measure	Description
	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).
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.
	TRANSPORTATION SECTOR	
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.
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.
	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.
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.
	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.
	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).
	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 in relevant areas.

Exhibit 4 Measures Included in Mitigation Scenario #2

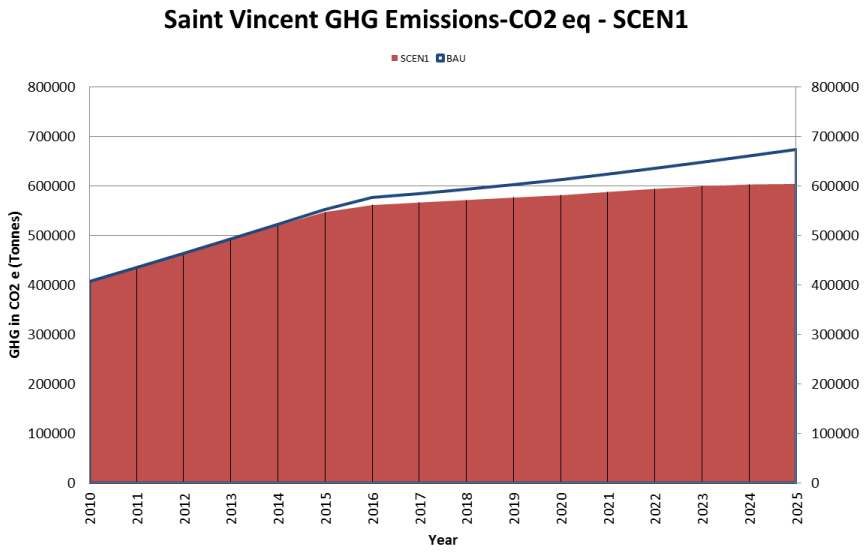
#	Measure	Description
	ADDITIONAL MEASURES FOR SCENARIO #2	
10	Waste reduction across all sectors	Reduce waste to landfill through a Reduce, Reuse, Recycle programme. This measure applies to all sectors.
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	Assess 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.
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.

The following charts present a summary of the emissions impact of Mitigation Scenarios #1 and #2 relative to the Baseline Scenario (BAU), for the period to 2025. Due to data limitations, elaborated in the main report, the emissions impact of Measures #5 and #6 are not included in these results.

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



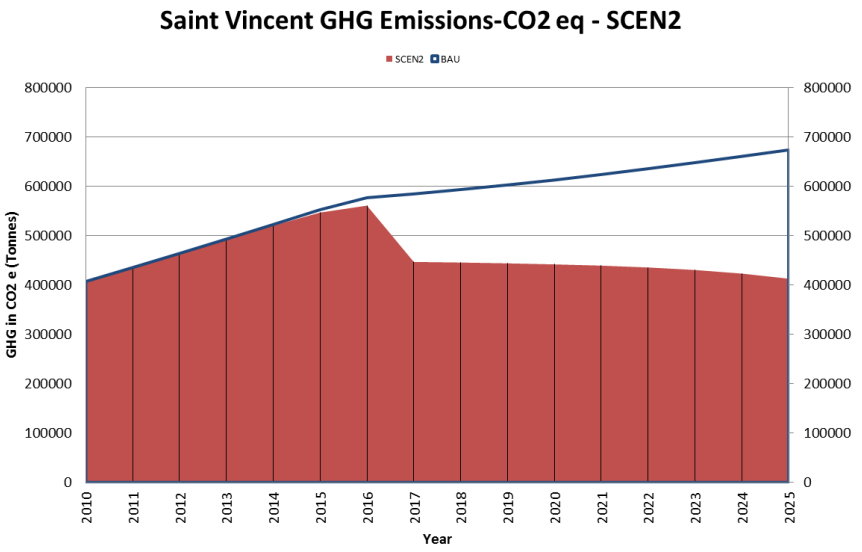
Impact of Mitigation Scenario #1 on sectoral GHG emissions relative to baseline by 2025

- 17% reduction in Residential Sector emissions
- 0.4% reduction in Industry Sector emissions
- 17% reduction in Commercial and Tourism Sector emissions
- 0% reduction in Agriculture, Forestry and Fishing Sector emissions
- 10% reduction in Transport Sector emissions
- 1% reduction in Waste Sector emissions

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

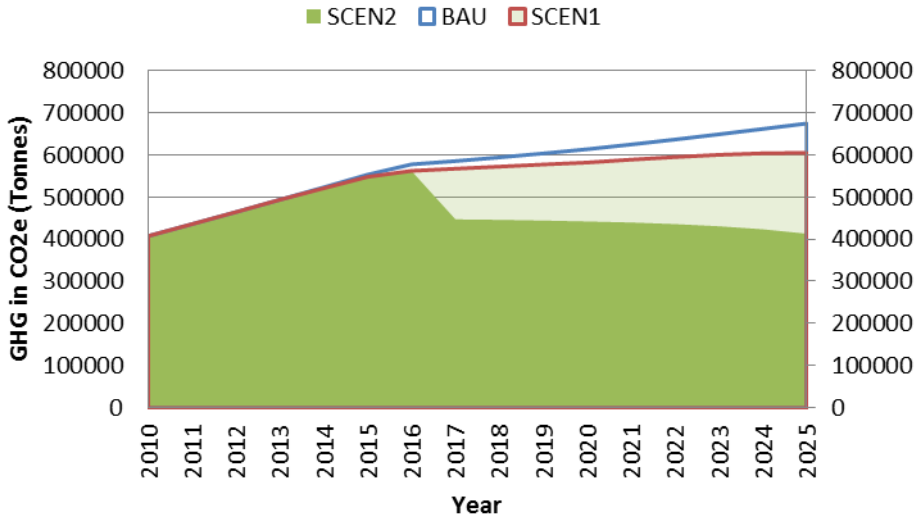


Impact of Mitigation Scenario #2 on sectoral GHG emissions relative to baseline by 2025

- 83% reduction in Residential Sector emissions
- 11% reduction in Industry Sector emissions
- 91% reduction in Commercial and Tourism Sector emissions
- 0% reduction in Agriculture, Forestry and Fishing Sector emissions
- 10% reduction in Transport Sector emissions
- 5% reduction in Waste Sector emissions

Exhibit 5 presents a comparison of Mitigation Scenarios #1 and #2 relative to the BAU.

Exhibit 5 Comparison of Mitigation Scenarios #1 and #2 (t CO_2e)



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. 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; by changes to the vehicle taxation system; and by development of geothermal energy. Emission reductions generated by the measures will continue to grow after 2025, particularly in the case of buildings, vehicles, and equipment with a long service life.

Co-benefits

The mitigation measures presented in this assessment provide a wide range of important co-benefits, in addition to the GHG emission reductions. The measures dealing with energy efficiency and renewable energy provide important energy-related benefits, such as decreased dependence on imported fossil fuels, improved energy security, reduced costs, enhanced business competitiveness, and environmental benefits. Several of the energy and non-energy measures also offer other significant co-benefits, such as the measures that reduce waste quantities will also increase life expectancy for existing waste disposal sites. Several measures will also present new business opportunities and potential for economic development.

Uncertainties

There is uncertainty in the emissions projected for the Baseline and Mitigation Scenarios due to the fact that the scenarios presented in this report do not attempt to predict future emissions; rather they provide an indication of what GHG emissions might be in the future, based on a defined set of future events and plausible assumptions. Moreover, many of the demographic, economic, and technical variables that will affect future emissions are unknown and unknowable (at least with any precision). Finally, 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. To illustrate this, the interactive effect of varying the results for the Baseline and Mitigation Scenarios has been tested by varying GHG emissions growth in the Baseline Scenario by ±25% and varying the aggressiveness of the Mitigation Scenarios by ±25%. The two extreme scenarios yield the following results:

- Highest baseline emissions + least aggressive mitigation: 2025 emissions are 683,065 tonnes of CO2e (68% above 2010 levels)
- Lowest baseline emissions + most aggressive mitigation: 2025 emissions are 313,245 tonnes of CO2e (23% below 2010 levels).

Future Work

Future Mitigation Assessments will be required as part of future National Communications. As such, internal capacity building will be critical to support St. Vincent and the Grenadines future efforts in preparing these assessments. This capacity building should include two streams: technical capacity and knowledge based resources. In addition to being a requirement for the Second National Communication to the UNFCCC, this Mitigation Assessment (and future assessments) can also contribute to ongoing mitigation planning and implementation in St. Vincent and the Grenadines, including the development of a climate change mitigation strategy and implementation plan.

As a developing country signatory to the UNFCCC, the concept of Nationally Appropriate Mitigation Actions (NAMAs) is relevant to St. Vincent and the Grenadines. The measures included in the Mitigation Scenarios in this report are nationally appropriate for St. Vincent and the Grenadines and suitable for consideration as NAMAs, should St. Vincent and the Grenadines be interested in pursuing NAMAs as part of the climate change mitigation strategy and implementation plan.

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List of Acronyms

Acronym	Definition
BAU	Business-as-usual
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
ECGC	East Caribbean Group of Companies
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GHG	Greenhouse gas
HFC	Hydrofluorocarbon
IMF	International Monetary Fund
IPP	Independent power producer
kW	kilowatt
LEAP	Long-range Energy Alternatives Planning System
LPG	Liquefied petroleum gas
LUCF	Land use change and forestry
MRV	Measurement, reporting, and verification
MSW	Municipal solid waste
N_2O	Nitrous oxide
NAMAs	Nationally Appropriate Mitigation Actions
NMVOC	Non-methane volatile organic compound
PV	Photovoltaic
SNC	Second National Communication
SVG	St. Vincent and the Grenadines
t	Tonne
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USD	United States dollars
VINLEC	St. Vincent Electricity Services Limited

1 Introduction

1.1 Background

In accordance with the reporting obligations to the United Nations Framework Convention on Climate Change (UNFCCC), St. Vincent and the Grenadines is preparing its Second National Communication (SNC). The Environmental Management Department of the Ministry of Health, Wellness and the Environment is responsible for preparation of the SNC.

The SNC includes a number of components including the *Greenhouse Gases Inventory* and the *Mitigation Assessment*, both of which were contracted to ICF Marbek of Canada. The greenhouse gas (GHG) inventory was successfully completed in 2008. The Mitigation Assessment component includes analysis of the potential impacts of various technologies and practices that can mitigate climate change, while also supporting sustainable development in St. Vincent and the Grenadines. The intent of this information is to inform policy decision, particularly supporting the development of programmes to mitigate climate change by addressing anthropogenic GHG emissions by sources and removals by sinks (for GHGs not controlled by the Montreal Protocol). The Mitigation Assessment also aims to help decision makers to prioritize mitigation programmes.

1.2 Objectives

The objectives of this assignment are as follows:

- To prepare St. Vincent and the Grenadines National Mitigation Assessment for inclusion in the St. Vincent and the Grenadines SNC to the UNFCCC, in accordance with the principles and objectives of Articles 4 and 12 of the Convention.
- To enhance the capacity of local experts to conduct a Climate Change Mitigation Assessment for the critical sectors in the country.

In order to achieve these objectives, ICF Marbek developed a methodology that was:

- Based on the UNFCCC guidance relating to Mitigation Assessments, but also
- Modest in scale and complexity, so as to limit the overall cost of the assessment.

The ICF Marbek approach stressed the contribution of the Ministry of Health, Wellness and the Environment to this assignment, along with the important role of National Consultants recruited and engaged directly by the Ministry. The use of National Consultants was intended to strengthen the capacity building impact of the project. Accordingly, the work to be undertaken was at several points dependent on information and data provided by the National Consultants.

1.3 Structure of this Report

The balance of this report is organized as follows:

- Section 2: Scope
- Section 3: Methodology
- Section 4: Data
- Section 5: Baseline Scenario
- Section 6: Mitigation Scenarios
- Section 7: Analysis and Discussion

- Section 8: Implementation Priorities
- Section 9: Future Work
- Section 10: References

The Appendices to this report provide additional information, including the "long list" of candidate mitigation measures considered in the development of the Mitigation Scenarios, and the detailed baseline assumptions used in the LEAP model. In addition, the LEAP data files have been provided separately to the Ministry of Health, Wellness and the Environment.

2 Scope

This section presents the basic framework for the Mitigation Assessment and the approach taken to training national consultants. The selection of key parameters (emission sources, base year, timeframe) was guided by established international practice and UNFCCC guidance.

2.1 Emission Sources

While the Mitigation Assessment should focus on key sectors of the economy, there may be certain sectors or sub-sectors of the economy that could have been excluded because of their relatively low contribution to St. Vincent and the Grenadines overall emissions profile or because mitigation options are limited or known to be cost ineffective.

Based on the contribution of emissions reported in the 2000 and 2004 GHG inventories, the key sectors outlined in **Error! Reference source not found.** were considered in the Mitigation ssessment.

Exhibit 6 Key Source Sectors

Sector	Key Source Categories	Applicable GHG	Percentage of Total SVG CO_2e (2000)	Percentage of Total SVG CO_2e (2004)
Energy	Mobile combustion (Transport - road vehicles)	CO_2	22.1%	27.4%
Energy	Stationary combustion (diesel)	CO_2	25.1%	24.0%
Waste	Solid waste disposal sites	CH_4	18.3%	14.0%
Agriculture	Agricultural soils (direct and indirect)	N_2O	13.6%	13.2%
Industrial Processes	Consumption of halocarbons	HFC	10.6%	12.3%
Energy	Other sectors (residential, commercial, manufacturing industries and construction)	CO_2	4.2%	3.9%

The key emission sources to be initially considered for mitigation options were selected as those that contributed more than 2% to the total St. Vincent and the Grenadines CO_2e emissions in 2000 and 2004. Other smaller sources of emissions (less than 2%) were also considered, including emissions from manure management. Finally, although the 2000 and 2004 inventory results for the LUCF sector showed net removal of GHGs, LUCF was also considered for mitigation options.

2.2 Base Year

The latest national inventory of greenhouse gases for St. Vincent and the Grenadines presented an updated inventory of greenhouse gas emissions and removals by sinks for the years 2000 and 2004. This set of data could be used to establish the base year for the Mitigation Assessment. However, the selection of the base year for the Mitigation Assessment should reflect the most current data available. Consequently 2010 was selected as the base year and new inventory data was gathered to establish this more current base year.

2.3 Assessment Timeframe

UNFCCC guidance indicates that the selection of the assessment timeframe should ideally be based on the long-term to reflect economic lifetime and the potential for stock turnover of major technologies. However, the documentation recognizes that long-term projections can be very difficult, especially in developing countries where there can be considerable uncertainties over future development and limited availability of statistical projections. The UNFCCC document further concludes that nearer term assessments (10-20 years) based on national plans and sectoral assessments are generally the most practical for most developing countries. Consequently, for St. Vincent and the Grenadines, a detailed Mitigation Assessment was considered over a relatively short term to 2025.

2.4 Modelling Platform

The Long-range Energy Alternatives Planning System (LEAP) model was used for preparation of the Baseline and Mitigation Scenarios. LEAP is a flexible "bottom up" modelling framework that provides a comprehensive and integrated system covering energy supply-side and demand-side mitigation options. LEAP was developed by the Stockholm Environment Institute (Boston). According to UNDP, LEAP has been used to undertake National Communication Mitigation Assessments in some 85 countries. Based on experience, it was deemed to be the most suitable off-the-shelf model for the St. Vincent and the Grenadines Mitigation Assessment, because it is relatively easy to use, it can be applied in situations where there are data limitations, and the depth of analysis can be tailored to the needs of the user. Another important advantage is that LEAP is available free of charge to users in developing countries.[1]

[1] Information regarding LEAP is available on the SEI website (http://www.sei-us.org/leap). Further information is available here: http://www.energycommunity.org/default.asp?action=47, including the application to receive a LEAP license free of charge.

3 Methodology

This section presents the methodology used in the St. Vincent and the Grenadines Mitigation Assessment. The methodology is divided into the following subsections:

- Subsection 3.1: Baseline Scenario Methodology
- Subsection 3.2: Mitigation Scenario Methodology
- Subsection 3.3: Training

The two subsections on scenario methodology, present the two major steps to undertaking a Mitigation Assessment: (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 defined emission reduction measures. The third subsection on training details the training mechanisms used to help build local capacity.

3.1 Baseline Scenario Methodology

Establishing a baseline from which to critically analyse possible mitigation scenarios and evaluate their potential impact is essential to this process. A baseline represents a plausible and consistent description of how GHG emissions in St. Vincent and the Grenadines might evolve into the future in the absence of explicit new GHG mitigation policies. Providing a reasonable baseline is critical to a mitigation analysis since mitigation measures must be largely judged on the incremental costs and benefits relative to this baseline.

Different approaches can be taken to developing national baseline forecasts of GHG emissions. Some countries use sophisticated integrated economic and energy forecast models that allocate materials to establish supply and demand equilibrium based on forecast prices. These models generally assume an economic efficiency case, with perfect allocation of resources and in these types of models, mitigation measures typically imply an economic loss. The disadvantage of these models is that they require substantial resources and expertise and are unable to capture inefficiencies in the economy related to market distortions as well as broader social, political and cultural effects. Countries with sufficient resources will often develop multiple baselines to reflect these uncertainties, although this requires a separate mitigation analysis for each baseline.[2]

It is also possible to develop baselines without the use of these integrated economic and energy models, by considering a continuation of historic trends. Given the limited resources of St. Vincent and the Grenadines, this business as usual (BAU) approach has been 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 and practices and structural shifts in the economy.

Three main steps were undertaken to develop the business as usual (BAU) Baseline Scenario:

- Step 1: GHG emissions for year 2010 were estimated for the main economic sectors based on the existing year 2004 St. Vincent and the Grenadines GHG Inventory developed for the Second National Communication along with additional data.

[2] UNFCCC, Mitigation Assessments, Training Package (http://unfccc.int/resource/cd_roms/na1/mitigation/index.htm - date accessed: March 2012).

- 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 development and socio-economic trends and assumptions regarding technology adoption.

The methodology of these steps is outlined below.

3.1.1 Estimating Emissions from 2004 to 2010

The starting foundation of the BAU baseline is the existing year 2004 *National Inventory of Greenhouse Gases for St. Vincent and the Grenadines* (ICF Marbek, 2008). These emissions, which were estimated for the Second National Communication, are used as a starting point for estimating current emissions and then projecting future emissions. The current year for this project is 2010 as the project commenced in 2011 and full year data was only available at that time for 2010.

Wherever possible, 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[3] and estimating new GHG emission levels. As part of this process a 2010 energy balance was developed to determine sectoral fossil fuel consumption. This energy balance includes the main imported fuels (gasoline, diesel, kerosene, LPG and aviation gas) and was primarily based on import data available from Customs and Excise and diesel consumption data from VINLEC. This data set was used to generate sector estimates based on sectoral distributions of the year 2004 energy balance. In non-energy related sectors data was gathered to estimate how emissions changed between 2004 and 2010. Specific data sources and assumptions are summarized in Section 4.

3.1.2 Allocation of Emissions and Energy-Use to Sector End-Uses

The Long-range Energy Alternatives Planning System (LEAP) model is a tool that can be used to help develop and analyse GHG baseline and mitigation scenarios. The model is based on a simple physical accounting of energy demand and supply. According to the UNDP, LEAP has been used to undertake National Communication Mitigation Assessments in some 85 countries. In our judgement, it is the most suitable off-the-shelf model for the St. Vincent and the Grenadines Mitigation Assessment, because it is relatively easy to use, it can be applied in situations where there are data limitations, and the depth of analysis can be tailored to the needs of the user. Another important advantage is that LEAP is available free of charge to users in developing countries, which facilitates its adoption and use in St. Vincent and the Grenadines.

The model requires, as a minimum, fuel usage by end-use to consider the potential effects of mitigation measures. In order to generate the model input, it is necessary to allocate 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. Data sources and assumptions that were used to estimate this allocation are summarized in Section 4.

[3] 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_roms/na1/ghg_inventories/index.htm

3.1.3 Future GHG Emissions and Energy Consumption

Very little forecast data is available in St. Vincent and the Grenadines to estimate future end-use energy demand and GHG emissions. Long-term forecasts of GDP growth, vehicle sales, commercial space, industrial production and appliance penetration that could be used to estimate energy usage were seldom available. In most cases, growth rates for energy use and GHG emissions were estimated based on population, historical growth in the sector, and the projections stated in the recent publication entitled *Energy Action Plan for St. Vincent and the Grenadines* (First Edition, January 2010). Data was also collected to assess how technology changes and stock turnover affect end-use energy efficiency and emissions.

In most cases, 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) was projected to grow by the estimated sector growth rates to project the future population. The LEAP model included factors to account for any anticipated changes in end-use energy efficiency (e.g., vehicle fuel efficiency) based on technology changes. Non-energy sector emissions were typically based only on historical trends. Detailed data assumptions are provided in Section 4.

3.2 Mitigation Scenario Methodology

3.2.1 Overview

Mitigation Scenarios can be used to project GHG emissions in the future, assuming implementation of a set of defined emission reduction measures. By definition, the measures included in a Mitigation Scenario must go beyond what would be expected in the business-as-usual case represented by the Baseline Scenario.

The mitigation measures of interest are not GHG-reducing technologies *per se*. Rather, the measures are potential policies, programs, or projects that are designed to reduce GHG emissions. Thus, for instance, the measures to be considered would not include solar water heaters as such, but might include a program designed to support installation of solar water heaters in the residential sector.

For the St. Vincent and the Grenadines Mitigation Assessment, two Mitigation Scenarios were developed and analysed. Mitigation Scenario #1 included 9 measures, and Mitigation Scenario #2 included the same measures plus 3 more.

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: The measures to be analysed were selected through a stakeholder process.
- Step 2: These measures were analysed individually.
- Step 3: The combined effect of the measures was analysed, first for Mitigation Scenarios #1 and then for Mitigation Scenario #2.

These steps are further elaborated below.

3.2.2 Step 1: Selection of Measures

Selection of mitigation measures was undertaken via an iterative process involving participation of key national experts.

The first task was to identify potential mitigation measures that could be implemented in St. Vincent and the Grenadines (the "long list"). The long list was developed by ICF Marbek based primarily on measures described in existing St. Vincent and the Grenadines policy documents, including:

- *Sustainable Energy for SVG: The Government's National Energy Policy*, February 2009
- *Energy Action Plan for St. Vincent and the Grenadines*, First Edition, January 2010
- *Initial National Communication on Climate Change: St. Vincent and the Grenadines*, November 2000
- *St. Vincent and the Grenadines Top-up Activity for Climate Change*, Final Report (Draft), July 2005
- *St. 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 2011
- *Technology Needs Assessment Workshop Report*, St. Vincent and the Grenadines, July 2004
- *Powerline*, January – June 2010, VINLEC
- SVG Baseline Scenario Workshop Documents – Workshop Exercise (inputs from participants)

The long list of candidate mitigation measures is presented in Appendix A.

The next task was to screen the long list to identify the most promising options for further analysis. The screening process was undertaken by stakeholders at the *St. Vincent and the Grenadines GHG Mitigation Assessment Stakeholder Workshop and Training Session,* which took place February 29, 2012. The workshop was organized by the Environmental Management Department of the Ministry of Health, Wellness and the Environment, with presentations and facilitation provided by ICF Marbek. Participants included Ministry personnel, National Consultants, and other stakeholders identified by the Ministry.

The selection of measures was undertaken using criteria developed initially by ICF Marbek based on UNFCCC sources, and then refined by workshop participants. The workshop participants selected the final criteria based on what they thought important for St. Vincent and the Grenadines. The final screening criteria were as follows:

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

The first criterion (potential GHG impact) takes into account expected growth in sectoral emissions to 2025. Workshop participants also proposed that the mitigation scenarios should target "no-regrets" options, cost effective options, and implement specific technologies appropriate to St. Vincent and the Grenadines.

Using a screening matrix, workshop participants systematically applied the weighted screening criteria to the long list of candidate measures. The result of this process was a priority list of 14 measures addressing emissions in all priority sectors. By combining similar measures, the final result was a list of 9 measures that was accepted by the Environmental Management Department as the basis for Mitigation Scenario #1. These measures are presented in Section 6 of this report.

An additional 3 measures were accepted for Mitigation Scenario #2. These measures attracted considerable support at the workshop and appeared to offer significant potential for further emission reduction. The additional measures are also presented in Section 6.

Note that upon further analysis, one of the additional measures (Encourage use of methane from farm waste for energy) was deemed to be unfeasible. For biogas to be a viable option, there needs to be a sufficient animal population within a central area. There is not one large farm on St. Vincent that houses a significant portion of the total pig population, nor is there a centralized location for multiple, independent pig farms. Therefore, to ensure sufficient feedstock for the biogas plant, manure would need to be transported to a centrally located biogas plant, making it unrealistic for implementation as well as reducing the potential impact of this measure (e.g., increased emissions due to transport). Another popular measure from the screening exercise (Source reduction program for waste across all sectors) was selected and accepted by the Environmental Management Department as a replacement measure. This means that there were no measures included in the final scenarios that were in the agricultural sector.

3.2.3 Step 2: Analysis of the Individual Measures

The selected mitigation measures were first analysed individually to determine their standalone impacts, and then analysed together to determine their combined impacts. The analysis of individual impacts is described in this Step 2; the analysis of combined impacts of the measures included in Scenarios #1 and #2 is described in Step 3 below.

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. In turn, these two variables each depend on other factors. For instance, technical potential for an equipment replacement program will depend on the emissions profile of the old and the new equipment, how much the equipment is used, how the electricity powering the equipment is generated, and other factors. Similarly, penetration rate will depend on program design, consumer behaviour, and other factors.

Due to data limitations, a full analysis of all these factors was well beyond the available resources for this project. Relevant data was provided by the National Consultants where available. In other cases indicative international reference data was available within LEAP, or other international "rules of thumb" were used. In still other cases assumptions were made based on the professional judgement of the consultant team and the Ministry of Health, Wellness and the Environment.

These data assumptions are presented in Section 4. Based on these assumptions, the estimated GHG impacts of each individual measure were analysed using the LEAP model. These results are presented in Section 6.

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

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

It is important to recognize that 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.

The key output of this Step 3 analysis was the estimated emission reductions that would be generated by the two Mitigation Scenarios, relative to the Baseline Scenario. These results are presented in Section 6.

3.3 Training

There were two training mechanisms used throughout this project to help build local capacity. First, several of the workplan research tasks were assigned to the National Consultants. The work of the National Consultants made an important direct contribution to the Mitigation Assessment, but it also provided a mechanism for the National Consultants to learn by doing. Second, the project included two targeted training sessions for National Consultants.

Workshop and Training Session #1 took place early on in the project, and began with a general introduction, but otherwise focused primarily on preparation of the Baseline Scenario. The training included an introduction to (and high level training of) the LEAP model. The session was one day and concluded with the participants undertaking data collection assignments required in support of the Baseline Scenario. Stakeholder Workshop and Training Session #2 had two objectives: (i) presentation and review of the Baseline Scenario; and (ii) identification and screening of mitigation options. The session was one day and concluded with participants undertaking data collection assignments in support of the mitigation scenario.

To ensure efficient use of resources, the training used existing UNFCCC training materials to the maximum degree possible. Copies of the slide decks and training materials used at the two training sessions were provided to the participants and to the Ministry of Health, Wellness and the Environment. The training sessions were organized by the Ministry and led by ICF Marbek.

4 Data

4.1 Data Collection and Sources

Data collection is a crucial activity that requires the participation of a large number of organizations and government departments. 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.

Sources of data included:

- Official government publications,
- Directly from government agencies, energy utilities/suppliers, and others, and
- Informed estimates with assistance from agencies, utilities, and others.

For all of these inputs, National Consultants, engaged by the Ministry of Health, Wellness and the Environment, were responsible for obtaining the data required for the Mitigation Assessment, based on guidance provided by the ICF Marbek team. Where local data or credible estimates were unavailable, default (international) inputs were used where possible. In addition, ICF Marbek met directly with several agencies to obtain available data, including:

- VINLEC regarding current generation, end-use demand and future projects.
- Ministry of Agriculture, Forestry and Fisheries regarding land use data and timber harvesting.
- Customs and Excise regarding current vehicle stock, equipment containing HFCs, and clarification on diesel import data.

4.2 Data Limitations and Key Assumptions

There were a number of data limitations encountered in this process that ultimately affect the accuracy of the sector and end-use energy demand and GHG emission projections and, to some extent, the base year GHG emissions as well. Some of the key data limitations, impact, and subsequent assumptions are highlighted in Exhibit 7 below. Data sources and assumptions are further detailed by sector in Section 5.

As noted, percent 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%.[4]

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

Exhibit 7 Key Data Limitations, 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 St. 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 following sectors: residential, commercial. Population growth/decline was also used to project changes 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 projections.	To remain consistent, the assumptions used to estimate 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 is 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, LUCF emissions/sinks have not been estimated in the Baseline Scenario. This is quantitatively equivalent to an assumption that there will be no net LUCF emissions or removals. It can be expected that the 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.

[5] International Monetary Fund, *St. Vincent and the Grenadines: Statistical Appendix*, April 2009 [IMF Country Report No. 09/119] (http://www.imf.org/external/pubs/ft/scr/2009/cr09119.pdf - date accessed: February 2012).

5 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. Each of these were further broken down, as required. For example, Energy comprised the following end-use sectors: energy industries; manufacturing and construction; transport; international bunkers; commercial and institutional; and residential.

For the Mitigation Assessment, sectoral key assumptions and emission results are presented by *economic* sector. The brackets indicate the associated sector(s) in the GHG inventory.

- Residential (Energy)
- Industry (Energy; Industrial Processes; Solvents)
- Commercial and Tourism (Energy)
- Agriculture, Forestry and Fishing (Agriculture; LUCF)
- Transport (Energy)
- Waste (Waste)

The Baseline Scenario is presented below by economic sector. A summary of the baseline is also provided at the end of this section. Additional data can be found in Appendix B.

5.1 Residential

5.1.1 Current Allocation of Emissions and Energy Use

The residential sector includes emissions from energy sources, including electricity, LPG, and charcoal[6]. Key assumptions used to determine overall emissions and energy demand in the residential sector between 2004 and 2010 and allocate them to sector end-uses are reported in Exhibit 8.

Exhibit 8 Key Assumptions and Data Sources for Allocating Energy Demand and Emissions in the Residential 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% of the total imported LPG and 100% of the charcoal.
Total Indirect Household Energy Use (i.e., electricity)	Total electricity generation provided by VINLEC. IMF Country Report No. 09/119[7] 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.

[6] CO_2 emissions are not included for emissions from charcoal combustion. Note that 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 are included in the total emissions.

[7] International Monetary Fund, *St. Vincent and the Grenadines: Statistical Appendix*, April 2009 [IMF Country Report No. 09/119] (http://www.imf.org/external/pubs/ft/scr/2009/cr09119.pdf - date accessed: February 2012).

5.1.2 Sector Growth Rate from 2010 to 2025

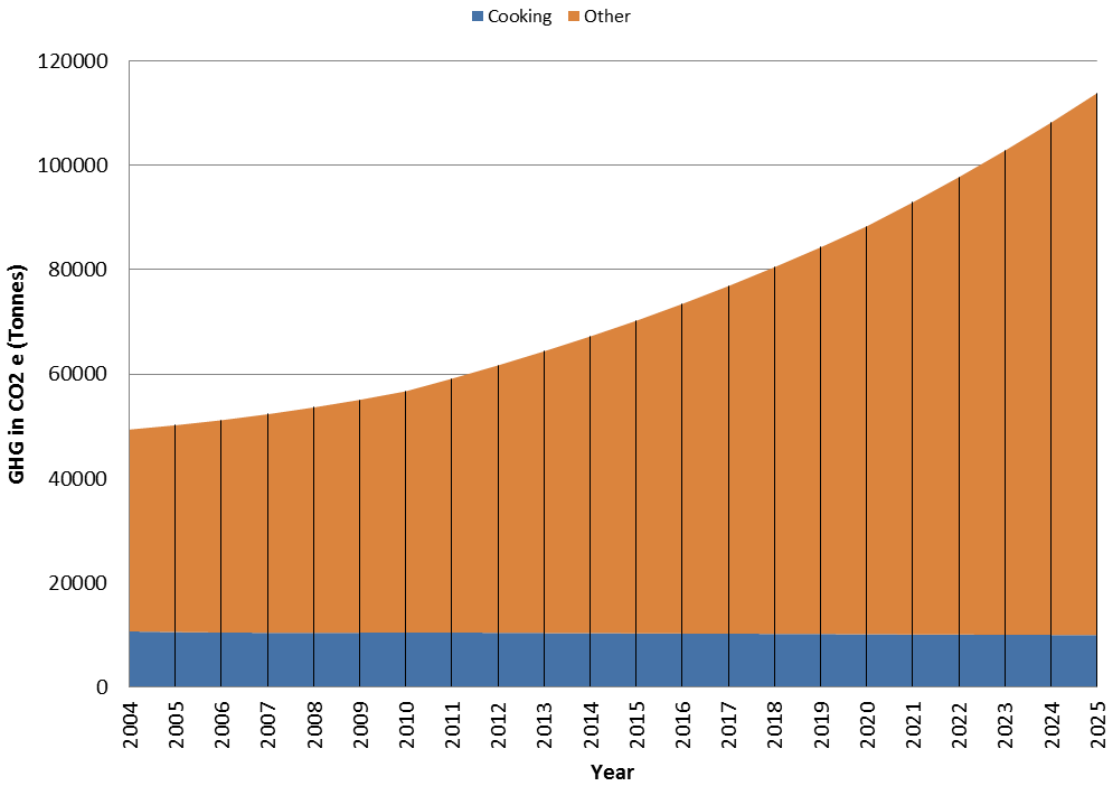
No forecasts were available to project how the residential sector might fare in the future. However, as stated in the *Energy Action Plan for St. Vincent and the Grenadines*, the electricity demand has grown annually by 5.4% in the residential sector between 1998 and 2007. Energy demand in the residential sector has increased despite a decline in population. This is likely due to greater energy intensity per household. It is assumed that the growth rate for electricity demand will continue at 5.4% per year until 2025.

The majority of emissions from the residential sector are attributable to electricity consumption; however, growth in the other fuels in use in the residential sector (LPG and charcoal) also needs to be accounted for. Given that there was no forecast data available for these fuels, it is assumed that consumption of LPG and charcoal follow the trend in population. Therefore, LPG and charcoal use are assumed to decline at 0.34% per year until 2025.

5.1.3 Baseline Residential GHG Emissions

Baseline GHG emissions in the residential sector are expected to rise 101% from 56,730 tonnes in 2010 to 113,801 tonnes in 2025, as shown in Exhibit 9. Exhibit 9 presents two end use categories: Cooking (including LPG and charcoal cooking, but excluding electric cooking); and Other (including LPG for domestic hot water heating and electricity for all other end uses, primarily air conditioning, lighting, refrigeration, and electric cooking). The Cooking end use accounts for 9% of emissions in 2025 and the Other end use, which as noted depends entirely on electricity except for LPG domestic hot water, accounts for 91% of emissions in 2025.

Exhibit 9 Residential Sector GHG Emissions (t CO_2e)



5.2 Industry

5.2.1 Current Allocation of Emissions and Energy-Use

The industry sector includes emissions from energy sources, including electricity used in industrial processes and diesel consumption from manufacturing and construction. It also includes 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 energy industry. Key assumptions used to determine overall emissions and energy demand in the industrial sector between 2004 and 2010 and allocate them to sector end-uses are reported in Exhibit 10.

Exhibit 10 Key Assumptions and Data Sources 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% 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%. 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% of flour was used for cakes and 95% 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.

5.2.2 Sector Growth Rate from 2010 to 2025

No forecasts were available to project how the industrial sector might fare in the future. However, as stated in the *Energy Action Plan for St. Vincent and the Grenadines*, the electricity demand grew by 1.1% annually in the industrial sector between 1998 and 2007. It is assumed that this annual growth in electricity demand will continue to 2025.

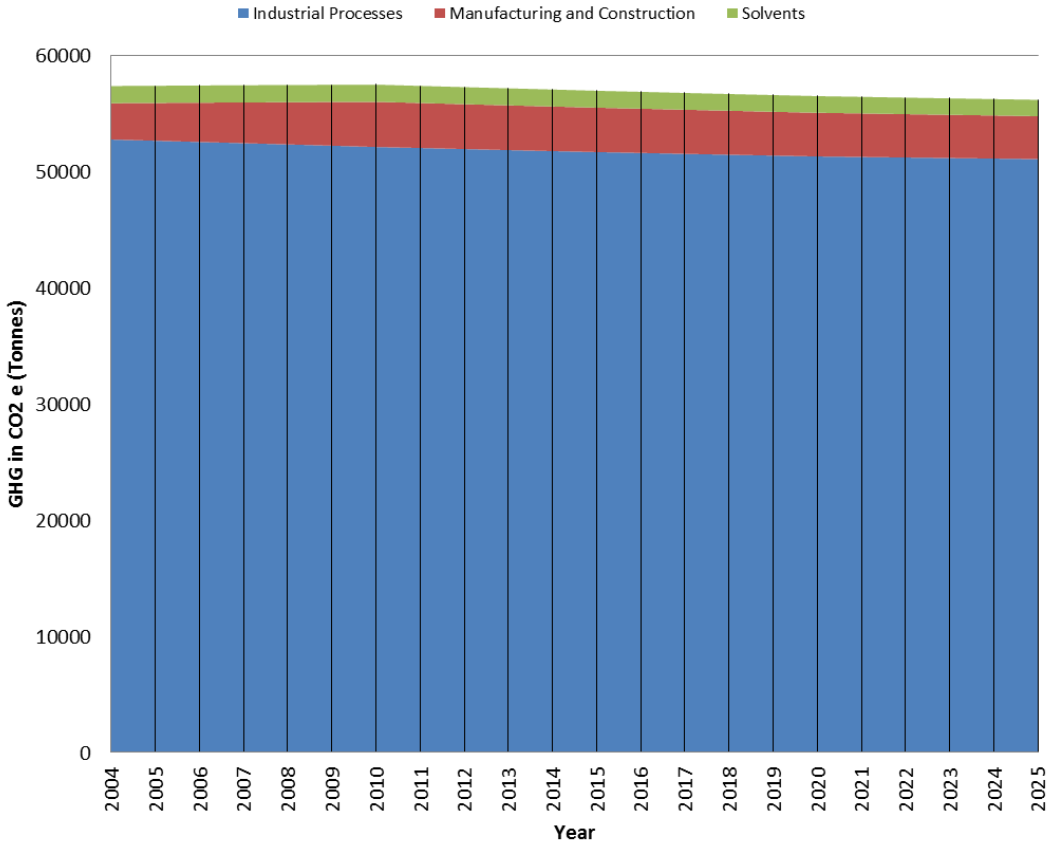
Electricity consumption plays a relatively minor role in total industrial emissions. The larger contributors in this sector are the non-energy sources (e.g., NMVOCs from road paving and from food and beverage manufacturing, and HFCs from consumption of halocarbons). Given that there was no forecast data for these non-energy sources as well as use of lubricants, NMVOCs and N_2O from solvent use, it is assumed that emissions from these sources follow the trend in population. Therefore, non-energy industrial sources are assumed to decline at 0.34% per year until 2025.

The second largest contributor to industrial emissions is diesel use. There was no forecast data for the diesel use in industry, therefore diesel consumption is assumed to decline at 0.34% per year until 2025, following the trend in population.

5.2.3 Baseline Industrial GHG Emissions

Baseline GHG emissions in the industrial sector are expected to decrease 2% from 57,494 tonnes in 2010 to 56,182 tonnes in 2025, as shown in Exhibit 11. Industrial Processes are the largest contributor to emissions in this sector (91% 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 is the second largest contributor (7% in 2025). NMVOC and N_2O emissions from solvent use are the smallest contributor (at 2% in 2025) to total industrial GHG emissions and comprise the consumption of solvents by industry. Note that minor residential solvent use has not been separated out, but is included here.

Exhibit 11 Industry Sector GHG Emissions (t CO_2e)



5.3 Commercial and Tourism

5.3.1 Current Allocation of Emissions and Energy-Use

The commercial and tourism sector includes emissions from energy sources, including electricity and LPG. Key assumptions used to determine overall emissions and energy demand in the commercial and tourism sector between 2004 and 2010 and allocate them to sector end-uses are reported in Exhibit 12.

Exhibit 12 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% 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.

5.3.2 Sector Growth Rate from 2010 to 2025

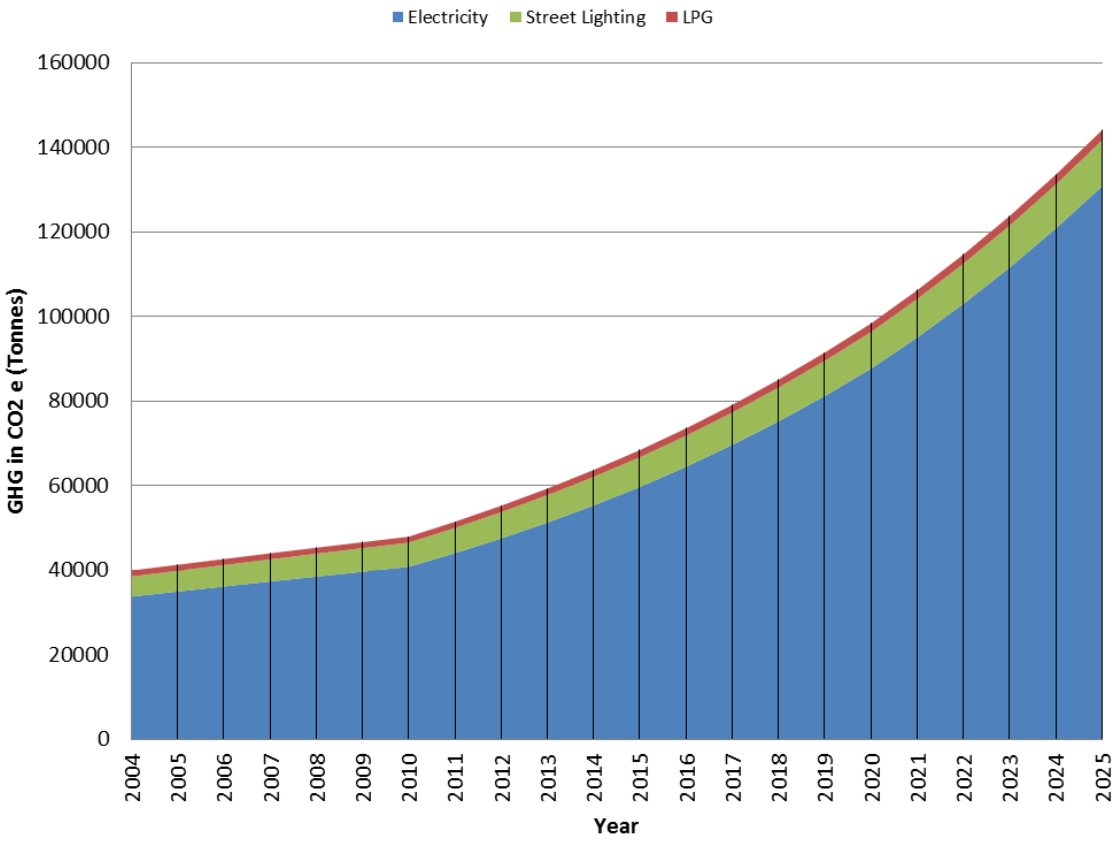
No forecasts were available to project how the commercial and tourism sector might fare in the future. However, as stated in the *Energy Action Plan for St. Vincent and the Grenadines*, the electricity demand has grown annually by 7.7% in the commercial sector between 1998 and 2007. It is assumed that this annual growth rate for electricity demand will continue to 2025. Similarly, the *Energy Action Plan for St. Vincent and the Grenadines* states that the annual growth, between 1998 and 2007 for street lighting, has been 4%. This was also applied to project electricity demand for street lighting out to 2025.

The majority of emissions from the commercial and tourism sector are attributable to electricity consumption; however, growth in the other fuel in use in the commercial and tourism sector (LPG) also needs to be accounted for. The Ministry of Tourism and Physical Planning provided an estimated increase in tourist visitations of 3.66%, corresponding to the construction of the new international airport. It is assumed that with increased visitors comes increased use of LPG for cooking and domestic hot water. Therefore, 3.66% is assumed to be the projected annual growth in LPG use out to 2025.

5.3.3 Baseline Commercial and Tourism Sector GHG Emissions

Baseline GHG emissions in the commercial and tourism sector are expected to rise 201% from 47,937 tonnes in 2010 to 144,101 tonnes in 2025, as shown in Exhibit 13. Electricity demand end-uses, such as air conditioning, lighting, refrigeration, and cooking, account for a majority of total energy demand (91% in 2025) and drive the large expected increase. Street lighting and LPG end uses make up the remainder, contributing 7% and 2%, respectively to total emissions in 2025.

Exhibit 13 Commercial and Tourism Sector GHG Emissions (t CO_2e)



5.4 Agriculture, Forestry and Fishing

5.4.1 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. In the absence of land-use area and forest land-use data 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. Key assumptions used to determine the historical growth rate in the agriculture, forestry and fishing sectors between 2004 and 2010 and allocate them to sector end-uses are reported in Exhibit 14.

Exhibit 14 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 for 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).

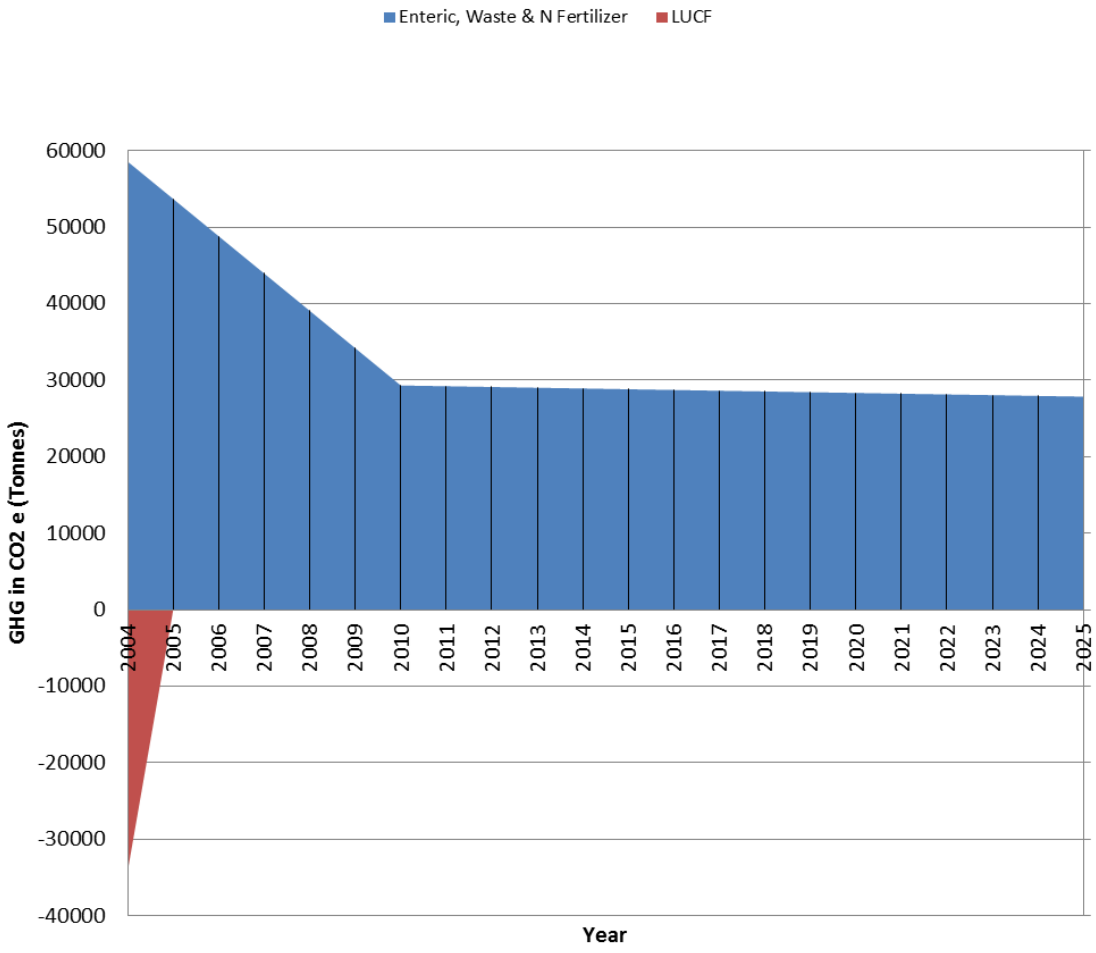
5.4.2 Sector Growth Rate from 2010 to 2025

The total yield and value of crop production has increased and decreased year to year between 2006 and 2010. Compared to other sectors, the agricultural sector is more vulnerable to external factors such as severe weather events and pest infestations. As such, it is more difficult to establish a growth trend in this sector. No forecasts were available to project how the agricultural, forestry and fishing sectors might fare in the future. In the absence of data, it is assumed that these sectors will decline with population, at a rate of 0.34% per year. As with the 2005 to 2010 period, due to lack of data, projections to 2025 were not made for land use change and forestry.

5.4.3 Baseline Agriculture, Forestry and Fishing Sector GHG Emissions

Baseline GHG emissions in the agriculture, forestry and fishing sector are expected to decrease 5% from 29,319 tonnes in 2010 to 27,859 tonnes in 2025, as shown in Exhibit 15. Emissions are generally dominated by enteric fermentation, manure waste management, and the application of nitrogen fertilizer in the agriculture sector. In the 2004 inventory, it was determined that LUCF was a sink. However, as noted above, in the absence of land-use area and forest land-use data for a current/recent year, LUCF emissions have not been estimated. Because of this, emissions from enteric fermentation, manure waste management, and the application of nitrogen fertilizer make up 100% of the emissions in 2025.

Exhibit 15 Agriculture, Forestry and Fishing Sector GHG Emissions (t CO_2e)



5.5 Transport

5.5.1 Current Allocation of Emissions and Energy-Use

The transport sector includes emissions from energy sources, including gasoline, diesel, and avgas plus lubricants (used domestically). Key assumptions used to determine overall emissions and energy demand in the transport sector between 2004 and 2010 and allocate them to sector end-uses are reported in Exhibit 16.

Exhibit 16 Key Assumptions and Data Sources for Allocating Energy Demand and Emissions in the Transport Sector

Data Variable	Assumption / Data Source
Number and Type 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% 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% 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% of lubricants imported to St Vincent are assumed to be used in the transport sector and are included along with the avgas energy use.

5.5.2 Sector Growth Rate from 2010 to 2025

Although the number of vehicles imported annually is not growing quickly, the road transport sector has seen a fast growing demand for fuels, indicating that there are 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).

Based on the projected growth rates from the *Energy Action Plan for St. Vincent and the Grenadines*, a 15% annual growth rate for gasoline consumption (assumed to be passenger vehicles) and a 10% annual growth rate for diesel consumption (assumed to be freight vehicles) are assumed for the years 2010 to 2014 (inclusive). In 2015, this growth rate is assumed to decrease by half; therefore in 2015, the gasoline consumption increases by 7.5% and the diesel consumption increases by 5%. It is assumed that by the beginning of 2016, a saturation in the number of vehicles is reached. 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 fleetwide performance from jurisdictions where vehicles are imported. Based on recent corporate average fuel efficiency (CAFE) standards passed into law in the US[8], the fleetwide 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 year between 2010 and 2016. By 2016, the US vehicle fleet fuel efficiency is expected to improve up to 4% annually. As a result the baseline assumes, from 2010 to 2015, an annual decrease in fuel consumption of the sector of 2%, rising to 4% for 2016 to 2025.

[8] United States, Energy Independence and Security Act of 2007

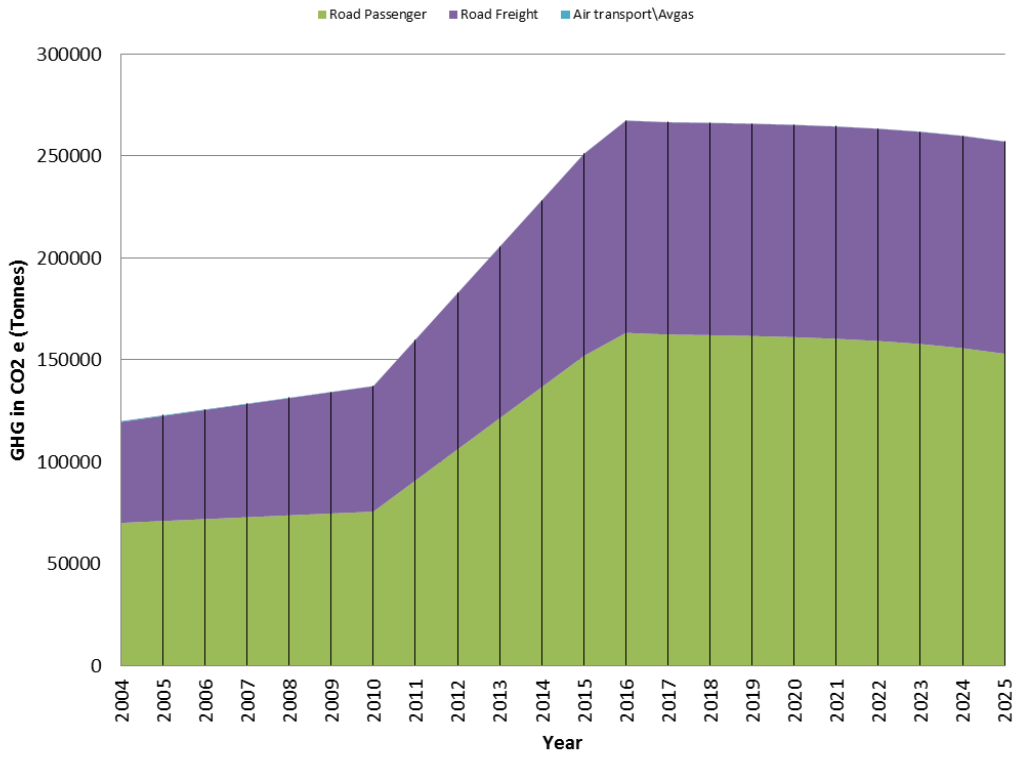
The Ministry of Tourism and Physical Planning provided an estimated increase in tourist visitations of 3.66%, as a result of the increased traffic at the new international airport. It is assumed that domestic flights will increase at the same rate as international, in order to keep up with demand. Therefore Avgas demand in the transport sector will increase at 3.66% per year until 2025. Lubricant use is assumed to increase by 10% annually from 2010 to 2025.

5.5.3 Baseline Transport Sector GHG Emissions

Baseline GHG emissions in the transport sector are expected to rise 88% from 137,034 tonnes in 2010 to 257,029 tonnes in 2025, as shown in Exhibit 17. These emissions include only domestic transport and international travel is excluded from the estimates. Emissions from on-road passenger travel (light duty gasoline vehicles) contribute 59% to total transportation emissions in 2025. Emissions from on-road freight transportation (heavy duty diesel vehicles) make up the remainder at 41% in 2025. The contribution of avgas, used domestically, is minor and accounts for only 0.03% 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 speaking, 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. Where there are differences, are 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 St. Vincent and the Grenadines. 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 St. Vincent and the Grenadines. By attributing all imported gasoline to passenger road transportation results in a higher estimate of GHG emissions. By attributing all diesel imported for the transportation sector to road freight results in a lower estimate of GHG emissions. Without 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.

Exhibit 17 Transport Sector GHG Emissions (t CO_2e)



5.6 Waste

5.6.1 Current Allocation of Emissions and Energy-Use

The waste sector includes emissions from non-energy sources, including emissions from landfills and wastewater. Key assumptions used to determine the historical growth rate in the waste sector between 2004 and 2010 are reported in Exhibit 18.

Exhibit 18 Key Assumptions and Data Sources 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 tonnes/capita/year) was applied. Note that data used in the 2004 inventory was sourced from *Solid Waste Characterization Studies in St. 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 St. 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).

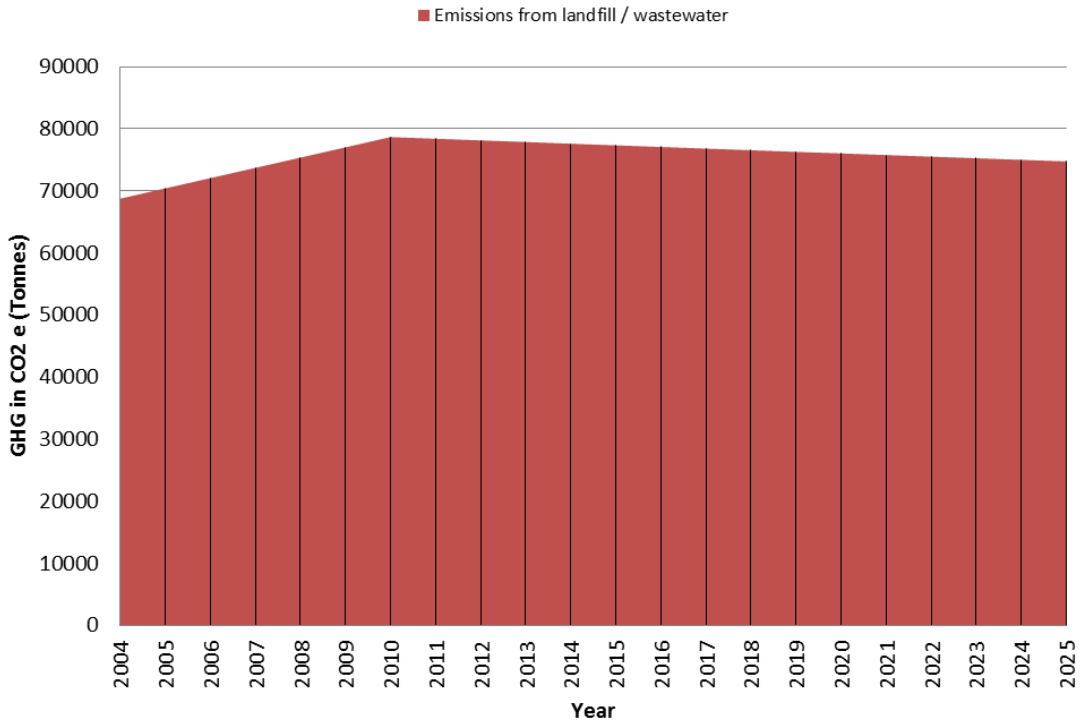
5.6.2 Sector Growth Rate from 2010 to 2025

No forecasts were available for future waste disposal rates. Because total waste disposed was determined using a tonnes per capita factor, future waste disposal data was projected based on the population projections of -0.34%. The same assumption was applied to project wastewater handling

5.6.3 Baseline Waste Sector GHG Emissions

Baseline GHG emissions in the waste sector are expected to decrease 5% from 78,685 tonnes in 2010 to 74,766 tonnes in 2025, as shown in Exhibit 19. Waste sector emissions are dominated by methane emissions from landfills. However, in addition to methane emissions, there are also nitrous oxide emissions from wastewater.[9]

Exhibit 19 Waste Sector GHG Emissions (t CO_2e)

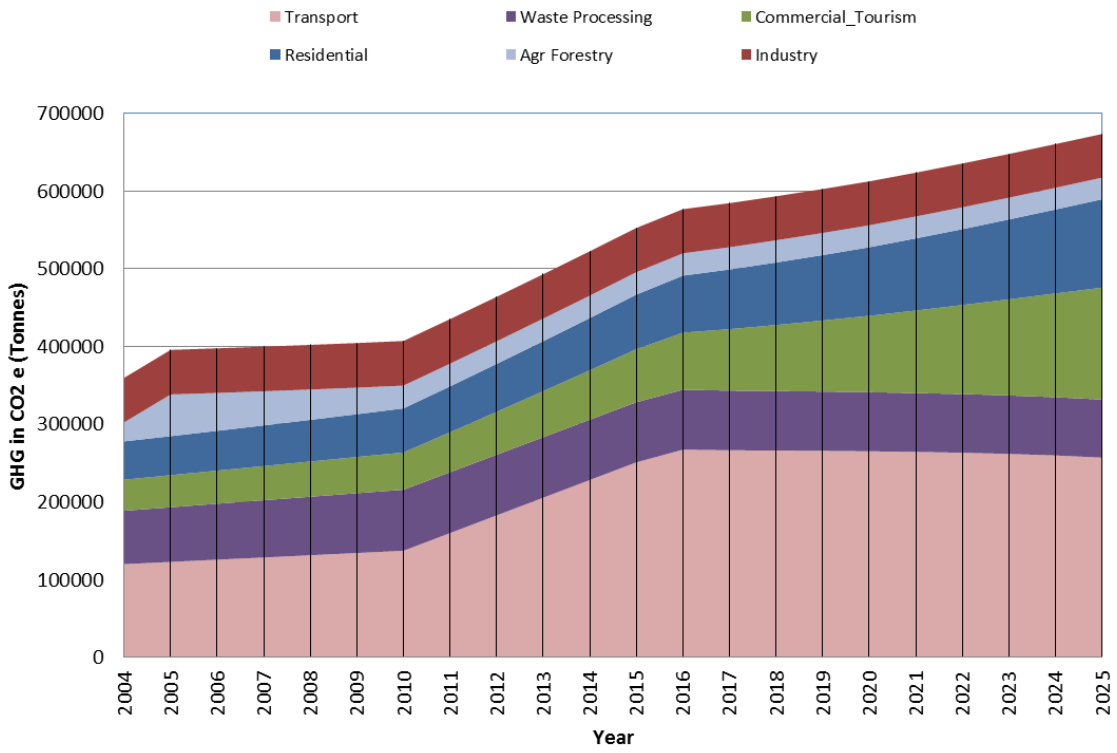


[9] These have been combined in Exhibit 19.

5.7 Summary of Baseline Emissions

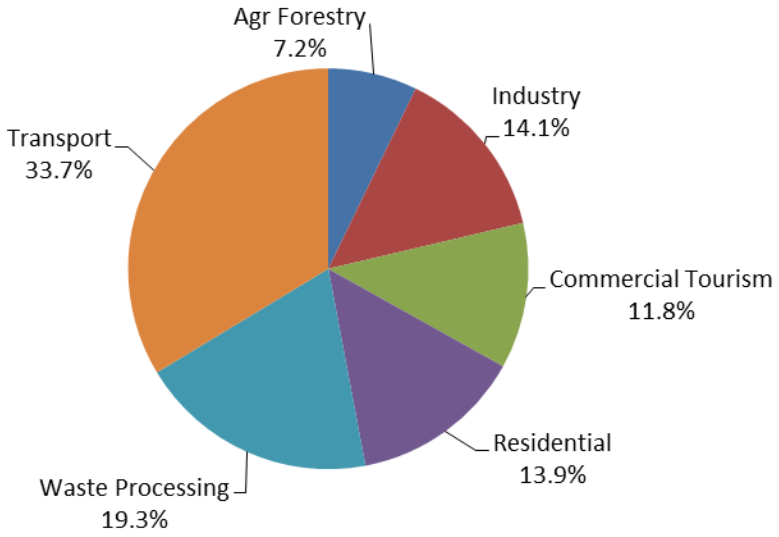
Total GHG emissions are projected to rise from 407,199 t in 2010 to 673,738 t in 2025. This is an overall 65% increase in emissions for the period between 2010 and 2025, or an average annual increase of 3.4%. Exhibit 20 indicates the relative emission shares of each of the six economic sectors. The residential, commercial and tourism, and transport sectors are all projected to have increasing emissions over the forecast time period, with the commercial sector having the fastest growing emissions. The industry, waste, and agriculture, forestry, and fishing sectors are all projected to have decreasing emissions (at a similar rate) over the forecast time period.

Exhibit 20 Total Baseline GHG Emissions by Sector (t CO_2e)



The sectoral breakdown for 2010 is presented in Exhibit 21 below. The transport sector is the largest contributor to emissions, followed by the waste sector. The third largest contributor in 2010 is the industry, followed closely by the residential sector, the commercial and tourism sector, and finally, the agriculture, forestry and fishing sector. The share of emissions for all six economic sectors in 2010 is depicted in Exhibit 21.

Exhibit 21 Sectoral Breakdown of GHG Emissions in 2010 (t CO_2e)



Looking at the sectoral breakdown in 2025, the transport sector is still the largest contributor to emissions, but this is followed by the commercial and tourism sector. It is expected that in 2025, the third largest contributor will be the residential sector, followed by waste, industry, and finally, the agriculture, forestry and fishing sector. The share of emissions for all six economic sectors in 2025 is depicted in Exhibit 22.

Exhibit 22 Sectoral Breakdown of GHG Emissions in 2025 (t CO_2e)

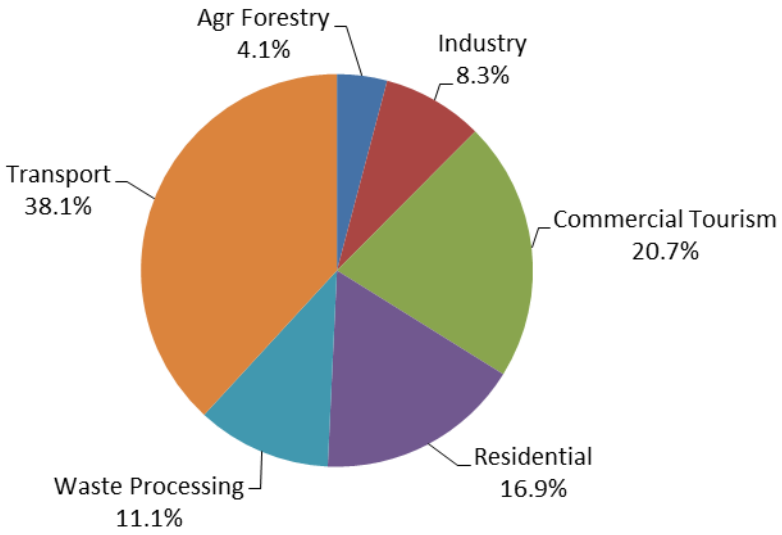


Exhibit 23 summarizes the growth decline in each sector. The commercial and tourism sector has the highest growth, followed by the residential sector. The waste and agriculture, forestry and fishing sectors show the largest decline.

Exhibit 23 Summary of Sectoral Emissions Changes

Sector	2010 GHG Emissions (t CO_2e)	2025 GHG Emissions (t CO_2e)	% Change (negative)
Residential	56,730	113,801	101%
Industry	57,494	56,182	(2%)
Commercial and Tourism	47,937	144,101	201%
Agriculture, Forestry and Fishing	29,319	27,859	(5%)
Transport	137,034	257,029	88%
Waste	78,685	74,766	(5%)

6 Mitigation Scenarios

6.1 Introduction

This section presents the two Mitigation Scenarios in the following subsections:

- Subsection 6.2 presents an overview of the measures that have been included in Mitigation Scenarios #1 and #2.
- Subsection 6.3 provides a summary of the emissions impact of Mitigation Scenario #1, for St. Vincent and the Grenadines as a whole and separately for each sector (industrial, commercial, residential, transportation, etc.).
- Subsection 6.4 provides a detailed summary of the emissions impact of each of the individual measures included in Mitigation Scenario #1.
- Subsection 6.5 provides a summary of the emissions impact of Mitigation Scenario #2, for St. Vincent and the Grenadines as a whole and separately for each sector (industrial, commercial, residential, transportation, etc.).
- Subsection 6.6 provides a detailed summary of the emissions impact of each of the individual measures included in Mitigation Scenario #2.

The presentation of the individual measures in subsections 6.4 and 6.6 uses a standard reporting format, as follows:

- Description of the measure
- Assumptions concerning the physical impact of the measure
- Additional information (if any)
- Impact of the measure on St. Vincent and the Grenadines GHG emissions
- Impact of the measure on emissions from the sectors impacted by the measure.

Section 7 presents a comparison of the impact of the Mitigation Scenarios, and additional analysis of the results.

6.2 Description of the Mitigation Scenarios

This subsection presents the measures included in Mitigation Scenarios #1 and #2.

Exhibit 24 presents the measures included in Mitigation Scenario #1. These measures are also included in Mitigation Scenario #2, along with the additional measures presented in Exhibit 25.

Exhibit 24 Measures Included in Mitigation Scenario #1

#	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		
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 in relevant areas.	No

Exhibit 25 Measures Included in Mitigation Scenario #2

#	Measure	Description	Modelled?
	ADDITIONAL MEASURES FOR SCENARIO #2		
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

As noted in Exhibit 24 and Exhibit 25 there were a few measures that were not modelled. Following are the reasons for this:

- 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.

6.3 Summary – Mitigation Scenario #1

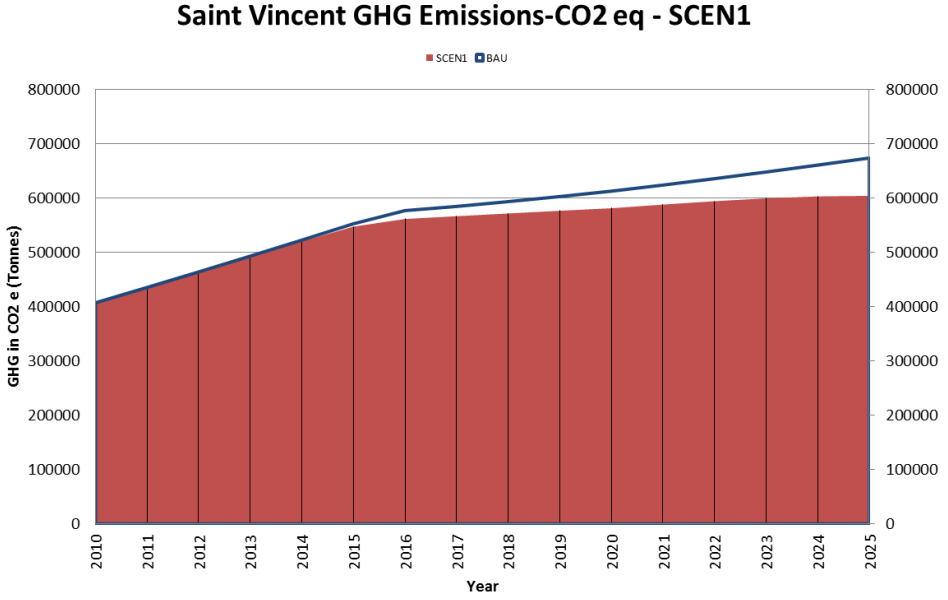
This subsection presents a summary of the emissions impact of Mitigation Scenario #1 relative to the Baseline Scenario (BAU), for the period to 2025. The summary includes results for St. Vincent and the Grenadines as a whole, together with results by sector.

Results for the individual measures included in Mitigation Scenario #1 are presented in subsection 6.4.

MITIGATION SCENARIO #1

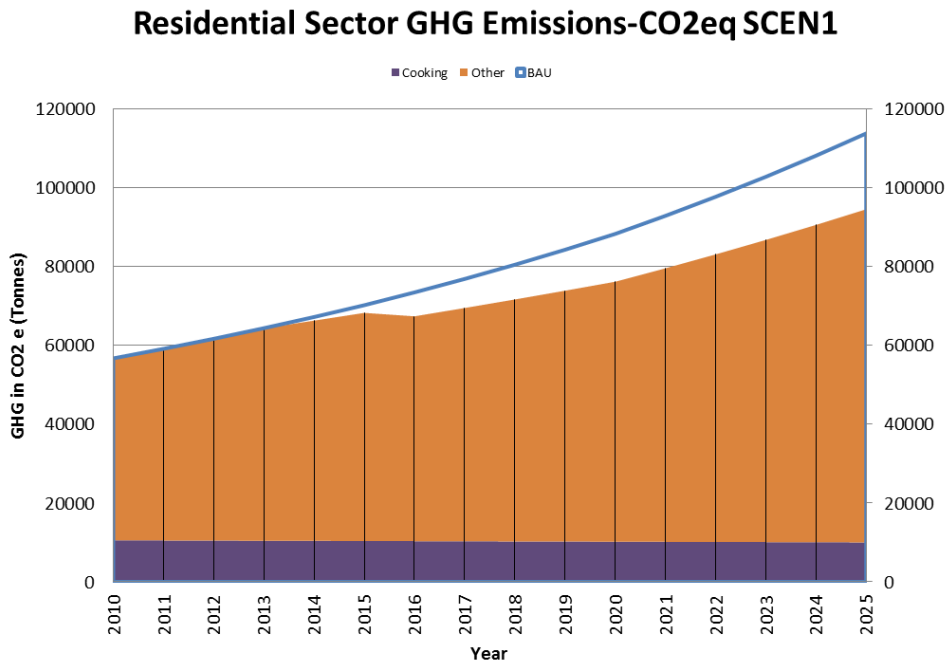
Impact of scenario on overall St. Vincent and the Grenadines GHG emissions

- 10% reduction in overall emissions relative to baseline by 2025



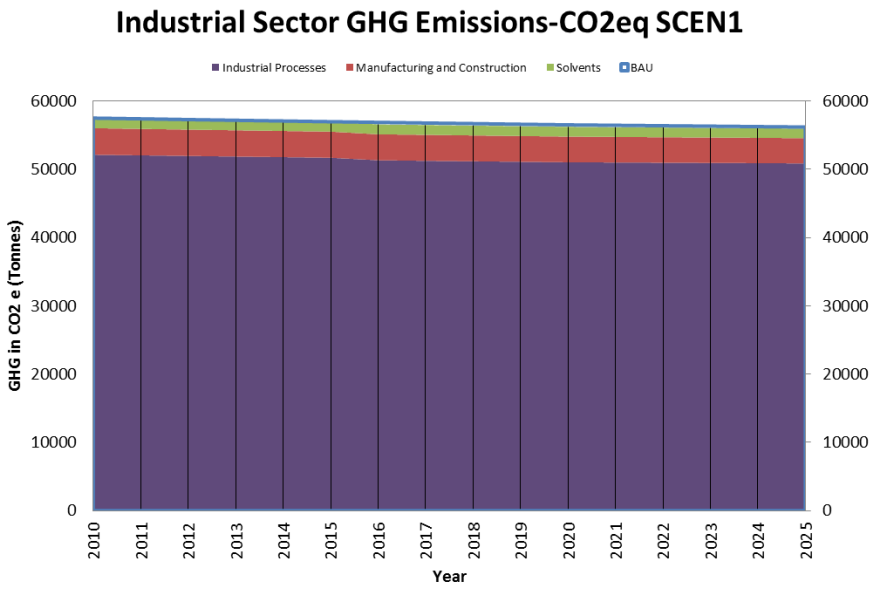
Impact of scenario on sectoral GHG emissions

- 17% reduction in Residential Sector emissions relative to baseline by 2025

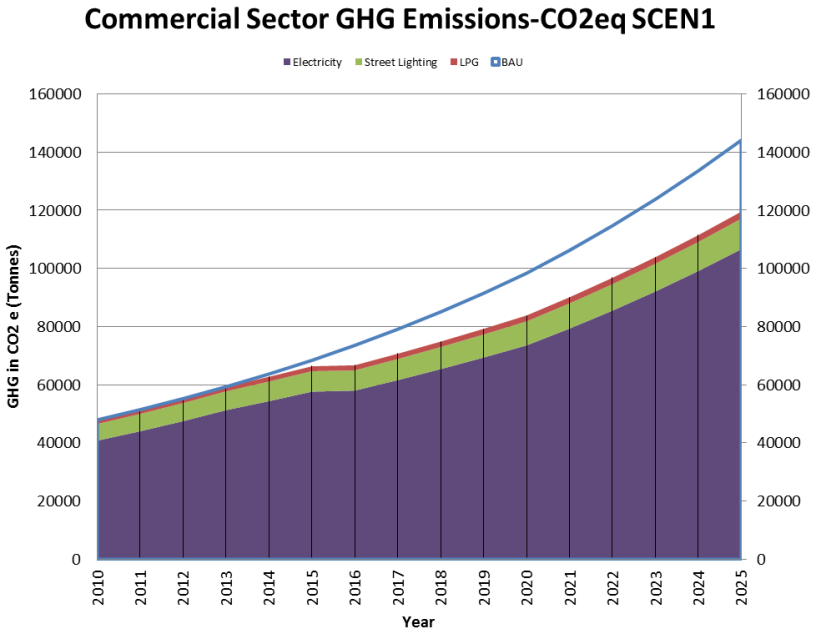


MITIGATION SCENARIO #1

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

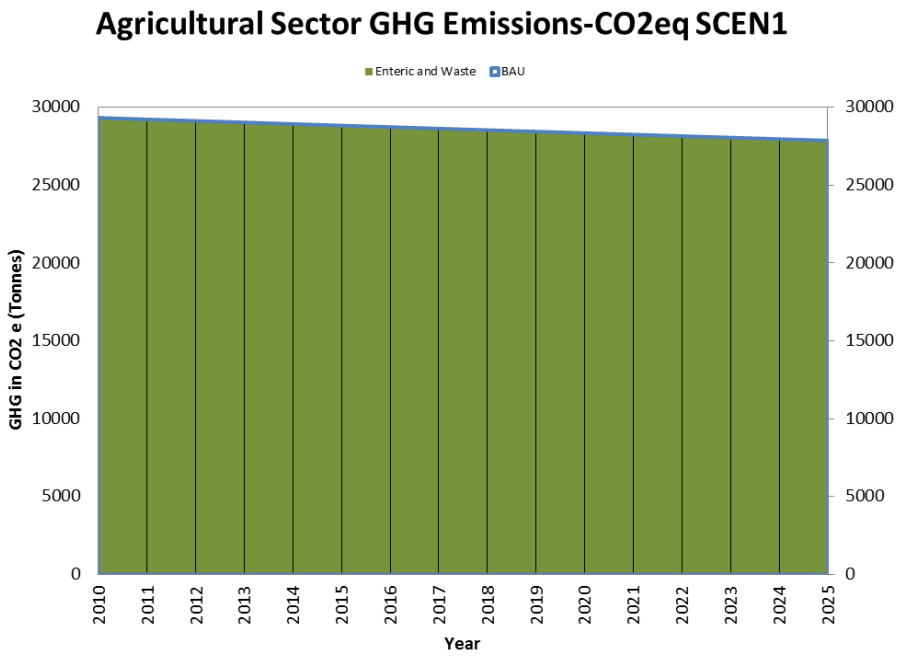


- 17% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025

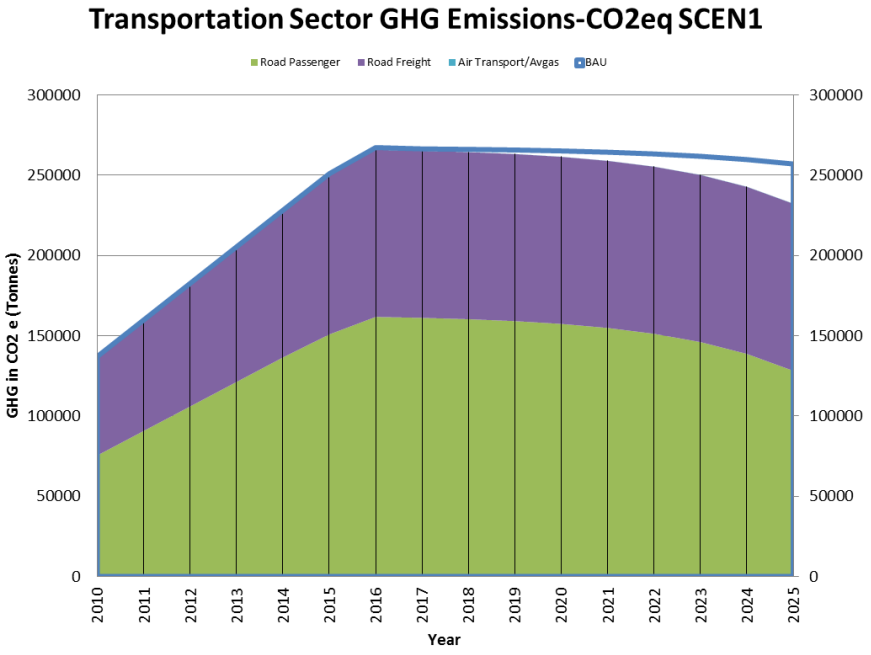


MITIGATION SCENARIO #1

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

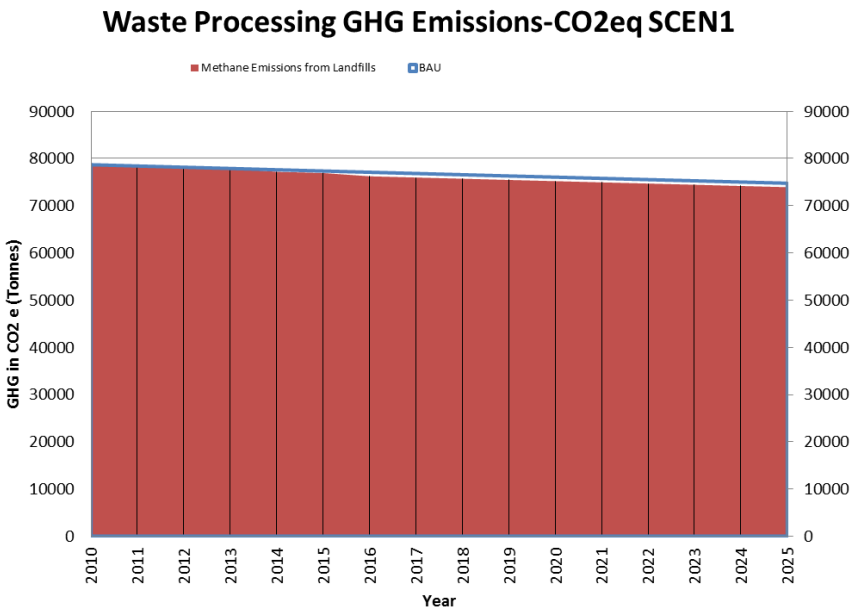


- 10% reduction in Transport Sector emissions relative to baseline by 2025



MITIGATION SCENARIO #1

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



6.4 Details by Measure – Mitigation Scenario #1

This subsection provides a detailed summary of the emissions impact of each of the individual measures included in Mitigation Scenario #1, organized in a standard 1-2 page presentation for each measure. Specifically, for each measure the summary provides a description; assumptions concerning the physical impact of the measure; the impact of the measure on St. 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.

Please note that 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, although the consulting team believes the assumptions made are reasonable and offer a plausible characterization of each of the proposed mitigation measures, the results presented here should be considered indicative rather than definitive.

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% in each year starting in 2014, then 15% 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 year, in addition to any improvements generated by Measure #2 (efficient equipment and appliances). This figure rises to 3% in 2020.

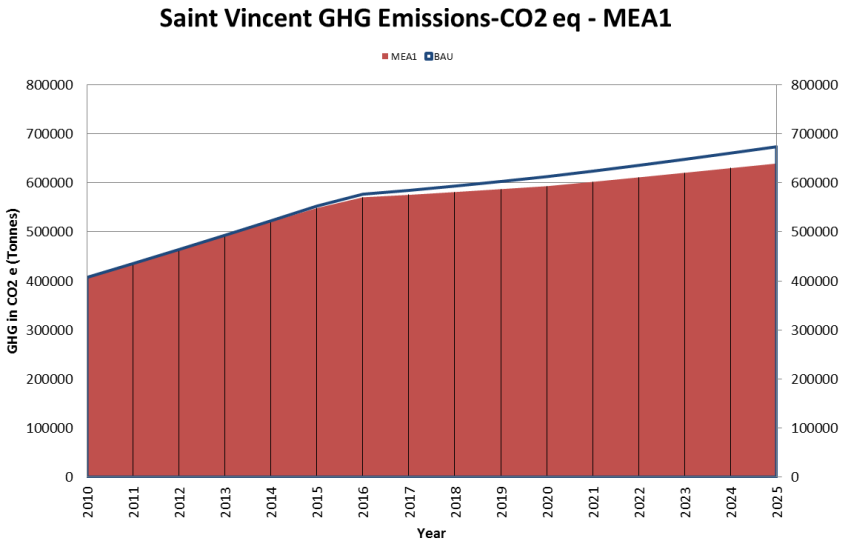
Additional Information

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

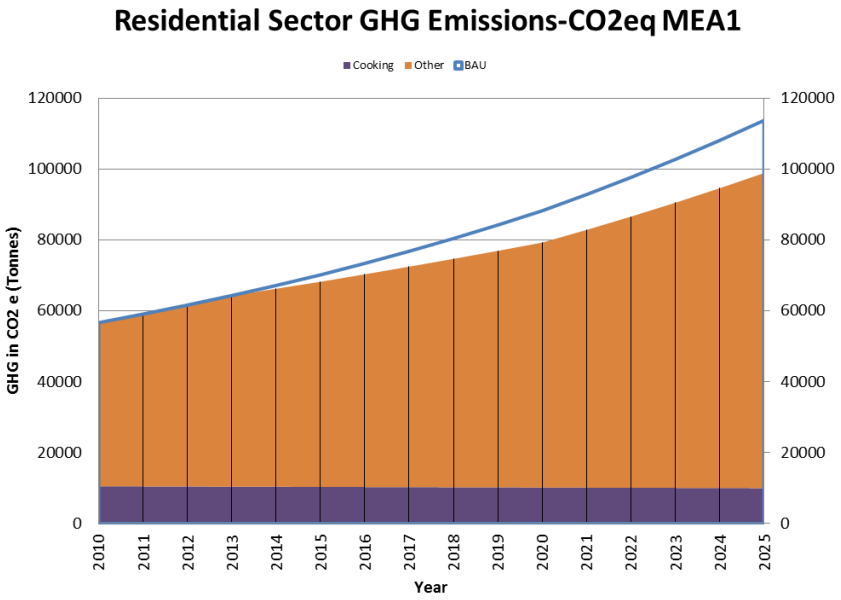
- 5% reduction in overall emissions relative to baseline by 2025



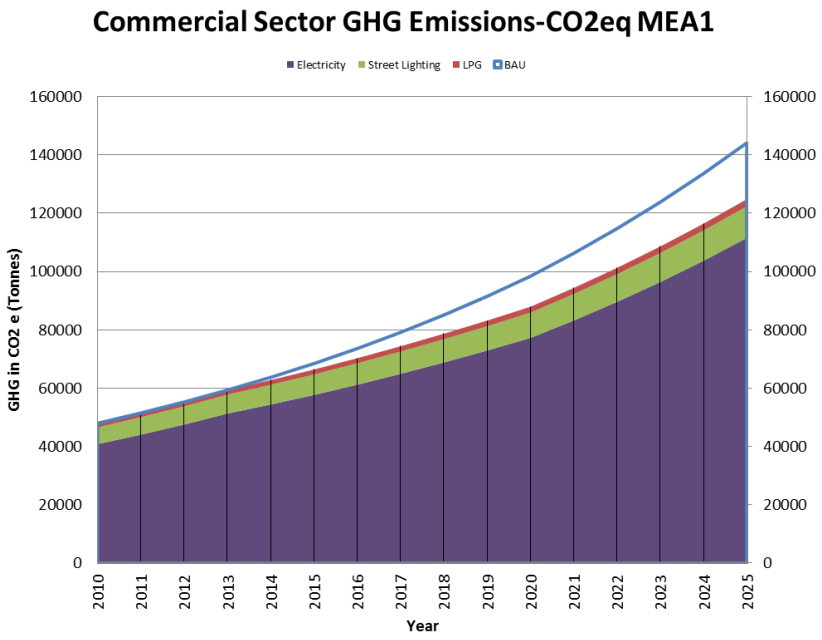
RESULTS: Impact of measure #1 on sectoral GHG emissions

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
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).

Assumptions

This measure would take effect in 2013. It is assumed that by 2025, 25% 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% to 25%).

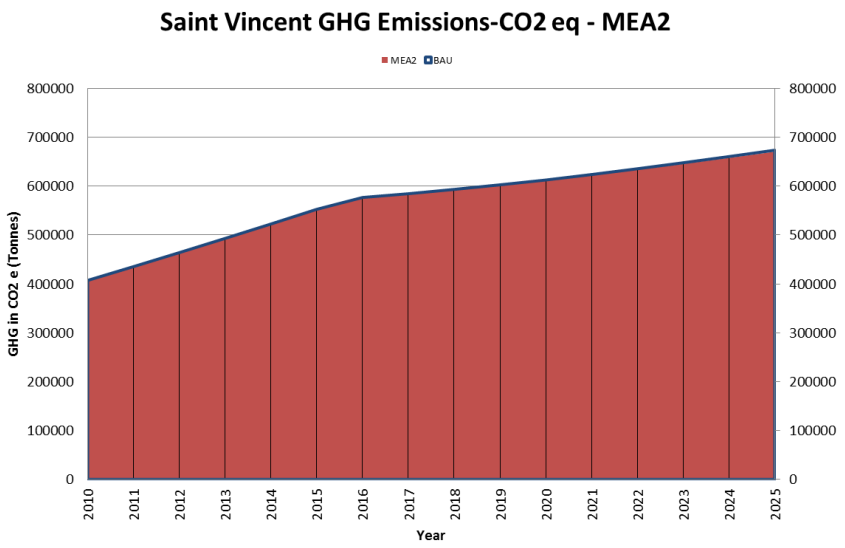
Additional Information

The following is the modelled energy consumption by efficient equipment compared to standard equipment: air conditioning (86%); and refrigeration (80%).

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

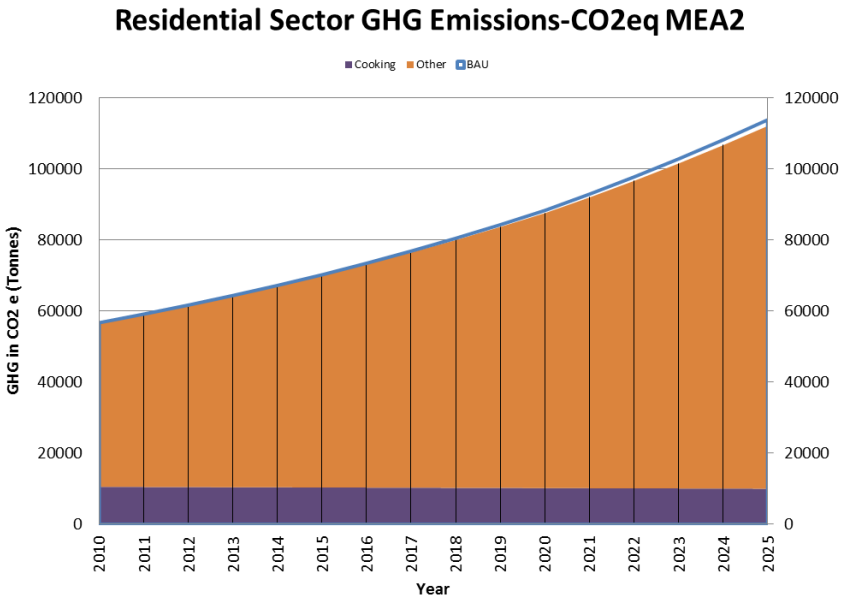
- 0.5% reduction in overall emissions relative to baseline by 2025



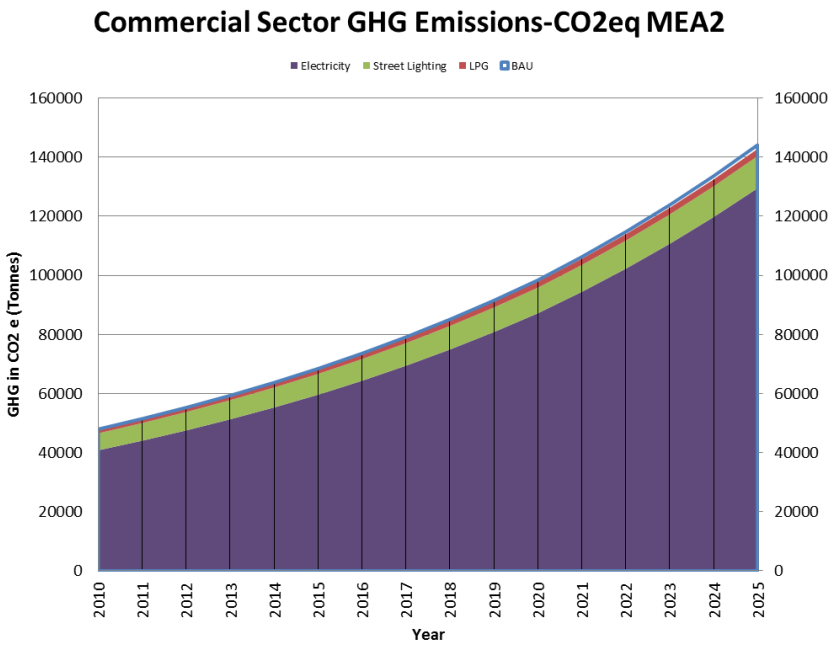
RESULTS: Impact of measure #2 on sectoral GHG emissions

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
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 St. Vincent and the Grenadines. This measure does not affect the number of vehicles or the annual average kilometers 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%. In addition, annual vehicle turnover is assumed to be 3% beginning in 2016.

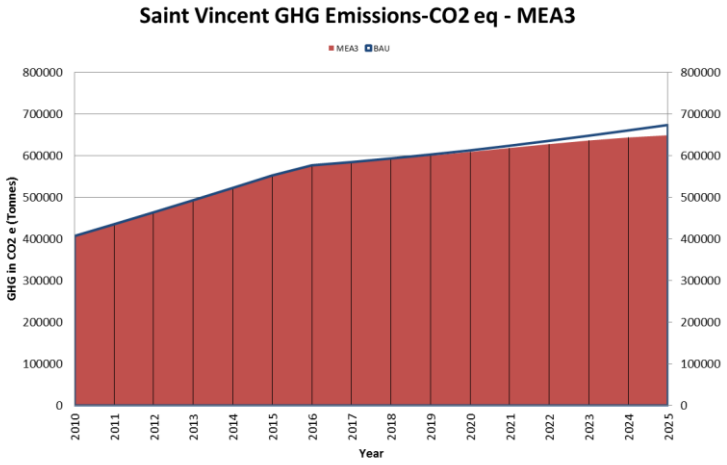
Additional Information

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.

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

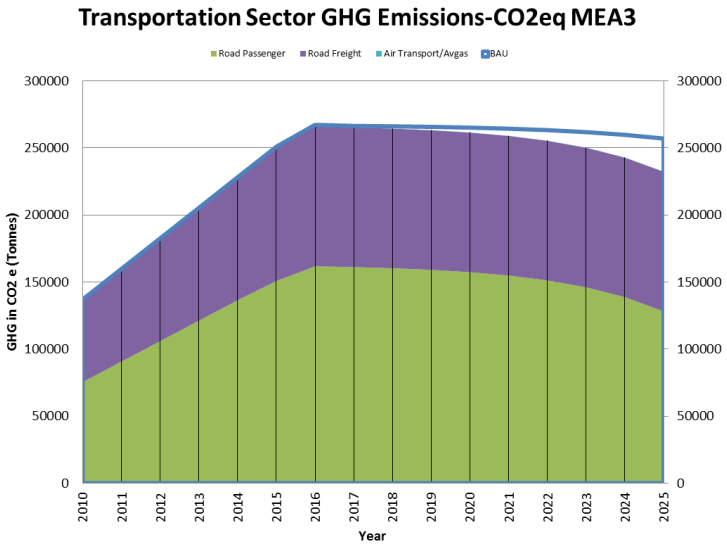
- 4% reduction in overall emissions relative to baseline by 2025



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
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 St. 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 St. 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 not modelled separately.

Additional Information

None

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
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
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 modelled 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% of organic waste from the commercial sector in 2014, rising to 40% diversion in 2016.

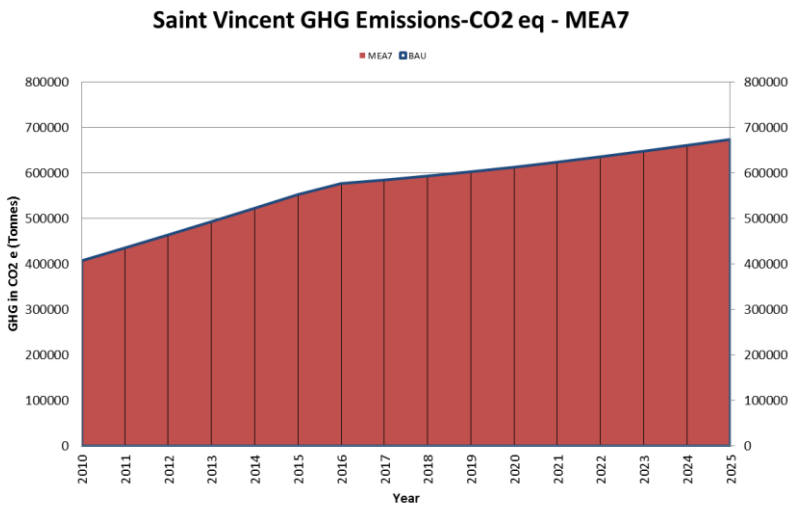
Additional Information

It is assumed that only the commercial and residential sectors contribute degradable waste to the landfills. The commercial sector accounts for 20% of the total waste generated by St. Vincent and the Grenadines, but only 15% of the degradable waste that is producing emissions. Of this 15%, 19% 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

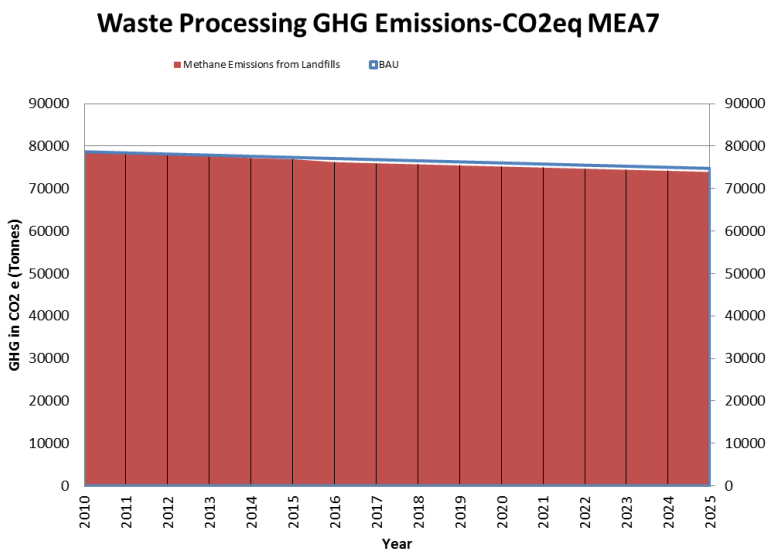
- 0.1% reduction in overall emissions relative to baseline by 2025



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
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 modelling 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%.

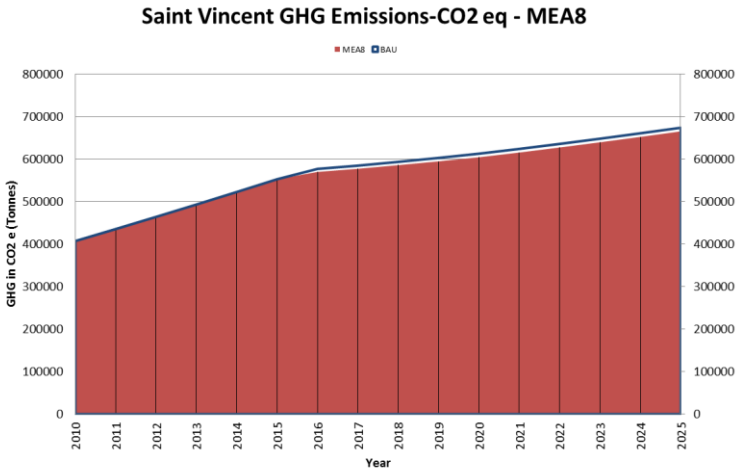
Additional Information

Hydro power 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

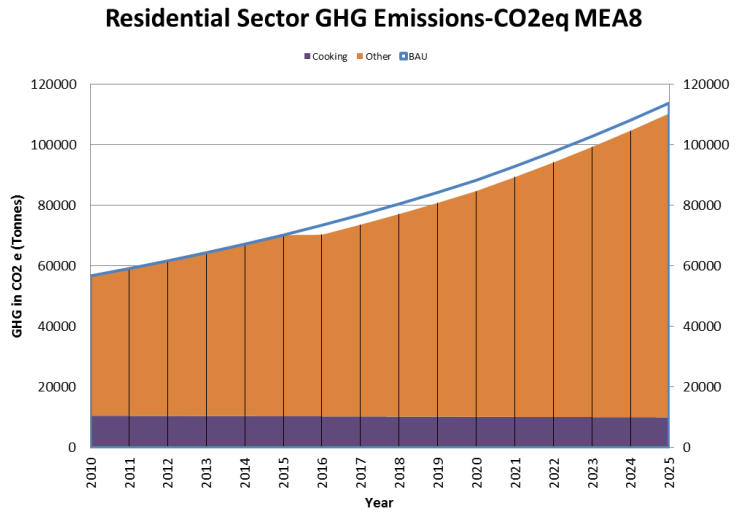
- 1% reduction in overall emissions relative to baseline by 2025



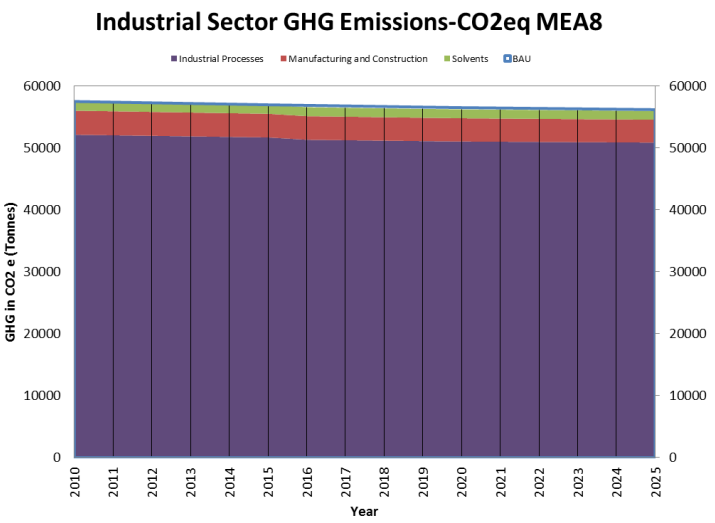
RESULTS: Impact of measure #8 on sectoral GHG emissions

Impact of measure #8 on sectoral GHG emissions

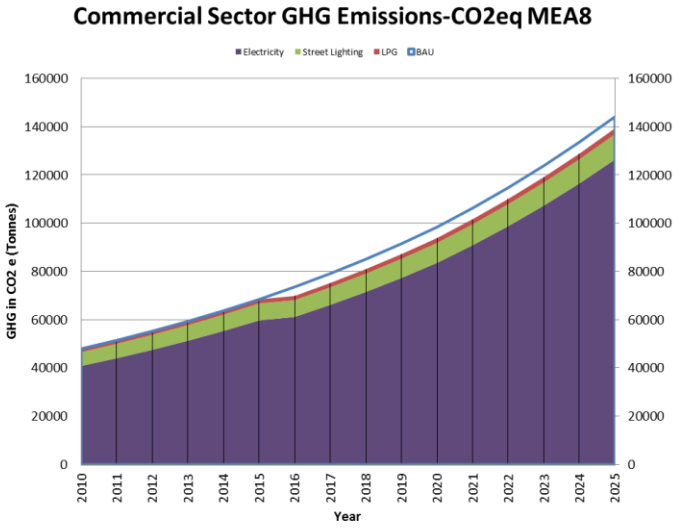
- 3% reduction in Residential Sector emissions relative to baseline by 2025



- 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

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 modelled separately.

Additional Information

None

6.5 Summary – Mitigation Scenario #2

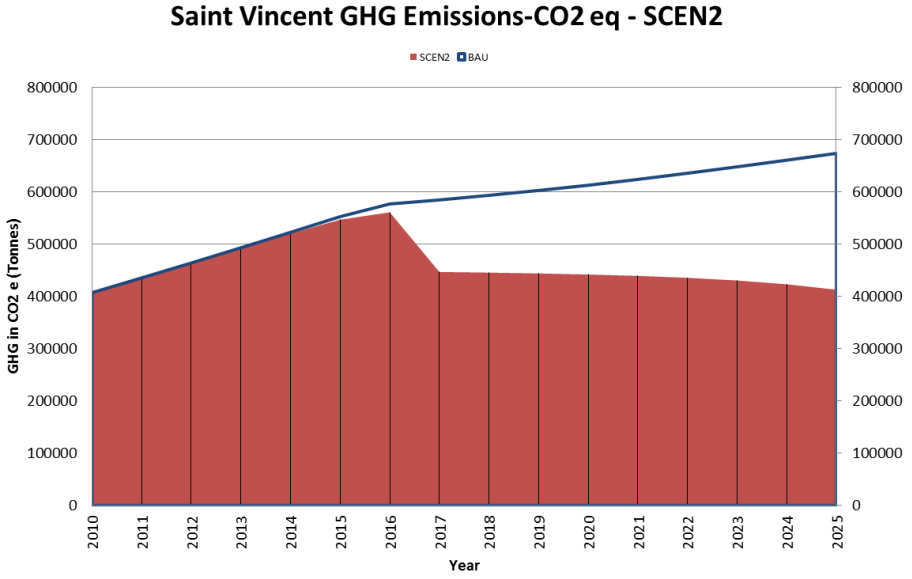
This subsection presents a summary of the emissions impact of Mitigation Scenario #2 relative to the Baseline Scenario (BAU), for the period to 2025. The summary includes results for St. Vincent and the Grenadines as a whole, together with results by sector.

Results for the individual measures included in Mitigation Scenario #2 are presented in subsection 6.6.

MITIGATION SCENARIO #2

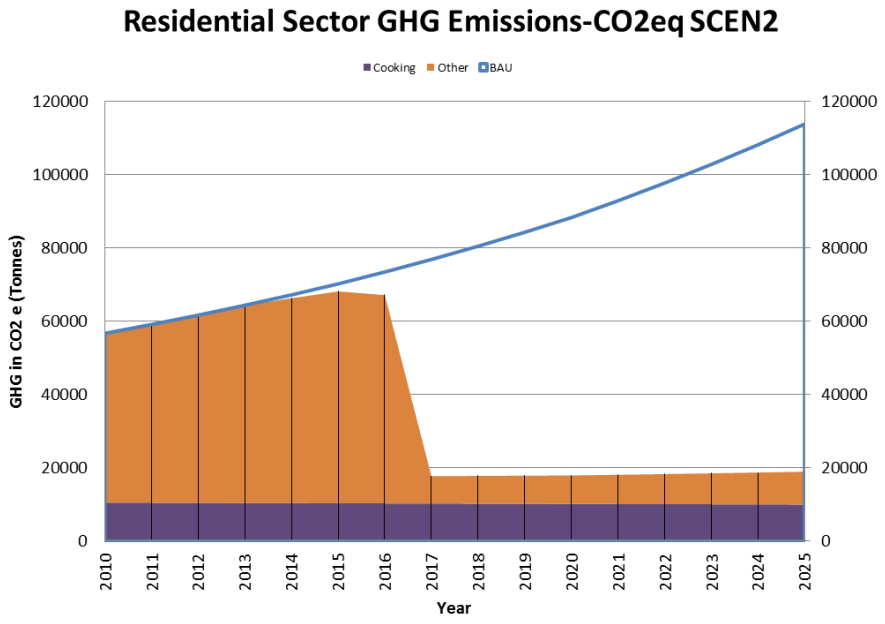
Impact of scenario on overall St. Vincent and the Grenadines GHG emissions

- 39% reduction in overall emissions relative to baseline by 2025



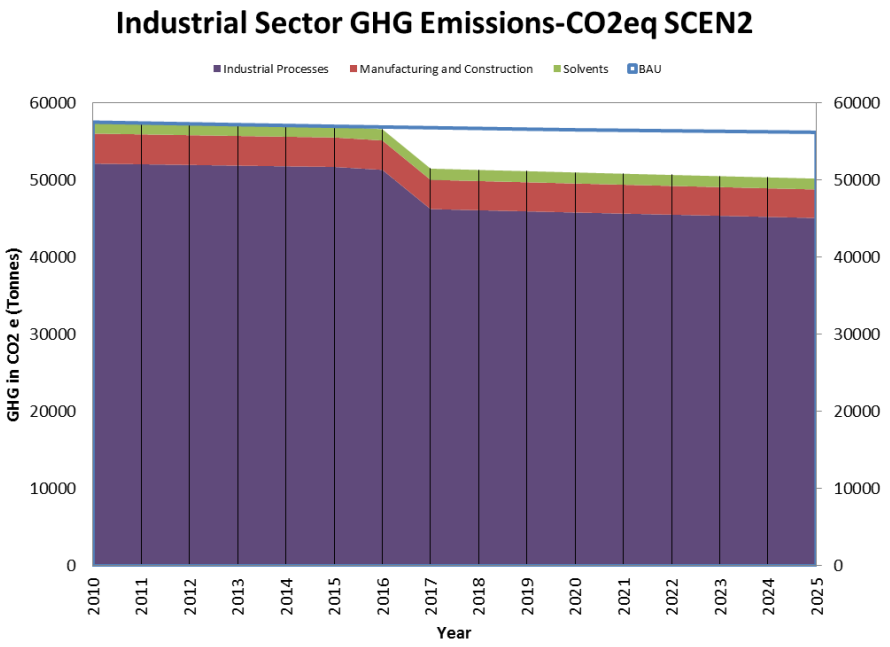
Impact of scenario on sectoral GHG emissions

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

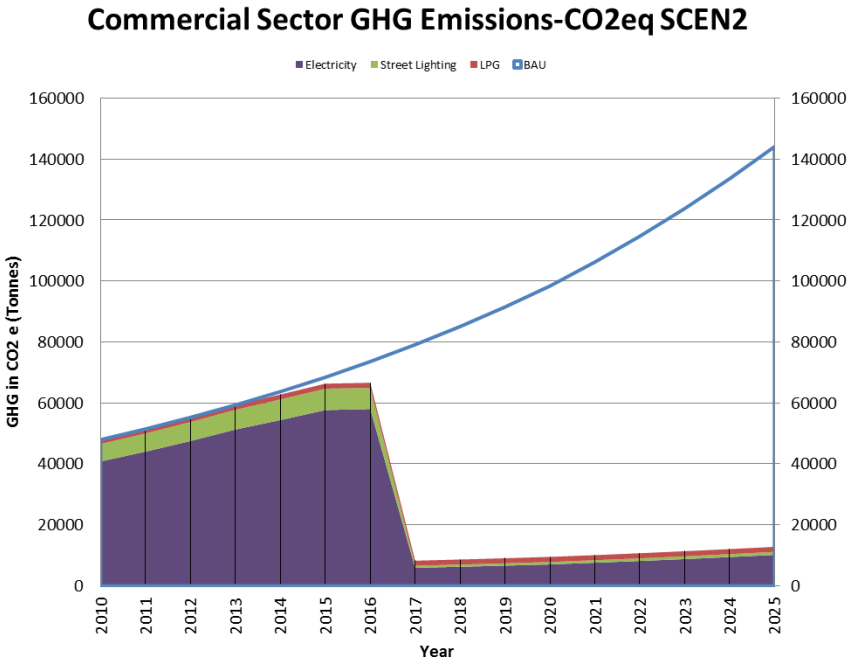


MITIGATION SCENARIO #2

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

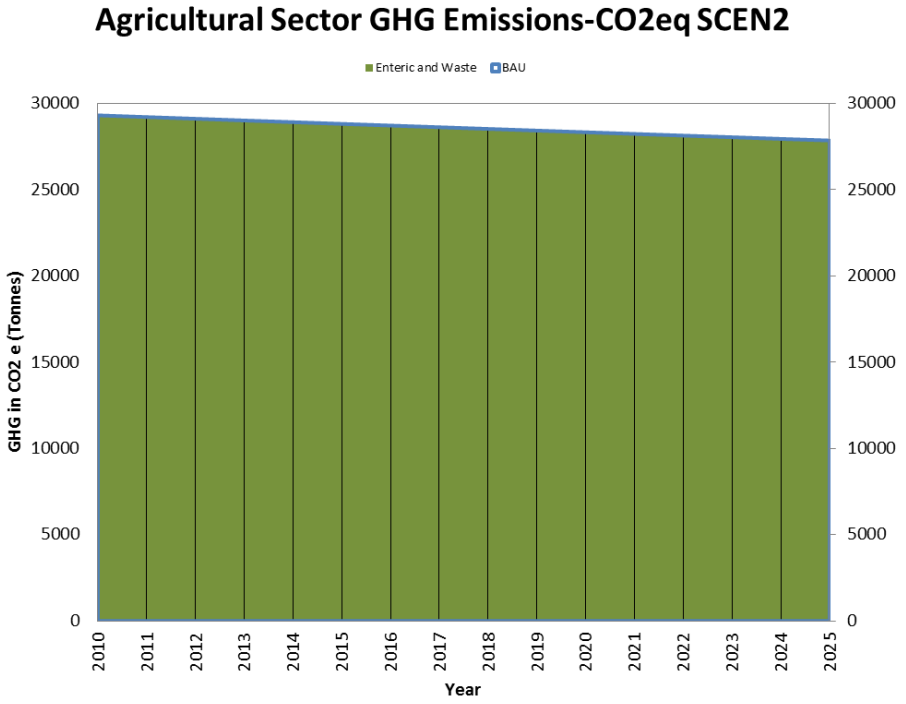


- 91% reduction in Commercial and Tourism Sector emissions relative to baseline by 2025

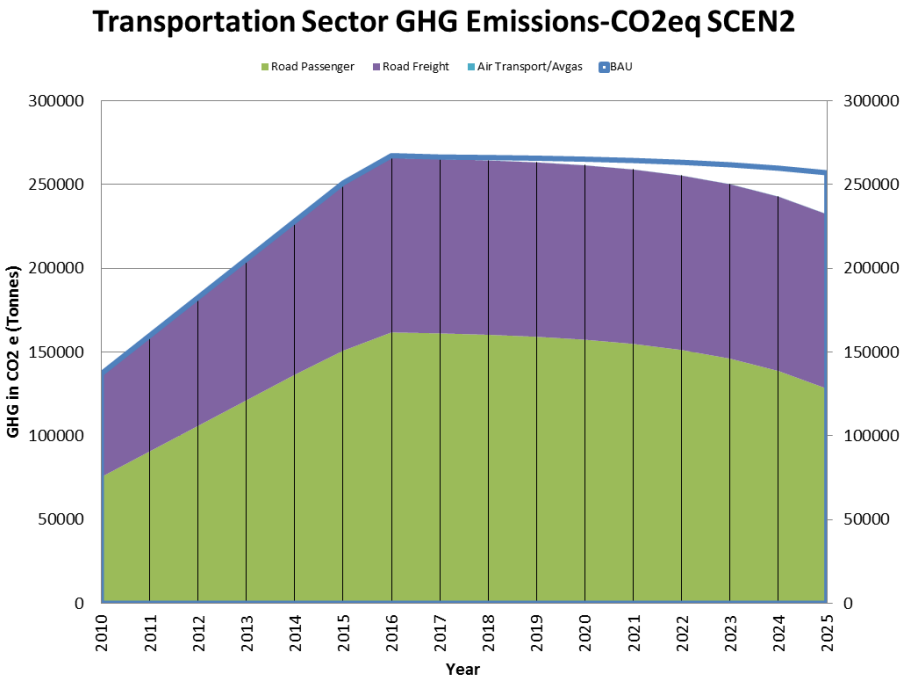


MITIGATION SCENARIO #2

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

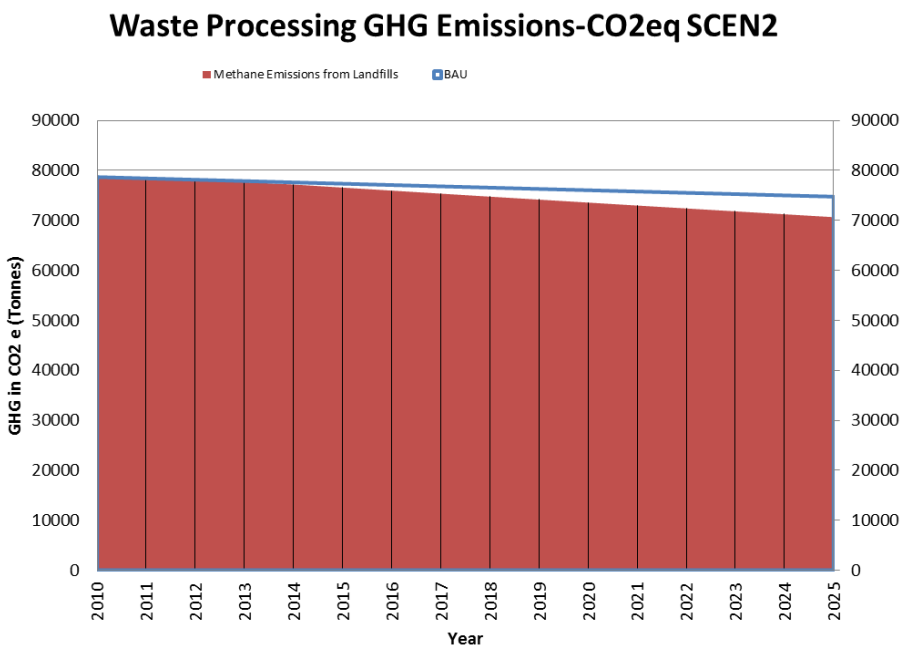


- 10% reduction in Transport Sector emissions relative to baseline by 2025



MITIGATION SCENARIO #2

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



6.6 Details by Measure – Mitigation Scenario #2

Mitigation Scenario #2 includes all of the Scenario #1 measures, plus three additional measures. This subsection provides a detailed summary of the emissions impact of these three additional individual measures, organized in a standard 1-2 page presentation for each measure (as in Mitigation Scenario #1).

Please note that 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, although the consulting team believes the assumptions made are reasonable and offer a plausible characterization of each of the proposed mitigation measures, the results presented here should be considered indicative rather than definitive.

MEASURE #10
Waste reduction across sectors

Description

This measure involves the reduction of waste to landfill through a **Reduce, Reuse, 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% to a maximum of 15% in 2025.

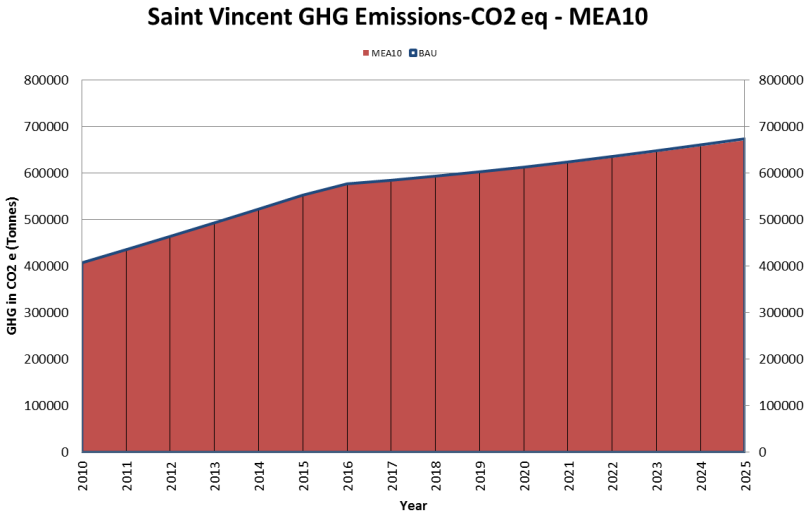
Additional Information

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% of the degradable waste that is producing emissions, the residential sector accounts for the remaining 85%. Of the commercial sectors' 15%, 81% is paper waste and of the residential sectors' 85%, 21% 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

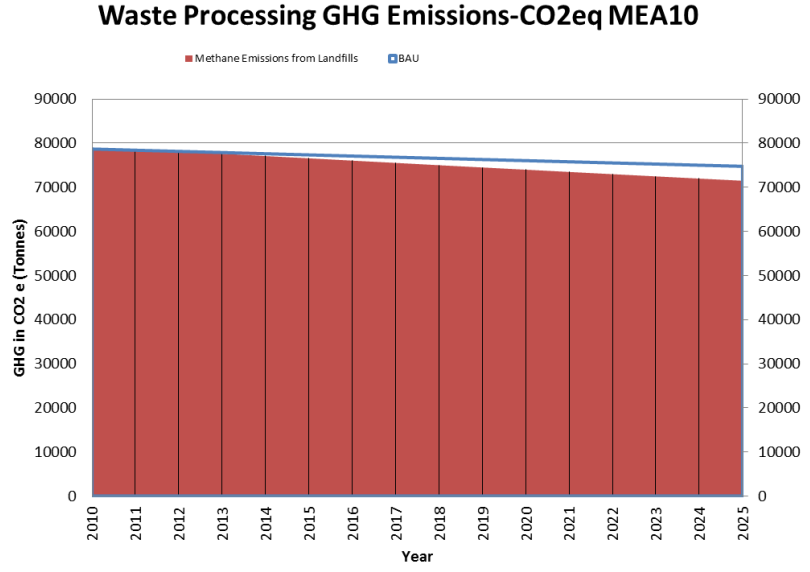
- 0.5% reduction in overall emissions relative to baseline by 2025



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
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.

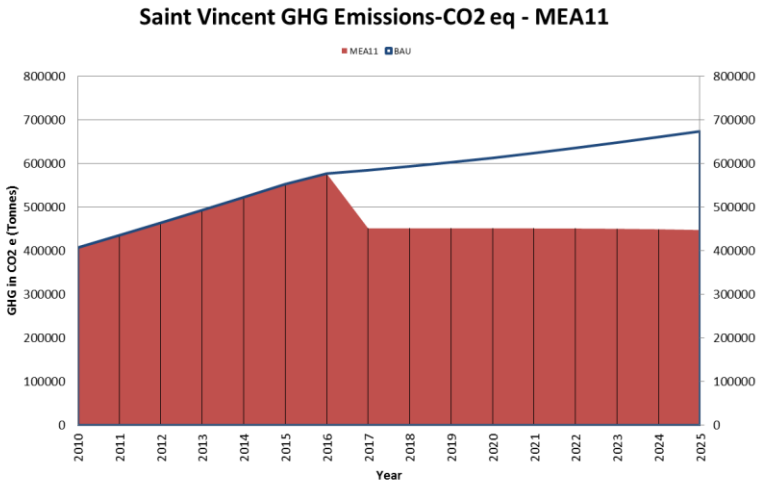
Additional Information

As noted, in this measure geothermal displaces all diesel-generated electricity on the island of St. Vincent. Therefore, this measure is applied to 90% of the total diesel used for electricity generation, as 10% is used for electricity generation on the Grenadine islands. Given the lack of sectoral and end-use breakdowns, the remaining 10% 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

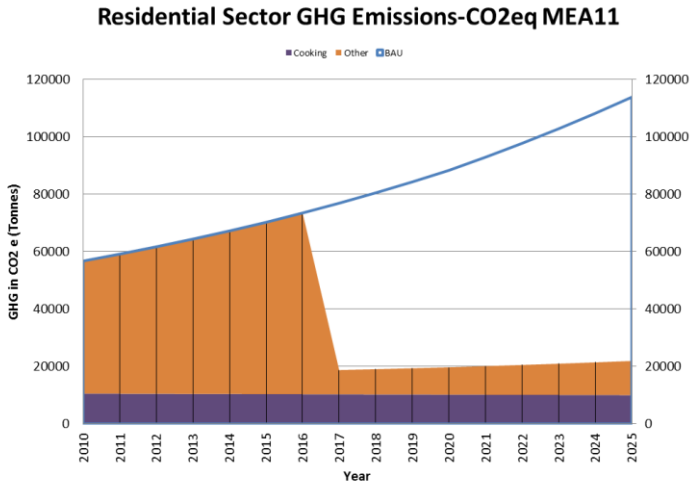
- 34% reduction in overall emissions relative to baseline by 2025



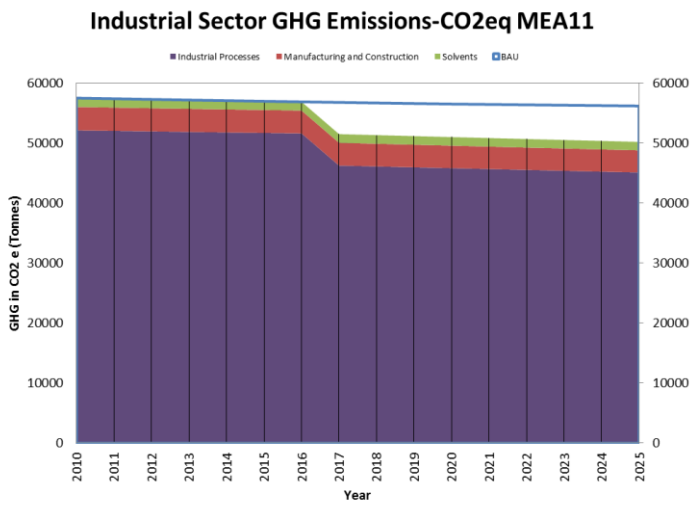
RESULTS: Impact of measure #11 on sectoral GHG emissions

Impact of measure #11 on sectoral GHG emissions

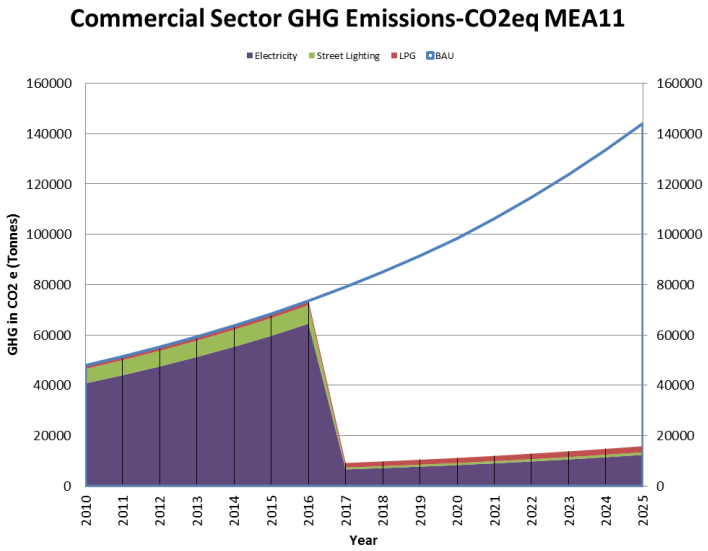
- 81% reduction in Residential Sector emissions relative to baseline by 2025



- 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
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 St. 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% penetration in both the commercial and residential sectors, by 2025 (i.e., 50% of LPG use for hot water will be replaced with solar hot water by 2025).

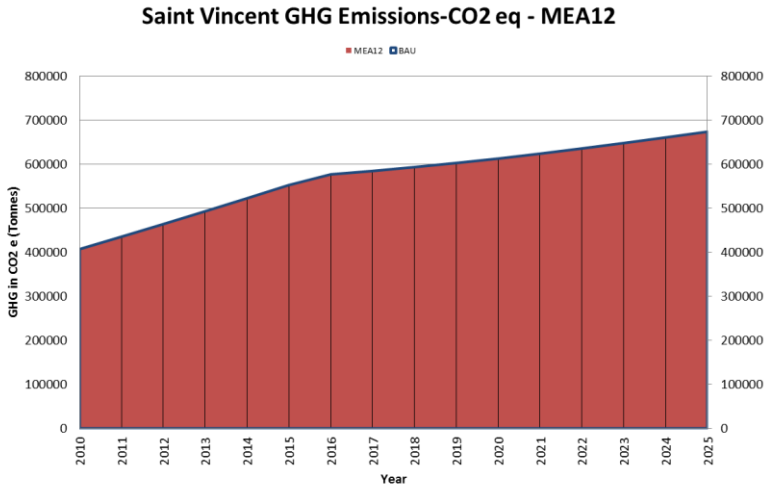
Additional Information

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

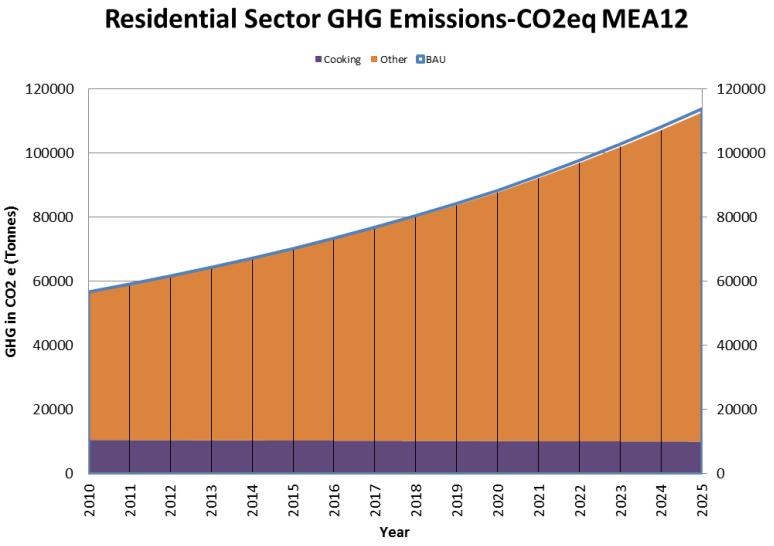
- 0.3% reduction in overall emissions relative to baseline by 2025



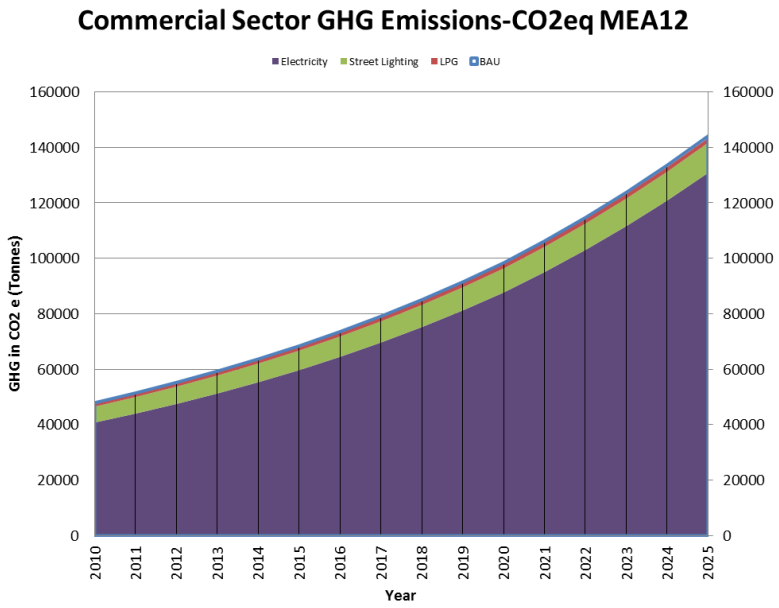
RESULTS: Impact of measure #12 on sectoral GHG emissions

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



7 Analysis and Discussion

7.1 Introduction

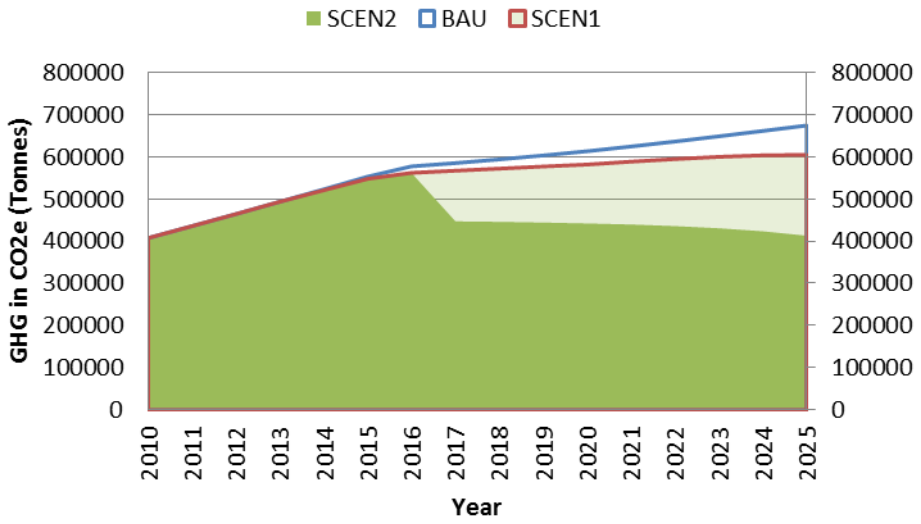
This section presents analysis and discussion of the results presented in the previous sections. The topics addressed are as follows:

- Subsection 7.2 compares the impacts of Mitigation Scenarios #1 and #2.
- Subsection 7.3 compares the impact of the individual measures.
- Subsection 7.4 discusses some co-benefits of the mitigation measures.
- Subsection 7.5 discusses costs.
- Subsection 7.6 discusses barriers, constraints, and uncertainties.

7.2 Comparison of Mitigation Scenarios #1 and #2

Exhibit 26 provides a comparison of Mitigation Scenarios #1 and #2 relative to the Baseline Scenario (BAU).

Exhibit 26 Comparison of Mitigation Scenarios #1 and #2 (t CO_2e)



As illustrated, Scenario #2 provides a large incremental reduction relative to Scenario #1. Specifically:

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

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.

7.3 Comparison of Measures

Exhibit 27 provides a comparison of the modelled impact of the individual measures relative to the Baseline Scenario.[10]

Exhibit 27 Comparison of Emission Reductions Relative to the Baseline Scenario

#	Measure	Emissions Reduction (2025)
	RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS	
1	Adopt standards and guidelines for the construction of energy efficient buildings	5%
2	Set energy performance standards for importation and sales of major energy consuming equipment and appliances	0.5%
	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%
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%
	ELECTRICITY GENERATION	
8	Implement a program for the installation of grid-connected wind and PV power systems	1%
	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	N/A
	ADDITIONAL MEASURES FOR SCENARIO #2	
10	Waste reduction across all sectors	0.5%
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	34%
12	Support the development of innovative financing mechanisms for the deployment of solar water heaters	0.3%

A number of observations can be made based on Exhibit 27:

- 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.
- 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 measures addressing

[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.

adopting 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 the St. Vincent and the Grenadines economy.

- On the other hand, certain other 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).
- As has been noted, 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 will continue to generate emission reductions beyond 2033. For some measures, the emission reductions will even continue to grow. For example, Measure #1 (standards and guidelines) will 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 turnover stock to more efficient units, such as vehicles and appliances.

7.4 Co-benefits

The mitigation measures presented in this assessment provide a wide range of important co-benefits, in addition to the GHG emission reductions.

First and perhaps most significantly, the measures dealing with energy efficiency and renewable energy provide an important cluster of energy-related benefits, including:

- Measures designed to improve energy efficiency and enhance use of renewable energy sources decrease dependence on imported fossil fuels, with positive economic benefits (e.g., improved balance of payments, improved energy security).
- For energy end users, improved energy efficiency reduces costs, improves commercial and industrial competitiveness, and strengthens household finances.
- More broadly, energy efficiency and use of renewable energy sources offer significant environmental benefits (for instance, reduced air emissions).

Several of the energy and non-energy measures also offer other significant co-benefits. These include:

- Measures (#7 and #10 Compost and Waste Reduction) that reduce waste quantities will increase life expectancy for existing waste disposal sites.
- Several measures will also present new business opportunities and potential for economic development.

Although not modelled, there are also diverse benefits associated with reforestation and reduced deforestation, including watershed protection and sustainable use of the forest resource (Measures #5 and #6 Reforestation, Agroforestry and Reduction of Deforestation).

7.5 Costs

A full cost-benefit analysis of the proposed measures is beyond the scope of this study, as is examination of the macroeconomic impacts of the Mitigation Scenarios (impacts on GDP growth, employment, industrial structure, etc.). Instead, this study has attempted to document (qualitatively) some of the costs associated with each measure, to the extent possible with available information and resources. The result is not intended to be a full costing, but is rather intended to provide some initial insight into cost factors. This information is presented below in Exhibit 28. In addition to the cost elements specified here, most measures would also involve additional program administration costs, in most cases incurred by government.

Exhibit 28 Indicative Cost Elements for the Mitigation Measures

#	Measure	Cost Elements (Indicative)
	RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS	
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)
	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.

#	Measure	Cost Elements (Indicative)
	AGRICULTURE, FORESTRY AND FISHING SECTOR	
5	Implement programmes of reforestation and agro-forestry	▪ Cost of 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 of 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	
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 sectors	▪ 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

#	Measure	Cost Elements (Indicative)
12	Support the development of innovative financing mechanisms 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 installation and servicing of solar hot water) ▪ Cost of installation of solar hot water on government buildings (to create an addition market driver). ▪ 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).

As noted above, for all measures, the overall cost of program administration must also be considered. Many of the measures are closely related, allowing for coordinated or integrated program delivery arrangements and associated cost efficiencies.

7.6 Barriers and Uncertainties

7.6.1 Barriers

The barriers to climate change mitigation in general, and more specifically the barriers to implementation of the measures described in this report, need to be considered in any mitigation planning process. Small countries such as St. Vincent and the Grenadines face a particular set of implementation challenges that arise from inherent resource limitations.

Barriers can typically be divided into three categories: technical, economic or financial, and institutional. Technical barriers may be the easiest to overcome. The technical measures that have been proposed in this assessment all relate to technically mature technologies and equipment. For example, wind and solar PV have been proven successful in numerous jurisdictions around the world. Higher efficiency vehicles and equipment (e.g., refrigeration and air conditioning units) already exist and are currently in use in the jurisdictions from which St. Vincent and the Grenadines imports. However, in many cases these technologies are newer, more expensive, and not typically imported. In addition, some of these measures and technologies may be dependent on professional or technical services that are not readily available in St. Vincent and the Grenadines, such as wind, solar PV, and geothermal installation or energy efficient building design, construction, operation and certification (e.g., Leadership in Energy and Environmental Design (LEED)). Another technical barrier may involve infrastructure or other support that does not yet exist in St. Vincent and the Grenadines.

Economic and financial barriers can be more challenging to overcome. Depending on the measure, the initial costs may be incurred by government, the private sector, individuals, or a combination thereof. Regardless of who is incurring the costs, some measures may simply 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. Obtaining financing for a technology that has not yet been proven at that location may also be challenging, which presents a further barrier. 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) will have financial paybacks over time (e.g., fuel cost savings and savings on electricity bills). Addressing these financial barriers is complicated by the fact that in certain situations, the entity incurring the initial costs (government, business, individual) will 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, for instance.

Finally, institutional barriers generally consist of capacity and structural barriers, in addition to the overall willingness and support of the institution. Institutional capacity includes technical, financial, and management capabilities as well as sufficient human resources. If any one of these capacities is insufficient, particularly with respect to mitigation program delivery, this would be considered an institutional barrier. These types of institutional barriers can also be difficult to overcome, especially in a resource strapped municipality, region, or country. Structural barriers result from the institutional organization and existing rules, regulations and frameworks. For example, overlapping or unclear mandates between organizations that potentially deal with similar resources (such as the Energy Unit and VINLEC), could present a barrier to successfully developing, implementing and running a program that impacts both organizations. Existing rules may also pose a structural barrier; for example independent power production from renewable sources depends on regulations regarding market (and grid) access for the power producer.

These various barriers were both implicitly and explicitly considered by the National Consultants involved in identification of the mitigation measures presented in this report. As a result, the selected measures can be expected to face fewer implementation barriers than some potential measures that were not selected for further development. Nonetheless, the detailed design of the individual measures will need to consider options to overcome barriers that potentially reduce the effectiveness of the measures.

7.6.2 Uncertainties

The scenarios presented in this report do not attempt to predict future emissions; rather they provide an indication of what GHG emissions might be in the future, based on a defined set of future events and plausible assumptions. From this it follows that there is great uncertainty in the emissions projected for the Baseline and Mitigation Scenarios. In addition, in St. Vincent and the Grenadines significant data gaps affect any analysis of the type undertaken here. Moreover, many of the demographic, economic, and technical variables that will affect future emissions are unknown and unknowable (at least with any precision). Finally, as has been previously noted, 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. Because of these factors, the uncertainty associated with the scenarios presented here is significant. Thus, although the consulting team believes the assumptions made are reasonable and offer a plausible characterization of the emissions baseline and of the proposed mitigation measures, the modelling results should be considered indicative rather than definitive.

Because uncertainty affects a wide range of data inputs, and because no single input has a strongly dominant impact on the results, a conventional sensitivity analysis is beyond the resources available for this study (and the value of a complex analysis would be questionable in any case). Instead, for illustrative purposes the interactive effect of varying the results for the Baseline and Mitigation Scenarios has been tested, as follows:

- Varying GHG emissions growth in the Baseline Scenario by ±25%
- Varying the aggressiveness of the Mitigation Scenarios by ±25%

Exhibit 29 presents the emissions that would be expected under these modified sets of assumptions.

Exhibit 29 Alternative Emissions Growth and Mitigation Scenarios

	GHG Emissions (tonnes CO_2e)		
	Lower Baseline Emissions Growth (-25%)	As Modelled	Higher Baseline Emissions Growth (+25%)
		BASELINE SCENARIO	
2010	407,199	407,199	407,199
2025	607,103	673,738	740,373
		MITIGATION SCENARIO #1 (2025)	
25% Less Aggressive	560,111	621,588	683,065
As Modelled	544,447	604,205	663,963
25% More Aggressive	528,783	586,822	644,860
		MITIGATION SCENARIO #2 (2025)	
25% Less Aggressive	430,789	478,071	525,354
As Modelled	372,017	412,849	453,681
25% More Aggressive	313,245	347,627	382,008

The two extreme scenarios presented in Exhibit 29 show the following results:

- Highest baseline emissions + least aggressive mitigation: 2025 emissions are 683,065 tonnes of CO2e (68% above 2010 levels)
- Lowest baseline emissions + most aggressive mitigation: 2025 emissions are 313,245 tonnes of CO2e (23% below 2010 levels).

8 Implementation Priorities

Development of a full implementation strategy is outside the scope of this project. However, to provide a point of departure, this section considers implementation priorities for the various measures included in Mitigation Scenarios #1 and #2.

The following screening criteria are proposed for use in identifying priority mitigation measures for early implementation. The first three criteria have been selected from the original screening criteria presented in subsection 3.2.2. The final criterion complements the first three by considering feasibility of early implementation.

- Potential GHG impact
- Sustainability
- Expected cost
- Feasibility of early implementation

For discussion purposes only, the consulting team has done a preliminary screening of the Mitigation Scenario #1 and #2 measures. First, all measures that achieve a 1% reduction or more of GHG emissions have been 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.

Measures carried forward include:

- Measure #1: Adopt standards and guidelines for the construction of energy efficient buildings [5% 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%]
- 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%]
- 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%]

These measures were next evaluated relative to the four criteria: potential GHG impact, sustainability, expected cost, and feasibility of early implementation. Exhibit 30 presents the results of this illustrative screening process, for discussion purposes only. The scoring was done informally on a relative scale; the scores presented in the table are not absolute. In the case of the “potential GHG impact” criterion, measures with an impact of 5% or higher were given an H (high) rating; all below 5% were given an M (medium) rating.

Exhibit 30 Implementation Screening

#	Measure	Potential GHG Impact	Sustainability	Expected Cost	Feasibility of Early Implementation	Early Priority ?
	RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS					
1	Adopt standards and guidelines for the construction of energy efficient buildings	H	H	$$	H	Yes
	TRANSPORTATION SECTOR					
3	Revise the car taxation system to give incentives for the purchase and use of fuel-efficient passenger cars and other vehicles	M	M	$$	M	Yes
4	Provide information to the public on fuel consumption of different car models that are commonly imported	N/A	H	$	H	Yes
	ELECTRICITY GENERATION					
8	Implement a program for the installation of grid-connected wind and PV power systems	M	H	$$ (wind)	H	Yes
	CROSS-CUTTING MEASURES					
9	Implement energy related education and training at all education levels from primary schools up to college courses, and implement public awareness campaigns to promote energy conservation and waste reduction	N/A	H	$$	H	Yes
	ADDITIONAL MEASURES FOR SCENARIO # 2					
11	Undertake sustainable development of geothermal resources in the Soufriere Resource Area	H	H	$$$$	L	?

All measures score well against the defined criteria, as would be expected given the prior involvement of stakeholders in selecting the measures for analysis, and the focus here on measures with significant emissions reduction potential. Note, despite the high cost and potentially lengthy implementation time, Measure #11 (geothermal resources) was carried throughout this illustrative screening process due to its potentially high impact on GHG emission reductions.

Based on this illustrative screening, all measures presented in Exhibit 30 would be candidates for priority focus and early implementation in St. 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 St. Vincent and the Grenadines, and have not been subjected to critical review and evaluation. This type of strategic planning is an important next step in the development of a practical GHG mitigation strategy and implementation plan for St. Vincent and the Grenadines, as is discussed in the next section of this report.

9 Future Work

This concluding section discusses next steps and future work arising out of this Mitigation Assessment. The discussion is broken into two subsections:

- Subsection 9.1 addresses the strengthening of future Mitigation Assessments.
- Subsection 9.2 discusses the ongoing mitigation planning and implementation, including development of Nationally Appropriate Mitigation Actions (NAMAs).

9.1 Future Mitigation Assessments

Future Mitigation Assessments will be required as part of future National Communications. One of the main challenges in developing this Mitigation Assessment was data availability and accessibility. As such, internal capacity building will be critical to support St. Vincent and the Grenadines future efforts in preparing Mitigation Assessments. This will also help to improve both the content and the accuracy of the Mitigation Assessments.

Capacity building should include two streams: technical capacity and knowledge based resources. Recommendations to improve knowledge based resources include expanding the training of government staff and local consultants to do research, data collection and analyses. This will not only improve the availability and quality of input data, but also decrease uncertainties in the baseline and mitigation scenarios. In addition to specific training, continual engagement should also be considered a priority. For example, a benefit of updating the GHG emission inventory, baseline and mitigation scenarios more frequently (e.g., every three years) is that the stakeholders involved (government staff and local consultants alike) are more likely to remain engaged in the process. This would improve understanding, participation, data collection, and results. It would also feed into the ongoing mitigation planning (discussed in subsection 9.2).

In terms of technical capacity, it is recommended that a data repository and archiving system be established and housed at the Environmental Management Department of the Ministry of Health, Wellness and the Environment. Data, information sources, assumptions, and methodologies for the GHG Emission Inventory and Mitigation Assessment would be stored and managed in this data collection system and made available for future reference. In addition to overall improvement in data collection and management, St. Vincent and the Grenadines should consider explicitly addressing the key data gaps that have been identified in this Mitigation Assessment.

Some of these recommendations for capacity building were first identified in the *National Inventory of Greenhouse Gases for Saint Vincent and the Grenadines*, prepared by ICF Marbek in 2010.

9.2 Ongoing Mitigation Planning and Implementation

In addition to being a requirement for the Second National Communication to the UNFCCC, this Mitigation Assessment (and future assessments) can also contribute to ongoing mitigation planning and implementation in St. Vincent and the Grenadines. The Mitigation Assessment process has provided a solid foundation on which to develop a climate change mitigation strategy and implementation plan, which would include specific measures and actions. To summarize, the Mitigation Assessment has:

- Addressed all priority GHG emission sources.
- Built upon previously adopted government policy documents (e.g., *The Government's National Energy Policy*, *Energy Action Plan for St. Vincent and the Grenadines*).
- Helped identify mitigation priorities and opportunities in different sectors and worked with stakeholders to identify the high priority mitigation measures appropriate for implementation in St. Vincent and the Grenadines.
- Provided information on the potential GHG emission reductions associated with each measure, sector and overall.

This groundwork can now lead to the development of a climate change mitigation strategy and implementation plan. There are several key steps to this process. As a first step, national experts and stakeholders should be consulted in order to validate the findings of the Mitigation Assessment and to confirm implementation priorities. Each measure should then be further developed into a detailed design, which would include an analysis to confirm feasibility, determine implementation requirements, and identify financial requirements. Once each detailed measure has been completed, the implementation plan can be developed for consultations and review. Finally, the last step before active implementation is to address the implementation requirements, identified earlier in the process, including establishing partnerships and securing financial commitments. An important part of the climate change mitigation strategy and implementation plan is development of a measurement, reporting, and verification (MRV) plan to be implemented during implementation (particularly if St. Vincent and the Grenadines is interested in pursuing international support for Nationally Appropriate Mitigation Actions (NAMAs)).

As a developing country signatory to the UNFCCC, the concept of NAMAs is relevant to St. Vincent and the Grenadines. The measures included in the Mitigation Scenarios in this report are nationally appropriate for St. Vincent and the Grenadines and suitable for consideration as NAMAs, should St. Vincent and the Grenadines be interested in pursuing NAMAs. Types of NAMAs submitted to the UNFCCC to date include: emission targets; strategies and plans; policies and programs; and projects. A good NAMA tends to evolve out of a locally driven process and is integrated with national policy objectives. Continued development of the mitigation strategy and implementation plan referred to above, and detailed design of individual measures, would put St. Vincent and the Grenadines in a good position to seek support for these measures via the NAMA mechanism.

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Appendix A "Long List" of Mitigation Measures

THE "LONG LIST" OF CANDIDATE MITIGATION MEASURES
(Preliminary List based on SVG Government Documents)

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, daylighting, 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**

COMMERCIAL (Including Tourism and Institutional)

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**

AGRICULTURE / FORESTRY / FISHING

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., by 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 **(**VINLEC). ▪ **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.

ELECTRICITY GENERATION

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**

Appendix B Baseline Data Assumptions

Summary of Significant Baseline Data Assumptions (Additional information provided in Section 5)

End Use	Assumptions for Base Year (2010)	Assumptions for BAU Growth
	RESIDENTIAL	
Cooking	▪ **LPG:** ▪ Total LPG consumption provided by Customs and Excise. ▪ Residential sector consumes 90% of total imported LPG. ▪ 81% of LPG for residential sector is used for cooking (the remaining for Domestic Hot Water). This is based on previous ICF Marbek studies in similar climatic conditions. ▪ **Charcoal:** ▪ All charcoal is used for cooking. Charcoal use was assumed to be the same as in the 2004 GHG inventory. Only non-biogenic emissions from charcoal were included.	▪ LPG use is assumed to follow the trend in population, therefore consumption assumed to decline at 0.34% per year. ▪ Charcoal use is assumed to follow the trend in population, therefore consumption assumed to decline at 0.34% per year.
Other	▪ **Electricity:** ▪ Total electricity generation provided by VINLEC. ▪ IMF Country Report No. 09/119 provided a sector breakdown for 2004 data. Assuming this breakdown did not change between 2004 and 2010, the 2004 sectoral ratio was applied to 2010 data to determine electricity consumption in the residential sector. The residential sector consumed 42% of total electricity. ▪ **Energy Intensity per household:** ▪ Number of households estimated based on total population and assumed number of people living in one house (5 people per household). ▪ **LPG for Domestic Hot Water:** ▪ 19% of residential LPG use is for hot water.	▪ The *Energy Action Plan for St. Vincent and the Grenadines* stated that electricity demand had grown annually by 5.4% in the residential sector between 1998 and 2007. It is assumed that the growth rate for electricity demand will continue at 5.4% per year until 2025. ▪ LPG use is assumed to follow the trend in population, therefore consumption assumed to decline at 0.34% per year.
	INDUSTRY	
Industrial Processes	▪ **Electricity:** ▪ Total electricity generation provided by VINLEC. ▪ IMF Country Report No. 09/119 used for sectoral breakdown. Industry consumed 5% of total electricity. ▪ **Non-energy - road paving:** ▪ Import data for bitumen provided by Customs and Excise. Bitumen was converted to asphalt based on a ratio of 10%. ▪ **Non-energy - food and beverage manufacturing:** ▪ 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 provided by ECGC. It was assumed that 5% of flour was used for cakes and 95% for bread. ▪ Production data for meat, fish, poultry, and animal feed was provided by ECGC and the	▪ The *Energy Action Plan for St. Vincent and the Grenadines* stated that electricity demand had grown annually by 1.1% in the industrial sector between 1998 and 2007. It is assumed that the growth rate for electricity demand will continue at 1.1% per year until 2025. ▪ Bitumen for paving and other non-energy manufacturing processes are assumed to follow the trend in population, therefore assumed to decline at 0.34% per year. ▪ Non-methane volatile Organic Compounds (NMVOCs) in the food and beverage manufacturing is assumed to follow the trend in population, therefore assumed to decline at 0.34% per year. ▪ Non-energy HFCs consumption is assumed to follow the trend in population, therefore assumed to decline at 0.34% per year. ▪ Lubricant use is assumed to follow the

	Ministry of Agriculture. ▪ **Non-energy – HFCs:** ▪ Import data for equipment containing HFCs provided by Customs and Excise. ▪ **Lubricants:** ▪ Total Lubricant consumption provided by Customs and Excise. ▪ 50% of the lubricants are used by the Energy Industry	trend in population, therefore consumption assumed to decline at 0.34% per year.
Manufacturing and Construction	▪ **Diesel:** ▪ Total diesel consumption provided by Customs and Excise. ▪ The industry sector consumes 2% of the total diesel imported to St. Vincent and the Grenadines.	▪ Industrial diesel consumption is assumed to follow the trend in population, therefore consumption assumed to decline at 0.34% per year.
Solvents	▪ Note that minor residential solvent use has not been separated out, but is included under industrial solvent use. ▪ Import data for solvents provided by Customs and Excise. ▪ For solvents, product use was estimated for 2010 based on default factors for per capita consumption and the 2010 population.	▪ Solvent use is assumed to follow the trend in population, therefore consumption assumed to decline at 0.34% per year.
COMMERCIAL AND TOURISM		
Electricity	▪ **Electricity:** ▪ Total electricity generation provided by VINLEC. ▪ IMF Country Report No. 09/119 used for sectoral breakdown. The Commercial sector consumed 39% of total electricity.	▪ The *Energy Action Plan for St. Vincent and the Grenadines* stated that electricity demand had grown annually by 7.7% in the commercial sector between 1998 and 2007. It is assumed that the growth rate for electricity demand will continue at 7.7% per year until 2025.
Street Lighting	▪ **Electricity:** ▪ Total electricity generation provided by VINLEC. ▪ IMF Country Report No. 09/119 used for sectoral breakdown. Street lighting consumed 2% of total electricity.	▪ The *Energy Action Plan for St. Vincent and the Grenadines* stated that electricity demand had grown annually by 4% for street lighting between 1998 and 2007. It is assumed that the growth rate for electricity demand will continue at 4% per year until 2025.
LPG	▪ Total LPG consumption provided by Customs and Excise. ▪ Commercial sector consumes 10% of total imported LPG (for cooking and hot water).	▪ The Ministry of Tourism and Physical Planning provided an estimated increase in tourist visitations of 3.66%, as a result of the increased traffic at the new international airport. It is assumed that the growth rate for LPG demand in the commercial sector will follow this trend and therefore grow at 3.66% per year until 2025.
AGRICULTURE, FORESTRY AND FISHING		
Enteric Fermentation and Manure Management	▪ Livestock populations for 2002 were used to calculate emissions (as in the 2004 GHG inventory). All cattle were assumed to be non-dairy.	▪ Livestock populations are assumed to follow the trend in population, therefore emissions are assumed to decline at 0.34% per year.
Agricultural Soils and Application of Nitrogen Fertilizer	▪ Crop production data for 2010 was provided by the Agriculture Statistics Unit. ▪ Nitrogen fertilizer application data was provided for the year 2010 by the Agricultural Input Warehouse.	▪ Crop production and fertilizer use are assumed to follow the trend in population, therefore emissions are assumed to decline at 0.34% per year.

LUCF	▪ In the absence of land-use area and forest land-use data for a current/recent year, emissions/removals from LUCF have not been estimated.	▪ Due to lack of data, projections to 2025 were not made for land use change and forestry.
TRANSPORT		
Road Passenger	▪ Total gasoline consumption provided by Customs and Excise. ▪ Total number of registered vehicles provided by Motor Vehicle Registration Statistics. ▪ Road Passenger sector consumes 100% of total imported gasoline. ▪ Energy use per vehicle is developed based on recent corporate average fuel efficiency (CAFE) standards passed into law in the US. Vehicle energy consumption is set to match energy balance of fuel use.	▪ Based on the projected growth rates from the *Energy Action Plan for St. Vincent and the Grenadines*, a 15% annual growth rate for gasoline consumption (assumed to be passenger vehicles) is assumed for the years 2010 to 2014 (inclusive). In 2015, this growth rate is assumed to decrease by half; therefore in 2015, the gasoline consumption increases by 7.5%. It is assumed that by the beginning of 2016, a saturation in the number of vehicles is reached. Therefore, from 2016 to 2025, the number of vehicles will remain constant, and the fleet would be replaced by more efficient vehicles. ▪ Changes in fuel efficiency correspond to an average increase in fuel efficiency of approximately 2% per year between 2010 and 2016. By 2016, fleet fuel efficiency is expected to improve up to 4% annually.
Road Freight	▪ Total Diesel consumption provided by Customs and Excise. The number of diesel vehicles was back-calculated based on average fuel consumption of a diesel vehicle and the diesel consumed. ▪ Road Freight sector consumes 38% of total imported Diesel. ▪ Energy use per vehicle is developed based on recent corporate average fuel efficiency (CAFE) standards passed into law in the US. Vehicle energy consumption is set to match energy balance of fuel use.	▪ Based on the projected growth rates from the *Energy Action Plan for St. Vincent and the Grenadines*, a 10% annual growth rate for diesel consumption (assumed to be freight vehicles) is assumed for the years 2010 to 2014 (inclusive). In 2015, this growth rate is assumed to decrease by half; therefore in 2015, the diesel consumption increases by 5%. It is assumed that by the beginning of 2016, a saturation in the number of vehicles is reached. Therefore, from 2016 to 2025, the number of vehicles will remain constant, and the fleet would be replaced by more efficient vehicles.
Air Transport/ Avgas	▪ Total Avgas consumption provided by Customs and Excise. ▪ Domestic air transport sector consumes 100% of total imported Avgas.	▪ The Ministry of Tourism and Physical Planning provided an estimated increase in tourist visitations of 3.66%, as a result of the increased traffic at the new international airport. It is assumed that domestic flights will increase at same rate as international, therefore Avgas demand in the transport sector will increase at 3.66% per year until 2025.
Other	▪ **Lubricants:** ▪ Total Lubricant consumption provided by Customs and Excise. ▪ 50% of the lubricants are used by the transport sector.	▪ Lubricant use is assumed to increase by 10% annually from 2010 to 2025.

WASTE		
Methane Emissions from Landfills	▪ IPCC regional waste generation default for the Caribbean region (0.49 tonnes/capita/year) was applied to total population to determine total waste.	▪ Methane emissions from Landfills are assumed to follow the trend in population, therefore emissions are assumed to decline at 0.34% per year.
Nitrous Oxide Emissions from Wastewater	▪ Nitrous oxide emissions directly correlate to the amount of human waste disposed (population) and the amount of protein consumed. Protein consumed as reported by the FAO (2007 data available, 79g/capita/ day). ▪ Number and type of latrine systems was assumed to be the same as in the 2004 GHG inventory.	▪ Nitrous oxide emissions from waste water are assumed to follow the trend in population, therefore emissions are assumed to decline at 0.34% per year.
ENERGY INDUSTRY		
Power Generation	▪ Total Diesel consumption provided by Customs and Excise. ▪ The Energy Industry sector consumes 60% of total imported Diesel (for power generation). ▪ Total electricity generation capacity provided by VINLEC: 5.65 MW installed Hydro and 44 GW installed Diesel capacity. ▪ IMF Country Report No. 09/119 used for sectoral breakdown. Transmission losses are assumed to be 8.6% of total generated electricity.	▪ The *Energy Action Plan for St. Vincent and the Grenadines* stated that electricity demand will require an installed capacity of 48MW and 55 MW by 2015 and 2020 respectively. It is assumed that the growth rate for installed diesel-electric capacity will continue at the commercial electricity growth rate at 7.7% per year from 2020 to 2025. ▪ It is assumed that Hydroelectric installed capacity will remain constant until 2025.