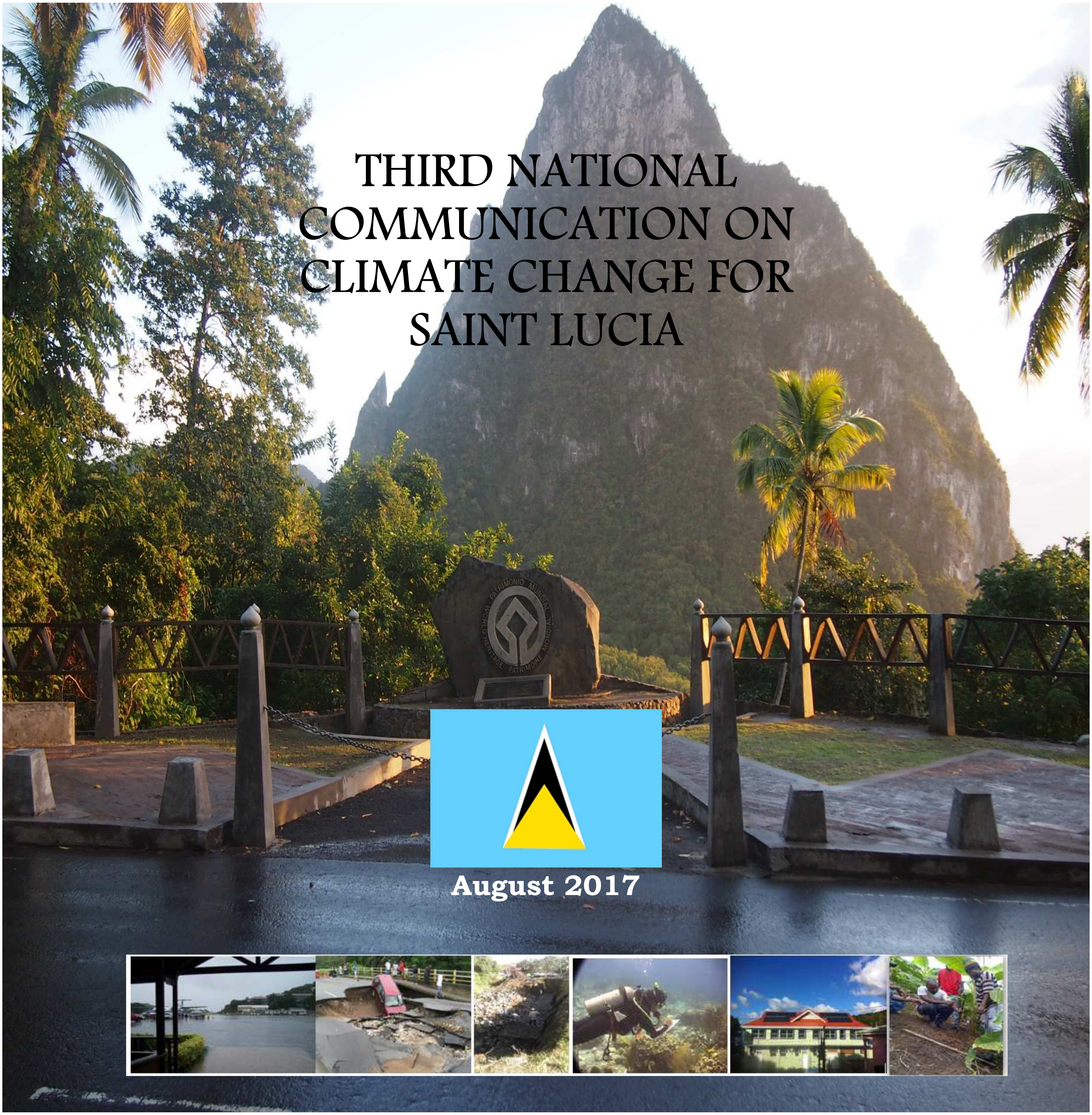
# THIRD NATIONAL COMMUNICATION ON CLIMATE CHANGE FOR SAINT LUCIA



**August 2017**

Prepared on behalf of

The Government of Saint Lucia

Ministry of Education, Innovation, Gender Relations & Sustainable Development

Department of Sustainable Development

In fulfillment of its obligations under the United Nations Framework Convention on Climate Change

August 2017

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## ACRONYMS

| | |
|---|---|
| $^{o}$C | Degrees Celsius |
| A1B | Median Emissions Scenario |
| ACP | Africa Caribbean Pacific |
| AF | Adaptation Fund |
| A-OGCM | Atmosphere-Ocean General Circulation Model |
| AOSIS | Alliance of Small Island Developing States |
| APL | Adaptable Program Loan |
| ARC | Atlantic Rally for Cruisers |
| BAM | Banana Accompanying Measures |
| BAU | Business as usual |
| BELFUND | James Belgrave Micro Enterprise Development Fund |
| BMZ | German Federal Ministry of Economic Cooperation and Development |
| BOE | Barrel of Oil Equivalent |
| BPoA | Barbados Programme of Action for the Sustainable Development of Small Island States |
| CAFF | Climate Adaptation Financing Facility |
| CAIB | Caribbean Association of Indigenous Bankers |
| CANARI | Caribbean Natural Resources Institute |
| CAT | Climate Adaptation Trust |
| CATS | Caribbean Aqua-Terrestrial Solutions |
| CAPE | Caribbean Advanced Proficiency Exam |
| CAPRA | Comprehensive Approach to Probabilistic Risk Assessment |
| CARDI | Caribbean Agricultural Research and Development Institute |
| CARE | Centre for Adolescent Renewal and Education |
| CARAIBE-HYCOS | Caribbean Hydrological Cycle Observing System |
| CariCOF | Caribbean Climate Outlook Forum |
| CARICOM | Caribbean Community |
| CARILEC | Caribbean Electrical Utility Services Corporation |
| CARITAS | Catholic organization, Latin for “love and compassion” |
| CARPHA | Caribbean Public Health Agency |
| CAT | Climate Adaptation Trust |
| CBD | Convention on Biodiversity |
| CBF | Caribbean Biodiversity Fund |
| CBO | Community Based Organisation |
| CCA | Climate Change Adaptation |
| CCAP | Climate Change Adaptation Policy |
| CCORAL | Caribbean Climate Online Risk and Adaptation tooL |
| CCRIF | Caribbean Catastrophe Risk Insurance Facility |
| CCCCC | Caribbean Community Climate Change Centre (5Cs) |
| CCI | Clinton Climate Initiative |
| CCSI | Climate Change Solutions International |
| CCST | Caribbean Council for Science and Technology |
| CDB | Caribbean Development Bank |
| CDM | Clean Development Mechanism |
| CDEMA | Caribbean Disaster Emergency Management Agency |

| | |
|---|---|
| CDF | CARICOM Development Fund |
| CEHI | Caribbean Environmental Health Institute |
| CEIS | Caribbean Energy Information System |
| CELP | Caribbean Emergency Legislation Project |
| CESDO | Chief Sustainable Development and Environment Officer |
| CFCs | Chlorofluorocarbons |
| $CH_4$ | Methane |
| CID | Climate Impacts Database |
| CIDA | Canadian International Development Agency |
| CIMH | Caribbean Institute of Meteorology and Hydrology |
| CITES | Convention on the International Trade in Endangered Species of Wild Fauna and Flora |
| CMS | Content Management System |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon dioxide |
| $CO_2$eq | Carbon dioxide equivalent |
| COMES | Council of Minister of Environmental Sustainability |
| COP | Conference of Parties to the UNFCCC |
| CPACC | Caribbean Planning for Adaptation to Climate Change |
| CREDP | Caribbean Regional Agency Development Programme |
| CRFM | Caribbean Regional Fisheries Mechanism |
| CReW | Caribbean Regional Fund for Wastewater Management Project |
| CROSQ | Caribbean Regional Organisation for Standards and Quality |
| CSA | Climate smart agriculture |
| CSDEO | Chief Sustainable Development and Environment Officer |
| CSO | Civil Society Organisation |
| CUBiC | Caribbean Unified Building Code |
| CWR | Carbon War Room |
| CXC | Caribbean Examinations Council |
| CYEN | Caribbean Youth Environmental Network |
| CZM | Coastal Zone Management |
| CXC | Caribbean Examinations Association |
| DANA | Damage and Needs Assessment |
| DCA | Development Control Authority |
| DDO | Deferred Drawdown Option |
| DEM | Digital Elevation Model |
| DFID | Department for International Development |
| DoE | Department of Environment |
| DOF | Department of forestry |
| DREAM | Disaster Risk and Energy Access Management |
| DRR | Disaster Risk Reduction |
| DSH | Desert Star Holdings |
| DSSAT | Decision Support System for Agro-technology Transfer |
| DTM | Digital Terrain Model |
| DVRP | Disaster Vulnerability Reduction Project |
| ECA | Economics of Climate Adaptation |
| ECCB | Eastern Caribbean Central Bank |

| | |
|---|---|
| ECELP | Eastern Caribbean Energy Labelling Project |
| ECERA | Eastern Caribbean Energy Regulatory Authority |
| ECFH | Eastern Caribbean Financial Holdings |
| ECHAM5 | European/German General Circulation Model (version 5) |
| EDF | European Development Fund |
| EE | Energy Efficiency; Environmental Education |
| EEZ | Exclusive Economic Zone |
| EF | Environmental Fund |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Information Systems |
| EMB | Environmental Management Bill |
| ESD | Energy for Sustainable Development |
| EOC | Emergency Operations Centre |
| ESCOs | Energy Service Companies |
| ESSB | Electricity Supply Services Bill |
| ESTs | Environmentally Sound Technologies |
| EU-SFA | European Union-Special Framework for Assistance |
| FAO | Food and Agriculture Organisation |
| FGD | Focus Group Discussion |
| FIEM | Framework for Integrated Environmental Management in Saint Lucia |
| FMIS | Forestry Management of Information System |
| FRP | Fibreglass Reinforced Pirogue |
| FSS | Financial Services Sector |
| FSRA | Financial Services Regulatory Authority |
| FTP | File Transfer Protocol |
| GAPP | Green architecture promotion pilot |
| GCC | Global Climate Change |
| GCCA | Global Climate Change Alliance |
| GCF | Green Climate Fund |
| GDA | Geothermal Development Agreement |
| GDP | Gross Domestic Product |
| GE | Green Economy |
| Gg | Gigagrams |
| GOSL | Government of Saint Lucia |
| GEF | Global Environment Facility |
| GFCS | Global Framework for Climate Services |
| GFDRR | Global Fund for Disaster Risk Reduction |
| GHG | Greenhouse Gas |
| GIS | Geographic Information Systems |
| GIVRADP | Global Islands' Vulnerability Research, Adaptation, Policy and Development |
| GIZ | German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit) |
| GLAB | Greaham Louisy Administrative Building |
| GMO | Genetically Modified Organisms |
| GNSS | Global Navigation Satellite System |
| GOSL | Government of Saint Lucia |

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|---|---|
| GPS | Global Positioning System |
| GRTA | Geothermal right transfer agreement |
| GTZ | German Technical Assistance (Deutsche Gesellschaft fur Technische Zusammenarbeit) |
| GWP | Global Warming Potential; Global Water Partnership |
| HadCM3 | Hadley Centre General Circulation Model (version 3) |
| HadCM3/ AEXSM | Version of Hadley Centre General Circulation Model |
| HadCM3Q11 | Hadley Centre General Circulation Model (QUMP) |
| HFCs | Hydrofluorocarbons |
| HOPE | Holistic Opportunities for Personal Empowerment |
| HRDC | Human Resource Development Centre |
| ICT | Information and Communications Technology |
| ICZM | Integrated Coastal Zone Management |
| IDB | Inter-American Development Bank |
| IFSSO | International Financial Services Sector Office |
| IICA | Inter-American Institute for Cooperation on Agriculture |
| ILO | International Labour Organisation |
| ILPM | Improving Land Policies and Land Management |
| INC | Initial NC |
| INDC | Intended Nationally Determined Contribution |
| INSMET | Instituto de Meteorologia de Cuba |
| IPCC | Intergovernmental Panel on Climate Change |
| IT | Information Technology |
| IWCAM | Integrating Watershed and Coastal Area Management |
| IWEco | Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States |
| IWRM | Integrated water resources management |
| JCCCP | Japan Caribbean Climate Change Partnership |
| JICA | Japan International Cooperation Agency |
| KAP | Knowledge Attitude and Practice |
| km | Kilometer |
| kW | kilowatt |
| kWh | Kilowatt hour |
| LDC | Least Development Country |
| LED | Light Emitting Diode |
| LEED | Leadership in Energy and Environmental Design |
| LiDAR | Light Detection and ranging |
| LIME | Landline Internet Mobile Entertainment |
| LIS | Land Information System |
| LPG | Liquefied Petroleum Gas |
| LPP | Livelihood Protection Policy |
| LUCELEC | Saint Lucia Electricity Services Ltd. |
| LULUCF | Land Use Land Use Change and Forestry |
| MALFF | Ministry of Agriculture, Lands, Forestry and Fisheries |
| MACC | Mainstreaming Adaptation to Climate Change |
| MDGs | Millennium Development Goals |

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|---|---|
| M&E | Monitoring and Evaluation |
| MALFF | Ministry of Agriculture, Lands, Forestry and Fisheries |
| MCII | Munich Climate Insurance Initiative |
| MOI | Ministry of Infrastructure |
| MEA | Multilateral Environmental Agreement |
| MIS | Management of Information System |
| MOF | Ministry of Finance, Economic Affairs, |
| MOA | Ministry of Agriculture |
| MOH | Ministry of Health |
| MOPD | Ministry of Physical Development |
| MOSD | Ministry of Sustainable Development |
| MOU | Memorandum of Understanding |
| MPA | Marine protected areas |
| MRV | Monitoring Reporting and Verification |
| MSDEST | Ministry of Sustainable Development, Energy, Science and Technology |
| MTDS | Medium Term Development Strategy |
| MW | Mega Watt |
| MWh | Megawatt hour |
| NAMA | Nationally Appropriate Mitigation Action |
| NAP | National Adaptation Plan |
| NASAP | National Adaptation Strategy and Action Plan |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NBTC | National Biodiversity Technical Committee |
| NCCAPP | National Climate Change Adaptation Policy and Plan |
| NCCC | National Climate Change Committee |
| NCCPAP | National Climate Change Policy and Adaptation Plan |
| NCF | National Conservation Fund |
| NCSA | National Capacity Self-Assessment |
| NCSP | National Communications Support Programme |
| NEC | National Environmental Commission |
| NEEP | National Environmental Education Policy |
| NEES | National Environmental Education Strategy |
| NEMO | National Emergency Management Organisation |
| NEMP | National Emergency Management Plan |
| NEMS | National Environmental Management Strategy |
| NEP | National Energy Policy |
| NEP | National Environment Policy |
| NETS | National Energy Transition Strategy |
| NFP | National Focal Point |
| NHS | National Hydrological Services |
| NGO | Non-Governmental Organisation |
| NICE | National Initiative to Create Employment |
| NIE | National Implementing Entity |
| NLP | National Land Policy |
| NMVOC | Non-methane Volatile Organic Compounds |
| $NO_X$ | Nitrogen Oxides |

| | |
|---|---|
| $N_2O$ | Nitrous oxide |
| NOAA | National Oceanographic and Atmospheric Administration |
| NRW | Non Revenue Water |
| NSDC | National Skills Development Centre |
| NTN | National Television Network |
| NURC | National Utilities Regulatory Commission |
| NWP | National Water Policy |
| NWSC | National Water and Sewerage Commission |
| OAS | Organisation of American States |
| OECS | Organisation of Eastern Caribbean States |
| OLADE | Latin-American Energy Organisation |
| PAHO | Pan American Health Organisation |
| PCU | Project Coordinating Unit |
| PEO | Public Education and Outreach |
| PISLM | Partnership Initiative for Sustainable Land Management for Caribbean SIDS |
| POA | Programme of action |
| PPA | Power Purchase Agreement |
| PPCR | Pilot Programme on Climate Resilience |
| PRECIS | Providing REgional Climates for Impacts Studies |
| PROUD | Programme for the Regularisation of Unplanned Devlopment |
| PSA | Public Service Announcement |
| PSEPA | Pointe Sable Environmental Protection Area |
| PSIP | Public Sector Investment Programme |
| PV | Photo-voltaic |
| RCP | Representative Concentration Pathway |
| RD | Relative Difference |
| RDVRP | Regional Disaster Vulnerability Reduction Project |
| REDD+ | Reducing Emissions from Deforestation and Forest Degradation in Developing Countries plus Conservation |
| REDiv | Renewable Energy Division |
| REETA | Renewable Energy and Energy Efficiency Technical Assistance |
| RFP | Request for Proposals |
| RMI | Rocky Mountain Institute |
| RMSE | Root Mean Square Error |
| RRACC | Reducing the Risks to Human and Natural Assets Resulting from Climate Change |
| RSL | Radio Saint Lucia |
| S&T | Science and Technology |
| SALCC | Sir Arthur Lewis Community College |
| SCADA | Supervisory control and Data Acquisition |
| SDED | Sustainable Development and Environment Division |
| SDG | Sustainable Development Goals |
| SDGNCC | National Coordinating Committee for SDGs |
| SEP | Sustainable Energy Plan |
| SETA | Sustainable Energy Technical Assistance |
| SGD | Saint Georges Declaration of Principles for Environmental Management |
| SGP | Small Grants Programme |

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| SIDS | Small Island Developing States |
| SLASPA | Saint Lucia Air and Sea Ports Authority |
| SLBS | Saint Lucia Bureau of Standards |
| SLDB | Saint Lucia Development Bank |
| SLM | Sustainable Land Management |
| SLNT | Saint Lucia National Trust |
| SLSWMA | Saint Lucia Solid Waste Management Authority |
| SMMA | Soufrière Marine Management Association |
| SNC | Second National Communication to the UNFCCC |
| $SO_2$ | Sulphur Dioxide |
| SOPs | Standard Operating Procedures |
| SPACC | Special Programme on Adaptation to Climate Change |
| SPARKS | Scientific Platform for Applied Research and Knowledge Sharing |
| SPC | Segregated Portfolio Company |
| SPCR | Strategic Program for Climate Resilience |
| SPI | Standardized Precipitation Index |
| SPSS | Statistical Package for Social Science |
| SRES | Special Report Emissions Scenarios |
| SST | Sea Surface Temperature |
| STO | Social Transformation Officer |
| STDM | Social Tenure Domain Model |
| SWMA | Solid Waste Management Authority |
| TA | Technical Assistance |
| TAOS | The Arbiter of Storms |
| TEPA | Trade Export Promotion Agency |
| THI | Temperature-Humidity Index |
| TICDF | Taiwanese Technical Assistance through the International Cooperation Development Fund |
| TNA | Technological Needs Assessment |
| TNC | The Nature Conservancy |
| TNC | Third National Communication |
| TOR | Terms of reference |
| TV | Television |
| UNCCD | United Nations Convention to Combat Desertification |
| UNDP | United Nations Development Programme |
| UNECLAC | Economic Commission for Latin America and the Caribbean |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNGA | United Nations General Assembly |
| UNICEF | United Nations International Children's Emergency Fund |
| UNISDR | United Nations Office for Disaster Risk Reduction |
| USAID | United States Agency for International Development |
| UV | Ultraviolet |
| UWI | University of the West Indies |
| VALERI | Vaughn Lewis Institute for Research and Innovation |
| V&A | Vulnerability and Adaptation |
| VCA | Vulnerability and Capacity Assessment |

| | |
|---|---|
| VRA | Vulnerability reduction assessment |
| WACDEP | Water, Climate and Development Programme |
| WASCO | Water and Sewerage Company |
| WB | World Bank |
| WCC | Wildlife Conservation and Education Centre |
| WCR | Wider Caribbean Region |
| WHO | Word Health Organisation |
| WHYCOS | World Hydrological Cycle Observing System |
| WINBAN | Windward Islands |
| WMO | World Meteorological Organisation |
| WRMA | Water Resources Management Agency |
| WTTC | World Travel and Tourism Council |
| XCD | Eastern Caribbean Dollar |
| YAEP | Youth Agricultural Entrepreneurship Programme |

# EXECUTIVE SUMMARY FOR POLICYMAKERS

**CHAPTER 1 – NATIONAL CIRCUMSTANCES** of the Third National Communication, briefly describes Saint Lucia's geography, geology, history, climate, demographics, economic context, key economic sectors including the energy sector, as well as the policy environment relevant to climate change.

Saint Lucia is a Small Island Developing State (SIDS) within the Lesser Antillean Arc of the Caribbean Archipelago. Saint Lucia is part of a volcanically active ridge formed along the subduction zone in the Eastern Caribbean, connecting to the islands of Martinique to the north and St. Vincent and the Grenadines to the south. The island is 42 km long and 22 km wide at its widest point, and its coastline is approximately 158 km in length. The land area is approximately 616 $km^2$. The coastal shelf has an area of 522 $km^2$, is relatively narrow and drops off sharply along the west coast. Saint Lucia's Exclusive Economic Zone (EEZ) is approximately 15,300 $km^2$. Saint Lucia has a very rugged landscape, characterized by mountains along a centrally located north-south oriented mountain range, deep valleys and rivers. Saint Lucia is almost entirely of volcanic origin, with the oldest rocks dating back to the Early Tertiary period.

Saint Lucia lies within the north-east Trade Wind belt, and is normally under an easterly flow of moist warm air. The island's location in the Atlantic Ocean/Caribbean Sea, means that average ambient sea surface temperatures vary little from 26.7$^{o}$C at any given time. The island receives an almost constant amount of surface solar radiation over time. These factors combine to give Saint Lucia a tropical maritime climate characterized by warm air temperature averaging near 28$^{o}$C, but rarely rising above 32$^{o}$ C or falling below 21$^{o}$C.

The island's weather is influenced by synoptic weather systems such as the Atlantic High Pressure system (Bermuda Azores), surface, mid and upper level low pressure systems, the Inter-Tropical Convergence Zone, tropical waves and cyclones and the occasional frontal system. Mesoscale and microscale weather features also affect the island.

The island has two climatic seasons, based on rainfall. The wet season extends from June to November while the dry season runs from December to May. The volume of rainfall in the wet season is determined mainly by the frequency and intensity of tropical disturbances (waves, depressions, storms, hurricanes) which account for the greater amount of the recorded rainfall during that season. Local convectional showers and other weather systems account for the remainder. In the dry season, most of the rainfall originates from mid-latitude systems (troughs, frontal troughs, jet streams) intruding into the region. The intrusion of dry season rain-producing systems is randomly distributed temporally, and thus, the rainfall they produce over the island is highly variable over time. Saint Lucia has experienced drought conditions each year since 2012, resulting in a decline in both the total annual and temporal distribution of rainfall. On the other hand, tropical disturbances in the wet season tend to occur with a predictable frequency of roughly one every four days. The geographic influence of rainfall is quite pronounced with amounts varying from about 1265mm in the relatively flat coastal regions to about 3420mm in the elevated interior region.

Saint Lucia had an estimated population of 172,623 in 2015. The population is relatively young, with 46.9% below 30 years old and 12.6% sixty years and older. The Castries district has the highest population density. Of the total 2010 population[1], 65,656, or 39.6% lived in the city and its suburbs. Gros Islet, which is the tourism centre of Saint Lucia is the next most populous district with 25,210 persons, representing 15.2% of the total population. Saint Lucia attained universal secondary education in 2006. In 2015 overall unemployment stood at 24.1%.

Saint Lucia joined the Caribbean Community (CARICOM) in 1974. In 1981, Saint Lucia also became a member of the Organisation of Eastern Caribbean States (OECS). Saint Lucia cooperates with other member states of CARICOM and the OECS in economic integration, foreign policy coordination and functional cooperation. In climate change, CARICOM has made strides in coordinating a regional response through, the creation of the Caribbean Community Climate Change Centre (CCCCC) through which a number of regional projects to address climate change mitigation and adaptation have been, and continue to be implemented in Member States. The current 2011-2021 Regional Framework for Achieving Development Resilient to Climate Change, and its implementation plan, are currently being updated to more adequately respond to the challenges facing the region in the upcoming next decade.

In 2015, Saint Lucia's GDP stood at XCD$2,498.4 million, an increase of 1.3% over 2014. Since 1990, the economy has undergone a structural adjustment that has seen the service sector, and in particular, tourism, leading economic growth. Between 1990 and 2015, the contribution of agriculture declined from 13.85% to 3.00% of GDP while the tourism sector's contribution moved from 9.18% to 10.9%. Real estate, construction and the transport (road, air and sea) sectors are the leading contributors to GDP. The percentage contributions of key economic sectors to GDP between 2000 and 2015 are listed in Table E1. Sectors which are more sensitive to the vagaries of Climate (shown in italics and bold font in Table E1), together accounted for 60.7% of GDP in 2015, underscoring the vulnerability of the local economy to the impacts of climate change.

Key public sector policies and measures under the Saint Lucia Development Strategy 2012-2016 Sectoral Action Plan are described in the report, for the following sectors:

1. The Macro Economy
2. Tourism
3. Agriculture
4. Manufacturing
5. Information and Communications technology
6. Creative Sector
7. Human Resource Development, Science and Technology
8. Population, Youth Employment and Technology
9. Physical Planning and Infrastructure
10. Environment and Physical Development
11. Renewable Sources of Energy
12. Housing and Human Settlements
13. The Environment Protection and Preservation Framework
14. Watershed Management
15. Disaster Risk Management
16. Social Services, Social Justice and Governance

[1] Central Statistics Office, Saint Lucia.

**Table E1. Sector Contribution to GDP (XCD billions)**

| Gross Domestic Product at 2005 Constant Prices | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Industry Contribution to the Economy (%) | | | | | | | | | |
| **Economic Activity** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** | **2012** | **2014** | **2015** |
| **GDP (XCD billions)** | 2.14 | 2.05 | 2.31 | 2.47 | 2.57 | 2.54 | 2.54 | 2.48 | 2.50 |
| ***Agriculture, Livestock, Forestry, Fishing*** | *6.26* | *5.65* | *4.50* | *3.55* | *4.41* | *3.02* | *2.95* | *2.8* | *3.0* |
| Mining and Quarrying | 0.09 | 0.10 | 0.03 | 0.28 | 0.32 | 0.30 | 0.51 | 0.1 | 0.1 |
| Manufacturing | 4.92 | 4.92 | 5.24 | 4.90 | 4.93 | 5.06 | 4.81 | 4.7 | 4.8 |
| ***Construction*** | *11.1* | *9.23* | *11.55* | *12.16* | *10.65* | *9.73* | *9.54* | *7.3* | *7.8* |
| ***Electricity and Water*** | *3.80* | *3.98* | *3.87* | *3.84* | *3.93* | *4.24* | *4.31* | *4.4* | *4.4* |
| Distributive Trade Services | 7.35 | 7.01 | 7.34 | 9.19 | 9.20 | 7.65 | 8.44 | 7.6 | 7.5 |
| ***Hotels and Restaurants*** | *10.5* | *9.85* | *10.63* | *10.21* | *9.57* | *10.30* | *9.84* | *11.0* | *10.9* |
| ***Transport*** | *11.4* | *11.96* | *12.71* | *10.93* | *12.66* | *12.69* | *11.77* | *13.1* | *13.4* |
| ***Communication*** | *6.06* | *7.40* | *8.11* | *8.89* | *7.43* | *7.60* | *7.16* | *6.0* | *5.7* |
| ***Financial Intermediation*** | *6.47* | *6.48* | *6.04* | *6.87* | *7.63* | *7.50* | *7.81* | *8.0* | *8.9* |
| Real Estate, Renting and Business Activities | 16.4 | 17.55 | 16.06 | 15.94 | 16.01 | 17.16 | 17.50 | 18.9 | 18.4 |
| Public Administration & Compulsory Social Services | 7.32 | 7.23 | 6.26 | 5.94 | 5.83 | 6.23 | 6.46 | 6.8 | 6.7 |
| Education | 4.76 | 4.75 | 4.10 | 3.88 | 3.89 | 4.15 | 4.30 | 4.5 | 4.4 |
| ***Health*** | *2.17* | *2.20* | *1.91* | *1.85* | *1.84* | *1.96* | *2.05* | *2.1* | *2.1* |
| ***Other Community, Social and Personal Services*** | *2.74* | *3.17* | *2.91* | *3.35* | *4.11* | *4.88* | *5.08* | *4.5* | *4.5* |

(Source: Central Statistics Office, Saint Lucia)

Information is provided on sector growth and climate vulnerabilities for the key economic sectors of tourism, agriculture, infrastructure, as well as for other critical sectors such as water, health, energy, biodiversity and land use.

A description of the global, regional and national responses to climate change is also provided. At a national level, the policy environment is detailed, as well as institutional arrangements to implement the Convention. A comprehensive listing of climate programmes and projects is provided.

**CHAPTER 2–NATIONAL GREENHOUSE GAS INVENTORY**, responds to the UNFCCC requirement of all parties to the Convention to update and report periodically on their inventory of anthropogenic emissions and removals of greenhouse gases (GHGs). Following the recommendation of the Intergovernmental Panel on Climate Change (IPCC) this inventory reports greenhouse gas emissions and removals by sinks for years between and including 2000 and 2010. The greenhouse gas inventory was conducted on a sector basis for the following IPCC category sectors; Energy, Industrial Processes, Solvent and Product Use, Agriculture, Land Use, Land-Use Change and Forestry (LULUCF) and Waste. The GHGs included are Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O) and partially fluorinated hydrocarbons (HFCs) not covered under the Montreal Protocol. Indirect GHGs including Non-Methane Volatile Organic Compounds (NMVOC), Carbon Monoxide (CO) Nitrogen Oxides (NOx) and Sulphur Dioxide (SO2) are also reported as they have an important influence on chemical reactions in the atmosphere that can lead to the formation of greenhouse gases.

GHGs are expressed as Carbon Dioxide Equivalent ($CO_2$eq) by IPCC sectors. $CO_2$eq expresses the overall radiative forcing of different GHGs by a common metric, so that the relative importance of emissions of GHGs such as $CO_2$, $CH_4$ and $N_2O$ can be easily compared. Figure 0.1 indicate the relative contribution of the four main greenhouse gases to total emissions for each of the inventory years 2000, 2005 and 2010. Figure E1 excludes the LULUCF sector and Figure E2 includes the impact of LULUCF.

**Figure E1: Total Greenhouse Gas Emissions expressed in $CO_2$eq Excluding LULUCF (Gg)**

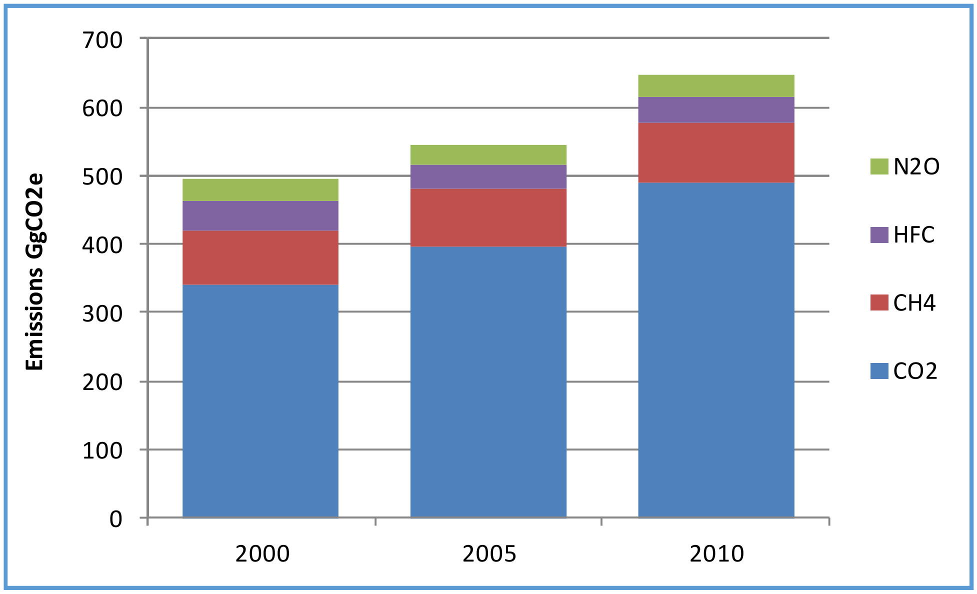
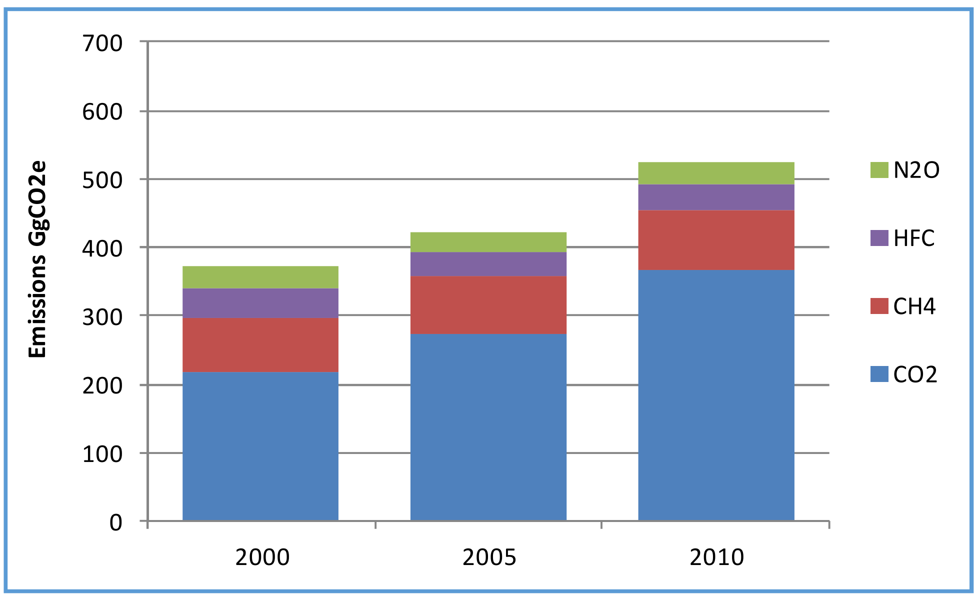



**Figure E2: Total Greenhouse Gas Emissions expressed in $CO_2$e Including LULUCF (Gg)**




Overall GHGs in Saint Lucia have increased at a rate similar to overall economic growth over the same period. Average annual growth in emissions excluding LULUCF was 2.7% per year and including LULUCF it was 3.5% per year. Average economic growth for Saint Lucia over the same time period was estimated at 2.5% (World Bank, 2014).

$CO_2$eq mission growth is primarily driven by the growth in energy emissions related to increased demand for fossil fuels. Emissions in the energy sector increased on average by 3.1% annually between 2000 and 2010. Emissions from the waste sector that are dominated by the solid waste disposal source category are growing at a slower rate of 1.1% annually. Industrial Processes and Agriculture emissions remain virtually unchanged since 2000. Estimates of emissions and removals for the LULUCF sector indicated that LULUCF acts as a large carbon sink. Accounting for this LULUCF removal decreases overall $CO_2$eq emissions by approximately 18%.

Trends in total $CO_2$eq emissions for each IPCC category over 2000 to 2010 are shown in

Figure 0.14E3 excluding the LULUCF sector. Figure 0.15 identifies the emissions profile with the LULUCF sector contributing as a net sink.

**Figure E3: Greenhouse Gas Emissions in GgCO2e excluding LULUCF (2000-2010)**

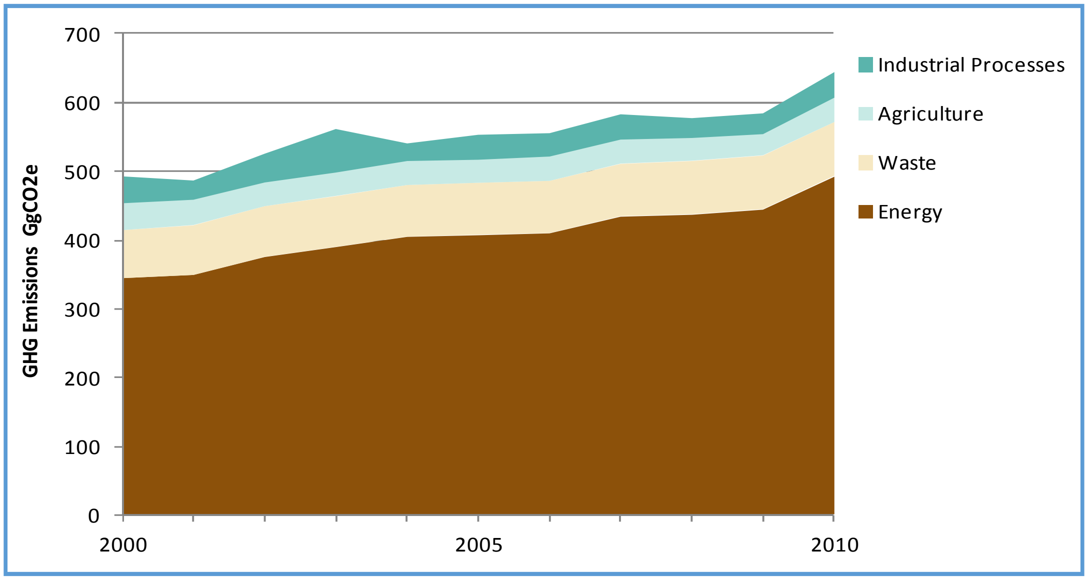
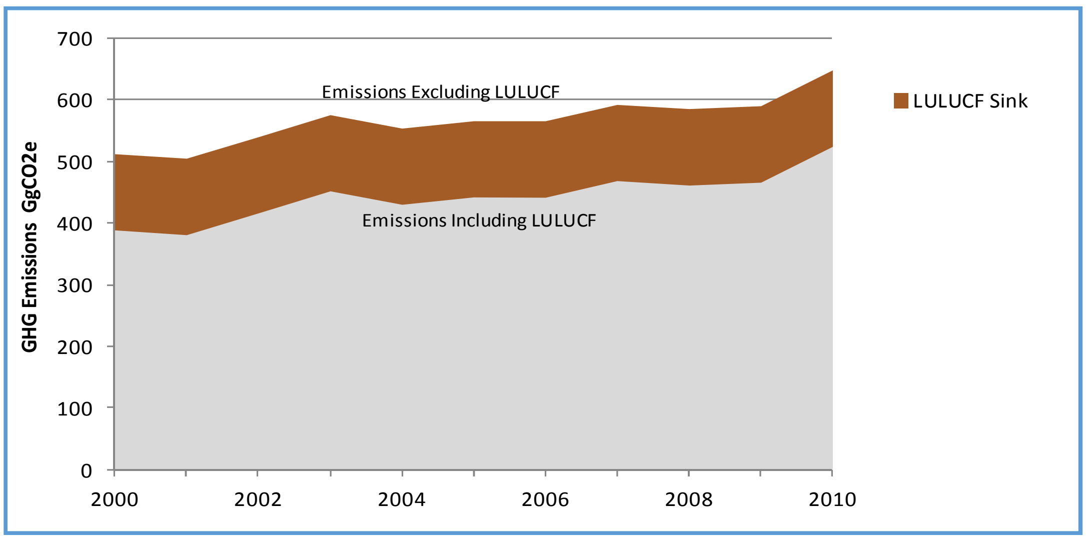



**Figure E3: Greenhouse Gas Emissions in MtCO2e including LULUCF (2000-2010)**




GHG emission contributions by sector and GHGs are summarized in Table 0.1 for the year 2010. The percent share of emissions by sector is shown in the last column of Table E2. LULUCF removals that reduce total emissions by 19% are indicated at the bottom of Table E2.

**Table E2: Summary of Greenhouse Gas Emissions and Removals in 2010 by Sector (Gg)**

| Sector | Emissions (Gg) | | | | | Percent Share (%) |
|---|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | HFC | Total in $CO_2e$ | |
| Energy | 489 | 0.119 | 0.005 | - | 493 | 76% |
| Industrial Processes | - | - | - | 0.023 | 36 | 5.6% |
| Solvent and Product Use | - | - | 0.007 | - | 2 | 0.3% |

| Sector | Emissions (Gg) | | | | | Percent Share (%) |
|---|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | HFC | Total in $CO_2e$ | |
| Agriculture | - | 0.508 | 0.082 | - | 37 | 5.7% |
| Waste | - | 3.55 | 0.012 | - | 78 | 12.1% |
| **Total Emissions** | **493** | **4.18** | **0.105** | **0.023** | **647** | **100%** |
| LULUCF | -122 | - | - | - | -122 | -19% |
| **Total Emissions and Removals** | **367** | **4.18** | **0.105** | **0.023** | **524** | **81% of total emissions** |

**CHAPTER 3–MEASURES TO MITIGATE CLIMATE CHANGE,** recognises the serious threats posed by climate change to Saint Lucia, and the requirement to secure the country's development against the adverse impacts of climate change. Saint Lucia has undertaken a detailed mitigation assessment, through this TNC, to determine proposed mitigation actions in response to the climate change challenge. The mitigation assessment will enable Saint Lucia to reduce the country's vulnerability to climate risk and allow Saint Lucia to prosper under a changing climate. Additionally, it will assist Saint Lucia in supporting global efforts to reduce GHGs.

The report presents Saint Lucia's mitigation evaluation analysis, describing the mitigation options undertaken in the six IPCC and UNFCCC mitigation sectors. Five of these are listed in the first column of Table E1 below, with the sixth being industrial processes. The assessment is a bottom-up assessment of mitigation opportunities that have been proposed and selected based on broad national consultation. Many of the mitigation options presented are already in the initial stages of planning and preparation. However additional finance to support implementation to achieve the emission reduction potentials is required. Ten prioritised mitigation actions were selected based on current evidence of alignment with government priorities; GHG mitigation potential and; the possibility to deliver sustainable development and adaptation benefits. These mitigation actions and expected emission reductions are summarized in Table 3..

The total emission reductions represent a decrease in baseline emissions of 11% from 2020, 14% from 2025 and 16% from 2030. Relative to 2014, the growth in emissions declines from an average emission growth rate of 1.4% per year to 0.4% per year. Emission reductions of the mitigation actions relative to the baseline are illustrated in Figure 3..

A summary of overall quantifiable sustainable development benefits related to implementing mitigation actions is provided in Table E4. Some additional benefits are difficult to monetize. These include increased GDP, employment, time savings related to reduced traffic congestion and climate change resiliency benefits such as water resource protection and wildlife habitat protection.

**Table E3: Summary of Mitigation Actions and Reduction Potentials**

| Sector | Prioritized Mitigation Actions | 2015 | 2020 | 2025 | 2030 | % of Overall Reductions (2015 to 2030) |
|---|---|---|---|---|---|---|
| **Energy Demand** | Energy Efficient Buildings | 0 | 2.0 | 4.8 | 7.0 | 4.5% |
| | Energy Efficient Appliances | 0 | 6.5 | 10.7 | 7.2 | 5.8% |
| **Electricity Generation** | 35% Renewable Energy Target by 2020 (Average of 3 scenarios) | 0 | 44.1 | 44.1 | 44.1 | 41.9% |

| Sector | Prioritized Mitigation Actions | 2015 | 2020 | 2025 | 2030 | % of Overall Reductions (2015 to 2030) |
|---|---|---|---|---|---|---|
| | Improvements to Grid Distribution and Transmission Efficiency | 0 | 6.6 | 7.3 | 8.1 | 7.4% |
| **Transportation** | Efficient Vehicles | 0 | 10.1 | 16.2 | 23.4 | 15.1% |
| | Improved and Expanded Public Transit | 0 | 0.3 | 1.8 | 3.0 | 1.6% |
| **Agriculture and Land-Use, Land-Use Change and Forestry (LULUCF)** | Agroforestry | 0 | 1.6 | 7.9 | 7.9 | 5.4% |
| | Forestry Management and Reforestation | 0 | 7.3 | 13.5 | 17.2 | 12.5% |
| **Waste** | Water Distribution and Network Efficiency | 0 | 0.8 | 1.9 | 2.1 | 1.6% |
| | HFC Phase-Out | 0 | 0.7 | 4.7 | 8.5 | 4.3% |
| **TOTAL Emission Reductions** | | **0** | **78.1** | **108** | **128** | **100%** |

**Figure E5: Emission Reductions for all Mitigation Actions ($GgCO_2e$)**

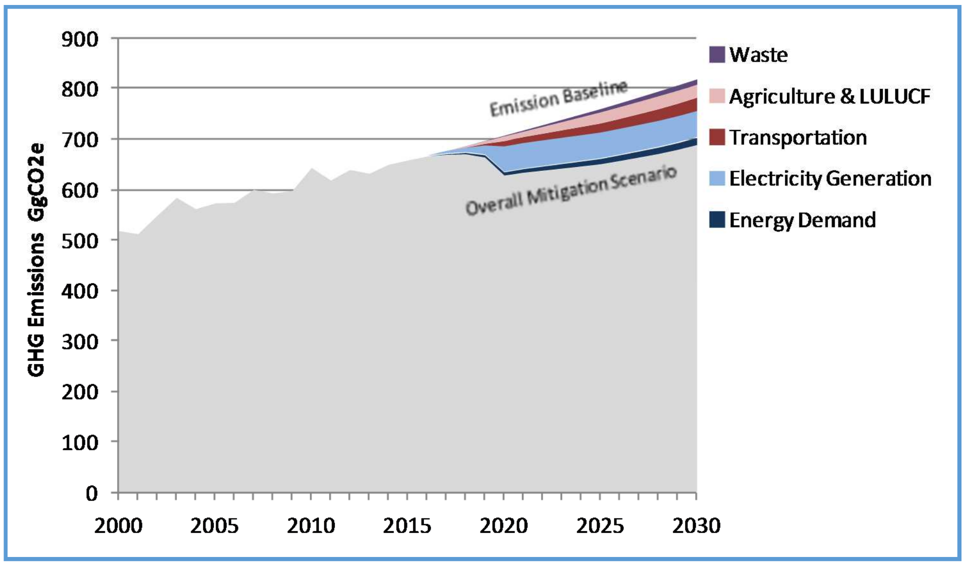


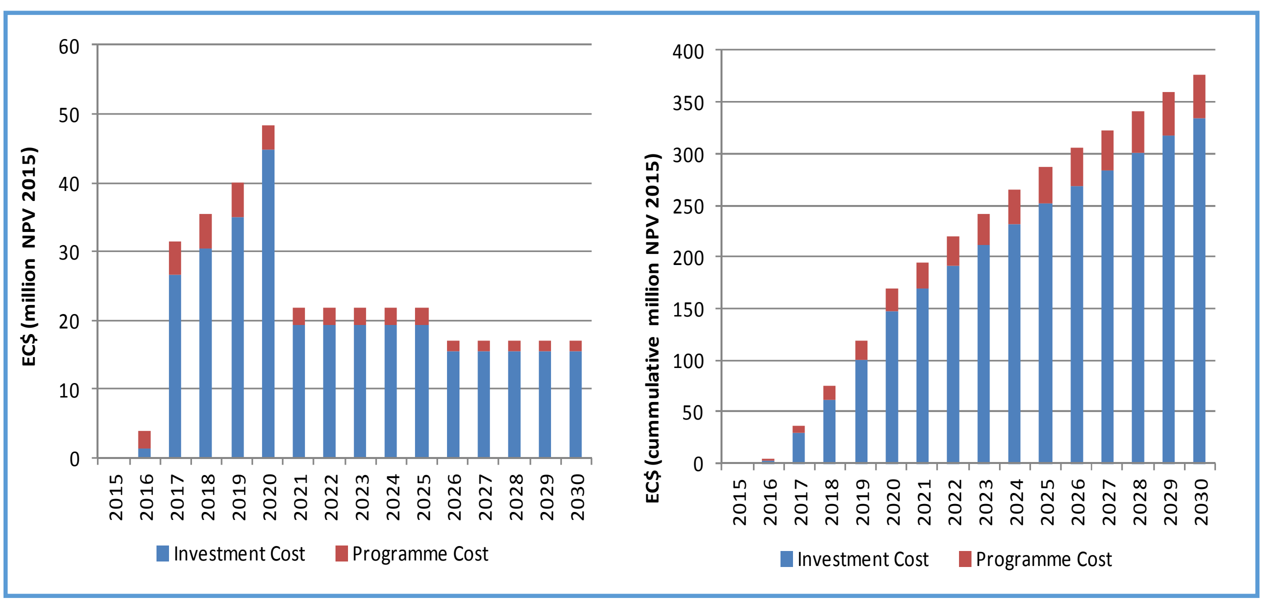
**Table E4. Summary of Sustainable Development Benefits**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| **GDP / Macro-economy** | Foreign exchange is reduced as a result of reduced demand for fuel. At 2014 average wholesale prices: EC$93 million per year by 2030. |
| **Energy Security** | Reduced overall demand: 26 million litres of diesel and 7.4 million litres of gasoline. |
| **Environment / Health** | Fuel combustion results in air pollutants that are in turn related to health risks including increased mortality and morbidity.<br>Overall emission reductions estimated at:<br>525 tonnes of nitrogen oxides (NOX)<br>2,200 tonnes of carbon monoxide (CO)<br>416 tonnes of non-methane volatile organic compounds (NMVOC)<br>37 tonnes of sulphur dioxide (SO2) |
| **Households** | Energy savings: $EC230 million between 2015 and 2030 |
| **Industry / Commercial** | Energy savings: $EC71 million between 2015 and 2030 |
| **Government** | Energy savings: $EC106 million between 2015 and 2030 |

Total investment and programme costs related to implementing the mitigation options are summarized in Figure E6 and E7. Investment costs refers to the total capital finance required to implement the mitigation actions that is incremental to baseline expenditures. This does not include the energy savings associated with implementing measures or changes in operating costs. Programme costs refer to expenditures by the government for supporting the programme and include costs for planning, conducting studies, developing strategies, implementing regulations, enforcement, capacity building, public awareness campaigns and capacity building.

Figure E6 identifies annual investment and programme costs and represent net present value (NPV) in current 2015 Eastern Caribbean Dollars (EC$2015). Figure E7 identifies the cumulative investment and programme costs over time.

**Figure E6: Annual Investment & Programme Costs Figure E7: Cumulative Investment & Programme Costs**



Total cumulative investment costs by 2030 are expected to be $EC 334 million while programme costs are estimated to be $EC 43 million. These costs are offset by energy savings and other benefits. It should be noted that expected net present value of energy savings of $EC361 million over the same time period are approximately equal to total investment costs and programme costs.

**Chapter 4–Measures to facilitate adequate adaption to climate change**, summarises the findings of the Vulnerability and Adaptation (V&A) assessment undertaken for the TNC of Saint Lucia. It focuses on a number of key socio-economic sectors of Saint Lucia including coastal development, agriculture including livestock, water, tourism, health, financial services and vulnerable settlements.

The sectoral V&A assessments were based on the scenarios of two of the more highly ranked downscaled global climate models. Two regional downscaled climate change scenarios provided requisite data for the pertinent climate variables. These included air temperature, rainfall, solar radiation and evaporation, on an annual, monthly and daily basis for a current 30-year period (1986-2014) and two future 30-year time slices (2040-2068 and 2070-2098), to cover the period of 1961 to 2100 for Saint Lucia. Nine (9) grid points (on a 25 km grid in and around Saint Lucia) were used for the mapping of minimum temperature (Tmin), maximum temperature (Tmax), mean temperature (Tmean), precipitation (rainfall) and water excess and deficits (P-E) for the entire island. For analysis of the socio-economic sectors, the lone land-based grid point located about 5 km north-east of Soufrière in the Forest Reserve was used. The models' results for temperature and rainfall are summarized in Table E5.

The ***coastal zone*** assessment revealed Saint Lucia's vulnerability to sea level rise and storm surges. As such, ecosystems (mangroves, sea grass, coral reefs), cities (Castries), infrastructure (e.g. buildings, roads, ports) and communities (e.g. fishing villages, coastal agricultural land) are likely to be at high risk to climate change and variability. Adaptations options and barriers to adaptation to climate change were identified. Adaptation options included economic resources, technical knowledge, adaptive capacity, land availability for displaced peoples. Possible opportunities and priorities for enabling effective and proactive adaptation to climate change and sea level rise in the coastal zone of Saint Lucia were identified. These include coastal protection infrastructure, enforcement of coastal zoning changes and setback limits.

In the ***water sector***, according to both downscaled climate scenarios changes in total annual rainfall are minimal, but changes in the variability (timing, amount and intensity) are expected to be significant in the future (2040-2069 and 2081-2100). The incidence of droughts as estimated by the Standardized Precipitation Index (SPI) does not change significantly, in spite of slight increases in intensity and frequency in the future (2040-2069 and 2081-2100), and continue to remain in the 'near normal' range according to both the downscaled climate scenarios. Water deficits are expected to increase slightly in the future (2040-2069 and 2081-2100) according to both the downscaled climate scenarios. Adaptation options in the water sector focused mainly on water conservation measures.

In the ***agriculture sector***, the focus was on crop yield changes in response to climate change. Three crops were chosen for study namely, taro/tanya (a root crop), tomato (a vegetable crop) and banana (a commercial crop). The results according to both downscaled climate models, show that taro and tomato yields are expected to decrease in the future (2040-2068 and 2070-2098). Banana yields are expected to increase during the two future periods (2040-2068 and 2070-2098). For the live-stock sub-sector, the results show that small ruminants (pigs and goats) and chicken will be negatively affected by climate change in the future (2040-2068 and 2070-2098). An assessment of the adaptive capacity of farmers showed that social capital and institutions, climate change and variability and water availability and supply were among the main factors affecting the ability of farmers to adapt to climate change. Adaptation options for the agriculture sector focused on technological innovations, government programs, farm production and farm management.

**Table E5. Results from two models for future projected changes in temperature and rainfall**

| Climate variable | Time slice | Model | Projected change (compared to 1981-2015) |
|---|---|---|---|
| Air temperature – wet season | 2040-2069 | 1 | ~1.75 0 C |
| Air temperature – wet season | 2040-2069 | 2 | ~1.25 $^{0}$C to ~1.75 $^{0}$C |
| Air temperature - dry season | 2040-2069 | 1 | ~2.5 0 C |
| Air temperature - dry season | 2040-2069 | 2 | ~1.25 0 C |
| Air temperature – wet season | 2081-2100 | 1 | ~ 2.75 0 C to > 3.0 0 C |
| Air temperature – wet season | 2081-2100 | 2 | ~ 3.00 $^{0}$C to ~ 3.25 $^{0}$C |
| Air temperature - dry season | 2081-2100 | 1 | ~ 2.75 0 C to > 3.0 0 C |
| Air temperature - dry season | 2081-2100 | 2 | ~ 3.0 $^{0}$C to ~ 3.25 $^{0}$C |
| Rainfall - wet season | 2040-2069 | 1 | Decreases in seasonal (June to December) rainfall in the future (2040-2069) along the western coast, ranging from ~ - 25 mm/season to ~ - 20 mm/season near Soufrière. For the rest of the island decreases in seasonal rainfall range from ~ - 60 mm/season along the east coast to ~ - 35 mm/season in the interior. |
| Rainfall – wet season | 2040-2069 | 2 | General decrease in seasonal (June to December) rainfall in the future (2040-2069), for most of the island, of the order of ~ - 75 mm. |
| Rainfall – dry season | 2040-2069 | 1 | Greater decreases in seasonal (January to May) rainfall in the future (2040-2069), especially along the eastern coast and of the order of ~ - 75 mm/season. For the rest of the island covering most of the west coast and the central regions, decreases in seasonal rainfall range from ~ - 100 mm/season to ~ - 125 mm/season in the interior. |
| Rainfall – dry season | 2040-2069 | 2 | Generalized decline in seasonal rainfall, with the decrease being of the order of ~ - 75 mm/season over most of the island. |
| Rainfall - wet season | 2081-2100 | 1 | Significant decreases in seasonal (June to December) rainfall, especially along the western and central parts of the country, ranging from ~ - 350 mm/season to ~ - 400 mm/season. |
| Rainfall – wet season | 2081-2100 | 2 | General increase in seasonal (June to December) rainfall in the future (2081-2100) for most of the island, of the order of ~ + 65 mm to ~ + 75 mm for most of the island. |
| Rainfall – dry season | 2081-2100 | 1 | Lesser decreases in seasonal (January to May) rainfall, averaging ~ 75 mm/season over most of Saint Lucia. |
| Rainfall – dry season | 2081-2100 | 2 | Generalized decline in seasonal rainfall, the decrease being of the order of ~ - 75 mm/season over most of the island. |

The current contribution of the ***tourism sector*** to the economy of Saint Lucia is acknowledged. Climate change along with sea level rise will directly and indirectly affect the tourism sector. Direct impacts will very likely result in loss of beaches, properties and public infrastructure and will make Saint Lucia less attractive as a tourist destination. Beach and reef-based activities attract the majority of foreign tourists.

Coral mortality from climate change and other human-induced impacts are likely to reduce the appeal of underwater recreational activities to visitors. The loss of beaches and coastline due to erosion, inundation and coastal flooding and loss of tourism infrastructure, natural and cultural heritage will reduce the amenity value for coastal users. The overall effect of a changing climate on Saint Lucia's tourism industry will be a loss of employment and higher insurance costs for properties in vulnerable areas.

Increases in air temperature (2˚C to 3˚C) towards the end of the century may make conditions unbearable, especially for the elder retired tourist, who make up a significant segment of the visitor population to Saint Lucia. Projected variability in precipitation will very likely lead to extreme conditions, with increasing drought in the dry season and torrential rains and flooding in the rainy season, and to water and food shortages (or higher prices of imported items). Tropical storms and hurricanes, compounded by sea level rise, are also likely to increase in number and intensity, and apart from flooding and erosion of recreational beaches, will also very likely cause flooding and damage to transport and other infrastructure. Demand-based considerations include weather conditions in countries of origin of tourists (mainly North America and Europe), perception issues such as security from extreme weather events and pricing policies for transport, lodging and entertainment may also contribute to the impacts on the sector.

For the ***health sector***, the emphasis was on vector-borne diseases (Dengue in particular), water-borne diseases (Gastroenteritis) and air quality-related diseases (respiratory diseases). The analysis also focused on the sex and age of people likely to be affected. There appears to be some relationship between the incidence of dengue and gastroenteritis and rainfall in the future (2040-2069 and 2081-2100) under the climate scenarios considered.

Vulnerabilities of ***critical infrastructure related to the Financial Services Sector*** (FSS) to future (2040-2065 and 2081-2100) climate change, climate-driven sea level rise and storm surges, within the coastal zone in the vicinity of Castries were examined. Infrastructure pertaining to the Financial Services sector (buildings, airport, ports and harbours, roads and bridges, electricity and telephone and telecommunication lines) that are likely to be at high risk to climate-driven sea level rise and storm surges were identified. Other climate change factors that may affect such infrastructure were examined, included high winds during storms and hurricanes, excessive rainfall and flooding, and extended droughts affecting water supply to financial institutions.

Since critical infrastructure (buildings, roadways, bridges, data storage facilities) that are located in the near shores will very likely come under direct threat as a result of sea level rise and storm surges, the insurance sector may increase premiums which will be passed on to consumers. As clients become more aware of the impacts of climate change and they attempt to reduce their vulnerability, the FSS will face increased demand for insurance coverage and bank loans to address adaptation concerns. This will require a broadening of FSS portfolios. Other factors that may affect the FSS will very likely include safety and security concerns, evacuation measures and plans (in response to hurricanes, droughts, etc.), comfort levels for workers in buildings (air conditioning under very hot conditions), and economic and governance issues relating to the security of investments.

Climate change and sea level rise will very likely affect ***vulnerable groups*** such as women, children and the elderly who are already beset by socio-economic and psycho-social problems, such as abject poverty; food insecurity and lack of proper diet; inadequate sanitary conditions and water quality; lack of education and labour skills; and poor housing and shelter. It is very likely that these living conditions will be exacerbated by climate change and climate-driven sea level rise and storm surges. The complex interactions of livelihoods, poverty and inequality with climate change, climate variability, and extreme events are explored, and impacts of climate change projected up until 2100. Observed evidence suggests that climate change and climate variability worsen existing poverty, exacerbate inequalities, and trigger new vulnerabilities. It is acknowledged though, that climate change is rarely the only factor that affects livelihood trajectories and poverty dynamics; climate change interacts with a multitude of non-climatic factors, which makes detection and attribution a challenge.

**Chapter 5– Other relevant information (ORI) to the achievement of the objectives of the UNFCCC,** covers six broad areas:

1. Steps taken to integrate climate change considerations into national development and policy formulation
2. Activities related to transfer of environmentally sustainable technologies
3. Information on climate change research and systematic observation
4. Information on climate change education, training, and public awareness
5. Information on capacity building activities, options and priorities
6. Measures to promote information exchange and networking

Since the preparation of the Second National Communication (SNC) there has been an infusion of climate change considerations into a variety of regional, national and sectoral policies. However, a number are still in draft form, and implementation of recommendations is quite low. Many stakeholders are calling for improved implementation of recommendations and more tangible action at the community level, if significant social, environmental and economic benefits on the ground are to be realised. The re-structuring of the policy environment and legal framework for the energy sector appears to be quite advanced, and construction of a 3MW solar project in the south, spearheaded by the power utility Saint Lucia Electricity Services Limited (LUCELEC), is projected to commence in 2017.

Saint Lucia has not yet succeeded in continuously generating and managing relevant and reliable environmental research data on a timely basis to guide and inform national decision making, public policy and development planning. Many agencies have a climate-relevant research and/or systematic observation responsibility, and some of their persistent needs will be addressed through initiatives planned under the PPCR/ DVRP. A Technology Needs Assessment (TNA) was undertaken in 2017, and development priorities and suggested technological responses were identified. Centralisation of certain actions at a regional level was also recommended to accelerate technology transfer, as well as improved synchronization of regional activity with national development priorities.

The role of the NCCC in sharing information between many relevant agencies and facilitating their networking and collaboration is acknowledged. In 2017 Cabinet endorsed signing of the Principle 10 Declaration on Access to Information by Saint Lucia. Principle 10 seeks to ensure that every person has access to information, can participate in the decision-making process and has access to justice in environmental matters. This aims to safeguard the right to a healthy and sustainable environment for present and future generations. In that regard, finalization and enactment of the Freedom of Information Bill to give the public a general right of access to official documents is also recommended in the ORI report.

A number of Knowledge Attitude and Practice (KAP) studies have been undertaken since 2010, with the latest being completed in 2017. The findings of these reports suggest that awareness of climate change has increased slightly. Most householders still view tackling climate change as a responsibility of the government of Saint Lucia and have little awareness of government initiatives to tackle climate change. The majority felt that information relayed on climate change was inadequate, and that increased education was a priority. Further, many felt that they were not in a position to make an impact in responding to climate change. In response, the Strategic Program for Climate Resilience (SPCR) gives special emphasis to PEO with the objective of empowering the general public to take meaningful action to build resilience at a national level. The main constraint to sustained PEO activities by public sector agencies is funding. Although there is significant collaboration among agencies in engaging communities on the ground, this is not institutionalised.

Gaps in human capacity in the public sector, both in terms of numbers and breadth of skills, need to be addressed. This will enable government agencies may fulfil their many roles more effectively, including those of data management, application and research, and transferring knowledge to the communities. Capacity building efforts are needed to transform finite projects into programmes that are sustained and expanded within the target communities. Most if not all climate projects have a capacity building component, but the reach of these has so far not been extensive enough to realise material improvements within the demographics targeted. More capacity building is required in the private sector and civil society in order to facilitate their uptake of adaptation and mitigation measures, and to access available climate funds. One of the key public sector agencies to facilitate this is the Ministry of Finance, which is currently engaged in readiness activities for accessing the Green Climate Fund (GCF).

A greater understanding of the risk of loss and damage to vulnerable economic sectors is required to avoid a situation of "abandon and retreat" in many coastal areas. Beyond understanding, decision makers will require the appropriate tools to be able to determine the expected magnitude and timing of impacts and develop plans for addressing them. Further, losses are being experienced today, with the risks of loss and damage starkly rising with increasing temperatures. With the aid of adequate and timely support, Caribbean countries like Saint Lucia will have to be equipped to respond to situations where climate change impacts overwhelm their coping capacities.

Saint Lucia has achieved substantial gains by way of integrating climate change considerations at the national and sectoral levels, promoting awareness of climate change issues, providing the necessary enabling environment and improving on the technology needs to facilitate data collection on key climate parameters. The country is poised to make significant strides towards infusing adaptation and mitigation measures into the daily lives and actions of people through the implementation of a number of climate and related programmes, projects and activities. Continued implementation of the proposed current and future initiatives will undoubtedly advance the country's progress on the path to sustainability in the face of climate change. The focus must be on initiatives that increase the uptake of recommended adaptation and mitigation measures by the population, that are consistent with, and supportive of, attaining the country's national development goals.

**Chapter 6– Constraints and gaps, and related financial, technical and capacity needs to the achievement of the objectives of the UNFCCC,** records progress against gaps identified in the SNC, and identifies persistent gaps as well as new challenges. In this regard, cross cutting information management is examined, as well as sectors such as agriculture, forestry, marine biodiversity, coastal zone, critical infrastructure, disaster management; financial services; health; human settlements; tourism; and water.

Broadly speaking, gaps identified relate to:

1. Inadequate financial, technical and human resources in all sectors to implement adaptation and mitigation measures;
2. Inadequate institutional co-ordination to implement measures;
3. Absence of an integrated development planning approach that is cognizant of climate impacts to guide sectoral planning and collaboration;
4. Unavailability and poor management of information required for decision making;

5. Inadequate policy, legal and institutional frameworks
6. inadequate supporting frameworks to enable and empower implementation of desirable adaptation and mitigation measures;
7. Poor enforcement;
8. Inadequate infrastructure; and
9. Low awareness of climate change issues and adaptation and mitigation measures that can be implemented.

In relation to technology transfer, the following barriers were identifed:

1. Costs of purchase and maintenance of technologies;
2. Low financial feasibility at the small scale required;
3. Limited institutional capacities to implement and sustain initiatives;
4. Costs of the supporting institutional structures (regulations, personnel, equipment)
5. Inadequate awareness of climate change impacts and of available technologies; and
6. Limited access to financial resources, especially in low income communities.

Initiatives since the SNC, some of which are still ongoing, relate to:

1. Development of climate-proof sectoral policies and strategies;
2. Budget reform to better integrate climate considerations;
3. Adoption of new technologies;
4. Availability of financing schemes and insurance to increase resilience;
5. Provision of incentives that seek to modify behaviour;
6. Improved research, data collection and management;
7. Development of tools for improved decision making;
8. Capacity building in public agencies and specific target groups;
9. Improved collaboration between agencies;
10. Increased public education and outreach.

Although more work is required, through these initiatives the identified gaps are narrowing. The chapter goes on to identify support provided by the GEF and UNFCCC Annex II parties, and multilateral and bilateral contributions, for climate change adaptation and mitigation. This includes support for the preparation of national communications, and project and programmes that are implemented on both a national and regional basis.

Recommendations for future projects are made. These recommendations emanate from the following source documents:

1. V&A assessments (GOSL, 2016);
2. Mitigation assessment (GOSL, 2014);
3. Climate Finance Readiness Mission to Saint Lucia (Charles, 2014);
4. CCAP-5Cs-USAID (ten project concepts were received under this project, to be reviewed for possible implementation); and
5. The SPCR project identification process (concepts can be found for projects that have not yet been realized, in Appendix 13 of the SPCR).

The Constraints and Gaps chapter, concludes, that more effort is required to facilitate the population’s understanding and implementation of adaptation and mitigation measures. This requires an understanding of how climate change can affect every individual, as well as what is within the power of individuals to address. It requires the transferring of requisite information and providing individuals with the means to implement the desired measures. This may include the offering of incentives, reducing costs of desirable technologies, and providing more tangible support to the vulnerable within the society.

Despite the many efforts to date, climate change information ought to be disseminated more broadly through the public sector. There is need to further build knowledge within the entire public sector, and in particular, among those public officers who interface with the public routinely. Civil society and membership organizations should also be targeted to increase sensitivity of these groups and their membership to climate change in a manner that will encourage application and effect change.

# CHAPTER 1. NATIONAL CIRCUMSTANCES

## 1.1 OVERVIEW

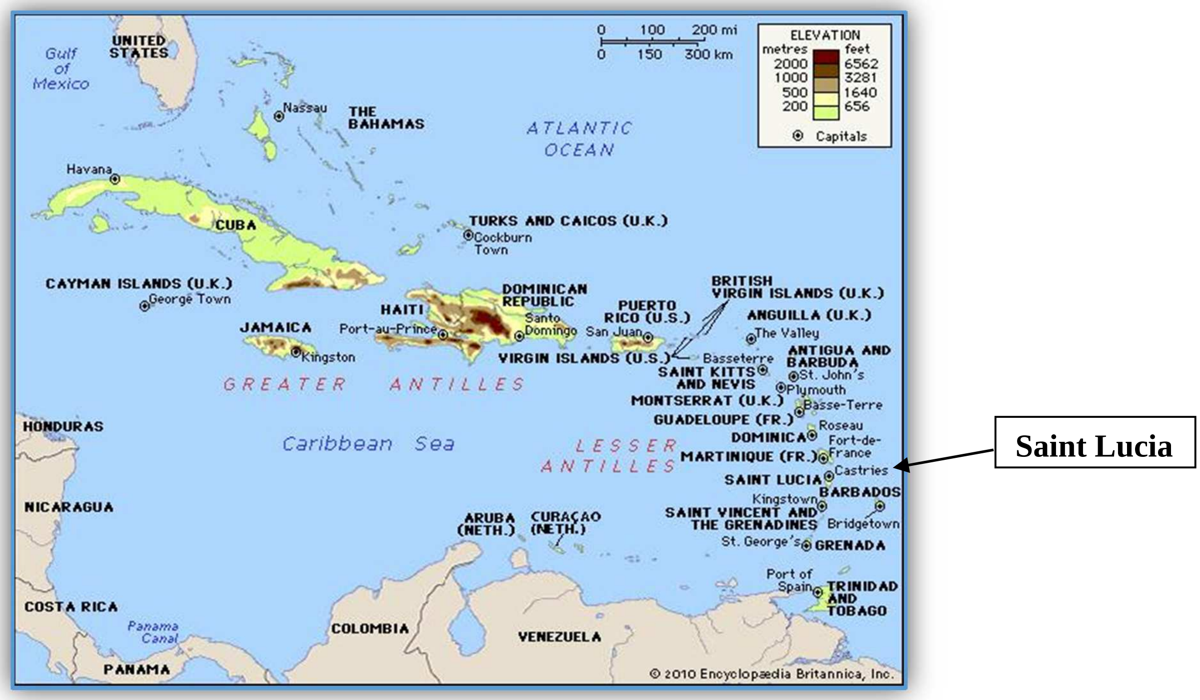
This chapter of the Third National Communications (TNC) briefly describes the geography, geology, history, and climate of Saint Lucia as well as the demographic, policy and economic context during the TNC preparation.

## 1.2 GEOGRAPHY

### 1.2.1 Location

Saint Lucia is a Small Island Developing State (SIDS) located at latitude 13° 59' N, and 61° W within the Lesser Antillean Arc of the Caribbean Archipelago (see Figure 1.1). It is situated on a volcanic ridge connecting to Martinique to the north and St. Vincent and the Grenadines to the south. The island is 42 km long and 22 km wide at its widest point, and its coastline is approximately 158 km in length. The land area is approximately 616 $km^2$. The coastal shelf has an area of 522 $km^2$, is relatively narrow and drops off sharply along the west coast. Saint Lucia's Exclusive Economic Zone (EEZ) is approximately 15,300 $km^2$.

**Figure 4.1: The Caribbean Basin**




Source: http://medis-2.web.britannica.com

### 1.1.1 Topography

Saint Lucia has a very rugged landscape, characterized by mountains along a centrally located north-south oriented mountain range, deep valleys and rivers. The highest point on the island is Mount Gimie at 950m above sea level. The spectacular Pitons are the key features of the Pitons Management Area World Heritage Site. These two volcanic spires rise side by side from the sea to heights of 770m and 743m.

### 1.1.2 Geology

Saint Lucia is almost entirely of volcanic origin, with the oldest rocks dating back to the Early Tertiary period. Similar to the other islands of the Lesser Antilles, Saint Lucia began as a series of submarine volcanoes. It is part of a volcanically active ridge formed along the subduction zone in the Eastern Caribbean. As a result, the island is affected by volcanic and seismic activity. The island's volcanic centres are divided into 3 broad groups based on age and geographic distribution, as follows:

Group 1: Eroded basalt and andesite centres; (the Northern Series)
Group 2: Dissected andesite centres (the Central Series)
Group 3: The Soufrière Volcanic Centre (the Southern Series)

## 1.3 BRIEF HISTORY

The earliest settlers of Saint Lucia were the Amerindian Ciboneys, who lived on the island about 2000 years before Columbus. The island was next occupied by the Arawak Indians from about 200 A.D. for a period of about 800 years. They were invaded by the Kalinago Carib Indians, whom the first Europeans encountered on the island.

In the seventeenth and eighteenth centuries, England and France fought for ownership of the island and changed hands fourteen times between the two countries. Saint Lucia was eventually ceded to Britain in 1814, under the Treaty of Paris.

Saint Lucia gained increasingly greater self-governance in the 20th-century. A 1924 constitution gave the island its first form of representative government, with a minority of elected members in the legislative council. Universal adult suffrage was introduced in 1951, and elected members became a majority of the council. Ministerial government was introduced in 1956, and in 1958 Saint Lucia joined the short-lived West Indies Federation, a semi-autonomous dependency of the United Kingdom. As an associated state of the United Kingdom from 1967 to 1979, Saint Lucia had full responsibility for internal self-government but left its external affairs and defence responsibilities to the United Kingdom. On February 22, 1979, Saint Lucia achieved full independence.

Saint Lucia joined the Caribbean Community (CARICOM) which was established under the 1973 Treaty of Chaguaramas in 1974. In 1981, Saint Lucia also became a member of the Organisation of Eastern Caribbean States under the Treaty of Basseterre. Under these regional integration treaties Saint Lucia cooperates with other member states of CARICOM and the OECS in economic integration, foreign policy coordination and functional cooperation. Issues such as the free movement of people, reform of the judiciary, cooperation in sports and cultural development as well as joint approaches to common development challenges are addressed. In climate change, CARICOM has made strides in coordinating a regional response through, for example, the 2009 Regional Framework for Achieving Development Resilient to Climate Change, and the creation of the Caribbean Community Climate Change Centre (CCCCC) through which a number of regional projects to address climate change mitigation and adaptation have been, and continue to be implemented in Member States.

## 1.4 GOVERNANCE

Since gaining independence in 1979, Saint Lucia has been governed by a Westminster style government. Its parliament comprises 17 elected district representatives and a Senate, or Upper House, comprising of 11 members and a President. Elections are constitutionally due every five (5) years.

The Head of State is the Governor General, who represents the British Monarch. The administrative arm of government comprises the Office of the Prime Minister, the Office of the Attorney General and line ministries with mandates determined by the Prime Minister. Whereas the ministerial portfolios and configurations of the ministries undergo changes based on decisions of the Prime Minister, key current ministerial portfolios of relevance to climate change causes and/or impacts include:

1. Minister for Education, Innovation, Gender Relations and Sustainable Development
2. Minister for Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives
3. Minister for Infrastructure, Ports, Energy and Labour
4. Minister for Economic Development, Housing, Urban Renewal, Transport and Civil Aviation
5. Minister for Health and Wellness
6. Minister for Finance, Economic Growth, Job Creation, External Affairs and the Public Service
7. Minister in the Office of the Prime Minister with responsibility for Tourism, Information and Broadcasting
8. Minister for Local Government and Culture
9. Minister for Equity, Social Justice and Empowerment
10. The Office of the Prime Minister (National Emergency Management Organisation).

The legal system is based on English common law and "Code Napoleon", and the highest judicial body is the Privy Council of the United Kingdom. The administration of the law is under the jurisdiction of the Eastern Caribbean Supreme Court.

## 1.5 CLIMATE AND CLIMATIC ELEMENTS

This section updates the regional and national contexts in which this TNC is presented, drawing on developments since the Second National Communication (SNC). The general outlook supports predictions for increased concentrations of atmospheric greenhouse gases and changes in average global temperature and sea level. It also validates predicted trends for climatic changes and related impacts at the national level.

### 1.5.1 Regional Trends

Their small size and location of islands in the Caribbean archipelago contribute to considerable vulnerabilities from extreme weather events and related this is vulnerability is expounded by the fact that the islands lie within the path of the Atlantic hurricane belt.

Average temperatures in the Region have increased by 0.1° to 0.2°C per decade over the past three decades and rainfall patterns have shifted, with the number of consecutive dry days expected to increase. Additionally, sea level rise has occurred at a rate of about two to four centimetres per decade over the past 33 years. This trend presents risks to the region's freshwater resources and to its largely coastal population dependent on tourism and agriculture. Projections indicate that losses could total US$22 billion annually by 2050.[2] North Atlantic hurricanes and tropical storms appear to have increased in intensity over the past thirty years, although there is still debate about whether this is a long term trend.[3]

### 1.5.2 National Trends

Saint Lucia lies within the north-east Trade Wind belt and is normally under an easterly flow of moist, warm air. The island's location in the Atlantic Ocean/ Caribbean Sea means that average ambient sea surface temperatures vary little from 26.7°C at any given time. The island receives an almost constant amount of surface solar radiation over time. These factors combine to give Saint Lucia a tropical maritime climate characterized by warm air temperature averaging near 28 ° C, but rarely rising above 32° C or falling below 21° C.

The island's weather is influenced by synoptic weather systems such as the Atlantic High Pressure system (Bermuda Azores), surface, mid and upper level low pressure systems, the Inter-Tropical Convergence Zone, tropical waves and cyclones and the occasional frontal system. Mesoscale and microscale weather features also affect the island.

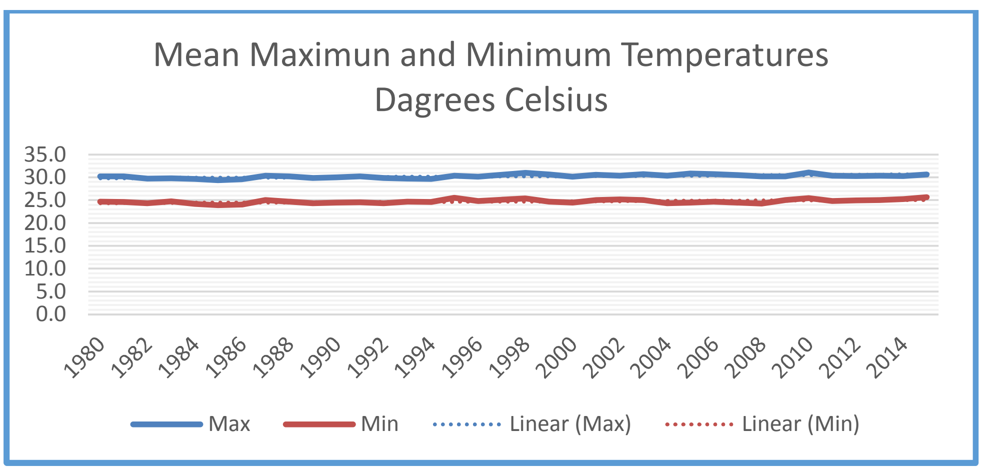
### 1.5.3 Temperature

Because of Saint Lucia's small size and its geographic location, air temperature is greatly determined by the winds off the surrounding oceans. There is very little variation annually in air temperatures over the island. However, diurnal temperatures can vary by as much as 10° C. Temperatures are lowest in the months of December to March and highest around June to September. Mean maximum temperature is about 30.2°C and mean minimum about 24.6° C. The island's mountainous topography, particularly in the more rugged interior, can also cause temperature variation between high and low-lying regions of between 2° C and 5 ° C.

Figure **1.2** shows mean maximum and minimum annual temperatures from 1980-2015 at Hewanorra Airport in the south of the island. The data shows that the average maximum temperature between 2000 and 2015 was 30.1°C, or 0.4°C higher than the average of 30.1°C between 1980 and 1999.

**Figure 1.2: Mean Maximum and Minimum Temperatures at Hewanorra Airport: 1980 – 2015**

(Source: Meteorological Services Department, Saint Lucia)




[2] Building Resilience to the Impacts of Climate Change in the Caribbean: Inter-American Development Bank(2013-14 Annual Report)

[3] Holland and Webster, 2007; Kossin et al. 2007; Elsner et al. 2008.

### 1.5.4 Rainfall

The island has two climatic seasons, based on rainfall. The wet season extends from June to November while the dry season runs from December to May. The volume of rainfall in the wet season is determined mainly by the frequency and intensity of tropical disturbances (waves, depressions, storms, hurricanes) which account for the greater amount of the recorded rainfall during that season. Local convectional showers and other weather systems account for the remainder.

In the dry season, most of the rainfall originates from mid-latitude systems (troughs, frontal troughs, jet streams) intruding into the region. The intrusion of dry season rain-producing systems is randomly distributed temporally, and thus, the rainfall they produce over the island is highly variable over time. On the other hand, tropical disturbances in the wet season tend to occur with a predictable frequency of roughly one every four days.

Figure 1.3 shows total annual rainfall at Hewanorra Airport from 1973-2015 while Figure 1.4 shows average monthly rainfall at Hewanorra for the same period.

**Figure 1.3: Total rainfall at Hewanorra Airport (1973-2015)**
(Source: Meteorological Services Department, Saint Lucia)

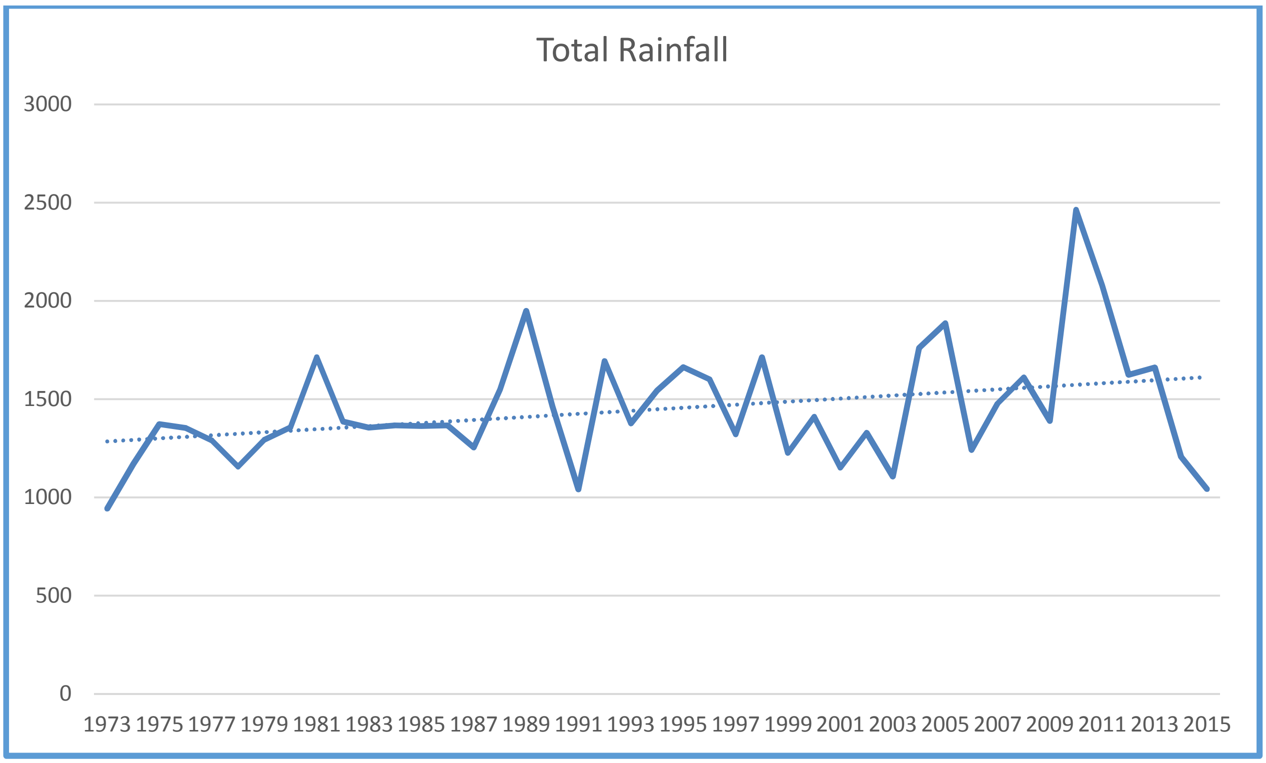
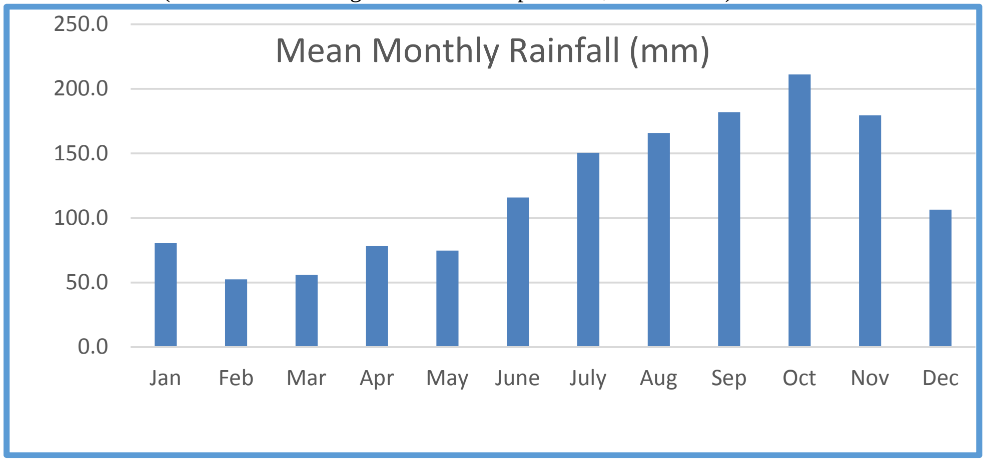


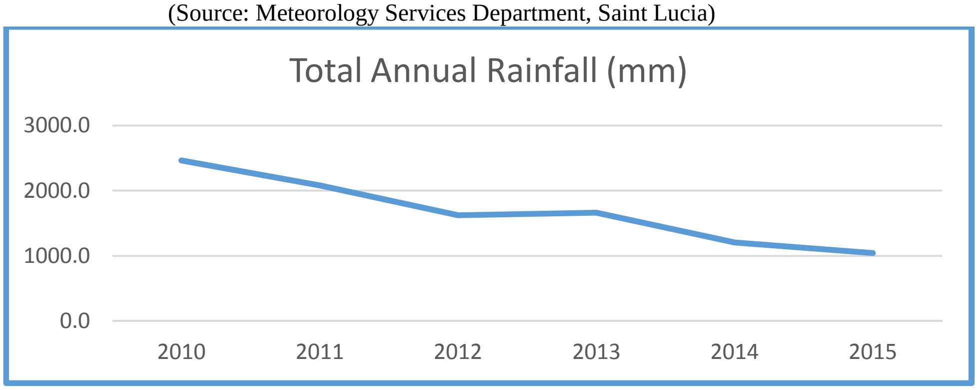
**Figure 1.4: Average Monthly Rainfall (1973 – 2015)**
(Source: Meteorological Services Department, Saint Lucia)




The geographic influence of rainfall is quite pronounced with amounts varying from about 1265mm in the relatively flat coastal regions to about 3420mm in the elevated interior region.

Saint Lucia has experienced drought conditions each year since 2012, resulting in a decline in both the total annual and temporal distribution of rainfall (see Figure 1.5).

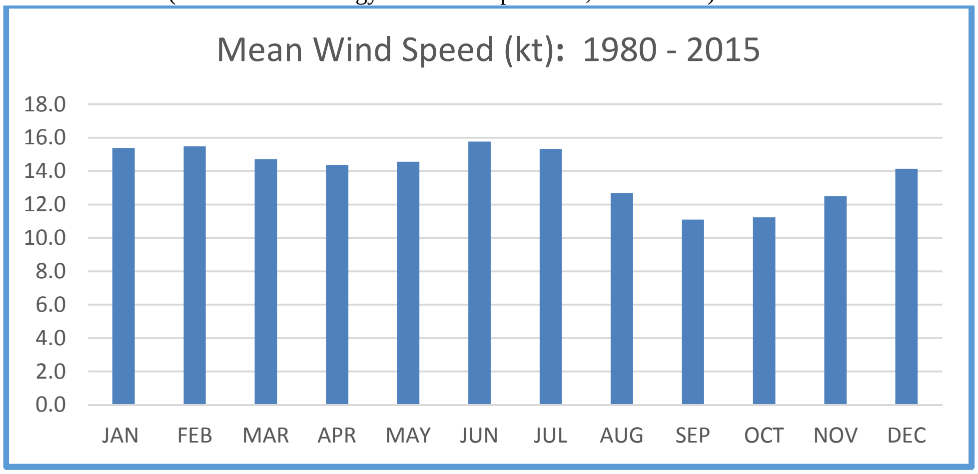
**Figure 1.5: Annual Rainfall**
(Source: Meteorology Services Department, Saint Lucia)




### 1.5.5 Winds

Saint Lucia lies within the northeast Trade Wind belt. Wind speeds are highest on average during the months of January to July, corresponding roughly with the dry season, when the average is 25.72kmh$^{-1}$. Between August and December, the speeds average 20.7 kmh$^{-1}$. Higher gusts are occasionally experienced with the passage of tropical disturbances and cyclones. Mean monthly wind speeds for the period 1973-2015 are shown in Figure .

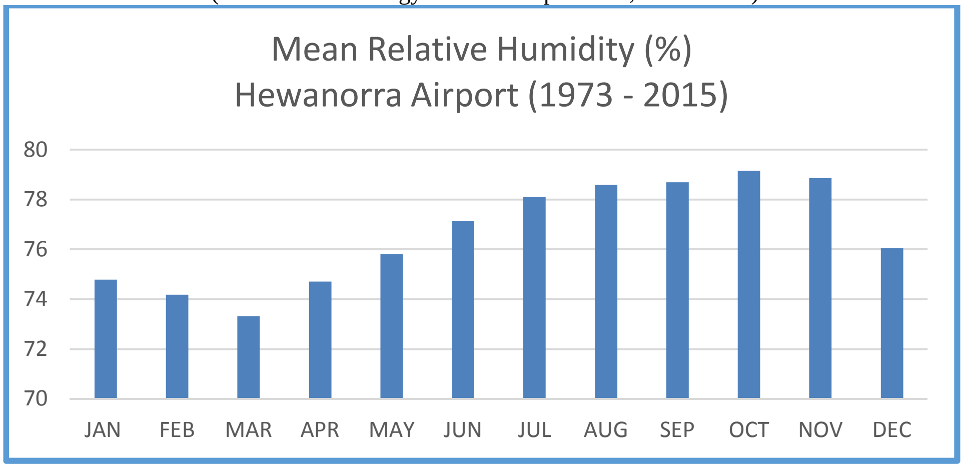
**Figure 5: Mean Monthly Wind Speed at Hewanorra Airport: 1980 – 2015**
(Source: Meteorology Services Department, Saint Lucia)




### 1.5.6 Humidity

Daily variation in relative humidity is at a maximum during the warmer months. The lowest value ever reported at Hewanorra was 31% in February 1998. The annual range is very small, with a mean of about 77%. Figure 6 shows mean monthly relative humidity for 1973 - 2015.

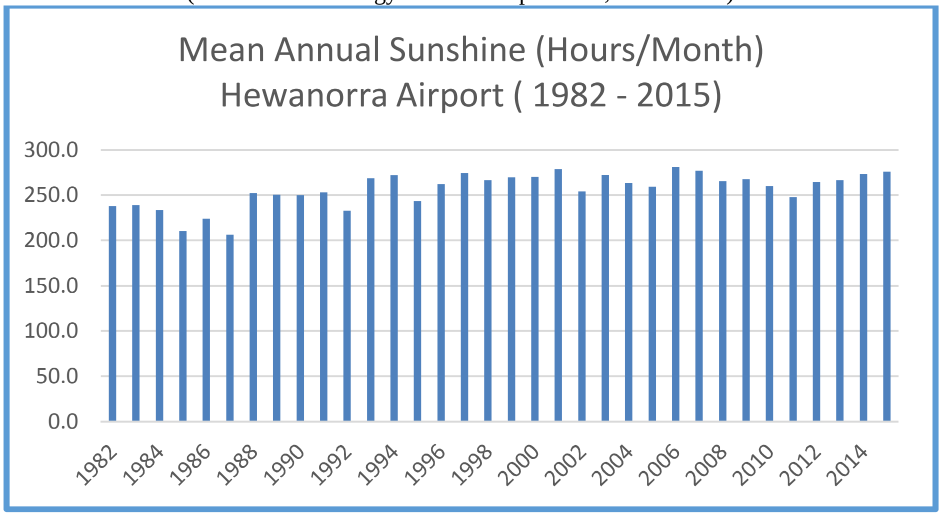
**Figure 6: Mean Monthly Relative Humidity at Hewanorra Airport: 1980 – 2015**
(Source: Meteorology Services Department, Saint Lucia)




### 1.5.7 Sunshine

The amount of daily sunshine received over Saint Lucia is at a maximum from February to May and at a minimum around September. Radiation values vary widely over the island and this is mainly due to cloud cover. As such, elevated regions with greater cloud cover receive less direct radiation than the low-lying coastal regions. Figure 7 shows mean monthly sunshine at Hewanorra Airport from 1982 to 2015.

**Figure 7: Mean Monthly Sunshine at Hewanorra Airport: 1982 to 2015**
(Source: Meteorology Services Department, Saint Lucia)

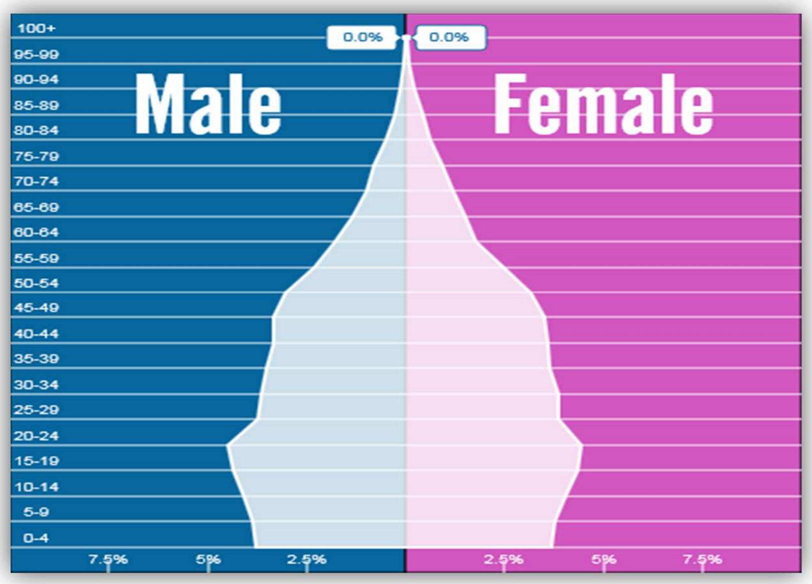



## 1.6 DEMOGRAPHY

Figures obtained from the Government Statistics Department show an estimated population of 172,623 in 2015. The population is relatively young, with 46.9% below 30 years old and 12.6% sixty years and older. Saint Lucia's 2014 population pyramid is shown in Figure 8.

**Figure 8: Population Pyramid (2014)**

Source: Department of Statistics Population Statistics (1960-2014).




While the island is divided into eight administrative regions, for demographic purposes it is divided into ten districts, each with a city, town or major village. The Castries district which includes the capital city of Castries, has the highest population density. Of the total 2010 population[4], 65,656, or 39.6% lived in the city and its suburbs. Gros Islet, which is the tourism centre of Saint Lucia is the next most populous district with 25,210 persons, representing 15.2% of the total population.

## 1.7 DEVELOPMENT PRIORITIES

### 1.7.1 Regional Development Priorities

The thirteen Member States of the Caribbean Community (CARICOM) and the five Associated Member States have agreed to a single vision for sustainable development which encompasses economic, social, environmental and governance dimensions. These are grouped into six broad elements:[5]

a) Self-sustaining economic growth based on strong international competitiveness, innovation, productivity, and flexibility of resource use;

b) A full-employment economy that provides a decent standard of living and quality of life for all citizens; elimination of poverty; and provision of adequate opportunities for young people, constituting an alternative to emigration;

c) Spatially equitable economic growth within the Community, giving regard to the high growth potential of member states with relatively low per capita incomes and large resources of under-utilised land and labour;

d) Social equity, social justice, social cohesion and personal security;

e) Environmental protection and ecological sustainability; and

f) Democratic, transparent and participatory governance.

Several CARICOM member states have developed, or are developing, sectoral policies; sustainable development strategies; strategic and medium term planning programmes and; natural resource management frameworks as the basis for a greener, low carbon, economic transition. These also addresses the sustainable development goals. CARICOM has also promoted greater attention to several developmental challenges, including:

a) Agriculture and food security;
b) Natural Resources Management, including fisheries management and oceans governance;
c) Water resources management;
d) Energy, including renewable energy and energy efficiency;
e) Climate change and sea level rise;
f) Sustainable Consumption and Production;

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[4] Central Statistics Office, Saint Lucia.
[5] The Caribbean Community (CARICOM) Submission to the United Nations Conference Sustainable Development (Rio+20) (2012).

g) Biodiversity;

h) Sustainable land management;

i) Waste management and chemicals management; and

j) Provision of means of implementation.

At the regional level also, the United Nations Environment Programme (UNEP) launched a Green Economy Initiative in 2008 with the overall objective to provide the analysis and policy support for investing in green sectors and in greening environmentally unfriendly sectors.

At the sub-regional level, Member States of the Organisation of Eastern Caribbean States (OECS) have agreed to a human development agenda with eight key elements: [6]

a) Reducing the levels of poverty;

b) Substantially increasing the number and quality of jobs;

c) Providing access to quality education for all;

d) Improving access to and the delivery of health services;

e) Sustaining an adequate stock of natural resources;

f) Empowering disadvantaged groups, at the household, community, national and regional levels, to take charge of their own lives;

g) Developing sports and enhancing participation at the national and regional levels; and

h) Strengthening the institutions and practices of good governance.

These development agendas embrace the sustainable development paradigm, seeking to meet key social and economic goals sustainably. Member States are expected to implement policies and measures to achieve these development goals.

### 1.7.2 National Development Priorities

**Strategic Interventions**

At the national level Saint Lucia, government approved a National Development Plan in 2008[7] which represents, in broad terms, the development priorities for each of four quadrants. This plan is a broad-based land use plan developed to support the expansion of tourism infrastructure, support some measure of environmental sustainability, and expansion of the housing and industrial sectors.

**Medium Term Development Goals**

Saint Lucia's Medium Term Development Plan of 2011[8] laid out sixteen development goals centred around five development themes, *viz*:

a) Stabilization of the Economy;

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[6] OECS Development Charter (2002)

[7] Saint Lucia National Vision Plan (2008)

[8] Saint. Lucia: Medium Term Development Strategic Plan (2011): Ministry of Finance, Economic Affairs and National Development

b) Poverty Reduction;

c) Gender Equality;

d) Environmental Sustainability; and

e) Education, Training and Human Resource Development.

Saint Lucia in its current National Development Planning process, has identified six pillars one of which is ***adaptation for environmental sustainability and climate change***. Under this pillar, Saint Lucia intends to "focuses on pathways towards the development of a Green Economy, and a focus on economic and social vulnerability management attached with environmental risks, disaster and climate change risk management"[9].

## 1.8 THE ECONOMY

### 1.8.1 Education and Employment

Saint Lucia attained universal secondary education in 2006. According to the 2010 population census, higher percentages of females were educated from the junior secondary school to the Masters Degree levels than that of their male counterparts, while a higher percentage of males pursued PhD level certification. However, of the total employed population, 44.9% were female compared to 55.1% male. Table 1.1 presents employment data for 2014, and clearly shows the imbalance in the distribution of employment rates by gender in the various sectors.

In 2015 overall unemployment stood at 24.1%.

**Table 1.1: Labour Force by Sex**
(Source: Central Statistics Office, Saint Lucia)

| LABOUR FORCE | Total | % Male | % Female |
|---|---|---|---|
| Size of Labour Force | 74844 | 53.7 | 46.3 |
| **Employment by Sector** | | | |
| Agriculture, forestry and fishing | 7347 | 75.3 | 24.7 |
| Mining and quarrying | 197 | 90.9 | 9.1 |
| Manufacturing | 3571 | 55.0 | 45.0 |
| Electricity, gas, steam and air conditioning supply | 463 | 64.5 | 35.5 |
| Water supply; sewerage, waste management and remediation activities | 554 | 85.3 | 14.7 |
| Construction | 5714 | 95.2 | 4.8 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | 11675 | 39.1 | 60.9 |
| Transportation and storage | 4159 | 88.0 | 12.0 |
| Accommodation and food service activities | 9613 | 41.3 | 58.7 |
| Information and communication | 1065 | 57.9 | 42.1 |
| Financial and insurance activities | 1629 | 25.9 | 74.1 |
| Real estate activities | 181 | 78.5 | 21.5 |
| Professional, scientific and technical activities | 1088 | 58.4 | 41.6 |

[9] Saint Lucia Country Presentation-Mainstreaming of Sustainable Development goals in Saint Lucia's National Development Plan, UNECLAC: Caribbean symposium on mainstreaming the sustainable development goals in national development planning, Jamaica, February, 2017.

| LABOUR FORCE | Total | % Male | % Female |
|---|---|---|---|
| Administrative and support service activities | 3623 | 67.4 | 32.6 |
| Public administration and defence | 7510 | 49.8 | 50.2 |
| Education | 4589 | 21.8 | 78.2 |
| Human health and social work activities | 1838 | 24.7 | 75.3 |
| Arts, entertainment and recreation | 817 | 62.8 | 37.2 |
| Other service activities | 1806 | 50.9 | 49.1 |
| Activities of households as employers | 2458 | 15.3 | 84.7 |
| Activities of extraterritorial organizations and bodies | 150 | 66.7 | 33.3 |
| Not Stated | 4796 | 57.3 | 42.7 |

### 1.8.2 Key Economic Indicators

In 2015 Saint Lucia's GDP stood at XCD$ 2,498.4 million, an increase of 1.3% over 2014. Since 1990, the economy has undergone a structural adjustment that has seen the service sector, and in particular, tourism, leading economic growth. Between 1990 and 2015, the contribution of agriculture declined from 13.85% to 3.00% of GDP while the tourism sector's contribution moved from 9.18% to 10.9%. Real estate, construction and the transport (road, air and sea) sectors are the leading contributors to GDP. The percentage contributions of key economic sectors to GDP between 2000 and 2015 are listed in Table 1.2.

Climate sensitive sectors (shown in italics in the Table) together accounted for 60.7% of GDP in 2015, underscoring the vulnerability of the local economy to the impacts of climate change.

The steady growth experienced since 2000 was interrupted by the terror event in the United States in 2001 and again by the global economic crisis of 2008. The slower-than-expected recovery of the global economy exerted downward pressures on the local economy, resulting in negative growth between 2009 and 2014. This was mainly attributable to significant downturns in the distributive trades, construction, transport and communications.[10] All sectors experienced declines except the utilities, real estate, public administration and education sectors. Agriculture experienced the greatest accumulated decline in this period. In the short term, expected growth in the tourism sector holds prospects for a turnaround in the local economy.

**Table 1.2: Sector Contribution to GDP (XCD billions)**

(Source: Central Statistics Office, Saint Lucia)

| Gross Domestic Product at 2005 Constant Prices | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Industry Contribution to the Economy (%) | | | | | | | | | |
| **Economic Activity** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** | **2012** | **2014** | **2015** |
| **GDP (XCD billions)** | 2.14 | 2.05 | 2.31 | 2.47 | 2.57 | 2.54 | 2.54 | 2.48 | 2.50 |
| *Agriculture, Livestock, Forestry, Fishing* | *6.26* | *5.65* | *4.50* | *3.55* | *4.41* | *3.02* | *2.95* | *2.8* | *3.0* |
| Mining and Quarrying | 0.09 | 0.10 | 0.03 | 0.28 | 0.32 | 0.30 | 0.51 | 0.1 | 0.1 |
| Manufacturing | 4.92 | 4.92 | 5.24 | 4.90 | 4.93 | 5.06 | 4.81 | 4.7 | 4.8 |
| *Construction* | *11.1* | *9.23* | *11.55* | *12.16* | *10.65* | *9.73* | *9.54* | *7.3* | *7.8* |

[10] Economic and Social Review 2012.

| Gross Domestic Product at 2005 Constant Prices | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Industry Contribution to the Economy (%) | | | | | | | | | |
| **Economic Activity** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** | **2012** | **2014** | **2015** |
| *Electricity and Water* | *3.80* | *3.98* | *3.87* | *3.84* | *3.93* | *4.24* | *4.31* | *4.4* | *4.4* |
| Distributive Trade Services | 7.35 | 7.01 | 7.34 | 9.19 | 9.20 | 7.65 | 8.44 | 7.6 | 7.5 |
| *Hotels and Restaurants* | *10.5* | *9.85* | *10.63* | *10.21* | *9.57* | *10.30* | *9.84* | *11.0* | *10.9* |
| *Transport* | *11.4* | *11.96* | *12.71* | *10.93* | *12.66* | *12.69* | *11.77* | *13.1* | *13.4* |
| *Communication* | *6.06* | *7.40* | *8.11* | *8.89* | *7.43* | *7.60* | *7.16* | *6.0* | *5.7* |
| *Financial Intermediation* | *6.47* | *6.48* | *6.04* | *6.87* | *7.63* | *7.50* | *7.81* | *8.0* | *8.9* |
| Real Estate, Renting and Business Activities | 16.4 | 17.55 | 16.06 | 15.94 | 16.01 | 17.16 | 17.50 | 18.9 | 18.4 |
| Public Administration & Compulsory Social Services | 7.32 | 7.23 | 6.26 | 5.94 | 5.83 | 6.23 | 6.46 | 6.8 | 6.7 |
| Education | 4.76 | 4.75 | 4.10 | 3.88 | 3.89 | 4.15 | 4.30 | 4.5 | 4.4 |
| *Health* | *2.17* | *2.20* | *1.91* | *1.85* | *1.84* | *1.96* | *2.05* | *2.1* | *2.1* |
| *Other Community, Social and Personal Services* | *2.74* | *3.17* | *2.91* | *3.35* | *4.11* | *4.88* | *5.08* | *4.5* | *4.5* |

During the decade ending in the 2014/15 financial year, government revenues were fairly constant at about 26% of GDP while expenditures declined from 35.55% of GDP to 30.5%. In 2015 public debt stood at 75.4% of GDP and the total debt service to current revenue ratio was 16.9%. Balance of payments stood at XCD$ (99.2) million or 2.6% of GDP, compared to 37.5% of GDP in 2006. External reserves stood at $243.04 million in 2006 and $268.38 in 2015, but these figures mask the negative reserve position the country was in between 2007 and 2014. These figures point to a highly-geared economy which is beginning to show signs of recovery and stable fiscal balances.

### 1.8.3 Economic Policies and Measures

Saint Lucia's economic growth and development is concentrated on tourism, agriculture, infrastructural development and commercial sectors, with tourism being at the centre of the thrust. Under the Saint Lucia Development Strategy 2012-2016 Sectoral Action Plan, the following two strategic goals are to be pursued:

a) An economy characterized by increased productivity levels and enhanced work ethic; and

b) A more integrated economy, with sustainable links between the productive sectors.

The goals and key policies and measures are summarized in Table 1.3.[11]

**Table 1.3: Key Public Sector Policies and Measures**

| Sectors | Key Measures and Strategies |
|---|---|
| **The Macro Economy** | The goal is a sustainable growth path and improved levels of living, supported by a stable macroeconomic environment through:<br>✓ Maintaining stable interest rates;<br>✓ Expansion of credit for productive investments;<br>✓ Broadening the tax base as the economy expands; |

[11] Saint Lucia Development Strategy 2012-2016 Sectoral Action Plan

| Sectors | Key Measures and Strategies |
|---|---|
| | ✓ Implementing performance-based accounting for capital investments;<br>✓ Encouragement of innovation and credit-extension initiatives; and<br>✓ Investments in human resources to build a skilled labour force. |
| **Tourism** | The goal is for a sustainable tourism sector with increased contribution to the development of communities and the national economy by:<br>✓ Instituting measures to increase the sector's contribution to GDP;<br>✓ Upgrading products and services, including facilities for yachting;<br>✓ Increasing local support for the industry in the face of the negative public perception and attitudes towards the sector; and<br>✓ Addressing crime and violence and security of the individual. |
| **Agriculture** | The goal is for a revitalized agricultural sector capable of responding to food security and export development imperatives by:<br>✓ Ensuring domestic and regional food security;<br>✓ Changing taste and national *psyche* for domestic produce;<br>✓ Adopting Farm to Market value food chain;<br>✓ Undertaking demand and supply studies;<br>✓ Expanding opportunities for accessing agricultural credit;<br>✓ Mounting a freshman programme for young entrepreneurs;<br>✓ Overcoming monoculture through mixed agricultural operations;<br>✓ Improving agricultural outputs through better technical inputs;<br>✓ Modernizing and expanding the scope of extension services;<br>✓ Upgrading agricultural research ;<br>✓ Formulating integrated technological packages by adopting best practices;<br>✓ Training to improve the educational and technical competencies of farmers;<br>✓ Sustainable land use practices;<br>✓ Linking agriculture and tourism; and<br>✓ Promoting agricultural science in schools. |
| **Manufacturing** | The goal is for a revamped manufacturing sector, differentiated on the basis of unique attributes by:<br>✓ Development of a vision for the manufacturing sector;<br>✓ Creating a forum for public/private sector dialogue;<br>✓ Developing a policy to facilitate private sector growth;<br>✓ The removal of barriers for the development of manufacturing companies;<br>✓ Promoting areas of manufacturing that offer competitive advantage;<br>✓ Coordination of industrial development and export promotion;<br>✓ Improvement in regional shipping arrangements;<br>✓ Simplification of customs procedures;<br>✓ Facilitation of capacity development and ease of doing business. |
| **Information and Communications technology** | The goal is the rationalization of the potential of ICTs for contributing to the economy through:<br>✓ Constant reviews and adoption of technological advances, and policy responses;<br>✓ Adaptation of the economy to promote e-commerce penetration;<br>✓ Strengthening of regulation of the telecommunications sector;<br>✓ Strengthening of institutional arrangements to champion ICT development within the public sector;<br>✓ Enshrining ICT access as a civil right;<br>✓ Implementing the "Quick Win" projects in the 2010 National ICT Strategy.[12] |
| **Creative Sector** | The goal is to ensure the flowering of the creative potential of the citizenry in various dimensions, by:<br>✓ Updating intellectual property and copyright legislation;<br>✓ Enacting a Creative Sector Development Act;<br>✓ Encouraging greater professional involvement in the Arts and Culture;<br>✓ Introducing Arts and Culture in the school curriculum; and |

[12] National ICT Strategy of Saint Lucia: 2010 - 2015

| Sectors | Key Measures and Strategies |
|---|---|
| | ✓ Encouraging the creating of professional associations in the Arts and Creative Industries. |
| **Human Resource Development, Science and Technology** | The goal is to develop the human resources of Saint Lucia as the foundation on which will be built the social and economic superstructure of the economy by:<br>✓ Ensuring major upgrade in educational quality;<br>✓ Inculcating the notion of education and training as a life-long process;<br>✓ Providing breadth and depth in the educational curricula;<br>✓ Promoting ICT access; and<br>✓ Mobilising the science and technology infrastructure to improve adaptability |
| **Population, Youth Employment and Technology** | The goal is to achieve a significant reduction in the barriers to youth engagement and benefit from economic opportunities through the following actions:<br>✓ Develop mechanisms to improve the attendance of boys and girls in school;<br>✓ Develop and expand, as the case may be, after school programmes to encourage positive attitudes among the young; and<br>✓ Develop programmes to target out-of-school and unemployed youth. |
| **Physical Planning and Infrastructure** | The goal is the creation of an infrastructure that abides by the highest tenets of physical planning for a country characterised by high physical vulnerability through:<br>✓ Expansion and retrofitting of the physical public infrastructure in light of environmental hazards;<br>✓ Improving significantly, the physical living conditions in depressed rural and urban communities; and<br>✓ The development of effective housing delivery systems. |
| **Environment and Physical Development** | ✓ Optimal usage and stewardship of land and environmental resources supporting social and economic needs of the population through:<br>✓ Implementation of the National Land Policy; and<br>✓ Mainstreaming environment in development interventions and initiatives. |
| **Renewable Sources of Energy** | The goal is to reduce dependence on fossil fuels as an energy source by identifying and developing environmentally-friendly and cheaper sources of energy. |
| **Housing and Human Settlements** | The goal is an effective housing delivery system promoting the sustainable development of communities by:<br>✓ Fast tracking the development of the poorest and most environmentally vulnerable urban and rural communities;<br>✓ Identifying and implementing priority areas of the National Housing Policy and Action Plan; and<br>✓ Instituting measures to make housing more accessible to all income brackets. |
| **The Environment Protection and Preservation Framework** | The goal is the protection of the environment and amenity resources of the country by:<br>✓ Sensitive stewardship of these assets with the view to ensuring a legacy for succeeding generations;<br>✓ Sustainability in the links and functioning of the productive sectors; and<br>✓ Increased reliance on renewable energy. |
| **Watershed Management** | The goal is to increase and sustain the watershed's ability to provide for the diverse needs of communities that depend on it by:<br>✓ Rationalizing and prioritizing forest restoration and regeneration;<br>✓ Protection of untenured areas through improved legislation and enforcement;<br>✓ Delineation of forest boundaries and resource assessments;<br>✓ Developing community-based handicraft industries based on forest products;<br>✓ Developing and implementing a water sector road map and resource management framework;<br>✓ Developing and continuously updating a hydrological database. |
| **Disaster Risk Management** | The main imperative is that public authorities, development organisations and communities understand and anticipate future hazard events through:<br>✓ Education and awareness;<br>✓ Disaster risk reduction interventions;<br>✓ Hazard mapping; and<br>✓ Early warning systems. |

| Sectors | Key Measures and Strategies |
|---|---|
| **Social Services, Social Justice and Governance** | The goals are, in addition to the attainment of the targets in the Millennium Development Goals (MDG), to pursue the following key objectives:<br>✓ Reduction of unemployment, in addition to poverty reduction;<br>✓ Reversing the increase in crime and growth of the underground economy;<br>✓ Countering the absorption of negative external cultural influences; and<br>✓ Reducing the exposure to pandemics and high incidence of lifestyle diseases. |

### 1.8.4 Key Economic Sectors

**Tourism**

The tourism sector is the lead growth sector of the local economy but is challenged by the sluggish global economic recovery. Value added, as measured by the performance of the hotel and restaurant sectors, grew by 2.85% in 2014 and the sector's contribution to GDP grew by an annual average of 2.44% between 2010 and 2014.

In 2014, total visitor arrivals grew by 7.7% over the previous year, to 1,034,332, the highest ever recorded. Stay over visitors increased by 6.1% to 338,158 guests and cruise arrivals increased by 8.0% to 641,452. Visitor expenditure also increased by 14.3%, to XCD$2 billion. The yachting sector experienced growth of 19.0%, with 42,173 passenger arrivals. Hotel occupancy averaged 62.6 % between 2005 and 2014. Ongoing and planned investments are likely to increase room stock considerably.

Most hotels, both existing and proposed, are coastal developments close enough to the sea to be impacted by sea level rise. The tourism sector is vulnerable to the impacts of climate change at several levels, including:

a) Loss of infrastructure due to storms and sea level rise;

b) Degradation of the tourism product through storm damage, loss of near-shore tourism resources and reduced attractiveness of environmentally-based tourism attractions;

c) Drought conditions placing pressures on the tourism product;

d) Impacts on supporting sectors such as agriculture, fisheries, water and transport; and

e) Increased health pandemics reducing attractiveness of the destination.

**Agriculture**

The agriculture sector's contribution to GDP continues on a downward trend (see Table E1). This trend is likely to continue, given the abandonment of farmlands, the loss of prime agricultural lands to physical development, loss of interest by the young in agriculture as a career and the impacts of extreme weather conditions, including droughts, among others. Notwithstanding, the sector will remain a key component of the local economy for employment generation, foreign exchange earnings and food security, as well as to retard urban drift.

The sector is sensitive to climate change, and future plans must ensure its resilience against the key potential impacts of increased temperatures, precipitation variability, possible land degradation, including loss of productive topsoil, and storm events. Policy makers in the sector must incorporate climate change adaptation measures into agricultural planning and production.

**Infrastructure**

The major towns and villages in Saint Lucia are located on the coast, as are the major roads which connect them. Key economic infrastructure such as airports, sea ports, fuel storage and hotels are also on the coast, while social infrastructure such as hospitals, schools and security services are typically located within the population centres in coastal areas. The total road network of Saint Lucia comprises just over 1210 km of road of which 20% are primary roads, 17% secondary and 63% tertiary[13]. The entire road network traverses rugged coastal and inland terrain. Telecommunications infrastructure and the power supply network are generally further inland, but their distribution networks are located in the population centres. Within the housing sector, the number of structures located in or near flood- and landslide-prone areas is cause for concern, as is the number of structures not built to hurricane-resistant specifications. In addition, unplanned development continues to escalate despite Government's interventions to regularize this practice.

The susceptibility of the island's housing and infrastructure to the impacts of climate change is a consequence of both their location and the island's topography. Whereas near-shore structures are likely to be impacted by sea level rise and coastal erosion, storm events pose the greatest risk. High wind and rainfall events are likely to result in increased floods, land slippages, wind and water damage and tree fall events. Historically, these impacts have constituted the major recovery cost following storm events and these are likely to be exacerbated by the anticipated increases in the severity and possible frequency of these events.

Potential impacts on critical infrastructure include:

1 greater inundation and possible loss of low-lying, coastal development and communities;

2 loss of recreational value and carrying capacity of beaches;

3 poor operational performance of inundated municipal and household septic systems, contaminating drainage and water supplies;

4 reduced effectiveness of drainage infrastructure and bridges, increasing risk of flooding in low-lying coastal areas;

5 interruptions in local, regional and international communication;

6 damage or destruction of critical infrastructure such as coastal roads and bridges which will disrupt several types of economic, social and cultural activities.

Policies to address these challenges are in place but enforcement is inadequate.

The anticipated impacts of climate change will exacerbate current vulnerabilities of the housing and critical infrastructure sub-sectors.

### 1.8.5 Other Critical Sectors

**Water**

The water sector is critical to national development. Current water shortages in some parts of the island are due to supply deficiencies as well as treatment and distribution constraints. These conditions are aggravated by increased human activities along river banks and extraction for agricultural use, which compromise supplies of raw water.

Anticipated changes to temporal precipitation distribution and intensity are likely to exacerbate supply deficiencies. Severe drought conditions of the recent past underscore the vulnerability of both potable and agricultural water supplies to the impacts of climate change and variability. This deficiency is

[13] World Bank: knoema.com/WBWDIGDF2015Dec

aggravated in the north of the island by the severe silting of the John Compton Reservoir. Adaptation measures in the water sector will have major cost implications for the local economy but, if not addressed, will exert downward pressures on key sectors including tourism, agriculture, industry and health.

The Water Resources Management Agency (WRMA) was established by the promulgation of the Water and Sewerage Act No. 14 of 2005, and became functional in 2008. The WRMA was created to enable the sustainability of economic growth, human development and the environment by promoting and facilitating the efficient, equitable and effective use and management of the water resources of Saint Lucia. The Water and Sewerage Company (WASCO) has also launched the Southern Water Supply Redevelopment Project to improve supplies in the south of the island which has, for years, suffered from supply deficiencies.

**Health**

A number of existing health-related issues are likely to be exacerbated by climate change. These include vector-borne diseases such as dengue fever, Chikungunya, the Zika virus, *Leptospirosis* and yellow fever as well as water-related diseases such as *Schistosomiasis* and cholera. Incidences of food borne diseases, diarrhoea, gastroenteritis and respiratory diseases are likely to increase as well as stress, anxiety and heat-related health issues.

Given the sensitive nature of the health sector and the unpredictability of the onset of the health impacts of climate change, investments will be necessary at the primary health care level and in preventative measures, both of which are likely to be costly and difficult to programme. Increased education and awareness will be necessary to enable effective adaptation of the health sector to the impacts of climate change.

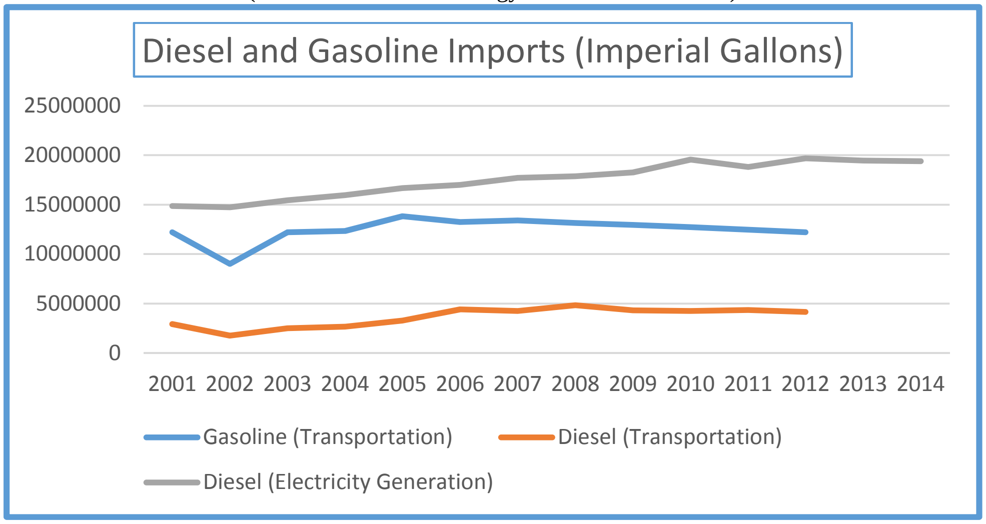
**Energy**

One of the primary sources of global greenhouse gas emissions is the combustion of fossil fuels. Saint Lucia is almost totally dependent on imported petroleum fuels for its energy needs and, as such, would have to focus much of its mitigation effort on abating emissions generated from these sources.

Demand for imported fuels has continued to increase over the last several years, despite sharp petroleum price fluctuations between 2005 and 2014. Figure 9 shows total imports of unleaded gasoline and diesel for the period 2001 - 2014[14]. The importation of leaded fuel was discontinued from 2001. It is noteworthy that, in spite the growth in vehicle stock and
Figure 1.14), imports of gasoline, which is used primarily in road transport, declined from 13.42 million gallons to 12.19 million gallons between 2007 and 2014 and diesel imports in the non-electricity sector declined from 4.27 million gallons to 4.14 million gallons in the same period. This is probably the response of motorists to the increasing cost of fuels for the transport sector in this period.

[14] Saint Lucia Energy Balance 2000 – 2012: OLADE CELAC (2014)

**Figure 9: Imports of Gasoline and Diesel**
(Source: Saint Lucia Energy Balance 2000 – 2012)




The Electricity Supply Act (Cap. 9.02 of the Revised Laws of Saint Lucia) granted the Saint Lucia Electricity Services (LUCELEC), the monopoly to generate and distribute electricity in Saint Lucia for eighty (80) years, commencing in 1965. In the 2015 amendment to the Act, the monopoly was restricted to electricity generation from fossil fuels only and created the National Utilities Regulatory Commission (NURC) to, *inter alia*, be responsible for the licensing and regulation of electricity generation from all sources. A new Electricity Supply Services Bill is currently in draft form and is expected to become law in 2016.

Electricity consumption has grown steadily over the last decade, particularly in the domestic, hotel and commercial sectors. LUCELEC's generation capacity has therefore had to increase in order to keep up with this trend.

Figure 10 shows installed generation capacity and peak demand from 2003 to 2014, during which time they grew by 56.0% and 27% respectively. On the other hand, diesel consumption grew by 25.7%, representing increased conversion efficiencies within LUCELEC's operations. shows total generation and electricity consumption by sector for the same period, during which consumption in the Domestic, Commercial (including hotels) and Industrial sectors grew by 20.5%, 35.3% and 34.0% respectively, and total generation grew by 26.9% (figure 11.).

**Figure 10: Installed Capacity and Peak Demand**
(Source: LUCELEC Annual Report (2014))

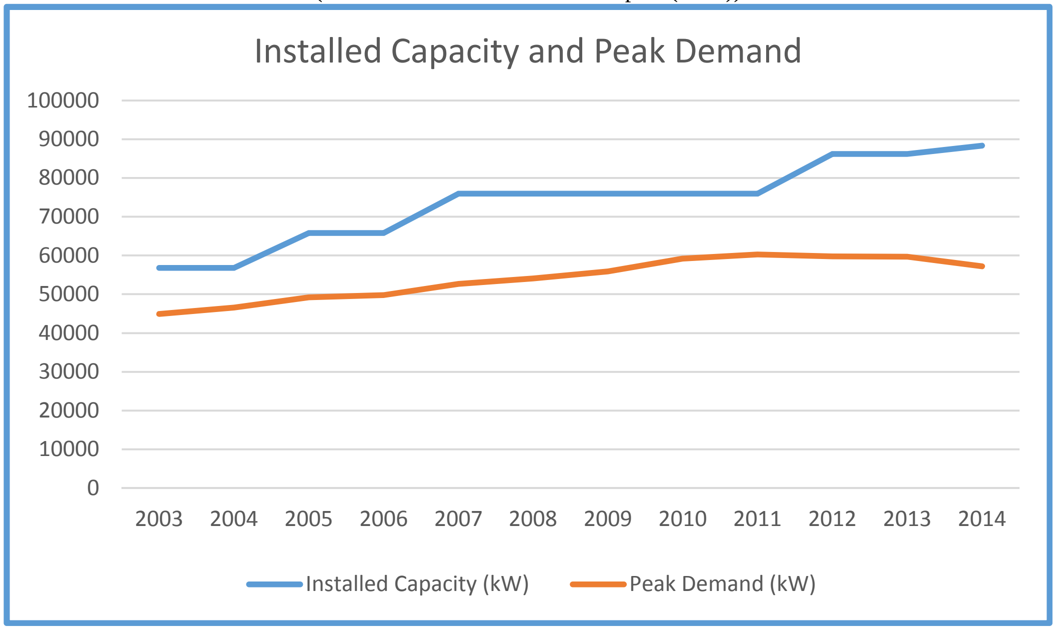
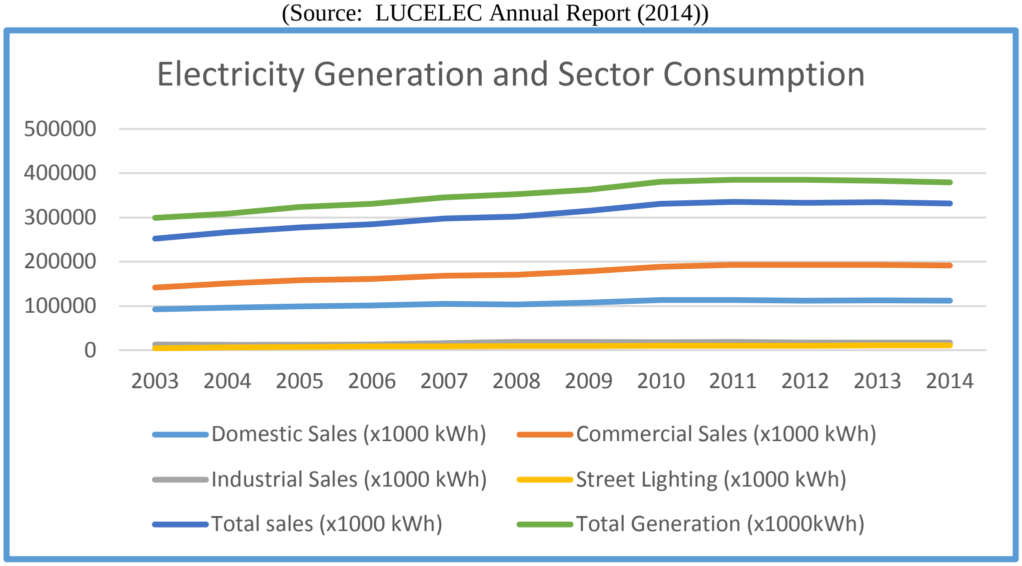



**Figure 11: Electricity Generation and Consumption by Key Economic Sectors**
(Source: LUCELEC Annual Report (2014))




Saint Lucia has committed to achieving a 35% penetration of renewable energy into the national grid by 2020 and 20% reduction in energy consumption in the public sector by the same year. To this end, LUCELEC, in collaboration with Carbon War Room/Rocky Mountain Institute/Clinton Climate Initiative (CWR/RMI/CCI), and with support from the Government of Saint Lucia, has invited bids for the construction of a 3 MW solar power plant in the south of the island and has commissioned, with the assistance of the Government of Saint Lucia, a feasibility study for a 12MW wind farm in the east of the island. A wind test tower was erected in April, 2014 for data collection. The company also started a pilot project to allow the interconnection of small solar PV systems to its grid.

The Government of Saint Lucia (GOSL) is currently engaged with the World Bank, Clinton Climate

Initiative (CCI) and the Government of New Zealand for the development of geothermal exploration. The Government of New Zealand has provided technical assistance to the Government of Saint Lucia to undertake surface exploration in recommended areas in the west coast of the island.

The GOSL through the Solid Waste Management Authority (SWMA) in collaboration with CWR/CCI/RMI is currently undertaking a waste stream assessment study. The study will analyse waste characteristics in an attempt to determine whether a waste-to-energy solution is a feasible option as it relates to management and longevity of the landfill and landfill diversion initiatives, including recycling and composting.

Another study on the wastewater potential in the Castries harbour has recently been completed under the GIZ-sponsored Renewable Energy and Energy Efficiency Technical Assistance (REETA) project. This study will determine the waste-to-energy potential of liquid waste in the Castries harbour.

On energy efficiency, the GOSL, through the Ministry of Finance, is currently in discussion with LUCELEC and the Caribbean Development Bank to undertaken the complete retrofit of all twenty-thousand-plus, high-pressure sodium and mercury-vapour streetlights on island.

The GOSL together with LUCELEC and the CWR/CCI/RMI signed an agreement to develop a National Energy Transition Strategy (NETS) in the first quarter of 2016. Under this agreement a thoughtful, iterative process for transitioning from conventional generation modes to renewable energy modalities will be completely mapped out. The NETS will focus on the electric utility to ensure that stability, reliability, and financial viability are maintained during the transition. The NETS will include three main components: (1) information gathering; (2) future energy scenario analysis; and (3) development of a business model, and will cover a grid integration study, demand-side management study, solar and wind resource assessment and feasibility reports, and an integrated resource plan (IRP).

In its Intended Nationally Determined Contribution (INDC) submitted to the UNFCCC in November 2015, Saint Lucia has committed to reducing its emissions of greenhouse gases by 16% by 2025 and 23% by 2030 against its Business-as-Usual emissions projections.

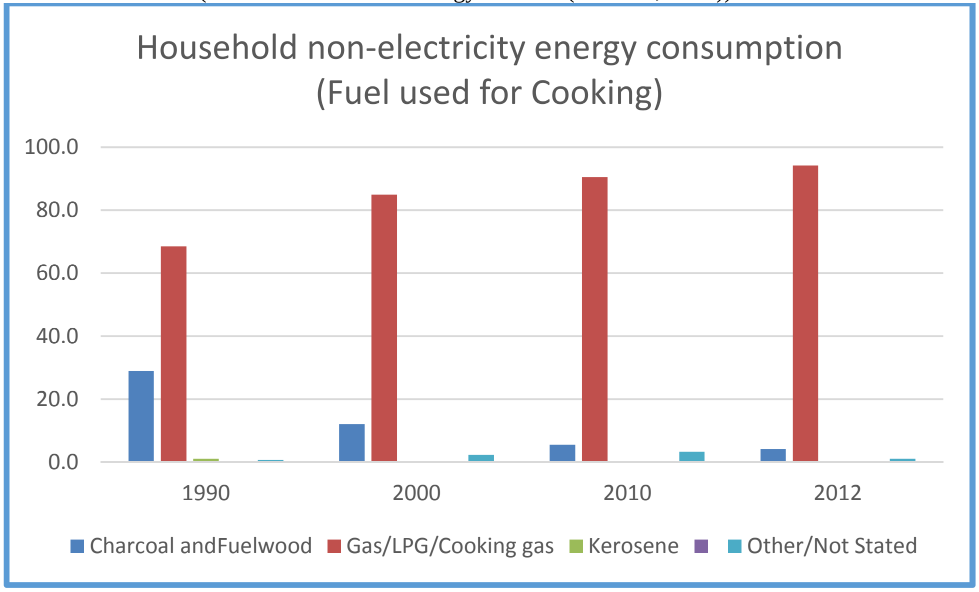
**Non-Electrical Domestic Energy Use**

The major use of non-electrical energy in the domestic sub-sector is for cooking. National census data and the 2012 OLADE Energy Balance reveal a shift away from the use of charcoal and fuel wood towards liquefied petroleum gas (LPG) as the primary cooking fuel, between 1990 and 2012. In 1990, while 28.9 percent of households used wood or charcoal, only 4.2 percent relied primarily on this fuel source in 2012. During the same period, use of LPG for cooking increased from 68.5% to 94.2%. Changes in non-electricity energy in the domestic sector is shown in Figure 1.13.

**Transport Sector**

Transportation is the largest consumer of fossil fuels in Saint Lucia. Recorded increases in vehicle imports between 1990 and 2015 display a cyclical trend, but with a longer sustained downward trajectory since 2008 (see Figure 1.14) and a steady increase in the total number of registered vehicles on the island (See Figure 1.1.5) In 2015, total recorded vehicle stock stood at 54,159. Notwithstanding the growth in the number of registered vehicles, it is difficult to determine the exact number of vehicles on Saint Lucia's roads because the official databases do not contain accurate information on vehicles taken off the roads due to accidents, obsolescence and other factors, nor do they reflect the number of unlicensed vehicles.

**Figure 1.13: Distribution of Households by Cooking Fuel**
(Source: Saint Lucia Energy Balance (OLADE, 2012))




The public transportation system comprises privately-owned 12 to 15 seat minibuses and a smaller number of larger buses licensed by the Ministry of Infrastructure, Transport and Port Services and assigned to specific routes. There is some attempt by the Transport Division to regulate the times when buses traverse their designated routes but this is largely ineffective, making the service unreliable during off-peak times.

**Figure 1.14: Number of Newly Registered Motor Vehicles 1990-2015**
(Source: Ministry of Communications, Works Transport and Public Utilities)

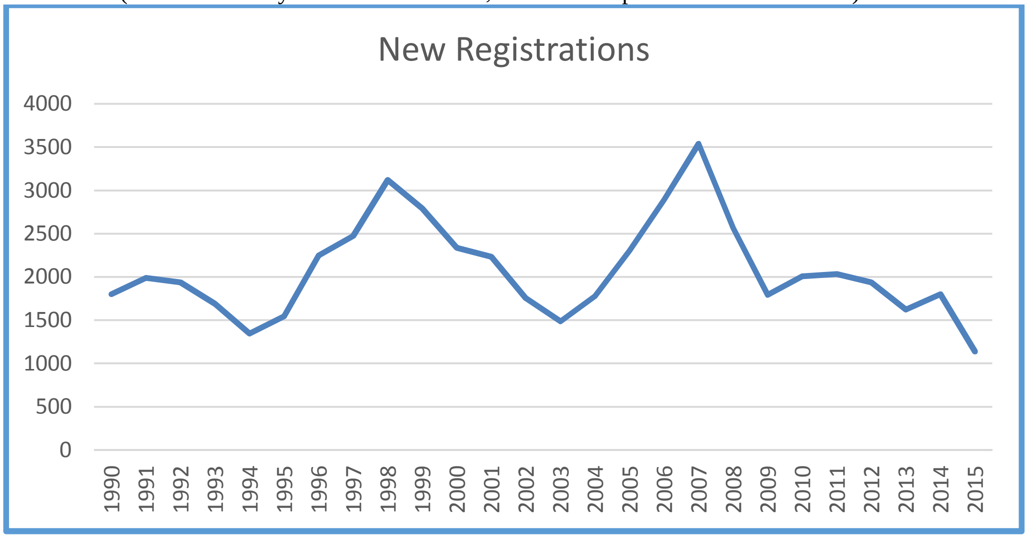
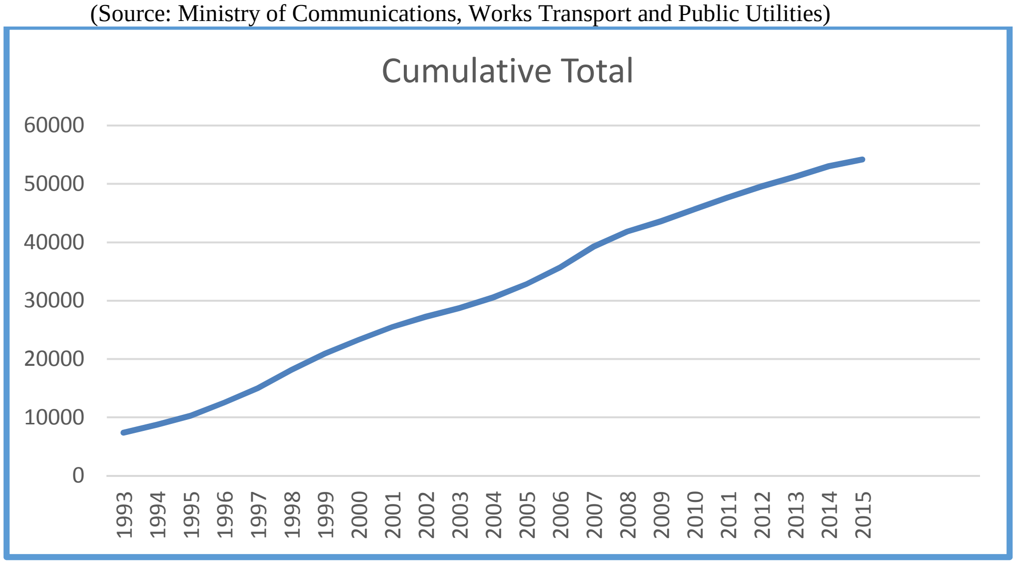


**Figure 1.15: Number of Registered Motor Vehicles**
(Source: Ministry of Communications, Works Transport and Public Utilities)




Drawing from the GHG inventory prepared for the TNC and the pronouncement in Saint Lucia's INDC, policies and programmes to encourage the importation of more efficient vehicles and an improved and expanded public transport system will be pursued as the most efficient ways to reduce greenhouse gas emissions from the transport sector.

**Biodiversity**

Notwithstanding its small size, Saint Lucia possesses a high degree of ecosystem diversity and is home to a wide range of flora and fauna. An estimated 35% of the island's landmass is under forest cover. While there is clearing for housing and other infrastructure projects, the decline of the banana industry has seen a return of once-cultivated banana plantations to natural forest.

The recorded biological diversity of the island consists of at least 1,985 species of vascular plants. Of these, 697 species are cultivated. There are 496 ornamentals, 166 comestibles and 88 medicinal. One hundred and eighty-five (185) wild and cultivated species have local medicinal uses. One thousand four hundred and sixty-six species grow wild, including three species of gymnosperms, 143 species of fern and 1320 species of flowering plants. There are 225 Caribbean endemics, of which 123 are Lesser Antillean endemics and including 9 Saint Lucian endemics. Of the 1,320 wild flowering plants, 1,171 are native species and 295 species are naturalized or escaped. Sixty-five species are believed to have not been seen since 1939. There are 118 fern species, with the majority found within the forest ecosystem. Seven of the fern species are considered endemic to Saint Lucia.[15]

There are twenty-seven endangered plants recorded in Saint Lucia, most of which are found in the coastal and lowland habitats. Of these, two species (*Tetrazygia angustifolia and Myrcia leptocelda*) are at immediate risk of extinction because their limited habitat is threatened by urban development. Three species associated with freshwater swamps are also at risk due to the disappearance of their habitats. They include *Pavonia paludicola*, *Machaerium lunatum and Montrichandia arborecens* (Graveson, 1998).

[15] Saint Lucian Plant Biodiversity: Roger Graveson, 2013

There are nine endemic plants in Saint Lucia. One of these, "palitivyè wouj" (*Chrytscohlamys caribaea),* a small stilt-rooted tree, grows along riverbanks in sheltered valleys where natural forest still occurs, and in the rain forest. "Lowye canelle" (*C. elongatum*), "balata" (*M. bidentata*) and "latanye" (*Coccothrinax barbadensis*) are other endemic plants which are threatened as a result of over-exploitation and extensive destruction of habitat.

There are over one hundred and fifty (150) bird species, seventeen (17) reptiles, nine (9) mammals and four (4) amphibians found in the terrestrial environment of Saint Lucia. The island is home to five endemic bird species: the rare Saint Lucian parrot or *Jacquot* (*Amazona versicolor*); the Saint Lucia Blackfinch or "Moisson Pied-Blanc" (*Melanospiza Richardsoni*); "Semper's Warbler" or "Pied Blanc" (*Leucopeza semperi* ); the Saint Lucia Oriole or "Carouje" (*Icterus laudibilis*); and Saint Lucia Pewee or Gobe Mouche" (*Contopus oberi*). The island possesses five endemic reptiles, one endemic sub-species, (the Saint Lucia Boa Constrictor) and six regionally endemic reptiles. The Saint Lucia Racer (Liophis ornatus), which is found only on the islet Maria Major, is believed to be the rarest snake in the world. There is one known threatened invertebrate sub-species of the Hercules beetle (*Cymnastes Hercules reide*) which is confined to the mountain areas.[16]

Coral reef systems along the west coast are more diverse than those on the east coast. In general, fringing reefs are located along the southeast (Anse de Sables), central west (off the districts of Anse-la-Raye, Soufriere and Laborie) and the northwest coast (Choc Bay). The healthiest and most diverse reefs are found along the central west coast, off Soufriere. Reefs in Saint Lucia are under threat from high levels of sedimentation and other land based pollutants and, therefore, near-shore fisheries are also threatened. Natural disasters such as hurricanes and storms have also taken a toll on Saint Lucia's reefs.

There are records of 45 species of coral[17] on the west coast in 1998. However, recent studies[18] identified only 23 species. In general, coral cover is on the decline and macro-algal cover is on the increase. An ecological survey conducted in Saint Lucia in 2011 revealed that coral recruitment is low with 6.1 recruits /$m^2$ , partly due to low availability of substrate as a result of the high abundance of cyanobacteria and silt. Additionally, in 2005, Caribbean countries experienced mass bleaching of their coral reefs and surveys conducted in Saint Lucia show that an average of 43.8% of corals were bleached, but only 4.3% of affected corals died in 2006.[19] Bleaching continues to occur at small localised levels around the island, and prevalence of coral disease is low[20].

While mean soft coral and invertebrate cover is low, sponge cover and diversity are high, with 59 sponge species.[21] Sponges are the second most dominant benthic substrate along the west coast.[22] Long-spined sea urchins (*Diadema antillarum*) are the most abundant species of invertebrates surveyed on reefs in Saint Lucia.

Seagrass beds are common along Saint Lucia's coasts and are composed mainly of turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*) and to a lesser extent, shoal grass (*Halodule wrightii*)

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16 Saint Lucia Second National Communications to the UNFCCC

17 Fenner, D., 1998. Reef topography and coral diversity of Anse Galet Reef, Saint Lucia. Caribb. Mar. Stu. 6: 19-26.

18 Future of Reefs in a Changing Environment (FORCE), 2011. *Summary of Saint Lucia Ecological Surveys July 2011*.

19 Australia Caribbean Coral reef collaboration and. *Status of CARICOM Coral reefs and their Management*.

20 Future of Reefs in a Changing Environment (FORCE), 2011. *Summary of Saint Lucia Ecological Surveys July 2011*.

21 Future of Reefs in a Changing Environment (FORCE), 2011. *Summary of Saint Lucia Ecological Surveys July 2011.*

22 Ibid

species. In general, larger and denser sea grass beds are found off the east coast, compared to the infrequent and sparsely covered sea grass patches along the west coast.

Three species of sea turtles are known to nest in Saint Lucia: the hawksbill (*Eretmochelys imbricata*), the green turtle (*Chelonia mydas)* and the leatherback (*Dermochelys coriacea*). Grand Anse beach on the north-east coast is the largest nesting site for leatherback turtles.

There are two known invasive marine species that have colonized Saint Lucia's marine environment. These are the lionfish (*Pterions miles/ P. volitans)* and an invasive species of seagrass (*Halophila stipulacea*). The lionfish was first sighted in Saint Lucia in 2011 and fishers and dive operators have reported sightings island-wide. The extent of the invasion of *H. stipulaceais* is unknown. However, it has been observed in the north of the island colonizing areas that were not previously inhabited by seagrass.

Current threats to biodiversity include poor land use practices which threaten land based biodiversity through habitat loss as well as marine biodiversity through siltation and other forms of pollution from land-based sources. These threats are likely to be exacerbated by the additional pressure arising from the impacts of climate change. These include deforestation, habitat fragmentation and/or loss, increased risks of landslides, soil erosion, siltation of rivers and near shore habitats, changes in wild life populations, storm impacts on near shore marine biodiversity, loss of coastal forests, salination of coastal and near-shore riverine habitats, and the impacts of floods and droughts on habitats and biodiversity.

**Land Use**

Inappropriate land use and management is a central factor contributing to environmental degradation in Saint Lucia. Current practices increase stress on natural resources and biodiversity, and diminish food and water productive capacities through degradation of the terrestrial and marine environments. In addition, the absence of effective forward planning, coupled with the ineffective enforcement of existing laws, is contributing to the growth of unplanned settlements, increased incidence of settlements in unsafe areas such as steep hillsides and flood plains, deforestation and poor building standards. In the long term, it is expected that soil fertility will be affected and sedimentation of the near shore marine environment will be accelerated.

**Table 1.4: Changes in Land Use with Special Regard to Forest-related Resources**

| IPCC Land-Use Categories | Land-Use Classifications | Area (hectares) | | Change in Area (000 hectares) from 1990 to 2010 |
|---|---|---|---|---|
| | | 2000 | 2009 | |
| Forest Land | Forest Reserve | 7,972 | 9,415 | +1,444 |
| | Natural Tropical Forest | 6,159 | 4,786 | -1,373 |
| | Scrub Forest | 6,756 | 6,303 | -453 |
| | Other Forest Vegetation | - | 8,691 | +8,691 |
| | Mangrove | 229 | 184 | -45 |
| Croplands | Densely Vegetated Farming | 3,586 | 13,652 | +10,066 |
| | Intensive Farming | 12,203 | 2,953 | -9,250 |
| | Mixed Farming | 11,479 | 1,556 | -9,923 |
| Grasslands | Grasslands | 2,694 | 188 | -2,507 |
| Wetlands | Ponds | 43 | 43 | 0 |
| Settlement | Built-up Areas | 9,049 | 10,131 | +1,082 |
| Other Land | Bare Ground / Scrub | 472 | 2,740 | +2,268 |
| **Total Area for Country** | | 60,641 | **60,641** | |

Notwithstanding the above, it is noteworthy that of the total land mass of 616 $km^2$, approximately 35.5 % is under some form of forest cover, 55% under some type of Agriculture and 9.14% is used for human settlements. Table 1.4, taken from the GHGI report, uses 2010 as the base year for the emissions analysis, and shows the changes in land use between 2000 and 2009[23].

## 1.9 RESPONDING TO CLIMATE CHANGE

### 1.9.1 Global Response

Beginning with the first global climate change conference in 1979, this issue has gained growing attention, culminating in the Paris Accord, where there was the widest yet agreement on the causes and responses to the phenomenon and related threats, and a global commitment to take action to achieve nationally determined mitigation targets. That said, the politics of climate change has extended the life of climate sceptics, stalled real progress in both the mitigation and adaptation fronts, contributed to underfunding of the agreed response mechanisms and overall, has retarded real progress in meeting the goals of the UNFCCC.

Over the years, developing countries have built considerable negotiating skills which must be recognised and nurtured as arguably their greatest asset in advancing a meaningful global agenda to address climate change. These resources should be channelled into reaching adequate levels of real funding, technical support, capacity development, research and systematic observation capabilities, technology transfer, global enforceable policies and standards, among others, to help these countries meet their mitigation targets and to adapt to the emerging impacts of climate change.

An important development to support effective responses to climate change impacts is the Warsaw International Mechanism for loss and damage. The creation of this mechanism signals the agreement of the international community that adaptation alone will not be adequate to address all climate change impacts, and that responding to the inevitable loss and damage from these impacts will require additional support, including financial support.

### 1.9.2 Regional Response

Caribbean Community (CARICOM) Member States created the Caribbean Community Climate Change Centre (CCCCC) in 2005 with a mandate to coordinate the region's response to climate change. The Centre is the repository and clearing house for regional climate change information and data and provides climate change-related policy advice and guidance to Member States through the CARICOM Secretariat. Through its efforts, A Regional Framework for Achieving Development Resilient to Climate Change (2009-15) was approved and the 2011–21 Implementation Plan developed. The Centre also coordinates regional fund raising and project implementation. In recent times, national delegations have started collaborating with their regional counterparts, as well as with like-minded countries within the Alliance for Small Island States (AOSIS), to develop common and/or supportive negotiating positions in preparation for international negotiations.

At the level of the Organisation of Eastern Caribbean States (OECS), Member States adopted the revised St. Georges Declaration of Principles for Environmental Sustainability, which specifically addresses climate change adaptation under Principle 8. In recent years, the OECS Commission transitioned from a programmatic approach to environmental sustainability to a project- led climate change agenda, which includes both mitigation and adaptation components.

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[23] *Source: National GHG Inventory Report 2015*

### 1.9.3 National Response

Saint Lucia has developed an impressive suite of policies and plans to address environment and sustainable development challenges generally, and climate change in particular, as discussed above. There are, however, two persisting challenges. Firstly, while policies, and in some cases, related laws are in place, implementation and/or enforcement remains elusive to the extent that often, policy reviews tend to repeat the challenges in their predecessor reports and recommendations for progress have much in common. Secondly, and in the case of climate change, the issues impact on all aspects of economic development, social advancement and environmental sustainability. Whereas an approved robust policy is in place, it has not received the wide cross-sectoral embrace necessary for meaningful advances in mitigation and adaptation efforts to effectively deal with the issues at the sector level, mainly because it is seen as the purview of the national climate change focal agency. A possible response to this challenge would be to review all national policies and plans with the view to ensuring that climate change mitigation and adaptation issues are factored into their frameworks and action plans. The current level of political recognition of the phenomenon and related threats make it opportune to pursue this matter at this time.

Notwithstanding these challenges, Saint Lucia has pursued an aggressive and broad approach to climate change mitigation and adaptation going back to the late 1990s when the country prepared its Initial National Communications to the Conference of the Parties to the UNFCCC. Sections 1.10 and 1.11 below expand on the policy environment created to support implementing the Convention as well as the projects and programmes being implemented to support climate change mitigation and adaptation.

## 1.10 POLICY ENVIRONMENT

Environmental management in Saint Lucia is guided by a number of national, regional and international policy imperatives and instruments. At the global level, Saint Lucia is party to the UNFCCC, the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol, the United Nations Convention on Biological Diversity and the United Nations Convention to Combat Desertification, among others.

Saint Lucia is also committed to the implementation of the Barbados Programme of Action (BPoA) and the Mauritius Strategy. The BPoA, adopted at the first Global Conference on Sustainable Development of Small Island Developing States held in Barbados in 1994, sets forth specific actions and measures to be taken at the national, regional and international levels to support the sustainable development of Small Island Developing States (SIDS). The Mauritius Strategy was adopted at the International Meeting to Review the Implementation of the SIDS Programme of Action in Mauritius in 2005. Both documents underscore the particular vulnerability of SIDS in the face of climate change and outline specific response measures to be taken at the national, regional and global levels.

In 2000, Saint Lucia committed to achieving the MDGs, including Goal 7, which seeks to ensure environmental sustainability, by “integrating the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources”. Actions called for under this target include immediate action to contain rising greenhouse gas emissions and limiting the use of ozone-depleting substances. This commitment now extends to achieving the goals of The 2030 Agenda for Sustainable Development which the country was involved in negotiating and to which it is committed. In particular, the island’s 2003 National Climate Change Policy and Adaptation Plan outlines an approach to achieving Goal 13 of the 2030 Agenda for Sustainable Development. Further, several of the seventeen goals are responsive to climate change impacts and in this regard, the Saint Lucia Climate Change Policy (2013), which provides a framework for addressing the impacts of climate change in an integrated manner, across all key sectors, is a key tool to enable achievement of The 2030 Agenda for Sustainable Development.

CARICOM, of which Saint Lucia became a member in 1974, has adopted a regional framework to addressing the challenges posed by climate change, to which the island subscribes. The framework proposes four key strategies, *viz*:

i. Mainstreaming climate change adaptation strategies into the sustainable development agenda of CARICOM Member States;

ii. Promoting actions to reduce greenhouse gas emissions through energy efficiency, conservation, and switching to renewable energy sources;

iii. Encouraging action to reduce the vulnerability of natural and human systems in CARICOM countries to the impacts of a changing climate; and

iv. Promoting actions to derive social, economic and environmental benefits through the prudent management of standing forests in CARICOM countries.[24]

The CCCCC is currently undergoing a process of updating the implementation plan for the Regional Framework, to among other things, incorporate new elements under the Paris Agreement.

Saint Lucia is also a member of the Organization of Eastern Caribbean States (OECS), established in 1981. Environmental management in the OECS is guided by the St. Georges Declaration of Principles for Environmental Sustainability (SGD), which was adopted in 2001 and revised in 2006. The overall aim of the SGD is to "Foster Equitable and Sustainable Improvement in the Quality of Life in the OECS Region". Principle 8 of the SGD seeks to "Address the Causes and Impacts of Climate Change". The Declaration is outdated as the timeframe on targets (2010) has run out, and there is need now for revision and establishment of new targets.

At the national level, Saint Lucia has established an extensive policy framework to guide national action on a wide range of environmental and sustainable development issues. While the general approach has been an iterative one that has seen the formulation of policies to address specific areas, there have also been attempts to address environmental management from a more holistic standpoint. To this end, a Legal and Institutional Review of Environmental Management was commissioned in 2002 to guide future expansion and strengthening of the legal, policy and institutional arrangements for the sector.

In addition, some specific policy instruments of relevance to addressing climate change have been adopted. These include a National Environment Policy (NEP) and a National Environmental Management Strategy (NEMS) (2004) and the 2015 Saint Lucia National Climate Adaptation Policy (CCAP), which superseded the 2003 National Climate Change Policy and Adaptation Plan and sets the stage for implementing an integrated response to the impacts of climate change

A Sustainable Energy Plan (SEP) was adopted in 2002 which, among other things, identifies a number of short and medium-term renewable energy targets. A National Energy Policy, which lays out the framework for the exploitation of renewable energy sources, energy security and reducing greenhouse gas emissions, was approved in 2010. In 2015 Saint Lucia submitted its Nationally Determined Contribution to COP 21, through which it committed to achieving a 16% reduction in greenhouse gas emissions by

[24] Climate Change and the Caribbean: A Regional Framework for Achieving Development Resilience to Climate Change (2009 – 2015)

2025 and 23% by 2030 against the business–as-usual emissions scenario, with 2010 as the base year for determining reductions.

Other relevant instruments include the National Water Policy, the National Land Policy and the National Biodiversity Strategy and Action. The Second National Communications reported on the policy framework in place to support environmental management up to 2010. Table 1.5 presents the key policies guiding environmental management in Saint Lucia which have been developed and adopted, or awaiting adoption, since that report.

**Table 1.5: Key Policies of Relevance to Climate Change Mitigation and Adaptation**

| Year | Policy | Goals and Objectives |
|---|---|---|
| 2010 | National Energy Policy | The Policy is based on the following tenets:<br>1. Procurement of least cost energy supplies through sector liberalization and private sector participation;<br>2. Energy security and reliability;<br>3. Diversification of the energy supply base;<br>4. Exploitation of indigenous renewable energy resources;<br>5. Efficiency in energy production, conversion and use;<br>6. Reduction of adverse environmental effects and pollution;<br>7. Implementing appropriate pricing policies; and<br>8. Establishing an appropriate regulatory framework. |
| 2014 | National Environment Policy (NEP) and a National Environmental Management Strategy (NEMS)<br>(Awaiting Adoption) | The overall objectives of the NEP/NEMS, which is awaiting the approval of Government, are to:<br>1. minimize environmental vulnerability and risk ;<br>2. support sustainable livelihoods;<br>3. engender food, water and energy security ;<br>4. develop a green economy; and<br>5. mainstream environmental management principles across sectors. |
| 2014 | Revised Draft Environmental Management Act<br>(Awaiting Enactment) | The purpose of the Act is to provide for the allocation of administrative responsibilities for environment management, the undertaking and coordination of environmental management and related activities. |
| 2015 | Saint Lucia Climate Change Adaptation Policy (CCAP) | The CCAP superseded the *National Climate Change Policy and Adaptation Plan* (NCCPAP) of 2002. The objectives of the CCAP are:<br>1. Creating the strategic direction and process for on–going climate adaptation and resilience-building;<br>2. Creating the appropriate enabling policy, legislative and institutional environment;<br>3. Mainstreaming climate change and climate variability into development processes, strategies and plans;<br>4. Engaging in and supporting capacity and awareness building activities that promote climate change adaptation and mitigation responses;<br>5. Providing the necessary incentives and economic instruments for ongoing adaptation and resilience-building; and<br>6. Identifying, establishing, and accessing, mechanisms for on-going adaptation and resilience-building. |
| 2015 | National Land Policy (Revised 2015, Awaiting Adoption) | The goal of the National Land Policy is to guide the use, management, development and administration of land resources in Saint Lucia in order to optimize the contribution of land to sustainable development. |

Saint Lucia has not promulgated legislation to deal specifically with climate change. Rather, the approach is to incorporate climate change considerations into acts and regulations that relate to sectors and issues that are climate sensitive, such as Utilities Regulation, Fisheries, Forestry, Tourism, to name a few. In 2001, Saint Lucia enacted the Montreal Protocol Act, giving national legal status to the Protocol.

Annex 1 provides a listing and description of key climate change-relevant policy instruments.

## 1.11 INSTITUTIONAL ARRANGEMENTS TO IMPLEMENT THE CONVENTION

Climate Change programming in Saint Lucia is coordinated by an informal climate change team within the Sustainable Development and Environment Division of the Ministry of Sustainable Development, Energy, Science & Technology. The team comprises four technical officers, one of which is the Chief Sustainable Development & Environment Officer (CSDEO), who also serves as the Technical Focal Point for the UNFCCC in Saint Lucia. This team is also engaged in implementation of Convention-related activities on behalf of Government of Saint Lucia. The Climate Change team reports, through the CSDEO, to the Permanent Secretary of the MSDEST, who is the National Focal Point (NFP) for the Convention. The NFP communicates as necessary with the UNFCCC Secretariat. The TNC is also coordinated within the Climate Change Team with regular contact with the United Nations Environment Programme (UNEP) office in Nairobi.

### 1.11.1 National Climate Change Committee (NCCC)

In 1998, a National Climate Change Committee (NCCC) was established by the Cabinet of Ministers. This committee became inactive within a relatively short time, but in 1999, upon commencement of activities for the preparation of Saint Lucia's Initial National Communication, the NCCC was re-established and re-constituted, with the aim of providing advice and support for national climate change programmes and activities. At that time, the Committee not only oversaw the Initial National Communications (INC) process but also guided, among others, the implementation of the Caribbean Planning for Adaptation to Climate Change (CPACC) Project. Since its revitalization, the NCCC has remained active. It meets periodically to provide guidance on, and monitor the implementation of, national and regional climate change activities. The Committee comprises representatives of public, statutory, academic and private sector bodies (See Table ).

The NCCC and its membership were mandated through Cabinet in 2003 to provide oversight of national climate change activities that are convened throughout the duration of the NC execution. This multi-sectoral committee and its membership provide validation of outputs developed through the NC process and general guidance through their areas of expertise, and provides a platform to facilitate knowledge management (Maurice-George, 2017). The wide composition of the NCCC engenders broad participation of various sectors and societal groups in the climate change dialogue, helping to facilitate mainstreaming of climate change issues at the sectoral level (SDED et al, 2015).

Over the years, the NCCC has helped to guide national efforts in:

- climate change adaptation and building resilience;
- national climate change action plans and mitigation strategies; and
- education, training, and public awareness campaigns designed to engage the general populace on the adverse impacts associated with climate change (Ibid.).

The Sustainable Development and Environment Division through the Climate Change Team also functions as the Secretariat for the National Climate Change Committee.

**Table 1.6: Composition of Saint Lucia's National Climate Change Committee[25]**

| Organisation | Department/Division/Section/Unit |
|---|---|
| Ministry of Education, Innovation, Gender Relations and Sustainable Development | Sustainable Development and Environment Division (Chair/Secretariat)<br>Biodiversity Unit<br>Sir Arthur Lewis Community College |
| Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Cooperatives | Department of Agriculture<br>Department of Forestry<br>Department of Fisheries<br>Physical Planning Section |
| Ministry of Health and Wellness | Environmental Health Division |
| Ministry of Tourism, Information and Broadcasting | |
| Ministry of Finance, Economic Growth, Job Creation, External Affairs and the Public Service | |
| Office of the Prime Minister | National Emergency Management Organisation |
| National Insurance Council of Saint Lucia | |
| Saint Lucia Bankers Association | |
| National Conservation Authority | |
| Saint Lucia Electricity Services Limited | |
| Saint Lucia Solid Waste Management Authority | |
| Saint Lucia Air and Sea Ports Authority | |

## 1.12 PROGRAMMES AND PROJECTS

Since 1997, several national and regional climate change initiatives have been undertaken in Saint Lucia, as reported in the SNC, for projects and programmes implemented or ongoing as of 2010. The following is a list of programmes and projects which have come on stream since 2010 which are of relevance and lend support to national responses to climate change mitigation and adaptation. Annex 2 also provides a list and description of major climate change projects since the second national communication.

[25] Saint Lucia PPCR Annual Monitoring and Evaluation Report (2015)

### 1.12.1 Pilot Project on Climate Resilience – Disaster Vulnerability Reduction Project (PPCR-DVRP) (2009)

Under this project, funding for technical assistance was provided through the International Development Association (IDA) and the International Bank for Reconstruction and Development (IBRD) to demonstrate approaches and options for strengthening resilience to climate change. Under this umbrella, the Strategic Programme for Climate Resilience (SPCR) was developed to pursue five strategic programmes, viz,

i. Human Welfare and Livelihood Protection;
ii. Integrated natural resource protection, conservation and management to promote sustainable development;
iii. Building resilience through business development, innovation and productivity enhancement;
iv. Capacity development and institutional strengthening; and
v. Reducing risks to climate related disasters.

The DVRP/PPCR Programme is being led by the Ministry of Sustainable Development, Energy, Science and Technology and the Ministry of Finance, Economic Affairs, Planning and Social Security, through the SDED and the Project Coordination Unit (PCU), respectively (SDED et al, 2016). Components and Activities of Saint Lucia's DVRP are contained in Table 1.7.

### 1.12.2 Pilot Programme for Climate Resilience (PPCR) Caribbean regional track

The Pilot Programme for Climate Resilience (PPCR) Caribbean regional track will look at improving geospatial data and management for adaptation planning, SLR and storm surge impact analysis; consolidating and expanding the regional climate network and global platform linkages; downscaling and expanding climate projection models and high resolution maps; and applied adaptation initiative. The latter will include the health, fisheries and agriculture sectors. The project is being implemented by UWI Mona, alongside CCCCC, CIMH, CARPHA, CARDI and the Caribbean Regional Fisheries Mechanism (CRFM) (OECS, 2017).

### 1.12.3 Hydro-meteorological/agrometeorological station installations (2011-2015)

CCCCC with support under the EU Global Climate Change Alliance (GCCA) has installed hydro-meteorological/agrometeorological stations and a network of other critical stations such as the Coral Reef Early Warning System (CREWS). The Continuous Observing Reference Stations (CORS) for observing the rate of SLR are already in place. Consideration is being given to installation of one Coral Reef Early Warning System in Saint Lucia. Additionally, a protocol for information sharing through the CCCCC Information Clearinghouse Facility will be developed (Ibid.).

### 1.12.4 Economics of Climate Adaptation (ECA) in the Caribbean (2010-11)

This project focused on developing a quantitative basis to assist decision-makers in defining and developing sound adaptation strategies and business cases for incorporation into national development plans and claims for adaptation assistance. Its execution was supported by the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and examined the implications or four hazards (wind, coastal flooding, inland flooding and salinization), and made recommendations for adaptation in the face of global climate change.

## Table 1.7. Components and Activities of Saint Lucia's DVRP

Extracted from PPCR Annual M&E Report Table 3 (SDED et al, 2016)

| BUILDING NATIONAL CLIMATE RESILIENCE, ONE PERSON, ONE HOUSEHOLD, ONE ENTERPRISE, ONE COMMUNITY, ONE SECTOR AT A TIME |
|---|
| **COMPONENT 1: ADAPTATION FACILITATION** |
| • Capacity Building and Institutional Strengthening for MIPS&T (US$750,000)<br>• Development of Bridge Maintenance Management System (US$400,000)<br>• Equipment for Institutional Strengthening of Materials Laboratory at MIPS&T (US$400,000)<br>• Development of a climate resilient Watershed Management framework and Plan for specific watersheds prone to flooding (US$200,000)<br>• Development of National Wastewater Management Strategic Plan (US$200,000)<br>• Rain Water Harvesting Pilot Program (US$100,000)<br>• Climate Change Public and Education Awareness Strategy (US$890,000)<br>• Sea Level Rise Modelling and Flood and Erosion Risk Mapping (US$1.5 million)<br>• Capacity Building for Meteorological Services, including design and deployment of a meteorological, hydrological, and monitoring network, training and procurement of equipment (US$1.9 million)<br>• Design and deployment of a sea level rise monitoring networks to provide high resolution hydrologic data (US$100,000)<br>• Evaluation of the health of coral reef systems and rapid monitoring methods for water quality and coral reef (US$500,000)<br>• Collection of high resolution LiDAR data and creation of a high resolution digital topographic and bathymetric model for Saint Lucia (US$775,000)<br>• Management of the GeoNode (US$600,000)<br>• Strengthening of the country's GIS analysis capacity to maintain risk and spatial data management system, through technical assistance, training and procurement of equipment (US$500,000)<br>• Development of Landslide Hazard Maps (US$600,000)<br>• Environmental Health Surveillance System with a focus on Climate Change (US$125,000)<br>• Support to NEMO, including review of operations and allied services (US$350,000)<br>• Enhancing the capacity of the Fire Department (US$600,000)<br>• Development of maintenance policy and strategy (US$200,000)<br>• Project management and implementation support (US$3 million) |
| **COMPONENT 2: ADAPTATION IMPLEMENTATION** |
| • Rehabilitation of Marchand Riverbank Protection (US$2.6 million)<br>• Slope stabilization and road rehabilitation along the Western Road (Sections between La Croix Maingot and Anse-la-Raye, and between Anse Le Raye and Canaries), and Bagatelle and Old Victoria Roads (US$5.45 million)<br>• Road Rehabilitation along the East-Coast Highway (Sections between Vieux-Fort and Micoud) (US$10 million)<br>• Improved Drainage Systems along select roads in Flood Prone Areas (US$2.2 million)<br>• Rehabilitation of Choc Bridge (US$6.2 million)<br>• Building stock of emergency Bailey-type bridges (US$1 million)<br>• Integrated Slopes, Landslides and Riverbank Stabilization at various locations (Forestry) (US$1.7 million)<br>• Retrofitting of Select Priority Emergency Shelters (US$1.5 million)<br>• Rehabilitation or retrofitting of Water Supply Systems (US$2.0 million)<br>• Re/construction or Rehabilitation of Schools and Health Centers (US$11.5 million)<br>• Flood Mitigation works at the Hewanorra International Airport (US$4.3 million) |
| **COMPONENT 3: ADAPTATION FINANCING** |
| • Climate Adaptation Financing Facility (US$5.0 million)<br>• Contingent Emergency Response Mechanism (US$1.0 million) |

### 1.12.5 Review of the Economics of Climate Change (2009-10)

Funded by UN ECLAC and DFID, this project was developed to assess the likely economic impacts of climate change on key sectors of the Caribbean economies, and to stimulate governments, regional institutions and private sector actions to develop and implement policies to mitigate and adapt to climate change. The project delivered four outputs, *viz*:

i. A scoping exercise and feasibility study that identify existing research and needs for further research as well as some initial thinking on the likely country-specific impacts of climate change and likely areas of regional interdependence;

ii. A cost/benefit analysis of taking action on climate change mitigation and adaptation in the Caribbean as compared to a "business as usual" scenario;

iii. Sensitisation of Caribbean public opinion on the urgency of the climate change challenge and its potential socio-economic impact on Caribbean countries; and

iv. Stimulating national/regional debate on the economics of climate change.

### 1.12.6 Enhanced Capacities for Disaster Risk Mitigation in Agriculture, Fisheries and Forestry (2010)

The purpose of this FAO - funded project was to achieve improved service delivery capacities of agriculture, fishery and forestry line departments, and enhanced know-how of farmers and fishermen organisations to implement natural hazard risk mitigation and preparedness measures, with particular emphasis on primary and secondary impacts of hurricanes and tropical storms.

### 1.12.7 EU Global Climate Change Alliance (EU-GCCA) Caribbean Support Project (2012 -14)

This regional project was implemented by the CCCCC and designed to assist participating countries to develop the capacity to design and implement climate change adaptation policies and measures by focusing on modelling, economic analysis and quantification of the costs and benefits of adaptation and mitigation options. The Saint Lucia component included:

i. Installation of meteorological & hydrological stations;

ii. Training and capacity building in climate modelling, conduct of vulnerability and capacity assessments building for nationals (VCA), risk management, installation and maintenance of equipment;

iii. Establishment & Expansion of Diversified, Cocoa-based Agro-Forestry Systems (Agriculture); and

iv. Development of a National Adaptation Strategy and Action Plan for Tourism Sector (NASAP)

### 1.12.8 The Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean

The OECS Commission launched the *Global Climate Change Alliance (GCCA) project on Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean* (2014 – 2018) with the objective to improve the resilience of the region's natural resource base to the impacts of climate change by defining and implementing sustainable land management (SLM) strategies and practices. SLM activities seek to attain an acceptable equilibrium between economic, social and environmental demands on limited land resources (OECS, 2017). The GCCA project consists of two components:

- Component A. Effective and sustainable land management frameworks and practices
- Component B. Specific physical adaptation pilot projects in relevant areas or sectors

### 1.12.9 Disaster Vulnerability Reduction Project (DVRP) (2014-19)

This World Bank-funded project, which was developed under the PPCR project (See Section 1.12.1 above), aims to reduce urgent disaster vulnerability and increase long term climate resilience by addressing the multi-faceted risks associated with hydro-meteorological events. The project also financed emergency reconstruction activities aftermath of the December 2013 trough. The PPCR contributes to strengthening Disaster Risk Management in four OECS countries and support investments and capacity building activities that foster disaster resilience across the Eastern Caribbean region

### 1.12.10 Hurricane Tomas Emergency Recovery Project (2011-14)

This World Bank-funded project was designed to support recovery and reconstruction in the aftermath of Hurricane Tomas. It comprised four components:

i. Support for early recovery through the provision of goods and technical advisory services and emergency operating costs;

ii. Institutional strengthening of key national organisations and Hazard and Risk Analysis to enable informed decision-making, undertake impact assessments and improve disaster management capacity.

iii. Reconstruction and rehabilitation of damaged critical public infrastructure; and

iv. Project management and monitoring support.

### 1.12.11 Global Islands' Vulnerability Research, Adaptation, Policy and Development (GIVRAPD) (2012-13)

Funded under the CARIBSAVE project, the focus of this initiative was in the Soufriere region and on the fisheries and tourism sectors. Through an combination of studies, surveys and workshops, this project sought to investigate and help understand the multi-scale socioeconomic, governance and environmental conditions that shape vulnerability and capacity to adapt to climate change within and between small and medium-sized coastal communities.

### 1.12.12 Third National Communication (2013-16)

This project is funded by the Global Environment Facility and implemented by UNEP. Its purpose is to support the publication of Saint Lucia's Third National Communications to the Conference of the Parties to the UNFCCC.

### 1.12.13 Reducing Risk to Natural and Human Assets Resulting from Climate Change (RRACC) (2012-14)

This regional project, which was extended to 2015, was funded by the United States Agency for International Development (USAID) and implemented by the OECS Commission. The Saint Lucia component focused on the water sector and was concerned with enhancing management of the water network and capacity in the use of GIS-related technologies to build resilience to climate change and climate variability. In this regard, the project was designed and executed to deliver the following objectives:

i. Establish a Geographic Information System (GIS) as a tool for data analysis to inform and support management decisions;

ii. Facilitate the use of technology for effective and efficient management of water infrastructure and use of water resources; and

iii. Enhance and strengthen capacity and capability within relevant agencies; and

iv. Enhancing management of the Water Network and Capacity through the Use of Geographic Information Systems (GIS).

The RRACC project also undertook interventions in freshwater and coastal area management to build resilience to climate change. In this regard, Saint Lucia has established a GIS platform to facilitate resilience building in the water sector to the effects of climate change.

### 1.12.14 Japan-Caribbean Climate Change Partnership (JCCCP) (2014)

This regional project, being implemented in collaboration with UNDP, will support interventions in Guyana, Grenada, Jamaica, Suriname, St. Vincent and the Grenadines, Saint Lucia, Dominica and Belize to build their capacity to cope with climate change. The project will help put in practice Caribbean countries' actions and policies to reduce greenhouse gas emissions and adapt to climate change, such as Nationally Appropriate Mitigation Actions and National Adaptation Plans. It will also boost access to sustainable energy and help reduce fossil fuel imports and dependence, setting the region on a low-emission development path, while addressing critical balance of payments constraints.

Outcomes and outputs listed in the project document ((UNDP, 2015) are as follows:

**Outcome 1**: NAMAs and NAPs to promote alternative low-emission and climate-resilient technologies that can support energy transformation and adaptation in economic sectors are formulated and institutionalized.

**Outcome 2**: Selected mitigation and adaptation technologies transferred and adopted for low emission and climate resilient development in the Caribbean

**Outcome 3**: Knowledge networks strengthened in Caribbean to foster South-South and North-South cooperation through sharing of experiences surrounding climate change, natural hazard risk and resilience

### 1.12.15 Building Capacity in the Public Sector to Facilitate Evidenced- Based Decision Making Towards the Reduction of Climate Change and Environmental Risks (2014)

This CDB-funded project was designed to:

i. equip policy makers with relevant information to enable mainstreaming of climate change into national development planning;

ii. facilitate training in Vulnerability Capacity Assessment (VCA) and Climate Change; and

iii. enable national reporting under the UNFCCC.

### 1.12.16 CCCCC Climate Change Adaptation Program (CCAP) - 2016 - 2020

United States Agency for International Development (USAID) has partnered with the Caribbean Community Climate Change Centre (CCCCC) to address some of the climate change and climate variability challenges in the region through an US$25.6 million investment in a CCAP over 2016 to 2020, with the programme goal to reduce risks to human and natural assets resulting from climate change vulnerability, and a larger goal to create a more secure and prosperous Caribbean Community through sustainable climate change adaptation measures. The activity seeks to strengthen an integrated system for the implementation and financing of sustainable adaptation approaches in the Eastern and Southern Caribbean region. The programme comprises three technical components (CCCCC, 2017):

Component 1: Promotes the use of climate data and information for use in decision-making

Component 2: Supports innovative adaption approaches which demonstrates proof of concept necessary to secure additional financing

Component 3: Fosters climate financing to support scale up and replication of sustainable adaptation initiatives.

### 1.12.17 Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco) (2016-18)

Component I of the IWEco project (2016-2018) aims to develop and implement integrated, targeted, innovative, climate-change resilient solutions appropriate for Caribbean and global SIDS. The Saint Lucia component seeks to address problems of land degradation and ecosystem degradation in the upper reaches of the Soufriere Watershed (Cox, 2016).

### 1.12.18 Caribbean Regional Fund for Wastewater Management Project (CReW) (2011-15)

The Caribbean Regional Fund for Wastewater Management Project (CReW) (2011-2015) focused on piloting revolving financing mechanisms (sustainable financing), appropriate waste water management technologies and related wastewater management reforms in the Wider Caribbean Region (WCR). The project, funded by the Global Environment Facility (GEF), was managed and implemented by the Inter American Development Bank (IDB) and the United Nations Environment Program (UNEP) (GOSL, 2012; UNDP, 2015) in 13 countries of the Wider Caribbean Region. Though not a project demonstration site, the Government of Saint Lucia received financial assistance from the GEF CReW project to build capacity and improve public awareness on wastewater management in Saint Lucia.

### 1.12.19 Sustainable Financing and Management of Eastern Caribbean Marine Ecosystems

This regional project ran from 2011 to 2016. It was funded by the GEF and implemented by the World Bank through The Nature Conservancy. Its purpose was to improve the management of existing and expanded marine protected area networks through the establishment of sustainable financing mechanisms. It is largely focused on setting up the financing mechanism and piloting in Soufriere MPA in Saint Lucia (Ibid.).

### 1.12.20 Improving the Management of Coastal Resources and the Conservation of the Marine Biodiversity in the Caribbean Region

This is one of two initiatives the German Agency for International Cooperation (GIZ) prepared for the region to address terrestrial and marine resources management. At the regional and national level, the 2012-2017 project focuses on strengthening the capacity of stakeholders through a common institutional framework for integrated coastal management and the strengthening of management of marine protected areas (MPA) in the Caribbean Region (Ibid.).

### 1.12.21 Caribbean Aqua-Terrestrial Solutions (CATS) Programme

Caribbean Aqua-Terrestrial Solutions (CATS) Programme (2013-2017) is a partnership between CARICOM and BMZ being implemented in Belize, Dominica, Grenada, Guyana, Jamaica, St Kitts and Nevis, Saint Lucia, and St Vincent and the Grenadines by the Caribbean Public Health Agency

(CARPHA) and GIZ. The Programme adopts a ridge-to-reef management approach, with two main components: adaptation of rural economies and natural resources to climate change and management of coastal resources and conservation of marine biodiversity (UNDP, 2015).

### 1.12.22 The Critical Ecosystem Partnership Fund (CEPF) in the Caribbean Islands Biodiversity Hotspots

This grant funded project (2010–2015) was implemented by the Caribbean Natural Resources Institute (CANARI) to support civil society's contribution to biodiversity conservation in eleven Caribbean islands for The CEPF was a joint initiative of l'Agence Française de Dévelopment, Conservation International, the Global Environment Facility, the Government of Japan, the John D. and Catherine T. MacArthur Foundation, and the World Bank. The goal of the CEPF was to support the work of civil society in developing and implementing conservation strategies, as well as in raising public awareness on the implications of loss of biodiversity. Saint Lucian civil society organisations were eligible to receive CEPF (GOSL, 2012).

### 1.12.23 Capacity building and Mainstreaming of Sustainable Land Management Project

This GEF/UNDP project ended in late 2012, aimed at building local and regional capacity to support SLM and develop pilot demonstration activities to address land degradation at the community level in eight Caribbean territories, including Saint Lucia (OECS, 2017).

### 1.12.24 Project for the Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States (ACS)

The Mexican funded project provided all OECS independent member countries with high resolution satellite images (2-5m resolution) acquired between late 2014 and early 2015. They can be used for the production of land cover map, land use mapping, create layers of buildings, roads, hydrology, and evaluation of coastal dynamics and in particulate update other thematic maps (Ibid.).

### 1.12.25 Strengthening Public Investment in Disaster Risk Reduction and Climate Change Adaptation in the Eastern Caribbean project (2015- )

The objective of this initiative is to strengthen the governments' capacity to systematically account for disaster loss, to identify hazards and develop risk assessments, as well as to use this information to strengthen public investment in disaster risk reduction. The impact of this initiative will ultimately contribute to improved resilience to natural hazards and the impacts of climate change through a better understanding of risk and incorporation of DRR strategies into investment planning. This will build on national disaster loss accounting databases (DesInventar) and create national risk profiles for countries throughout the sub-region using the Comprehensive Approach to Probabilistic Risk Assessment (CAPRA) methodology, with support from the World Bank Global Fund for Disaster Risk Reduction (GFDRR) and the UN Office for DRR (UNISDR). This will see training of personnel from multiple sectors, in particular finance and development planning, to integrate the risk assessments in evaluation of public investments and national plans and budgets (Ibid.).

### 1.12.26 Partnership Initiative for Sustainable Land Management for Caribbean SIDS (PISLM)

In the context of the UN Convention to Combat Desertification (UNCCD), UNEP is leading, among several partners including the CARICOM Secretariat, FAO and UNDP, the Partnership Initiative for Sustainable Land Management for Caribbean SIDS (PISLM). Its work programmes focus on capacity building and mainstreaming of SLM; creating synergy with other Conventions and multilateral environmental agreements; risk and disaster mitigation; sustainable flood systems; and integrated SLM projects (Ibid.).

### 1.12.27 Advancing Caribbean States' Sustainable Development Agenda through Green Economy (2012-2014)

The main objectives of this project are:

1. Support the creation of national Green Economy knowledge and network platforms and a regional Green Economy network for sharing of experiences and best practices.
2. Define country-relevant policy menus of Green Economy investment options and supportive policies based on quantitative assessment in Haiti, Jamaica and Saint Lucia.
3. Develop and support a regional centre of excellence on Green Economy; and production of capacity-building materials tailor-made for policymakers in the region.

UNEP and the CARICOM Secretariat are guiding this initiative with EU support, with ILO and UNDP among the other partners. (Ibid.).

### 1.12.28 CIMH transitioning to a WMO Regional Climate Centre

CIMH is a regional training centre under the World Meteorological Organisation (WMO) for meteorology, hydrology and associated sciences, the regional climate data centre, instrument centre, and Centre of Excellence for satellite meteorology. With investment from USAID, CIMH is becoming a WMO Regional Climate Centre, which will significantly improve capabilities to understand and predict climate issues. This will form part of the development of the Global Framework for Climate Services (GFCS) in the Caribbean which gives a roadmap for delivery of climate services to key climate-sensitive sectors such as health, agriculture, water resources and disaster risk management. The components that contribute to this include (Ibid.):

- The Caribbean Climate Outlook Forum (CariCOF) for real-time seasonal climate forecasts and interpretation to improve the effectiveness of EWS, including very timely drought forecasts
- Establishment of Caribbean Environmental and Climate Computational Centre to provide CIMH, regional scientists and end-users with needed resources to better understand and predict climate impacts
- Developing a Climate Services Information System (including DEWETRA and the Climate Impacts Database (CID)) to produce and distribute climate data, products and information according to the needs of users and to agreed standards

### 1.12.29 Water, Climate and Development Programme (WACDEP)

The Water, Climate and Development Programme (WACDEP) aims to promote water security and climate resilience through implementation of better water policies, strategies, programmes and adaptation actions, in response to the Implementation Plan of the Regional Framework for Achieving Development Resilient to Climate Change, building on a platform of integrated water resources management (IWRM). This is being collaboratively implemented by Global Water Partnership Caribbean (GWP-C) and CCCCC. The Caribbean Water and Climate Knowledge Platform has been developed as an associated knowledge resource. Recently launched under WACDEP is the "Climate-proofing water investment in the Caribbean" initiative which will include development of a Caribbean Climate Resilience and Water Security Investment Plan and subsequent identification of pilot projects for climate proofing (Ibid.).

### 1.12.30 Mainstreaming Climate Change in Disaster Management in the Caribbean Phase II (CCDMII) project

The Mainstreaming Climate Change in Disaster Management in the Caribbean Phase II (CC DMII) project builds on work completed by CDEMA, aiming to strengthen regional, national and community level capacity for mitigation, management and coordinated response to natural and technological hazards and the effects of climate change. Supported by the Australian Development Agency, the project uses a multi-sector multi-stakeholder participatory approach to target vulnerable groups (Ibid.).

### 1.12.31 Caribbean Climate Online Risk and Adaptation Tool (CCORAL)

Caribbean Climate Online Risk and Adaptation Tool (CCORAL) (2013) is an online support system for climate-resilient decision making. It assists decision-makers in applying a climate change perspective to activities and identify actions that minimise climate-related loss, maximize opportunities and build climate-resilience. It includes screening, climate risk assessment and a toolbox of appropriate tools relative to the initiative being assessed (Ibid.).

### 1.12.32 Country Documents for Disaster Risk Reduction

Coordinated through the UNISDR project under the DIPECHO Action Plan for 2013-2014, these comprehensive documents examine hazard threats, vulnerabilities, capacities and risk management and national and sub-national levels, with identification of national priorities and recommendations for future progress. CD-DRRs have been completed for Dominica, Barbados, Grenada, Guyana, Saint Lucia, St. Vincent and the Grenadines, Jamaica and Trinidad and Tobago (Ibid.).

### 1.12.33 Coastal Protection for Climate Change Adaptation project (2014-2018)

Coastal Protection for Climate Change Adaptation project – CCCCC, with support from KfW (German Development Bank) seeks to pursue the implementation of Local Adaptation Measures (LAMs) for the sustainable improvement of coastal ecosystems relevant for climate change adaptation in Grenada, Jamaica, Saint Lucia, and St. Vincent and the Grenadines (Ibid.).

### 1.12.34 GEF Small Grants Programme

The GEF Small Grants Programme supports development of both mitigation and adaptation projects by civil society. The approach builds capacity at the community level. Some of these are listed below. Many of these are pilots, and the challenge now is to build awareness of their potential, and to replicate and upscale them.

**Mitigation**:

1. Mobile desalination plant in Laborie
2. Solarisation of Praslin Seamoss Association processing facility
3. The Vaughn Lewis Institute for Research and Innovation VALERI

**Adaptation**

1. Climate smart agriculture
2. Bouton rain water harvesting
3. Impacts of rainfall runoff on the Laborie village
4. Farmers with disabilities from Choiseul

### 1.12.35 Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development

The Government of Saint Lucia will implement a 4-year project Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development to address capacity limitations identified in the National Capacity Self-Assessment (NCSA) project. Part of the project proceeds will implement tools for improved MEA and sustainable development reporting and monitoring. The funding will be used to strengthen environmental information systems, improve the capacity of the island to monitor and implement international conventions as a follow-up to the NCSA and to better integrate environmental concerns, and the value of ecosystems, into its broader development frameworks (GOSL, date unknown).The project outcomes include the following components:

1. Implement tools for improved MEA and sustainable development reporting and monitoring;
2. Mainstream environmental management and MEA objectives and;
3. Awareness raising, education and outreach.

### 1.12.36 Iyanola - Natural Resource Management of the NE Coast

The *Iyanola  Natural Resource Management of the NE Coast* project builds on the following initiatives (GOSL, 2012):

- Land use planning
- Management and carbon benefits in deciduous seasonal and low montane rainforest zones.
- Conservation and Sustainable Management of Ecosystems.
- Sustainable Use of Biodiversity.

**Component 1**. Enhanced land use planning and regulatory framework (as applied to NE Coast)

**Component 2.** Enhanced sustainable land management and carbon benefits in deciduous seasonal and low montane rainforest zones

**Component 3.** Iyanola conservation

**Component 4.** Enhanced capacity for the production of biodiversity

### 1.12.37 CARIBSAVE Partnership Seamoss Project

The CARIBSAVE Partnership is implementing a project on behalf of Department for International Development (DFID) through the Caribbean Community Climate Change Centre (CCCCC). The project is geared towards seamoss producers from Aupicon who operate in the Pointe Sable Environmental Protection Area (PSEPA). It includes the following components (Glenroy and Associates, 2016):

- Education, sensitisation and awareness building
- Provision of tools and equipment for seamoss production
- More effective marketing of sustainable seamoss production
- Promotion of efficient and hygienic dehydration of seamoss
- Provision of a small boat to assist with transportation of farmers and their produce (Fibreglass Reinforced Pirogue (FRP) and engine)

### 1.12.38 St Lucia Forest Restoration and Rehabilitation Project

This project was funded by the Government of Australia and intended to restore forest reserves damaged by Hurricane Tomas in October 2010.

### 1.12.39 Caritas Food for the Poor

Caritas (a Catholic charitable organization) funded installation of 14 greenhouses at schools and refurbishment of an additional 6 in 2015. The Ministry of Agriculture is working with the Ministry of Education and unemployed youth, with a view to allowing unemployed youth to operate the greenhouses and share the crops with the schools (Pers. Comm. Ministry of Agriculture, 2017).

### 1.12.40 Banana Accompanying Measures BAM ATP (European EDF)

Ministry of Agriculture is constructing a diagnostic facility for crop and livestock, to be completed in 2017. This will be able to undertake diagnostics for pests and disease whether zoonotic or plant related, and provide guidance to farmers. With climate change an influx of diseases from invasive species is anticipated. Invasive species such as the African snail, the hibiscus mealybug and the lion fish have already had adverse effects in Saint Lucia.

### 1.12.41 JICA Fisheries Machinery and Equipment Improvement Project

With JICA support, Department of Fisheries saw the introduction of refrigeration systems using ammonia at the complexes in Vieux Fort, Dennery and Gros Islet, and associated capacity building (pers. Comm., Department of Fisheries, 2017).

### 1.12.42 The James Belgrave Micro Enterprise Development Fund (BELFUND)

The BELFUND was established by the Government of Saint Lucia, primarily to promote sustainable development through self□help micro enterprise projects for individuals, families and groups among the less privileged sectors, through the provision of low cost loans, enterprise training, technical assistance and other support services.

### 1.12.43 Geothermal Resource Development (2014-17)

Funded by the World Bank, the United Kingdom Department for International Development (DFID) and the Government of New Zealand, this project is providing support for the Government of Saint Lucia to make informed decision regarding geothermal exploration and development by undertaking upstream preparatory activities, including support for regulatory reforms and negotiations.

### 1.12.44 Wind Farm Project

In 2015 the Government of Saint Lucia and the Saint Lucia Electricity Services Ltd. commenced wind regime studies to inform the feasibility of developing a 12 MW windfarm. Data on wind speeds, direction, humidity and barometric pressure will be collected to inform the feasibility analysis and provide input into project design. This initiative is one component of a multi-pronged approach being pursued to meet the target of providing 35% of electricity supply from renewable sources.

### 1.12.45 Sustainable Energy: From Concept to Action (2013-16)

The purpose of this project, which was funded by the Government of the Republic of Taiwan (China), is to introduce a suite of sustainable energy actions at the national level, with the public sector as the lead. It includes a public sector energy efficiency programme, LED street lighting, solar PV energy interventions, promoting the use of biogas digesters and supporting the institutional framework for sustainable energy planning and programming.

### 1.12.46 Street lighting

The Ministry of Finance has sought and received approval from the CDB for the full retrofit of approximately twenty one thousand streets lights. This project includes the full retrofit to LED of all the street lights.

### 1.12.47 Caribbean Energy Efficiency Lighting Project (2014-15)

This project was funded under the SIDS Dock Support Programme and implemented by UNDP. The project's goal was to reduce the cost of electricity and energy consumption in the public sector and help promote energy efficiency and increase public awareness in energy efficiency technologies. Activities included of undertaking lighting retrofits at the General Post Office, the High Court and the Parliament Building in Castries. Under the project 1342 fluorescent lamps were replaced by LED lighting.

### 1.12.48 Solar Power Plant

The Saint Lucia Electricity Services Ltd. (LUCELEC) proposes to construct a 3 MW solar power plant as part of the company's efforts to diversify its energy source and support government's efforts to promote the exploitation or renewable energy sources. The plan is to develop a 1 MW plant in 2016 and later expand the capacity to 3MW. The company has already invited tenders for the project.

### 1.12.49 PAHO's SMART Hospitals Toolkit

This is a practical guide (last edited in 2017) for hospital administrators, health disaster coordinators, health facility designers, engineers and maintenance staff to conserve resources, increase operational efficiencies and reduce carbon emissions. It includes a Baseline Assessment Tool, the Hospital Safety Index, a Green Checklist, cost-benefit analysis methodology, and model policy. There is potential for adapting this tool to other sectors e.g. education, tourism (Ibid.). The Toolkit is currently being applied by the Ministry of Health to adapt health facilities.

### 1.12.50 ESD Caraibe Project

Saint Lucia is one of four member states participating in the "Energy for Sustainable Development (ESD-Caraibes) in Caribbean Buildings" project. This regional project is the first of its kind and seeks to address the adverse impact of impact of Green House Gas emissions from fossil fuels and promote the benefits of sustainable energy. Saint Lucia focus of this project is lighting retrofits. Four buildings have been identified to undergo monitoring and eventually lighting retrofits of these buildings. The four buildings are Dennery Hospital, Vieux Fort police Station, Sir Arthur Lewis Community College - TR Theobalds building and the Bay Gardens Hotel.

### 1.12.51 Solar Heads of State

Through the Solar Head of State (SHOS) initiative, Government House received a 5.4kW Solar PV System. Final electrical installations of the system is still ongoing and the system has not yet been grid-connected.

### 1.12.52 SPACC - Solar PV System

Through Special Programme on Adaptation to Climate Change (SPACC), a 4.3kW system was installed on the Marchand Community Centre. This initiative was part of a Global Environmental Facility(GEF)-World Bank- funded Project, implemented and supported though the Caribbean Community Climate Change Centre (CCCCC), the Government of Saint Lucia (GoSL) and the Caribbean Renewable Energy Development Programme (CREDP).

### 1.12.53 SIDSDOCK - Solar PV Demonstration and Upscale Project

This project is undertaken with assistance of SIDSDOCK funds administered through the World Bank. This project is expected to install approximately 200kW Solar PV System at the Owen King EU National Hospital.

### 1.12.54 Roadmap for Government Fleet Transition to Electric Vehicles - United Nations Environment Programme (UNEP)

Following a request by REDiv, a study was undertaken by UNEP to develop a road map for Government Fleet transition into Electric Vehicles. The roadmap outlined a path to undertake this transition by conducting the following assessments:

- Fleet transition plan Readiness phase 1 (Objectives and Goals+ Vehicle eligibility criteria)
- Fleet transition plan Readiness phase 2 (Fleet assessment)
- Fleet transition plan Readiness phase 3 (Governance assessment+ Infrastructure assessment)

### 1.12.55 ECERA Project - Legislation development

REDiv is working closely with the Public Utilities Unit and the Eastern Caribbean Energy Regulatory Authority (ECERA) on a number of initiatives including drafting of the new Electricity Supply Services Bill (ESSB), drafting of the Energy Efficiency Bill and Revision of Grid Code. A number of public consultations were held for each of the above mentioned bills. Also the revision of the National Utilities Regulatory Commission (NURC) Bill which was NURC Act No. 3 of 2016.

### 1.12.56 The Carbon War Room’s Ten Island Challenge

The Carbon War Room’s Ten Island Challenge aims to work with pioneering island economies to reduce dependency on fossil fuels through the acceleration of commercial opportunities on islands, attracting expert engineering firms and investment. Saint Lucia is among the countries which have signed on to the initiative (UNDP, 2015).

### 1.12.57 Draft Science and Technology Policy

In September 2012, the Government of Saint Lucia, through the Energy, Science and Technology (EST) Section, began the development of a National Science and Technology Policy, Strategy and Action Plan. The Policy is to serve as an umbrella framework for future S&T initiatives, through the formalisation of a national S&T programme for Saint Lucia with related objectives. A draft policy has been developed and is currently undergoing review with the support of the National Science and Technology Policy Revision Committee.

# CHAPTER 2. NATIONAL GREENHOUSE GAS INVENTORY

## 2.1 OVERVIEW

All parties to the UNFCC are required to update and report periodically on their inventory of anthropogenic emissions and removals of greenhouse gases (GHGs). In 2012, Saint Lucia submitted its SNC which included a national inventory for the year 2000. Saint Lucia's Initial National Communication (INC) reported emissions for the year 1994.

This chapter presents a summary description of the greenhouse gas (GHG) inventory of the emissions and removals by sinks for years between and including 2000 and 2010. The greenhouse gas Inventory was conducted on a sector basis for the IPCC category sectors:

- Energy,
- Industrial Processes,
- Solvent and Product Use,
- Agriculture,
- Land Use,
- Land-Use Change and Forestry (LULUCF), and
- Waste.

The greenhouse gases included are Carbon Dioxide ($CO_2$), Methane ($CH_4$), Nitrous Oxide ($N_2O$) and partially fluorinated hydrocarbons (HFCs) not covered under the Montreal Protocol. Indirect greenhouse gases including Non-Methane Volatile Organic Compounds (NMVOC), Carbon Monoxide (CO) Nitrogen Oxides (NOx) and Sulphur Dioxide ($SO_2$) are also reported as they have an important influence on chemical reactions in the atmosphere that can lead to the formation of greenhouse gases.

The IPCC *Revised 1996 Guidelines for National Greenhouse Gas Inventories* (Volumes 1, 2 and 3) and the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* were used as the basis to undertake the necessary calculations on GHG Emissions and Removals. The use of these IPCC Guidelines fulfills the objective of the Conference of the Parties for the use of comparable methodologies. Complete documentation of methods, activity data and emission factors along with references of all data sources are reported in Saint Lucia's National GHG Inventory Report 2010. Emissions for the year 2000 have been revised based on new data not available at the time of preparation and new methodologies that improve the accuracy and ensure the comparability of the estimates.

The calculation of emissions was assisted using UNFCCC's Non-Annex I National Greenhouse Gas Inventory Software (version 1.3.2) and web application. Annex 3 of the Third National Communication presents the standard reporting tables for the year 2000, 2005 and 2010.

## 2.2 SUMMARY OF GHG EMISSIONS AND REMOVALS

This section presents an overall summary of greenhouse gas emissions for Saint Lucia between 2000 and 2010. Greenhouse gas emissions are expressed as $CO_2e$ (Carbon Dioxide Equivalent) by IPCC sectors. Carbon dioxide equivalent expresses the overall radiative forcing of different greenhouse gas emissions by a common metric (i.e., the radiative forcing of carbon dioxide) so that the relative importance of emissions of greenhouse gases such as $CO_2$, $CH_4$ and $N_2O$ can be easily compared.

The carbon dioxide equivalent is calculated using the 100 year global warming potentials for specific gases that are identified for use with the *Revised 1996 IPCC Guidelines*. The table below summarizes the global warming potentials that were used.

**Global Warming Potentials of Greenhouse Gases identified in Saint Lucia**

| Gas | 100 year GWP |
|---|---|
| Carbon Dioxide ($CO_2$) | 1 |
| Methane ($CH_4$) | 21 |
| Nitrous Oxide ($N_2O$) | 310 |
| HFC 134A | 1,300 |
| HFC 404A | 3,260 |
| HFC 410a | 1,725 |

**Note**: Since the publication of the revised 1996 IPCC report, new global warming potentials have been estimated based on improved research; however, national inventories reported to the UNFCCC are currently still prepared using the GWP indicated above.

Figure 0.12 and

Figure 0.13 indicates the relative contribution of the four main greenhouse gases (i.e., $CO_2$, $CH_4$, $N_2O$ and HFCs) to total emissions for each of the inventory years 2000, 2005 and 2010. The figures present the emissions of each IPCC Category as stacked columns to show their relative and total contribution. Figure 2.1 excludes the LULUCF sector and Figure 2.2 includes the impact of LULUCF.

**Figure 0.12: Total Greenhouse Gas Emissions expressed in $CO_2$e Excluding LULUCF (Gg)**

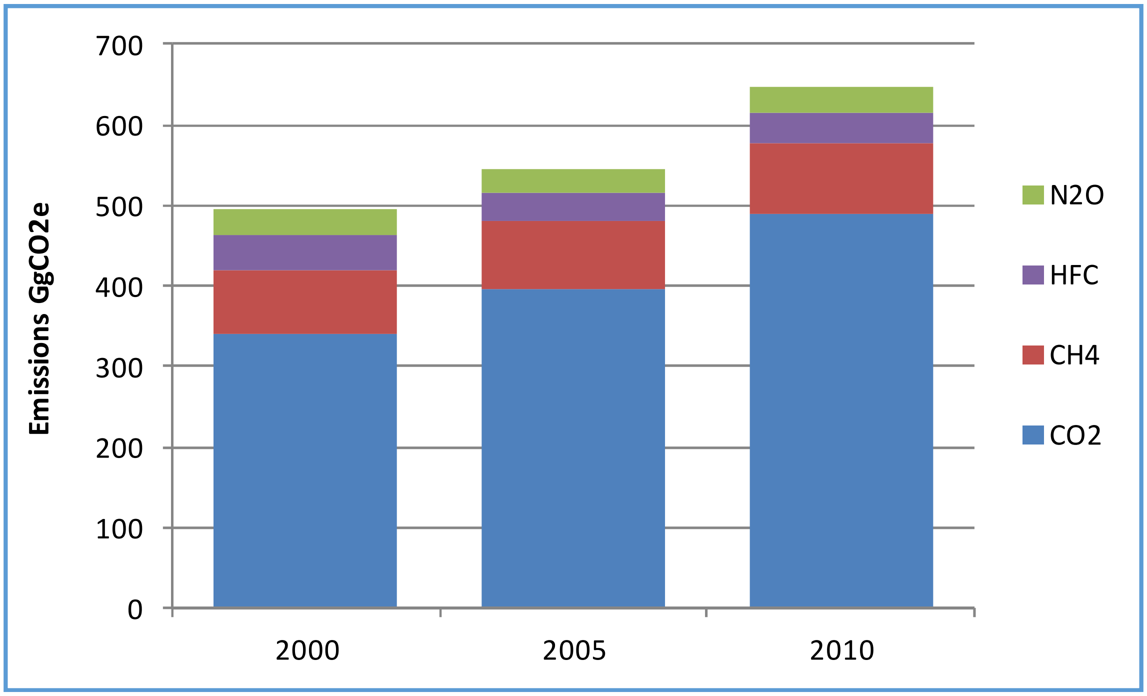
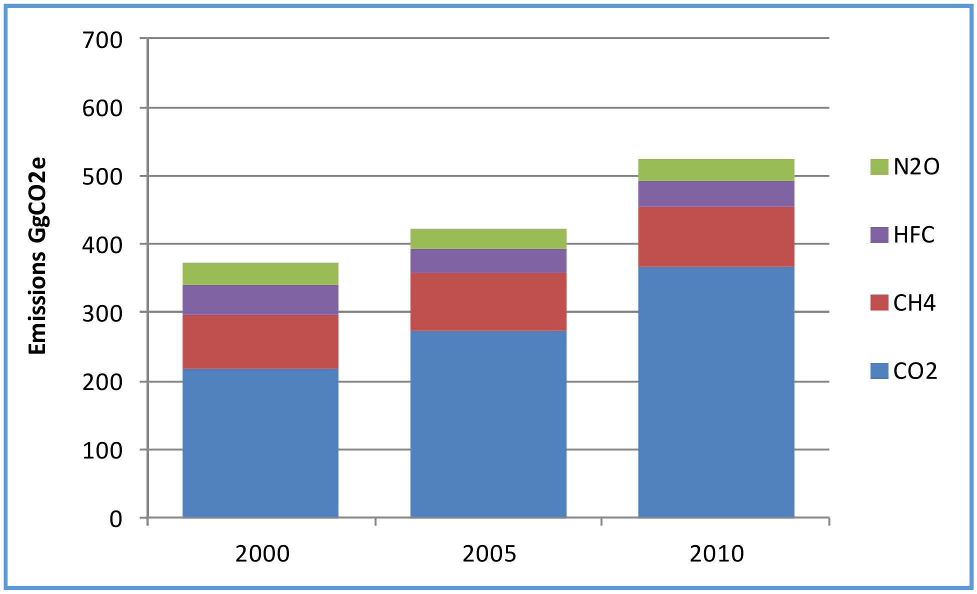


**Figure 0.13: Total Greenhouse Gas Emissions expressed in $CO_2e$ Including LULUCF (Gg)**




Overall greenhouse gas emissions in Saint Lucia have increased at a rate that is similar to overall economic growth over the same time period. Average annual growth in emissions excluding LULUCF was 2.7% per year and including LULUCF it was 3.5% per year. Average economic growth for Saint Lucia over the same time period was estimated at 2.5% (World Bank, 2014).

Total $CO_2e$ emissions for the year 2010 are estimated to be 647 Gigagrams (Gg) without the contribution of the LULUCF Sector, an increase from the year 2000 of 152 Gg or 31%. Emission growth is primarily driven by the growth in energy emissions related to increased demand for fossil fuels. Emissions in the energy sector increased on average by 3.1% annually between 2000 and 2010. Emissions from the waste sector that are dominated by the solid waste disposal source category are also growing but at a slower rate of 1.1% annually. Industrial Processes and Agriculture emission remain virtually unchanged since the year 2000. Estimates of emissions and removals for the LULUCF sector indicated that LULUCF acts as a large carbon sink leading to total $CO_2e$ removals of 122 GgCO2e annually over the ten year time period. Accounting for this LULUCF removal decreases overall $CO_2e$ emissions by approximately 18% to 524 Gg in 2010 and 371 Gg in 2000.

Trends in total $CO_2e$ emissions for each IPCC category for the complete time series 2000 to 2010 are shown in

Figure 0.14 excluding the LULUCF sector. Figure 0.1515 identifies the emissions profile with the LULUCF sector contributing as a net sink. The figures present the emissions of each IPCC Category as stacked wedges to show their relative and total contribution.

**Figure 0.14: Greenhouse Gas Emissions in GgCO2e excluding LULUCF (2000-2010)**

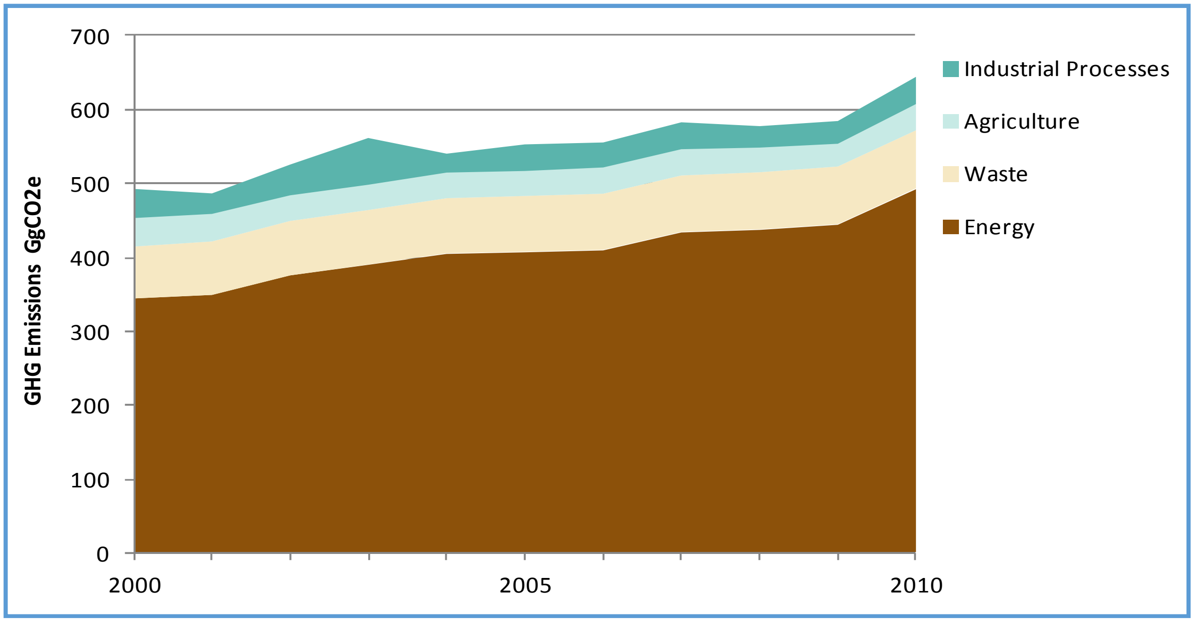
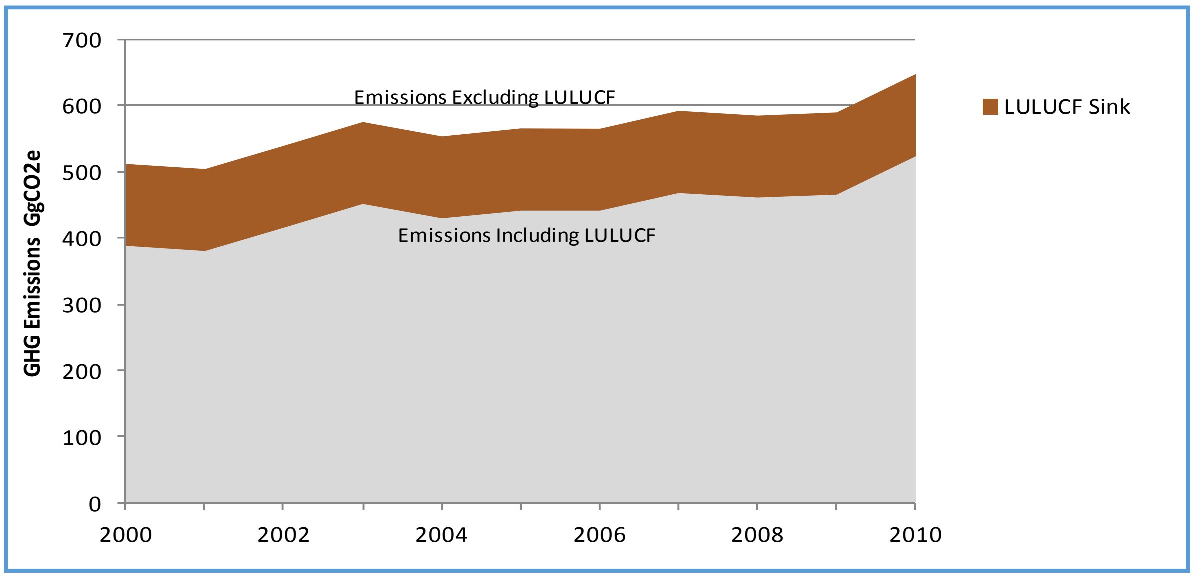



**Figure 0.15: Greenhouse Gas Emissions in MtCO2e including LULUCF (2000-2010)**




Greenhouse gas emission contributions by sector and greenhouse gas are summarized in Table 0.1 for the year 2010. The percent share of emissions by sector is shown in the last column of the table. LULUCF removals that reduce total emissions by 19% are indicated as well at the bottom of the table.

**Table 0.1: Summary of Greenhouse Gas Emissions and Removals in 2010 by Sector (Gg)**

| Sector | Emissions (Gg) | | | | | Percent Share (%) |
|---|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | HFC | Total in $CO_2e$ | |
| Energy | 489 | 0.119 | 0.005 | - | 493 | 76% |
| Industrial Processes | - | - | - | 0.023 | 36 | 5.6% |
| Solvent and Product Use | - | - | 0.007 | - | 2 | 0.3% |
| Agriculture | - | 0.508 | 0.082 | - | 37 | 5.7% |
| Waste | - | 3.55 | 0.012 | - | 78 | 12.1% |
| **Total Emissions** | **493** | **4.18** | **0.105** | **0.023** | **647** | **100%** |
| LULUCF | -122 | - | - | - | -122 | -19% |
| **Total Emissions and Removals** | **367** | **4.18** | **0.105** | **0.023** | **524** | **81% of total emissions** |

## 2.3 GHG EMISSIONS BY SECTOR

### 2.3.1 Energy Sector

The Energy Sector includes direct and indirect greenhouse gas emissions from the oxidation of carbon contained in fossil fuels during combustion, whether when generating other forms of energy, such as electricity, or in final consumption. The Energy Sector also includes fugitive emissions from fossil fuel production, transportation and processing.

Saint Lucia does not have primary fossil fuel production. All fossil fuel products are imported from other countries and the Hess Oil Buckeye facility stores and transfers crude oil. Overall demand for petroleum fuels has increased since 2000 at an average annual rate of close to 2.8%. The overall use of biomass fuels was estimated to decrease 3.5% annually from 2000 to 2010.

The national consumption of fossil and biomass fuels is identified in Table 2.2.

**Table 2.2: Domestic Consumption of Fuels 1000's Barrel Oil Equivalent - BOE (2000-2010)**

| Type | Fuel | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Secondary Fossil Fuels | LPG | 47.9 | 21.3 | 80.4 | 80.4 | 31.64 | 72.1 |
| | Gasoline | 287.3 | 303.4 | 318.7 | 313.5 | 378.1 | 312.1 |
| | Kerosene | 2.60 | 1.48 | 2.81 | 5.11 | 3.87 | 2.69 |
| | Jet Kerosene | 178.1 | 174.8 | 69.4 | 114.4 | 165.7 | 197.6 |
| | Diesel | 513.1 | 481.0 | 446.7 | 498.4 | 504.0 | 539.5 |
| | Waste Oil | - | - | - | - | - | - |
| | Lubricants | 6.7 | 6.46 | 6.61 | 8.10 | 7.45 | 7.54 |
| Biomass Fuels [4] | Fuelwood | 47.8 | 46.4 | 44.8 | 43.2 | 41.7 | 40.2 |
| | Charcoal | 2.05 | 1.99 | 1.92 | 1.85 | 1.78 | 1.72 |
| **Type** | **Fuel** | **2006** | **2007** | **2008** | **2009** | **2010 [1]** | |
| Secondary Fossil Fuels[2] | LPG | 39.95 | 59.53 | 58.68 | 64.13 | 60.6 | |
| | Gasoline | 318.97 | 333.3 | 326.79 | 321.4 | 331.1 | |
| | Kerosene | 5.70 | 4.29 | 3.13 | 4.15 | 5.1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Jet Kerosene | 159.7 | 208.0 | 224.3 | 223.3 | 225.1 |
| | Diesel | 579.6 | 595.0 | 614.3 | 610.6 | 743.7 |
| | Waste Oil | - | 0.71 | 2.5 | 3.0 | 2.2 |
| | Lubricants | 10.34 | 6.48 | 6.34 | 6.84 | 4.11 |
| Biomass Fuels | Fuelwood | 38.8 | 37.4 | 36.1 | 34.8 | 33.6 |
| | Charcoal | 1.67 | 1.61 | 1.55 | 1.49 | 1.44 |

Table 2.0 presents this information showing the sectoral approach.

Table 2.4 and Table 2.5 present combustion and fugitive emissions for $CO_2$, $CH_4$ and $N_2O$ based on the sectoral approach and for the years 2000, 2005 and 2010.

**Table 2.0: Total Energy $CO_2$ Emissions (Gg) Sectoral Approach**

| **Source** | Energy Sub-Sector | $CO_2$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Combustion Emissions | 1 Energy Industries | 176 | 202 | 251 | +43% |
| | 2 Manufacturing Industries & Construction | 5.15 | 3.05 | 6.9 | +34% |
| | 3.a Civil Aviation | 0 | 0 | 0 | +0% |
| | 3.b Road Transportation | 131 | 157 | 197 | +50% |
| | 3.d Navigation | 3.4 | 1.8 | 3.6 | +6% |
| | 4.a Commercial/Institutional | 8.6 | 5.5 | 4.6 | -46% |
| | 4.b Residential | 14.3 | 23.0 | 20.2 | +41% |
| | 4.c Agriculture/Forestry/Fishing | 1.7 | 2.7 | 5.6 | +222% |
| **Fugitive Emissions** | **Storage** | **-** | **-** | - | - |
| **TOTAL ENERGY EMISSIONS** | | **340** | **395** | **489** | **+44%** |

**Table 2.4: Total Energy $CH_4$ Emissions (Gg) Sectoral Approach**

| **Source** | Energy Sub-Sector | $CH_4$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Combustion Emissions | 1 Energy Industries | 0.011 | 0.011 | 0.012 | +15% |
| | 2 Manufacturing Industries & Construction | 0.000 | 0.000 | 0.000 | +6% |
| | 3.a Civil Aviation | 0.000 | 0.000 | 0.000 | 0% |
| | 3.b Road Transportation | 0.034 | 0.038 | 0.043 | +27% |
| | 3.d Navigation | 0.000 | 0.000 | 0.000 | +9% |
| | 4.a Commercial/Institutional | 0.001 | 0.001 | 0.001 | -38% |
| | 4.b Residential | 0.085 | 0.073 | 0.061 | -28% |
| | 4.c Agriculture/Forestry/Fishing | 0.000 | 0.000 | 0.001 | +485% |
| **Fugitive Emissions** | **Storage** | **-** | | - | - |
| **TOTAL ENERGY EMISSIONS** | | **0.131** | **0.125** | **0.119** | **-10%** |

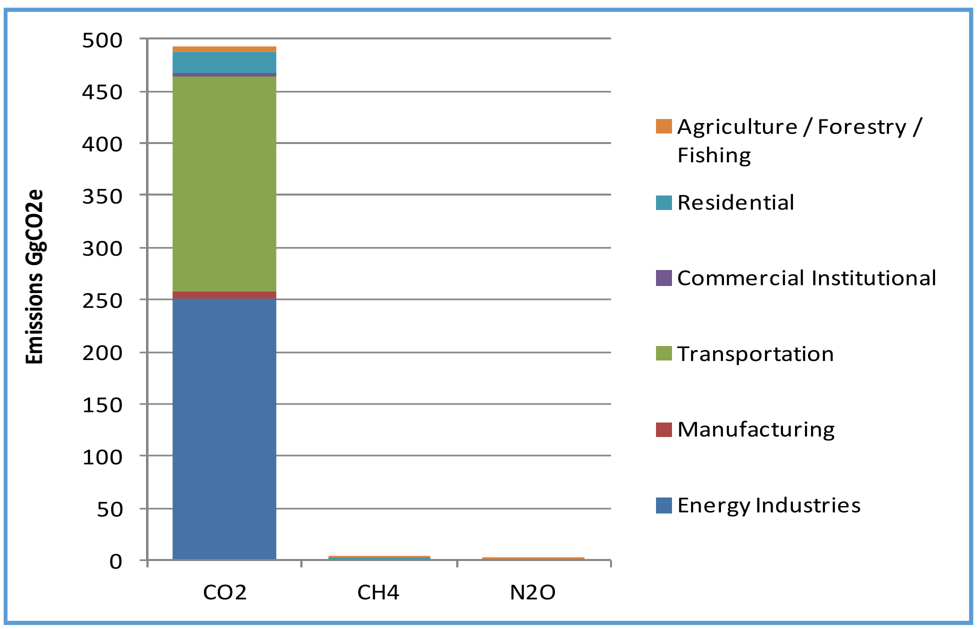
**Table 2.5: Total Energy $N_2O$ Emissions (Gg) Sectoral Approach**

| **Source** | Energy Sub-Sector | $N_2O$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Combustion Emissions | 1 Energy Industries | 0.0015 | 0.0017 | 0.0021 | +40% |
| | 2 Manufacturing Industries & Construction | 0.0000 | 0.0000 | 0.0000 | +7% |
| | 3.a Civil Aviation | 0.0000 | 0.0000 | 0.0000 | +0% |
| | 3.b Road Transportation | 0.0011 | 0.0013 | 0.0017 | +49% |
| | 3.d Navigation | 0.0000 | 0.0000 | 0.0000 | +7% |
| | 4.a Commercial/Institutional | 0.0001 | 0.0001 | 0.0000 | -40% |
| | 4.b Residential | 0.0012 | 0.0011 | 0.0010 | -22% |
| | 4.c Agriculture/Forestry/Fishing | 0.0000 | 0.0000 | 0.0000 | +233% |
| **Fugitive Emissions** | **Storage** | **-** | **-** | - | - |
| **TOTAL ENERGY EMISSIONS** | | **0.0040** | **0.0042** | **0.0049** | **+22%** |

In 2010 the energy industries sub-sector generated the largest proportion of $CO_2$ emissions (51%). These are emissions from the generation of electricity. $CH_4$ emissions are largest for the residential sub-sector accounting for 52% of these emissions; however, overall in carbon dioxide equivalent ($CO_2e$), $CH_4$ and $N_2O$ emissions represent only 1% of total energy sector emissions.

Figure 2.5 illustrates the contribution of emissions from different energy sub-sectors for each of the greenhouse gases.

**Figure 2.5: Energy Sector Greenhouse Gas Emissions in 2010 expressed in $CO_2e$ (Gg)**




Emissions from international bunker fuels are summarized in

**Table 2.6: Total GHG Emissions from Bunker Fuels in (Gg)**

| Source | Greenhouse Gas | Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Aviation International Bunker | $CO_2$ | 77.7 | 92.1 | 104.4 | +34% |
| | $CH_4$ | 0.0006 | 0.0007 | 0.0007 | +35% |
| | $N_2O$ | 0.0007 | 0.0008 | 0.0009 | +35% |
| Marine International Bunker | $CO_2$ | 23.6 | 1.7 | 3.6 | -85% |
| | $CH_4$ | 0.0016 | 0.0001 | 0.0002 | -85% |
| | $N_2O$ | 0.0002 | 0.0000 | 0.0000 | -84% |
| **TOTAL** | **$CO_2$** | **101.3** | **93.8** | **108.0** | **+7%** |
| | **$CH_4$** | **0.0022** | **0.0008** | **0.0009** | **-55%** |
| | **$N_2O$** | **0.0009** | **0.0008** | **0.0009** | **+8%** |

Indirect greenhouse gas emissions are presented in Table 2.7.

**Table 2.7: Total Energy Indirect GHG Emissions (Gg) Sectoral Approach**

| Indirect Greenhouse Gas Emission | Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|
| | 2000 | 2005 | 2010 | |
| Nitrogen Oxides ($NO_X$) | 1.845 | 2.097 | 2.700 | +46% |
| Carbon Monoxide (CO) | 14.70 | 16.19 | 17.36 | +18% |
| Non methane volatile organic compounds (NMVOC) | 2.670 | 3.177 | 3.408 | +26% |
| Sulphur Dioxide ($SO_2$) | 0.159 | 0.166 | 0.189 | +19% |

### 2.3.2 Industrial Processes Sector

The Industrial Process Sector includes anthropogenic emissions from industry production processes that are not a result of fuel combustion, since the latter are reported in the Energy Sector. The sub-sectors of importance in Saint Lucia include mineral products, food and beverage and the consumption of HFCs.

Table 2.8 presents industrial process emissions for HFCs.

**Table 2.8: Total Industrial Process HFCs Emissions (Gg)**

| Source | Energy Sub-Sector | HFC Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Consumption of HFCs | 1 Bulk Import Emissions | 0.007 | 0.007 | 0.009 | +28% |
| | 2 Product Emissions | 0.018 | 0.015 | 0.013 | -28% |
| **TOTAL INDUSTRIAL PROCESS EMISSIONS** | | **0.025** | **0.023** | **0.023** | **-9%** |

The average 100 year global warming potential of the different HFCs consumed is 1,640 and hence total HFC emissions in 2010 expressed in carbon dioxide equivalent is 37.0 $GgCO_2e$.

Indirect greenhouse gas emissions of NMVOC are the result of road paving with asphalt and food and beverage production. Table 2.9 identifies these emissions over time.

**Table 2.9: Total Industrial Process NMVOC Emissions (Gg)**

| Source | Energy Sub-Sector | NMVOC Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | 2000 | 2005 | 2010 | |
| Mineral Products | 6 Road Paving with Asphalt | 1.450 | 1,016 | 4.557 | +214% |
| Other Production | 2. Food and Drink | 0.310 | 0.111 | 0.135 | -56% |
| **TOTAL INDUSTRIAL PROCESS EMISSIONS** | | **1.760** | **1016.2** | **4.692** | **+167%** |

### 2.3.3 Solvent and Other Product Use

The use of solvents and certain products can lead to significant sources of emissions of non-methane volatile organic compounds (NMVOCs). Nitrous oxide is released in certain medical applications (anaesthetics).

Direct Greenhouse gas emissions arise only from the use of nitrous oxide gas for medical and other applications. Nitrous oxide emissions are summarized in Table 2.10.

**Table 2.10: Total Solvent and Other Product Use $N_2O$ Emissions (Gg)**

| Source | Energy Sub-Sector | $N_2O$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | **2000** | **2005** | **2010** | |
| Solvent and Other Product Use | Nitrous Oxide Product Use | 0.0014 | 0.0020 | 0.0068 | +386% |

Indirect greenhouse gas emissions of NMVOC are estimated for the application of paints and for domestic household product use. Table 2.11 identifies these emissions over time.

**Table 2.11: Total Solvent and Other Product Use NMVOC Emissions (Gg)**

| Source | Energy Sub-Sector | NMVOC Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|---|
| | | **2000** | **2005** | **2010** | |
| Solvent and Other Product Use | A Paint Application | 0.220 | 0.347 | 0.223 | +1% |
| | D. Household Product Use | 0.106 | 0.110 | 0.121 | +14% |
| **TOTAL SOLVENT AND OTHER PROCUCT USE EMISSIONS** | | **0.326** | **0.457** | **0.344** | **+6%** |

### 2.3.4 Agriculture

Agricultural activities contribute to $CH_4$ and $N_2O$ emissions through a variety of different processes. $CH_4$ emissions arise from enteric fermentation and manure management associated with livestock. $N_2O$ Emissions arise primarily from synthetic and natural fertilizers (i.e., manure, crop residues) applied to cultivation.

Table 2.12 and Table 2.13 present agricultural emissions for $CH_4$ and $N_2O$.

**Table 2.12: Total Agriculture $CH_4$ Emissions (Gg)**

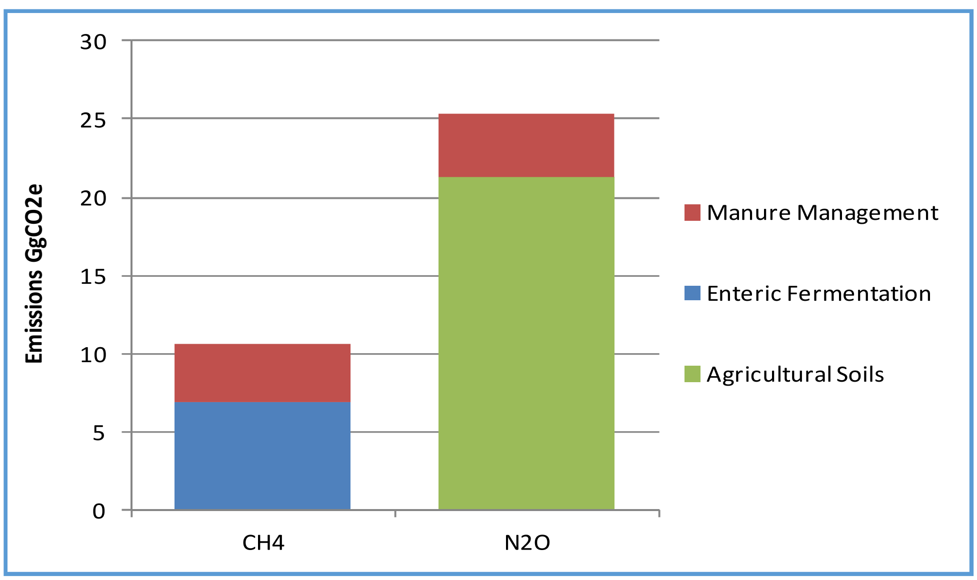
| Source | $CH_4$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|
| | 2000 | 2005 | 2010 | |
| A. Enteric Fermentation | 0.421 | 0.364 | 0.327 | **-22%** |
| B. Manure Management | 0.128 | 0.155 | 0.181 | **+41%** |
| D. Agricultural Soils | - | - | - | - |
| **TOTAL AGRICULTURE EMISSIONS** | **0.549** | **0.519** | **0.508** | **-7%** |

**Table 2.13: Total Agriculture $N_2O$ Emissions (Gg)**

| Source | $N_2O$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|
| | 2000 | 2005 | 2010 | |
| A. Enteric Fermentation | - | - | - | - |
| B. Manure Management | 0.0129 | 0.0109 | 0.0130 | **+1%** |
| D. Agricultural Soils | 0.0762 | 0.0641 | 0.0686 | **-10%** |
| **TOTAL AGRICULTURE EMISSIONS** | **0.0891** | **0.0750** | **0.0816** | **-8%** |

Enteric fermentation generated the largest proportion of $CH_4$ emissions (64% in 2010). The largest source of $N_2O$ emissions was the Agricultural Soils sub-sector accounting for 84% of these emissions. Figure 2.6 illustrates the contribution of emissions from different agricultural sub-sectors for each of the greenhouse gases. Emissions are expressed in carbon dioxide equivalent ($CO_2e$) so that the relative importance of emissions of $CH_4$ and $N_2O$ can be easily compared.

**Figure 2.6: Agriculture Sector Greenhouse Gas Emissions in 2010 expressed in $CO_2e$ (Gg)**



### 2.3.5 Land Use, Land-Use Change and Forestry

The LULUCF Sector includes estimates of emissions and removals of greenhouse gases associated with increases or decreases of carbon in living biomass as land-use changes occur over time, for example, in the conversion of a forest area to cropland, or when establishing new forest lands through reforestation or afforestation.

As recommended by the *2003 Good Practice Guidance for LULUCF*, estimations are provided for emissions and removals from land that did not undergo any land-use change, reflecting increase or loss of carbon under the same type of use, as well as, conversions of land between the six IPCC land-use categories (Forestland, Cropland, Grasslands, Wetlands, Settlements and Other Lands).

The inventory considers all forests in Saint Lucia as managed forest where forest management is defined as the process of planning and implementing practices for stewardship and use of the forest aimed at fulfilling relevant ecological, economic and social functions of the forest. This inventory uses the approach of calculating carbon gains and losses that occur over the period of 2000 to 2009 that corresponds to the land-use representation data that is available for that time period. Carbons stocks or gains and losses are calculated for above and below-ground biomass pools as well as soil organic carbon. Other pools such as dead organic matter (litter and dead wood pools) are not considered as little data is available to track the carbon flows of these pools and a simplifying Tier 1 assumption is made that the net flow of these carbon pools is zero.

Only $CO_2$ emissions and removals are projected from the year 2000 for the LULUCF Sector as there was no reported clearcut burning practices and wildfire that would lead to $CH_4$ and $N_2O$.

In order to estimate annual land-use changes between 2000 and 2009 initial areas in 2000 were compared to final areas in 2009. A non-spatially explicit land-use change matrix as described in the *2003 IPCC Good practice Guidance for LULUCF* was developed and is presented in Table 2.14.

**Table 2.14: Areas Land-Use Changes between 2000 and 2009 (ha)**

| | Forest Land | | | | | Cropland | | | Grasslands | Wetlands | Settlement | Other Land | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Final / Initial** | Forest Reserve | Natural Tropical Forest | Scrub Forest | Other Forest Vegetation | Mangrove | Densely Vegetated Farming | Intensive Farming | Mixed Farming | Grasslands | Ponds | Builtup Area | Bare Ground /Scrub | **FINAL TOTAL** |
| Forest Reserve | 7,972 | 1,373 | | | | | 71 | | | | | | **9,415** |
| Natural Tropical Forest | | 4,786 | | | | | | | | | | | **4,786** |
| Scrub Forest | | | 6,303 | | | | | | | | | | **6,303** |
| Other Forest Vegetation | | | | 0 | | | 2,302 | 4,531 | 1,858 | | | | **8,691** |
| Mangrove | | | | | 184 | | | | | | | | **184** |
| Densely Vegetated Farming | | | | | | 3,586 | 6,063 | 4,003 | | | | | **13,652** |
| Intensive Farming | | | | | | | 2,953 | | | | | | **2,953** |
| Mixed Farming | | | | | | | | 1,556 | | | | | **1,556** |
| Grasslands | | | | | | | | | 188 | | | | **188** |
| Ponds | | | | | | | | | | 43 | | | **43** |
| Builtup Area | | | | | | | 212 | 870 | | | 9,049 | | **10,131** |
| Bare Ground/Scrub | | | 453 | | 45 | | 602 | 519 | 649 | | | 472 | **2,740** |
| **INITIAL TOTAL** | **7,972** | **6,159** | **6,756** | | **229** | **3,586** | **12,203** | **11,479** | **2,694** | **43** | **9,049** | **472** | **60,641** |

Note: Land-use changes over a ten year period are indicated in yellow cells. Green cells represent areas over the period that remains the same land-use.

The general trend noted in land-use in Saint Lucia between 2000 and 2009 is an increase in forest cover as the proportion of cropland under the classification of densely vegetated farming croplands has increased significantly over the years. In addition, the total area of forest reserve increased by 18% from the year 2000 to 9,415 ha in 2009.

Table 2.15 **identifies that Saint Lucia's LULUCF** Sector was a net sink (net gain in carbon pools) between 2000 and 2009. The average annual CO2 removal over this time period was 123 Gigagrams (Gg) per year. This finding is consistent with the observed increase in forest cover on Croplands over the time period. Soil carbon stocks were estimated to change only for croplands where there was a very small increase in carbon stocks between 2000 and 2009 due to agricultural management practices.

Table 2.15 provides a summary of $CO_2$ emissions and removals that relate to different land-use categories, carbon pools and IPPC Guideline LULUCF categories. Removals are identified by a negative sign and emissions by a positive sign. The abbreviated IPCC land-use categories are as follows; FL- Forest Land, CL-Cropland, GL-Grassland, WL-Wetland, SL-Settlement Land, OL – Other Land.

Table 2.15 identifies that Saint Lucia's LULUCF Sector was a net sink (net gain in carbon pools) between 2000 and 2009. The average annual $CO_2$ removal over this time period was 123 Gigagrams (Gg) per year. This finding is consistent with the observed increase in forest cover on Croplands over the time period. Soil carbon stocks were estimated to change only for croplands where there was a very small increase in carbon stocks between 2000 and 2009 due to agricultural management practices.

**Table 2.15: Total LULUCF $CO_2$ Emissions (Gg)**

| Land-Use Category [3] | | Carbon Pool | Sector in IPCC Guidelines[1] | Annual Change in Carbon Stocks $CO_2$ (Gg) 2000 – 2009 [2] |
|---|---|---|---|---|
| **Initial Land Use** | **Land Use during Reporting Year** | | | |
| FL | FL | Living Biomass | 5A | -54.39 |
| | | Soil | 5D | 0 |
| CL | FL | Living Biomass | 5A | -29.19 |
| GL | FL | Living Biomass | 5A | -14.41 |
| Sub-Total For Forest Land | | | | **-98.00** |
| CL | CL | Living Biomass | 5A | -37.78 |
| | | Soil | 5D | +0.005 |
| Sub-Total For Cropland | | | | **-37.78** |
| GL | GL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| Sub-Total For Grassland | | | | **0** |
| WL | WL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| Sub-Total For Wetlands | | | | **0** |
| SL | SL | Living Biomass | 5A | -0.66 |
| | | Soil | 5A | 0 |
| CL | SL | Living Biomass | 5A | 0 |
| Sub-Total For Settlements | | | | **-0.66** |

| Land-Use Category[3] | | Carbon Pool | Sector in IPCC Guidelines[1] | Annual Change in Carbon Stocks $CO_2$ (Gg) 2000 – 2009[2] |
|---|---|---|---|---|
| Initial Land Use | Land Use during Reporting Year | | | |
| OL | OL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| FL | OL | Living Biomass | 5B | 7.91 |
| CL | OL | Living Biomass | 5E | 5.67 |
| GL | OL | Living Biomass | 5B | 0 |
| Sub-Total For Other Land | | | | **13.58** |
| **TOTAL** | | | | **-122.9** |

Notes: [1] Headings from the IPCC Guidelines Reporting Instructions p.1.14-1.16: 5A - Changes in Forest and Other Woody Biomass Stocks; 5B - Forest and Grassland Conversion; 5C - Abandonment of Managed Lands; 5D - Emissions and Removals from Soils, and 5E - Other.

### 2.3.6 Waste

Through the processes of disposal, treatment, recycling and incineration different types of waste can produce greenhouse gas emissions. Table 2.1 and

Table 2.17 present emissions of $CH_4$ and $N_2O$ for the waste sector.

**Table 2.16: Total Waste $CH_4$ Emissions (Gg)**

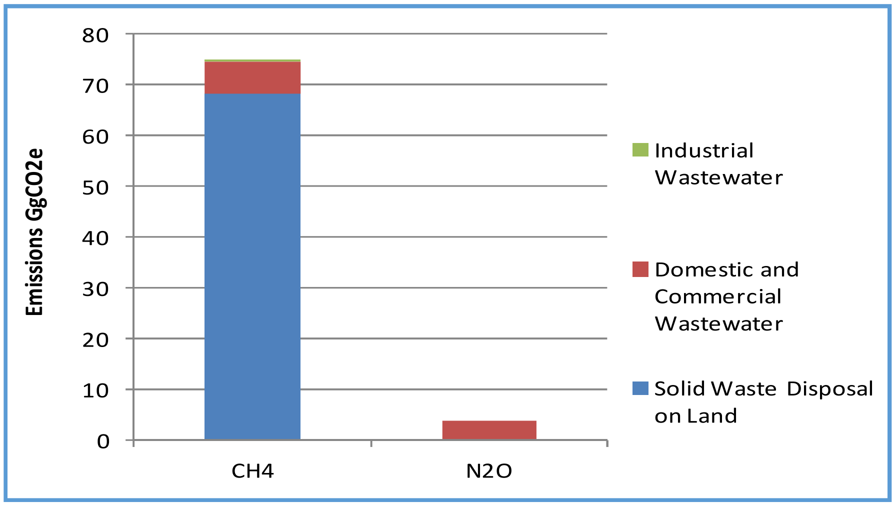
| Source | $CH_4$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|
| | 2000 | 2005 | 2010 | |
| A.2. Solid Waste Disposal on Land | 2.909 | 3.130 | 3.258 | **+12%** |
| B.1 Industrial Wastewater | 0.007 | 0.004 | 0.005 | **-40%** |
| B.2 Domestic and Commercial Wastewater | 0.225 | 0.257 | 0.291 | **+29%** |
| **TOTAL WASTE EMISSIONS** | **3.141** | **3.391** | **3.554** | **+13%** |

**Table 2.17: Total Waste $N_2O$ Emissions (Gg)**

| Source | $N_2O$ Emissions (Gg) | | | Change 2000-2010 |
|---|---|---|---|---|
| | 2000 | 2005 | 2010 | |
| B.2 Domestic and Commercial Wastewater | 0.0094 | 0.0104 | 0.0122 | **+30%** |

Methane from solid waste disposal accounts for more than 85% of overall $CH_4$ emissions. Figure 2.7 identifies the relative importance of $CH_4$ and $N_2O$ emissions for the different waste sub-sectors in 2010.

**Figure 2.7: Waste Sector Greenhouse Gas Emissions in 2010 expressed in $CO_2e$ (Gg)**




## 2.4 KEY CATEGORY ANALYSIS

Key category analysis is presented below for the 2010 inventory results. Two emission sources accounted for more than half of greenhouse gas emissions on a carbon dioxide equivalent ($CO_2e$) basis. The two most important emission sources were both related to the Energy Sector. $CO_2$ emissions related to electricity generation and road transportation accounted for 38.8% and 30.5% of overall emissions respectively (excluding LULUCF). The third largest emission source was related to methane emissions from solid waste disposal sites that contributed 10.6% of overall emissions. In total eight IPCC source categories listed in Table 2.18 comprised 95% of greenhouse gas emissions when the LULUCF Sector was excluded. Table 2.18 lists these key IPCC source categories from highest to lowest in the level of emissions.

**Table 2.18: Key Source Category Analysis (Excluding LULUCF)**

| IPCC Source Category | Sector | Source Categories to be Assessed in Key Source Category Analysis [1] | Applicable Greenhouse Gas | Emission Estimate (current year, non-LULUCF) (Gg CO2eq) | Level Assessment excl. LULUCF (%) | Cumulative level excl. LULUCF (%) |
|---|---|---|---|---|---|---|
| **Sum** | **Sum** | **Sum** | | **646.9** | | |
| 1.A.1 | Energy | CO2 Emissions from Stationary Combustion (Liquid-A) | CO2 | 251.3 | 38.8% | 38.8% |
| 1.A.3 | Energy | CO2 Mobile Combustion: Road Vehicles | CO2 | 197.1 | 30.5% | 69.3% |
| 6.A | Waste | CH4 Emissions from Solid Waste Disposal Sites | CH4 | 68.4 | 10.6% | 79.9% |
| 2.F | Industrial Processes | HFC Emissions from Substitutes for Ozone Depleting Substances (ODS Substitutes) | HFCs | 37.0 | 5.7% | 85.6% |

| IPCC Source Category | Sector | Source Categories to be Assessed in Key Source Category Analysis [1] | Applicable Greenhouse Gas | Emission Estimate (current year, non-LULUCF) (Gg CO2eq) | Level Assessment excl. LULUCF (%) | Cumulative level excl. LULUCF (%) |
|---|---|---|---|---|---|---|
| 4.D | Agriculture | N2O (Direct and Indirect) Emissions from Agriculutural Soils | N2O | 21.3 | 3.3% | 88.9% |
| 1.A.4 | Energy | Other Sectors: Residential | CO2 | 20.2 | 3.1% | 92.0% |
| 1.A.2 | Energy | CO2 Emissions from Manufacturing Industries and Construction | CO2 | 6.9 | 1.1% | 94.2% |
| 4.A | Agriculture | CH4 Emissions from Enteric Fermentation in Domestic Livestock | CH4 | 6.9 | 1.1% | 95.1% |

**Table 2.19: Key Source Analysis (Including LULUCF)**

| IPCC Source Category | Sector | Source Categories to be Assessed in Key Source Category Analysis [1] | Applicable Greenhouse Gas | Total absolute estimate incl. LULUCF (current year) (Gg CO2eq) | Level Assessment incl. LULUCF (%) | Cumulative level incl LULUCF (%) |
|---|---|---|---|---|---|---|
| **Sum** | **Sum** | **Sum** | | **524.0** | | |
| 1.A.1 | Energy | CO2 Emissions from Stationary Combustion (Liquid-A) | CO2 | 251.3 | 31.5% | 31.5% |
| 1.A.3 | Energy | CO2 Mobile Combustion: Road Vehicles | CO2 | 197.1 | 24.7% | 56.3% |
| 6.A | Waste | CH4 Emissions from Solid Waste Disposal Sites | CH4 | 68.4 | 8.6% | 64.9% |
| 5.A | LULUCF | 1. Forest Land Remaining Forest Land | CO2 | -54.4 | 6.8% | 71.7% |
| 5.A | LULUCF | 2. Land Converted to Forest Land | CO2 | -43.6 | 5.5% | 77.2% |
| 5.A | LULUCF | 1. Cropland Remaining Cropland | CO2 | -37.8 | 4.7% | 81.9% |
| 2.F | Industrial Processes | HFC Emissions from Substitutes for Ozone Depleting Substances (ODS Substitutes) | HFCs | 37.0 | 4.6% | 86.5% |
| 4.D | Agriculture | N2O (Direct and Indirect) Emissions from Agriculutural Soils | N2O | 21.3 | 2.7% | 89.2% |
| 1.A.4 | Energy | Other Sectors: Residential CO2 | CO2 | 20.2 | 2.5% | 91.7% |

| IPCC Source Category | Sector | Source Categories to be Assessed in Key Source Category Analysis [1] | Applicable Greenhouse Gas | Total absolute estimate incl. LULUCF (current year) (Gg CO2eq) | Level Assessment incl. LULUCF (%) | Cumulative level incl LULUCF (%) |
|---|---|---|---|---|---|---|
| 5.E | LULUCF | 2. Land Converted to Other Land | CO2 | 13.6 | 1.7% | 93.4% |
| 1.A.2 | Energy | CO2 Emissions from Manufacturing Industries and Construction | CO2 | 6.9 | 0.9% | 94.3% |
| 4.A | Agriculture | CH4 Emissions from Enteric Fermentation in Domestic Livestock | CH4 | 6.9 | 0.9% | 95.2% |

## 2.5 UNCERTAINTY ANALYSIS

Estimates of emissions and removals of greenhouse gases presented in this inventory have uncertainty related to the lack of precision of activity data and incomplete knowledge of the processes that cause emissions or removals of greenhouse gases. The *2000 Good Practice Guidance* recognizes that the uncertainty of estimates cannot be completely eliminated and that the main objective should be to produce accurate estimates. In accordance with the recommendations, an attempt was made in the inventory to ensure that estimates of greenhouse gas emissions and removals were not biased. Estimate precision varied depending on each sector's available data as well as resources that could be invested for determining emission factors that suited circumstances in Saint Lucia. Where emissions and removals were identified in the Key Category Analysis as the most important overall, emphasis was given where possible to ensuring that the best activity data and emission factors available were used.

The overall Inventory uncertainty is the result of the uncertainty associated with all activity and emission factor data and other parameters used in the estimates. For most sectors, it was not possible to conduct a detailed uncertainty analysis, since that would demand a considerable effort in analyzing the accuracy and precision of the basic activity data used. Nevertheless, a general evaluation of Inventory precision was conducted based on the judgment and knowledge of inventory specialists. The objective was to identify sources of emissions and removals where additional resources could be used in the future to reduce the level of overall uncertainty. The precision associated with activity data and emission factors, as well as emission or removal estimates, is expressed as ± a given percentage based on a 95% confidence interval limit.

Table 2.20 details the results of the analysis of uncertainty for emission and removal estimates. More detailed descriptions of uncertainties are provided in *Saint Lucia's National GHG Inventory Report 2010*.

The highest uncertainty of emission estimates when considering both uncertainty with activity data and emissions factors is related to the estimates of $CO_2$ from forest land remaining forest land in the LULUCF sector. The combined uncertainty as a percentage of total national emissions in 2010 is 7.4%. The next highest source is related to the estimates of $CH_4$ from solid waste disposal on land in the Waste Sector. The combined uncertainty as a percentage of total national emissions in 2010 for this source is 4.3%.

**Table 2.20: Tier 1 Uncertainty Calculations and Reporting**

| IPCC Source Category | Gas | Year t emissions 2010 | Activity data uncertainty | Emission factor uncertainty | Combined Uncertainty | Combined uncertainty as % of total national emissions in year 2010 |
|---|---|---|---|---|---|---|
| | | Gg $CO_2$ equivalent | % | % | % | % |
| 1.A.1Energy Industries Fuel Combustion | CO2 | 251 | 5 | 5 | 7.1 | 2.23 |
| | CH4 | 0.27 | 55 | 50 | 74.3 | 0.02 |
| | N2O | 0.66 | 55 | 100 | 114.1 | 0.09 |
| 1.A. 2 Manufacturing Fuel Combustion | CO2 | 6.90 | 10 | 5 | 11.2 | 0.10 |
| | CH4 | 0.00 | 10 | 50 | 51.0 | 0.00 |
| | N2O | 0.02 | 10 | 100 | 100.5 | 0.00 |
| 1.A.3 Transport fuel combustion | CO2 | 200.76 | 10 | 5 | 11.2 | 2.82 |
| | CH4 | 0.90 | 10 | 50 | 51.0 | 0.06 |
| | N2O | 0.53 | 10 | 100 | 100.5 | 0.07 |
| 1.A.4 Other Sectors Fuel Combustion | CO2 | 30.46 | 10 | 5 | 11.2 | 0.43 |
| | CH4 | 1.31 | 55 | 50 | 74.3 | 0.12 |
| | N2O | 0.32 | 55 | 100 | 114.1 | 0.05 |
| 2.F Consumption of Halocarbons | HFC | 37 | 50 | 0 | 50.0 | 2.32 |
| 3.C N2O Emissions from Product Use | N2O | 2 | 20 | 0 | 20.0 | 0.05 |
| 4.A Enteric Fermentation | CH4 | 7 | 10 | 30 | 31.6 | 0.27 |
| 4.B Manure Management | CH4 | 4 | 10 | 20 | 22.4 | 0.11 |
| | N2O | 4 | 10 | 50 | 51.0 | 0.26 |
| 4.D Agricultural Soils | N2O | 21 | 10 | 50 | 51.0 | 1.36 |
| 5.A.1 Forest Land Remaining Forest Land | CO2 | 54 | 104 | 30 | 108.4 | 7.40 |
| 5.A.2 Land Converted to Forest Land | CH4 | 44 | 67 | 30 | 73.1 | 4.00 |
| 5.A.1 Cropland Remaining Cropland | N2O | 38 | 67 | 30 | 73.1 | 3.47 |
| 5.D.1 Cropland Remaining Cropland | CO2 | 0 | 104 | 30 | 108.4 | 0.00 |
| 5.A.1 Settlements Remaining Settlements | CO2 | 1 | 67 | 30 | 73.1 | 0.06 |
| 5.E.2 Land Converted to Other Land | CO2 | 14 | 29 | 30 | 41.8 | 0.71 |
| 6.A Solid Waste Disposal on Land | CH4 | 68 | 5 | 50 | 50.2 | 4.31 |
| 6.B.2 Domestic and Commercial Wastewater | CH4 | 6 | 25 | 39 | 46.3 | 0.36 |
| 6.B.2 Domestic and Commercial Wastewater | N2O | 4 | 25 | 39 | 46.3 | 0.22 |
| | **TOTAL** | **796.9** | | | | |

**Note**: Highlighted values indicate sources of emissions or removals that contribute more than 2% to the combined uncertainty of total national emissions.

## 2.6 INVENTORY GAPS, NEEDS AND RECOMMENDATIONS

A number of gaps, needs and constraints were identified during the preparation of the Third National Communication (TNC) inventory. The sub-sections below summarize specific gaps, needs and recommendations associated with activity data collection, uncertainty in emission estimates, capacity building and development of an integrated and sustainable greenhouse gas inventory system.

### 2.6.1 Activity Data Collection

Key data gaps that were identified in regards to activity data are outlined in table 2.22 below and are organized by IPCC Sector. Specific recommendations are also provided that could be followed to address the data gaps.

**Table 2.22: Key Inventory Activity Data Gaps and Recommendations**

| IPCC Sector | Key Activity Data Gap Identified | Recommendation for Addressing Data Gap |
|---|---|---|
| Energy | National energy balances, including imports, exports, consumption and international bunker data for major economic sectors (e.g., residential, commercial, transportation etc) are not consistently available. | While the Latin American Energy Organization (OLADE) recently compiled an energy balance for Saint Lucia for 2010, 2011 and 2012, the overall process would benefit if the MSDEST prepared energy balances annually using sales data from fuel distributors as well as import data. This would allow the ministry to prepare consistent and comparable energy balances annually that could also be used for planning and policy development. |
| | Estimates of woodfuel and charcoal consumption have very high uncertainty and recent consumer and producer surveys are different by several orders of magnitude. | A comprehensive nation-wide bottom-up survey of producers and a top-down survey of consumers should be conducted to reduce the level of uncertainty associated with the production and demand for woodfuel and charcoal. |
| Industrial Processes | Information on the HFCs imported annually in bulk and in products is not complete and has a high degree of uncertainty. Bulk imports of HFCs are tracked by MSDEST based on surveys of importers; however, the reliability of data on imports of products containing HFCs (e.g., refrigerators, air conditioners) is low as there is no information gathered that identifies whether a product contains HFC and the type and amount of HFC. | Additional training and support should be provided to customs agents so that there is a reliable tracking system for HFCs. The primary route of entry for HFCs is through products and surveys should be conducted to reliably estimate the number of HFC containing products imported and the charge and type of HFCs in associated air conditioning, refrigeration and aerosol products. |
| Solvent and Product Use | Information on solvents and paints imported was obtained from customs and excise; however, there is limited knowledge in regards to the solvent content of these products. In addition information on other products containing solvents including household products (not including paints) is limited. | A national survey to characterize solvent and product use in Saint Lucia would be very useful to improve the overall quality of the data. However, it is recognized that for the greenhouse gas inventory as a whole this is likely a low priority. |
| Agriculture | Data on the fraction of different livestock that are managed under different animal waste management systems is lacking and default data was used. | The Ministry of Agriculture should undertake an assessment to accurately determine the fraction of different livestock that are managed under different animal waste management systems. |
| | The amount of Nitrogen applied through fertilizers was estimated on available data from distributors. The data is of low quality and provides only an average estimate between | The Ministry of Agriculture should conduct a detailed survey to develop an inventory for the different fertilizers sold to farmers in Saint Lucia, and prepare estimates of the overall nitrogen content. |

| IPCC Sector | Key Activity Data Gap Identified | Recommendation for Addressing Data Gap |
|---|---|---|
| | 2000 and 2009. In addition, the estimated nitrogen does not include some products such as bio-stimulants, foliar fertilizers and some pesticides. | |
| LULUCF | Changes in land-use were estimated using land-use classifications for the year 2000 and 2009. These classifications are not perfectly aligned as at least one category is not included for both years. Imperfect alignment of the land-use classifications results in greater uncertainty in emission estimates. | The Forestry Department should develop a national land classification system aligned with IPCC Guidance that uses consistent and directly comparable classifications in the future.<br><br>Continued research and effort is required to link the land-use changes indicated in this report to biomass stocks and changes in carbon pools. |
| | Biomass stocks in forest reserves were estimated from a recent forest inventory. However, IPCC defaults are used for other land-use classifications. | The Forestry Department could work to improve estimates of the biomass stocks related to different land-use classifications to improve the quality of the LULUCF inventory. |
| | Estimates of wood removal from forests for woodfuel and charcoal have high uncertainty (see Energy Sector above). | Work on estimates of woodfuel removal and charcoal production identified for the energy sector would greatly enhance the robustness of the removal and emission estimates of the LULUCF sector. |
| Waste | The total degrade-able organic content of domestic wastewater is based on an IPCC default coefficient that has a high degree of uncertainty. | The Water Resources Management Authority could potentially conduct tests to determine the average degrade-able organic content of wastewater related to different wastewater treatment systems. |

### 2.6.2 Uncertainty in Emission Estimates

The uncertainty analysis presented in Section 5 suggests that efforts to reduce the overall uncertainty of Saint Lucia's greenhouse gas inventory could be focused on a small number of emission sources. A total of seven source categories contributed to a combined uncertainty that is above 2% as a percentage of total national emissions in 2010. The following recommendations are made to reduce uncertainties associated with these seven source categories. Source categories in Table 2.23 appear in the order of greatest contribution of uncertainty to the total national emissions.

**Table 2.23: Recommendations for Reducing Overall Uncertainty in National Inventory**

| Source Category | Overall Uncertainty | Key uncertainty parameter | Recommendation for Reducing Uncertainty |
|---|---|---|---|
| Forest Land Remaining Forest Land | 7.4% | Overall understanding of carbon stocks and flows in forests over time | Improve and provide consistent representation of forest lands. Conduct monitoring through the examination of regular and consistent geo-spatial data to improve estimates of forest land-use changes. Link land-use changes from the available GIS data to above ground biomass stocks, biomass growth and biomass removals. Conduct surveys of biomass removal (see Table 2.18 energy above). |
| Solid Waste Disposal on Land | 4.3% | Emission Factors based on Tier 2 method (regional IPCC default values for many key parameters) | Country specific model values for the (a) fraction of DOC dissimilated, (b) Degradable Organic Carbon, (c) Fraction of Methane in landfill gas and (d) Oxidation Factor could be determined through measurement or other projection models. |
| Land Converted to Forest Land | 4.3% | Overall understanding of carbon stocks and flows | Conduct monitoring through the examination of regular and consistent geo-spatial data to improve estimates of |

| Source Category | Overall Uncertainty | Key uncertainty parameter | Recommendation for Reducing Uncertainty |
|---|---|---|---|
| | | related to land-use changes | forest land-use changes. Link land-use changes from the available GIS data to above ground biomass stocks, biomass growth and biomass removals. |
| Carbon emissions from Cropland remaining as Cropland | 3.5% | Overall understanding of carbon stocks and land-use changes for Croplands | Improve and provide consistent representation of croplands. Link cropland land-uses to above ground biomass stocks, biomass growth and biomass removals. |
| Transport fuel combustion | 2.8% | Uncertainty related to both activity data and emission factors is low (~11%) their overall combined contribution is important. | National energy balances should be developed annually that look at both import data and sales data from fuel suppliers to determine the point of sale of different transport fuels, so that consumption is accurately estimated. |
| Consumption of Halocarbons | 2.3% | Activity data for both bulk imports and imports of HFC's within products. | Tier 2 method could be employed that considers leakage rates of HFCs from products; however, uncertainty could be reduced more cost effectively by improving estimates of how much HFC and what species of HFC are imported in bulk and through products. Additional training and support could be provided to customs agents so that there is a reliable tracking system for HFCs. Surveys should also be conducted to reliably estimate the number of HFC containing products imported and the charge and type of HFCs in associated air conditioning, refrigeration and aerosol products. |
| Energy industries fuel combustion | 2.2% | Uncertainty related to both activity data and emission factors is low (~7%) their overall combined contribution is important. | Annual reporting of the following parameters by LUCELEC could reduce the level of uncertainty of estimates: (a) Amount of imported fuel annually; (b) Amount of fuel consumed annually; (c) Test results that determine the carbon content of the fuel (grams of carbon/KJ); (d) Test results that determine the sulfur content of the fuel. |

### 2.6.3 Capacity Building

Capacity building is required at both institutional and personnel levels. Multi-sectoral representation (i.e., Energy, Industrial Processes, Solvent and Product Use, Agriculture, LULUCF and Waste) is critical since expertise is typically embedded within institutions that follow similar sectoral divisions.

Different government departments and organizations integral to information gathering for the different sectors (e.g., MSDEST, Ministry of Agriculture, and Department of Forestry) need increased capacity to continue supporting the future development of GHG inventories. One suggested approach is to provide training for stakeholders with specific expertise and mandate required to complete inventories. Sector leads from each of the six major sink/source categories could be identified for the training that would include familiarizing them with inventory methodologies and tools, engaging them in the data collection process and providing them with hands-on experience with inventory data, methods and tools. The ultimate objective of the training should be such that appointed government staff can complete all aspects of inventory work with limited outside consultancy.

### 2.6.4 Sustainable Greenhouse Gas Inventory Systems

Developing a sustainable GHG Inventory system should be a key objective for Saint Lucia to address the challenge of more frequent and demanding reporting of inventories to the United Nations Framework Convention on Climate Change (UNFCCC). Frequent, accurate, consistent, complete and transparent reporting for Saint Lucia is crucial for not only meeting international obligations but for the assessment of Nationally Appropriate Mitigation Actions (NAMAs) and for projecting global progress towards targets to stop dangerous climate change warming.

In the context of more frequent reporting of national GHG inventories by non-Annex I Parties, it is imperative that the preparation process shift from a project-based approach to a more internalized and institutionalized approach (UNFCCC, 2012). This shift would support the timely delivery of the required information and more efficient use of available resources by Parties. Experience in Saint Lucia has demonstrated that because the development of greenhouse gas inventories has been conducted on an ad-hoc basis with the use of consultants there has been a “memory loss” between the preparation of the INC, SNC and TNC, and insufficient capacity developed within internal structures.

## 2.7 REFERENCES

European Environment Agency (2013). EMEP / EEA Emission Inventory Guidebook 2013. Domestic solvent use including fungicides. Retrieved from European Environment Agency website: http://www.eea.europa.eu/publications/emep-eea-guidebook-2013

Graveson, R. (2009) *The Classification of the Vegetation of Saint Lucia*. Technical Report No. 3 to the National Forest Demarcation and Bio-Physical Resource Inventory Project, FCG International Ltd, Helsinki, Finland.

Gustave, D., (2009). *Development of a Sustainable Charcoal Industry in Saint Lucia*.

IPCC (1996). *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Reference Manual. Intergovernmental Panel on Climate Change. Geneva.

IPCC (1996): *Climate Change 1995: The Science of Climate Change.* J.T Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell (eds.), Cambridge University Press, Cambridge, UK. Intergovernmental Panel on Climate Change.

IPCC (2000). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change. Geneva.

IPCC (2003). *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Published by the Institute for Global Environmental Strategies. Geneva.

IPCC (2005). *IPCC/TEAP Special Report: Safeguarding the Ozone Layer and the Global Climate System*. Refrigeration Chapter 4. Mobile Air Conditioning Chapter 6 and Residential and Commercial Air Conditioning Chapter 5. Cambridge University Press.

IPCC (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Volume 1 through Volume 8. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

Latin American Energy Organization (2014). *Energy Balances of Saint Lucia*. OLADE – CELAC. Paola Carrera. Castires, Saint Lucia. August 22, 2014

Saint Lucia Solid Waste Management Authority (2003) *Annual report for the Period April 2002 to March 2003.*

Saint Lucia Solid Waste Management Authority (2008). *2008 Waste Characterisation Study.*

Tennent, R.B. (2009) *Timber Inventory of Saint Lucia's Forests*. Technical Report No. 5 to the National Forest Demarcation and Bio-Physical Resource Inventory Project, FCG International Ltd, Helsinki, Finland.

UNFCCC (2012). *Handbook on Building National Greenhouse Gas Inventory Management Systems*. Consultative Group of Experts on National Communications from Parties not Included in Annex I to the Convention.

US EPA (2011). *National System Templates*. Developing a National Greenhouse Gas Inventory System. Template Workbook. Available for download at US EPA website: http://www.epa.gov/climatechange/EPAactivities/internationalpartnerships/capacity-building.html#National

World Bank (2014). World Development Indicators. Retrieved from World Bank website: http://data.worldbank.org/country/Saint Lucia

# CHAPTER 3. MEASURES TO MITIGATE CLIMATE CHANGE

## 3.1 OVERVIEW

Climate change and its impact on development are a serious concern for the Government of Saint Lucia. Saint Lucia has undertaken a detailed mitigation assessment to determine mitigation efforts that can equip the country to take key actions to respond to the challenges posed. The aim of the mitigation assessment is to not only enable Saint Lucia to contribute towards global efforts to reduce greenhouse gas emissions but also to address development goals, reduce the country's vulnerability to climate risk and allow Saint Lucia to prosper under a changing climate.

This chapter presents Saint Lucia's mitigation evaluation analysis, describing the mitigation options undertaken in the seven IPCC and UNFCCC mitigation sectors, namely energy demand, electricity generation, agriculture, industrial processes, land-use, land-use change and forestry (LULUCF) and waste. The assessment is a bottom-up assessment of mitigation opportunities that have been proposed and selected based on consultations with government ministries and a broad range of public and private stakeholders in Saint Lucia. Many of the mitigation options presented are already in the initial stages of planning and preparation, but still need a concerted program to finance and implement, to achieve the emission reduction potentials. The mitigation assessment provides the evidence base for prioritizing these actions and finding the financing for implementation. The mitigation chapter is organized as follows:

- Section 3.2: Key National Policies and Initiatives
- Section 3.3: Methodology for the Mitigation Assessment
- Section 3.4: Emission Baseline Projection
- Section 3.5: Mitigation Scenario
- Section 3.6: Summary of Impact of Implementation of Mitigation Actions

## 3.2 KEY NATIONAL POLICIES AND INITIATIVES

Climate change is a cross-cutting global challenge that requires broad political support and planning to effectively address the risks of climate change and maximize opportunities that it presents. Given limited resources Saint Lucia needs to base mitigation action to address climate change within the context of sustainable development so that it may not only contribute to the problem of climate change but also prosper and achieve national economic development goals that it has identified.

Saint Lucia has done much to address the issue of climate change. Policies, plans, strategies and initiatives to address and mainstream climate change measures are identified in Table 3.1.

## 3.3 METHODOLOGY FOR THE MITIGATION ASSESSMENT

Within the framework of Saint Lucia's national circumstances and the country's sustainable development objectives, the mitigation assessment presented below is designed to formulate and prioritize programmes containing measures to mitigate climate change and deliver sustainable development benefits. The prioritization of mitigation options therefore considers social, economic and environmental outcomes as well as the ability to reduce GHGs. Alignment with national development priorities is also a key prioritization criterion. The prioritized actions presented below, if successfully implemented, can therefore help Saint Lucia to transition to a low carbon future while delivering on national development priorities.

**Table 3.1: Key national policies, legislation and actions that address climate change**

| Sector | Key National Policies, Legislation and Actions |
|---|---|
| Energy Demand / Electricity Generation | • Adopted National Energy Policy 2010<br>• 35% Renewable Energy Target<br>• Introduced incentives for renewable energy<br>• Prepared draft of Revised Electricity Supply Act<br>• Draft of National Utility Regulatory Commission Bill (establishes an independent regulatory commission to oversee electricity production)<br>• Draft Revised Building Code (includes energy efficiency measures)<br>• National Energy Efficiency Labelling Standards (Air-Conditioning units, incandescent lamps and tubular and compact fluorescent lamps)<br>• National Energy Policy<br>• Developing draft geothermal development Bill |
| Transportation | • Introduced a new levy to control importation of used vehicles<br>• Exemptions of excise tax and duty for importers of fuel efficient vehicles |
| Agriculture / Fisheries | • National Fisheries Plan 2013 |
| Waste | • Secretariat of the National Water & Sewerage Commission to regulate water operators activated in 2012<br>• NURC |
| Land-Use, Land-Use Change and Forestry | • Conducted a comprehensive forest inventory in 2009<br>• Development of Iyanola natural resource management plan for north-east part of Saint Lucia<br>• Draft National Land Policy 2014 |
| Industrial Processes | • Approved hydrochloroflurocarbon (HCFCs) Phase Out Management Plan<br>• Code of practice for Refrigerant and Air Conditioners developed in draft form |
| General | • Established a multi-sectoral National Climate Change Committee<br>• Adopted a National Climate Change Adaptation Policy and Plan<br>• Adopted a National Coastal Zone Management Policy<br>• Adopted a National Environmental Policy (NEP)<br>• Adopted a National Environment Management Strategy (NEMS) |

The assessment of prioritized mitigation actions follows a Nationally Appropriate Mitigations Actions (NAMAs) prioritization framework developed by the International Institute for Sustainable Development (IISD) for implementing low carbon, climate resilient development. This framework helps to identify and develop information on priority mitigation actions so that they are likely to be supported across government, financed both at home and from abroad and successfully implemented. The steps of the prioritization exercise are highlighted in Assess current mitigation activities and policy. This step included the collection and review of Saint Lucia's existing climate change policies, sectoral action plans and strategies, and development priorities. The objective of the review was to identify and extract information to inform the mitigation assessment and the choice of mitigation options for review and consideration by stakeholders in Saint Lucia. More than 70 policy, strategy and planning documents were identified, including national policies and drafts related to energy, land, water, forest, agriculture and the environment, as well as internal planning and strategy documents for the MSDEST.

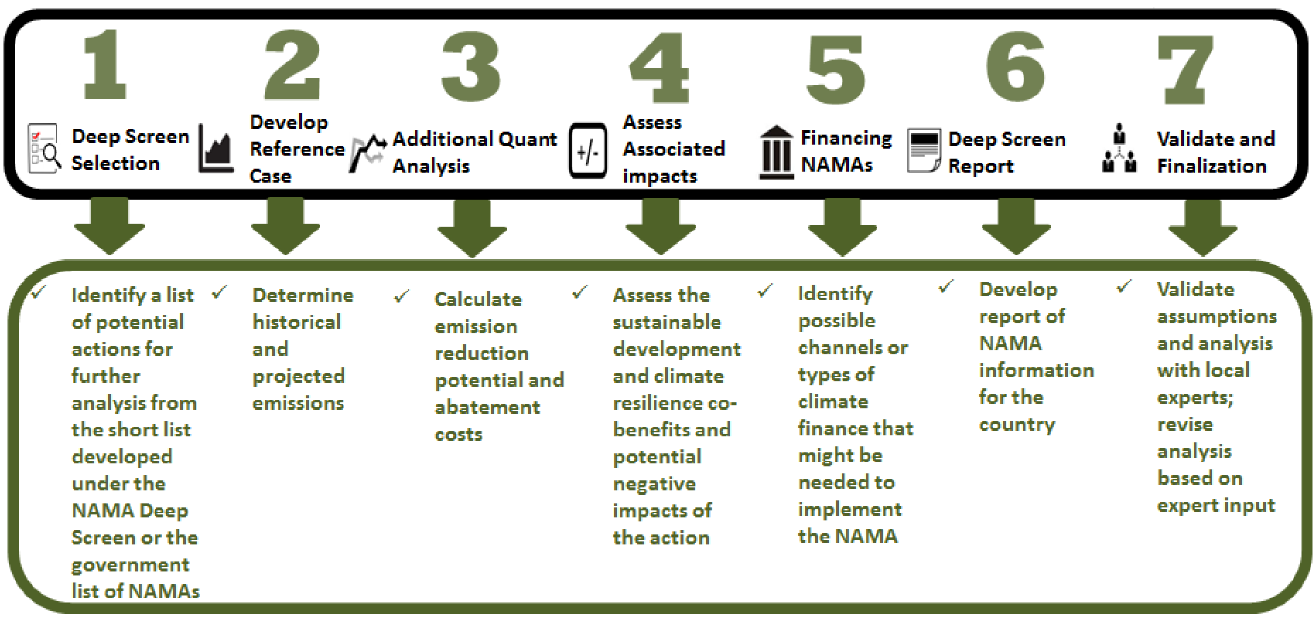
1. ***Long-list of Mitigation Options***. Current initiatives or planned, proposed and recommended actions identified in the previous step were categorized by UNFCCC mitigation sector and examined to determine if they have the potential to lead to emission reductions or enhance the sequestration or removal of carbon from the atmosphere (sinks). The GHG abatement options assessed included policies, programs or projects that are unlikely to be fully implemented or scale-

up without additional financial support (i.e., additional GHG reductions from a baseline scenario). A total of 44 potential mitigation actions were identified based on this review.

Figure 3.16 while the individual work elements are described in greater detail below.

2. ***Assess current mitigation activities and policy.*** This step included the collection and review of Saint Lucia's existing climate change policies, sectoral action plans and strategies, and development priorities. The objective of the review was to identify and extract information to inform the mitigation assessment and the choice of mitigation options for review and consideration by stakeholders in Saint Lucia. More than 70 policy, strategy and planning documents were identified, including national policies and drafts related to energy, land, water, forest, agriculture and the environment, as well as internal planning and strategy documents for the MSDEST.
3. ***Long-list of Mitigation Options***. Current initiatives or planned, proposed and recommended actions identified in the previous step were categorized by UNFCCC mitigation sector and examined to determine if they have the potential to lead to emission reductions or enhance the sequestration or removal of carbon from the atmosphere (sinks). The GHG abatement options assessed included policies, programs or projects that are unlikely to be fully implemented or scale-up without additional financial support (i.e., additional GHG reductions from a baseline scenario). A total of 44 potential mitigation actions were identified based on this review.

**Figure 3.16: IISD Low Carbon Development Methodology**




4. ***Prioritize Short-list of Mitigation Actions***. The long-list of mitigation actions were presented and assessed at a series of sector workshops with stakeholders. The final outcome of the workshops was a prioritized bundles of mitigation actions all ranked so that the most viable options could be identified for analysis in the TNC. The methodology for prioritization included the following steps:
   - Review of baseline sector emissions and list of sector mitigation actions;

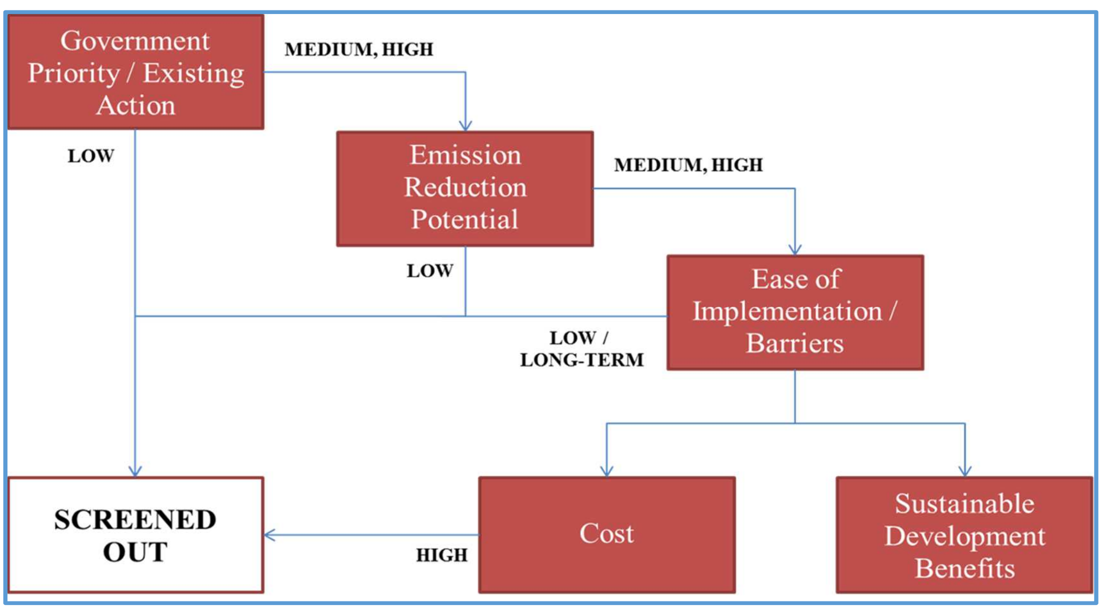
- Assessment of whether any important mitigation actions were missed in the development of the long-list of actions;
- Group exercise to discuss and qualitatively rate five different mitigation assessment criteria for each potential mitigation action (government priority and existing action, emission reduction potentials and costs, ease of implementation and barriers, sustainable development benefits and costs);
- Assign an overall rating to mitigation actions for comparability and identify implementation issues; and,
- Review and validation of the developed ratings for the mitigation actions in final workshop with all stakeholders.

The prioritization process using the mitigation assessment criteria is outlined in Figure 3.2.

The final result from the workshop and subsequent approval by the Government of Saint Lucia was a list of priority actions, or bundles of action organized under the UNFCCC mitigation sectors. This list then formed the basis of more detailed analysis.

5. ***Develop detailed Abatement Potentials and Costs***: This next step developed emission reduction potentials using in-country data where possible, but also relied on data related to similar mitigation measures implemented in comparable regions. Emission reductions were all estimated relative to a "no new measures" 2010 baseline emission projection. Costs are expressed as marginal abatement costs. These type of costs signal what society gains in terms of emission reductions from climate investment and what it will cost (i.e., cost of mitigating one tonne of carbon dioxide equivalent (CO2e) in comparison to other options. Capital, operating and program costs are all included where information is available.

**Figure 3.17: Workshop Prioritization Process for Potential Mitigation Actions**




6. ***Sustainable development benefit and climate resilience analysis***. A sustainable development benefit analysis was undertaken for each of the prioritized actions. Potential economic, environmental and social co-benefits were identified and qualitatively ranked.

7. ***Validate work with sectoral expert groups.*** The final step was a Stakeholder validation workshop testing the assumptions, analysis and conclusions. Input was received, and the report and analysis updated to reflect the workshop input.

## 3.4 EMISSION BASELINE PROJECTION

An assessment of mitigation options requires that there is a projection of expected baseline or "business as usual" emissions into the future that accounts for existing government policies from which to consider the impact of new or scaled-up mitigation actions. It is important that this projection reflects only existing policies, regulations and financial commitments and does not account for potential new policies or account for financing that is speculative in nature. For this reason, targets and goals expressed by the Government of Saint Lucia are not considered as constituting the baseline, **unless** appropriate policies have been put in place and funds committed to achieve them.

Saint Lucia's GHG inventory produced for the TNC provides historical emissions data between 2000 and 2010 for six major sectors that align with the 1996 Intergovernmental Panel on Climate Change (IPCC) guidelines for conducting emission inventories. Detailed methods and descriptions of the source emission categories are provided in Saint Lucia's National GHG Inventory Report (Stiebert Consulting, 2015). These historical emissions were allocated across seven sectors considered in the mitigation assessment:

- Energy demand
- Electricity generation
- Transportation
- Industrial processes
- Agriculture
- Land Use, Land-Use Change and Forestry (LULUCF)
- Waste

Projections out to 2030 were developed for each individual source category in the inventory. All major greenhouse gases that are reported under the UNFCCC are included. Many different types of information and assumptions are used to determine how activity related to specific sources of emissions will change over time. The main drivers of emissions are related to economic growth, changes in population, energy supply and prices as well as the adoption of new technologies and the impact of government policies and measures. While multiple baseline scenarios could have been considered in the analysis, a single baseline was selected in order to have a single starting point for the mitigation options analysis. However, there is a degree of uncertainty related to the drivers of emissions that should be recognized and the final section of this chapter presents the impact of different rates of economic growth to consider uncertainty.

The intent of this baseline is to capture existing policies and measures that are already in place (e.g., energy efficiency measures, regulations) and to present the most realistic projection of the future given what is known about planned private and public investment. The baseline is developed using a simple accounting type model and does not model individual policies and measures, but rather attempts to extrapolate existing trends and consider changes to energy end-uses, industrial production and activities that result in the generation of greenhouse gas emissions. Mitigation options then can be considered against this baseline to understand how they reduce greenhouse gas emissions.

The following sections detail the methods and data used to project baseline emissions for Saint Lucia out to 2030 for each of the seven sectors. In some cases data was available for specific activities that generated emissions in the recent historical period since 2010 (the latest inventory year). This data was used directly in the development of the emissions projection. Most projections for different sources of emission were based on long-term economic growth projections for Saint Lucia. These projections were often adjusted for technology deployment or expected trends in energy or service efficiency. Historical trends in activity, service demand or stock were also used for projections of some emission source categories.

Emissions are presented in gigagrams of carbon dioxide equivalent. A gigagram is equivalent to a kilotonne or 1,000 tonnes. Carbon dioxide equivalent expresses the overall radiative forcing of different greenhouse gas emissions by a common metric (i.e., the radiative forcing of carbon dioxide) so that the relative importance of emissions of greenhouse gases such as $CO_2$, $CH_4$ and $N_2O$ can be easily compared.

Final projections of the baseline emissions for all sectors with the exception of LULUCF out to 2030 are illustrated in Figure 3.18. The baseline projection presented in Table 3.2 is the baseline against which the abatement potential of mitigation action are assessed. All sectors including LULUCF are presented in Table 3.4.

**Figure 3.18: Emission Baseline Projection for Saint Lucia ($GgCO_2e$)**

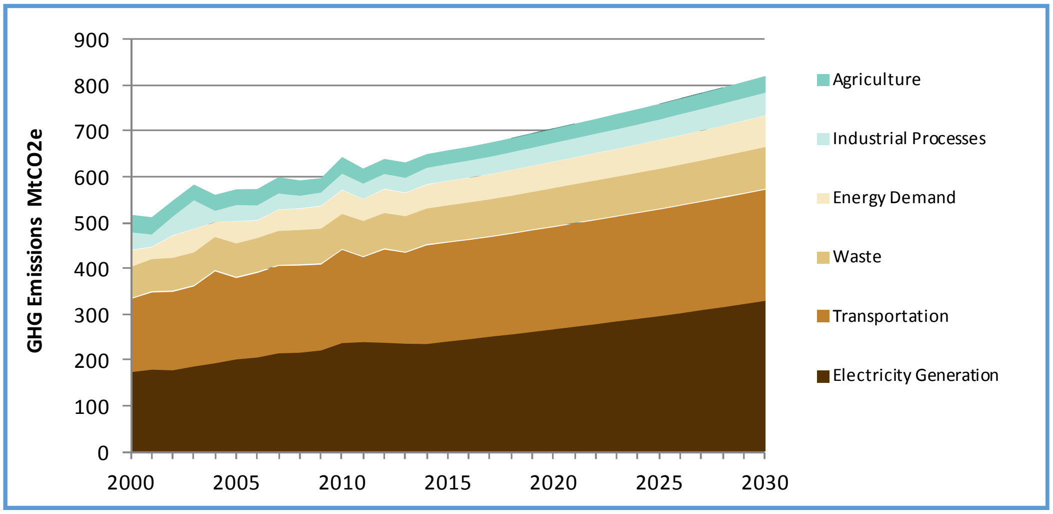



**Table 3.4: Emission Baseline Projection for Saint Lucia ($GgCO_2e$)**

| Sector | Baseline Emissions ($GgCO_2e$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
| Electricity Generation | 175 | 203 | 238 | 242 | 269 | 297 | 330 |
| Transportation | 158 | 177 | 203 | 216 | 222 | 232 | 242 |
| Waste | 70 | 75 | 78 | 80 | 84 | 88 | 92 |
| Energy Demand | 36 | 48 | 52 | 52 | 57 | 62 | 69 |
| Industrial Processes | 39 | 36 | 37 | 38 | 41 | 45 | 48 |
| Agriculture | 39 | 34 | 36 | 30 | 32 | 34 | 36 |
| **TOTAL (Without LULUCF)** | **518** | **572** | **643** | **658** | **705** | **758** | **816** |
| LULUCF | -123 | -123 | -123 | -61 | 0 | 0 | 0 |
| **TOTAL** | **395** | **450** | **520** | **596** | **705** | **758** | **816** |

Note: Negative emissions from LULUCF are net removals or carbon sinks

### 3.4.1 Energy Demand Sector

The Energy Demand sector includes all fuel combustion emission sources that are not related to the electricity generation sector and the transport sector. This includes fossil and biomass fuels consumed by residential, commercial, industrial and agriculture sectors. Note that for biomass fuels (fuelwood and charcoal), $CO_2$ emissions are not accounted for in Energy Demand emissions since the non-renewable fraction of these emissions are accounted for in the Land-Use Change and Forestry (LULUCF) Sector.

Fuel consumption by major Energy demand sectors is indicated in
Table **5**.3 below.

While fuel consumption does not need to be allocated to end-uses in order to generate an emissions baseline, it is critical in the analysis of demand side mitigation options that target specific end-uses.

**Table 5.3: Sectoral Energy Consumption (Barrel Oil Equivalent - BOE) in 2010** (Sources: [1] Latin American Energy Organization (2014). *Energy Balances of Saint Lucia*. OLADE – CELAC. Paola Carrera. Castries, Saint Lucia. August 22, 2014)

| Activity / Sector | Firewood | LPG | Gasoline | Kerosene | Diesel | Charcoal |
|---|---|---|---|---|---|---|
| Manufacturing Industries and Construction | 0 | 0 | 800 | 1,450 | 11,100 | 6 |
| Commercial/Institutional | 0 | 12,100 | 0 | 0 | 0 | 0 |
| Residential | 30,594 | 48,500 | 0 | 3,650 | 0 | 1,435 |
| Agriculture / Forestry / Fishing | 0 | 0 | 0 | 0 | 12,500 | 0 |

Historical information on the total consumption of different energy consumers (residential, commercial, industrial and agriculture sub-sectors) is available from national energy balances (Latin American Energy Organization, 2014). However, there is little comprehensive information available around the end-uses (i.e., where these fuels are ultimately consumed, such as for cooking, lighting and heating water). A number of reports provide details on usage patterns of households and ownership of appliances but this data only indirectly indicates energy consumption (ECELP, 2013). The lack of end-use data is not a challenge that is unique to Saint Lucia and requires substantial research and resources to obtain.

End-use allocation is based on data available from other countries and expert opinion provided in a mitigation assessment workshop held in August, 2015. Table 3.6 summarizes the allocation of different fuels to both consumers and specific end-uses.

**Table 3.6: Estimate of End-Use Consumption by Fuel and Consumer (%)**

| Fuel | Consumer | Total Fuel Share by Consumer | Water Heating | Lighting | Cooking | Charcoal Production | Mobile / Stationary | Process Heat |
|---|---|---|---|---|---|---|---|---|
| Kerosene | Residential | 71.6% | | 100% | | | | |
| | Industrial | 28.4% | | | | | | 100% |
| Diesel | Industry | 3.7% | | | | | | 100% |
| | Agriculture | 3.3% | | | | | 100% | |
| Waste Oil | Industry | 100% | | | | | | 100% |
| LPG | Residential | 80% | 25% | | 75% | | | |
| | Commercial | 20% | 5% | | 15% | | | |
| Gasoline | Industry | 0.2% | | | | | | 100% |
| Wood | Residential | 63.3% | | | 100% | | | |
| | Energy Industries | 36.7% | | | | 100% | | |
| Charcoal | Residential | 99.6% | | | 100% | | | |
| | Industry | 0.4% | | | | | | 100% |

Future growth in end-use consumption was estimated based on expected changes in stock (e.g., the population of end-use appliances), demand and efficiency of relevant end-uses, as summarized in. Table 3.7 Electric end-use appliances are considered under the Electricity Generation sector (see Table 3.11).

**Table 3.7: Projected Growth Rates in Energy Demand End-Uses (non-electric)**

| Sector | End-Use | Change in Stock | Change in Demand | Annual Change in Energy Consumption (Inverse is Autonomous Energy Efficiency Improvement) |
|---|---|---|---|---|
| Residential | Water heating | Based on household growth rate projections (2.0% declining to 1.7%) (GOSL, 2013) | 0.5% annually (assumption that follows historic trends) | 0% |
| | Lighting Fuels | | | 0% |
| | Cooking | | | 0% |
| Commercial | Water heating | Based on projected long-term IMF GDP Growth rate (1.8% rising to 2.2% in 2030) (IMF, 2015) | 0% | 0% |
| | Cooking | | | 0% |
| Agriculture | Mobile / Stationary | | 0% | -0.7% |
| Industry | Process Heat | | 0% | -0.5% |
| Energy Industries | Charcoal Production | | -2.0% (based on historical trend) | -0.5% |

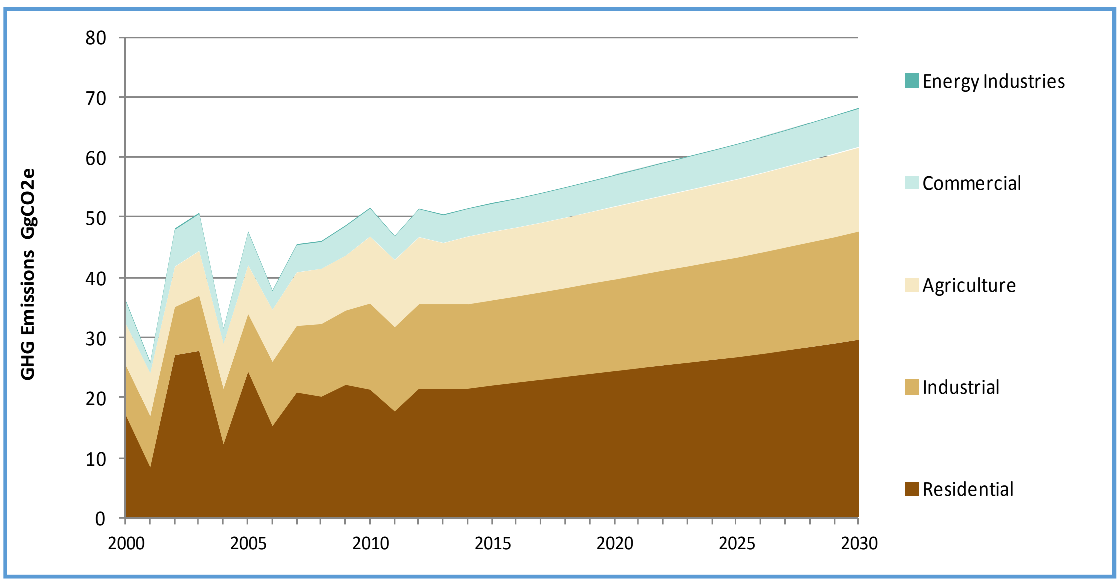
**Table 3.8: Projected Energy Fuel Consumption (TJ)**

| Sector | Fuel Type | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Residential | LPG | 18,965 | 19,338 | 21,678 | 23,915 | 26,707 |
| | Kerosene | 1,620 | 1,237 | 1,387 | 1,530 | 1,708 |
| | Fuelwood | 1,111 | 1,037 | 1,012 | 972 | 951 |
| | Charcoal | 48 | 959 | 936 | 899 | 879 |
| Commercial | LPG | 74 | 75 | 83 | 92 | 103 |
| Industry | Gasoline | 3 | 3 | 4 | 4 | 4 |
| | Kerosene | 9 | 7 | 7 | 8 | 9 |
| | Diesel | 170 | 172 | 185 | 201 | 219 |
| | Waste Oil | 13 | 12 | 13 | 14 | 15 |
| Energy Industries | Fuelwood | 75 | 64 | 62 | 61 | 60 |
| Agriculture | Diesel | 152 | 154 | 164 | 177 | 190 |

**Table 3.7: Emission Factors by Fuel and Sector (kg CO2e/TJ)** **Sources: (IPCC, 1996) and (IPCC, 2006)**

| Fuels | Sector | $kgCO_2e/TJ$ |
|---|---|---|
| **Kerosene** | **Commercial, Residential** | **71,544** |
| **Diesel** | **Industry, Agriculture** | **73,617** |
| **LPG** | **Commercial, Residential** | **62,942** |
| **Waste Oil** | **Industry** | **72,700** |
| **Fuelwood** | **Residential** | **7,540** |
| **Fuelwood** | **Energy Industries** | **1,870** |
| **Charcoal** | **Residential** | **4,510** |

**Figure 3.19: Emission Baseline Projection for Energy Demand Sectors (GgCO2e)**



### 3.4.2 Electricity Generation

The electricity generation sector includes GHG emissions from the combustion of fossil fuels during the production of electricity. Currently almost all grid connected electricity production is from diesel generation. There is a very small amount of generation from connected solar photovoltaic but is under 300 kW in comparison to nearly 88,400 kW of diesel generation installed.

Table 3.10 identifies the total consumption of diesel for the electricity sector based on data available from Saint Lucia Electricity Services Ltd. (LUCELEC, 2014).

**Table 3.10: Fuel Consumption of Diesel for Electricity Generation (TJ)**

| Fuel Type | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Diesel | 16,666 | 17,009 | 17,729 | 17,870 | 18,256 | 19,562 | 19,734 | 19,662 | 19,460 | 19,418 |

Historical information on the total electricity consumption by different end-uses in Saint Lucia (water heating, space cooling, lighting, refrigeration, plugload, industrial processes, street lighting) is not readily available. However, information is readily available on the consumption of electricity by different electricity consumers - residential, commercial, tourism, industrial sectors (LUCELEC, 2014).

End-use allocation is based on estimates from the United States and the Caribbean and adjusted based on expert review in workshops held for the Mitigation Assessment in Saint Lucia (August 3rd-August 9th, 2015). Although these estimates are subject to considerable uncertainty, they represent the best available information. Table 3.11 summarizes the allocation of electricity consumption to different consumers and end-uses.

**Table 3.11: Estimate of Electricity Consumption by Consumer and End-Use in 2012 (%)**

| Sector | Total Electricity Share by Sector | Water Heating | Space Cooling | Lighting | Refrigerat ion | Plug Load | Cooking | Industrial Processes | Street Lighting |
|---|---|---|---|---|---|---|---|---|---|
| Residential | 33.5% | 3.0% | 14.0% | 18.0% | 18.0% | 38%.0 | 6.0% | | |
| Commercial | 36.4% | 4.0% | 45.0% | 21.0% | 12.0% | 15.0% | 3.0% | | |
| Hotel | 22.1% | 8.0% | 40.0% | 17.0% | 14.0% | 21.0% | 3.0% | | |
| Industry | 5.3% | | | | | | | 100% | |
| Street Lighting | 3.3% | | | | | | | | 100% |

Future growth in end-use consumption was estimated based on expected changes in stock (e.g. number of appliances or fixtures), demand and efficiency, and is summarized in Table 3.11. Annual autonomous energy efficiency improvements for appliances and various end-uses are based on global estimates from a number of different countries.

**Table 3.12: Projected Growth in Electricity Sector End-Uses (%)**

| Sector | End-Use | Change in Stock | Change in Demand | Annual Change in Energy Consumption (Inverse is Autonomous Energy Efficiency Improvement) |
|---|---|---|---|---|
| Residential | Space Cooling | Based on household growth rate projections (2.0% declining to 1.7%)<br><br>(GOSL, 2013) | 0.5% annually (assumption that follows historic trends) | -0.5% |
| | Water Heating | | | -0.8% |
| | Lighting | | | -1.0% |
| | Refrigeration | | | -0.4% |
| | Plug-Load | | | -0.3% |
| Commercial / Hotel | Space Cooling | Based on projected long-term IMF GDP Growth rate (1.8% rising to 2.2% in 2030)<br><br>(IMF, 2015) | | -0.5% |
| | Water Heating | | | -0.8% |
| | Lighting | | | -1.0% |
| | Refrigeration | | | -0.4% |
| | Plug-Load | | | -0.3% |
| Industrial | Industrial Processes | | | -0.4% |
| Street Lighting | Lighting | Based on population growth rate projections (0.9% to 0.7% by 2030)<br>(GOSL, 2013) | 0.5% annually | -1.0% |

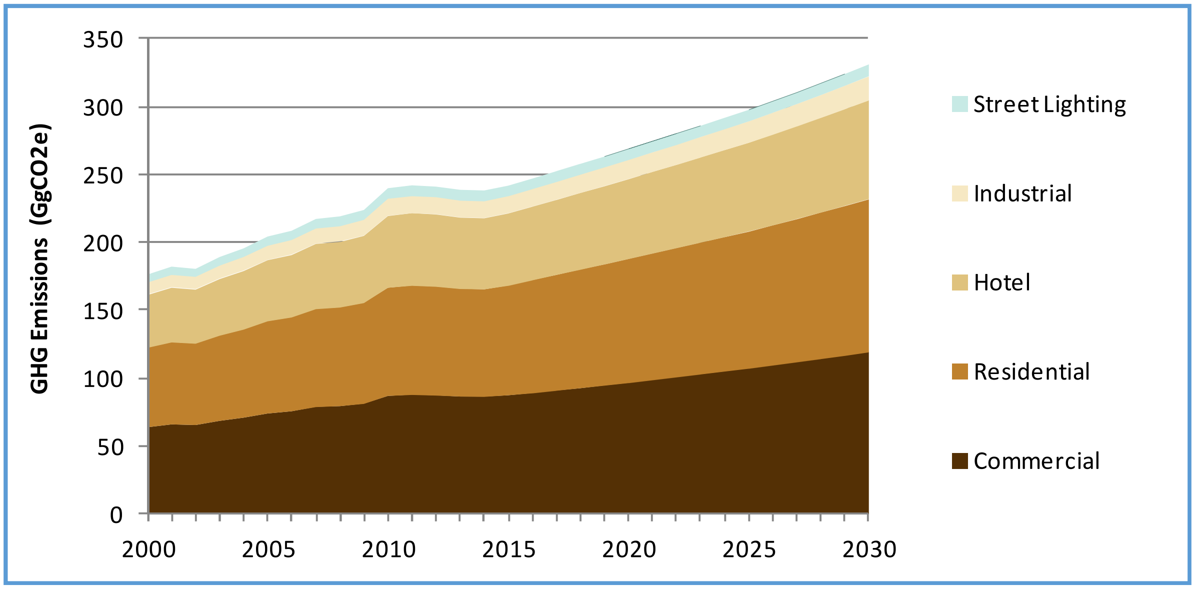
Emission Factors for diesel generation of electricity are based on IPCC defaults (IPCC, 1996). Emissions are associated with carbon and non-carbon emissions, methane and nitrous oxides. Table 3. indicates the IPCC default emission factor used.

**Table 3.13: Emission Factor for Diesel used in Electricity Generation (kg $CO_2$e/TJ)**

| Fuels | kg$CO_2$e/TJ |
|---|---|
| Diesel | 73,617 |

Total electricity generation emissions were 238 $GgCO_2e$ in 2014 and 330 $GgCO_2e$ in 2030 (see Figure 3.20).

**Figure 3.20: Emission Baseline Projection for Electricity Generation ($GgCO_2e$)**




### 3.4.3 Transportation

The transportation sector includes carbon dioxide, methane and nitrous oxide greenhouse gas emissions from the combustion of fossil fuels by transport vehicles. Off-road tractor vehicles are handled in analysis of the energy demand sector above. Consumption of electricity by vehicles is currently negligible and is not considered in the baseline.

Table 3.14 identifies the total consumption of transportation fuels based on data available from national energy balances (Latin American Energy Organization, 2014). Note that all aviation fuels are considered international bunker fuel and are excluded from the baseline.

**Table 3.14: Fuel Consumption in Transportation Sector (TJ)**

| Fuel Type | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Gasoline | 1,909 | 1,951 | 2,039 | 1,999 | 1,966 | 2,026 | 1,748 | 2,027 |
| Diesel | 3,301 | 3,546 | 3,640 | 3,758 | 3,736 | 4,550 | 4,565 | 4,552 |

Historical information on the total fuel consumption of different vehicle types (passenger vehicles, freight vehicles, marine) is not readily available. However, there is information available on the total number of road vehicles from the Ministry of Transport (GoSL, 2015). Information on average fuel efficiency and total fuel consumption by vehicle type was estimated based on available data (King-Joseph, A., 2010) and expert review.

Table 3. summarizes the end-use allocation.

**Table 3. 15: Estimate of Fuel Consumption by Fuel and Transport End-Use (%)**

| Fuel | Transport Sub-Sector | Total Fuel Share by Sector | Passenger Car | Passenger Taxis | Passenger Buses | Motorcycle | Freight Trucks | Other | Marine |
|---|---|---|---|---|---|---|---|---|---|
| Gasoline | Road Passenger | 85.9% | 53.1% | 22.3% | 24.1% | 0.5% | | | |
| | Road Freight | 14.1% | | | | | 100% | | |
| Diesel | Road Passenger | 31.3% | 53.5% | 22.3% | 24.2% | | | | |
| | Road Freight | 60.1% | | | | | 100% | | |
| | Other | 0.7% | | | | | | 100% | |
| | Marine | 1.1% | | | | | | | 100% |

Future growth in end-use consumption was estimated based on expected changes in stock (e.g., number of vehicles), demand and efficiency, and are summarized in Table 3.16.

**Table 3.16: Projected Growth Rates in Transport End-Uses (%)**

| End-Use | Change in Stock of Vehicles | Change in Demand (e.g., km travelled) | Annual Change in Energy Consumption (Inverse is Autonomous Energy Efficiency Improvement) |
|---|---|---|---|
| Road Passenger Vehicles | Based on projected long-term IMF GDP Growth rate (1.8% rising to 2.2% in 2030) | 0.25% | -1.75% |
| Road Freight Vehicles | | | -1.25% |
| Marine | | | -0.75% |

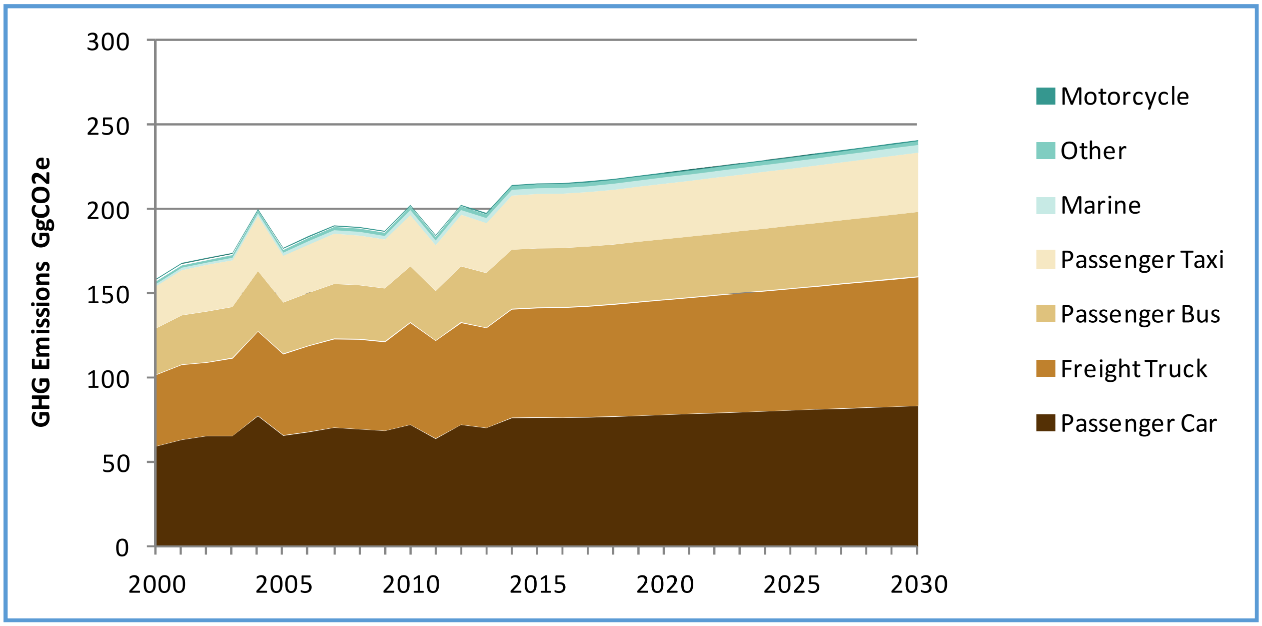
Emission Factors for transport fuel consumption are based on IPCC defaults from the revised 1996 Guidelines. Emissions are associated with carbon and non-carbon emissions, methane and nitrous oxides. Table 3.17 summarizes the IPCC default emission factors that are used.

**Table 3.17: Transport Emissions Factors by Fuel (kg $CO_2$e/TJ)**

| Fuels | kg$CO_2$e/TJ |
|---|---|
| Diesel | 73,617 |
| Gasoline | 69,213 |

Total transport emissions were 238 Gg$CO_2$e in 2012 and 330 Gg$CO_2$e in 2030. Figure 3.21 shows the baseline greenhouse gas emission projections by vehicles type between 2000 and 2030.

**Figure 3.21: Emission Baseline Projection for Transportation Vehicle Types (GgCO2e)**




### 3.4.4 Industrial Processes Sector

The Industrial Process Sector includes anthropogenic emissions from industry production processes that are not a result of fuel combustion. Combustion emissions are reported in the Energy Demand and Electricity Generation Sectors. In the case of Saint Lucia there is no production of cement, lime, soda ash or metal production that typically lead to significant industrial process emissions. The only direct greenhouse gas emissions are related to hydroflurocarbons (HFCs) imported into Saint Lucia through products and bulk imports.

Saint Lucia does not manufacture HFCs; however, emissions of HFCs can arise from the release of HFC gases imported in bulk that are used to recharge refrigeration and air conditioning products, as well as the stock of HFCs imported within refrigeration and air conditioning, aerosols and other products. Total estimated HFC imports between 2000 and 2010 by type are reported in Table 3.18

Table 3.18: HFC Imports in kg (2000 - 2010) (Sources: 1. MSDEST (2011). ODS Consumption 2010 Survey Report. National Ozone Unit; 2. Central Statistics Office (2014). *Flow Statistics by Commodity*. Import of air conditioners and refrigerators. HS Codes 841510000 to 84189900 and HS Codes 87031000 to 87039000, 84151000 and 84186900. Provided in a spreadsheet 20-Nov-2014. Average vehicle charge based on IPCC/TEAP Special Report: *Safeguarding the Ozone Layer and the Global Climate System*. Refrigeration Chapter 4. Mobile Air Conditioning Chapter 9 and Residential and Commercial Air Conditioning Chapter 5. Cambridge University Press)

| HFC Type | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HFC 134A | 20,173 | 11,191 | 22,006 | 38,356 | 9,299 | 17,357 | 15,507 | 17,509 | 11,589 | 11,292 | 16,391 |
| HFC 404A | 2,736 | 2,767 | 2,782 | 2,798 | 2,813 | 2,828 | 2,843 | 2,858 | 2,874 | 3,266 | 3,285 |
| HFC 410a | 2,310 | 2,337 | 2,350 | 2,362 | 2,375 | 2,388 | 2,401 | 2,414 | 2,427 | 2,835 | 2,835 |

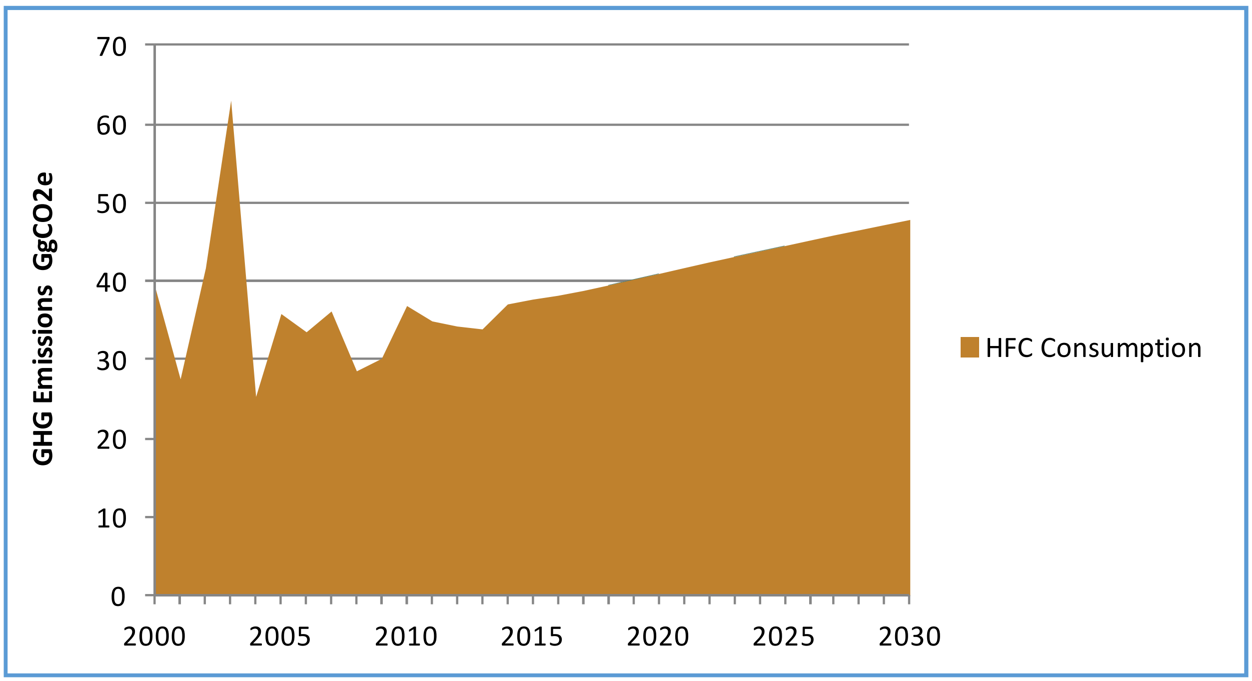
Projections of HFC emissions are based on assumptions regarding the growth in stock of appliances and vehicles that have air conditioning units charged with HFCs as well as the share of climate friendly alternatives to conventional HFCs.

**Table 3.19: Projected Growth Rates in Transport End-Uses (%)**

| End-Use | Change in Stock of Vehicles | Change in charge (e.g., grams of HFCs) | Supply of Climate Friendly Alternatives to HFCs |
|---|---|---|---|
| HFC Charged Appliances and Vehicles | Based on projected long-term IMF GDP Growth rate<br>(1.8% rising to 2.2% in 2030)<br>(IMF, 2015) | 0.0% | Growing from 8% in 2014 to 38% in 2030 |

Total industrial process emissions are projected to rise from 34 $GgCO_2e$ in 2012 to 48 $GgCO_2e$ in 2030. Figure 3.22 provides an illustration of HFC emissions between 2000 and 2030.

**Figure 3.22: Industrial Process Emission Projections from HFC Consumption (GgCO2e)**



### 3.4.5 Agriculture

Agricultural activities contribute to greenhouse gas emissions in Saint Lucia through a variety of different processes. $CH_4$ and $N_2O$ are the only significant greenhouse gases emitted by the Agriculture Sector. $CH_4$ emissions arise from enteric fermentation and manure management associated with livestock. $N_2O$ emissions arise primarily from synthetic and natural fertilizers (i.e., manure, crop residues) applied to cultivated soils and are based on IPCC assumptions regarding atmospheric deposition and leaching from soils.

The agriculture sector is examined separately from the Forestry and Other Land-Use Sector. All carbon releases and sinks that are a result of a land conversion from one type to another are included in the forestry sector. The agricultural sector does not include energy emissions from fuel combustion (e.g., water pumping, tractors), which are included in the energy demand sector.

Livestock is the major driver of agricultural emissions. Livestock populations were provided by the Ministry of Agriculture (Veterinary and Livestock Services Division, 2015) and are presented in Table 3.20.

**Table 3.20: Historic Livestock Populations (head of livestock) (2000-2010)**

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cattle | 5,026 | 5,127 | 5,345 | 3,164 | 2,864 | 4,856 | 3542 | 2,964 | 2,456 | 1,954 |
| Swine | 10,876 | 11,122 | 11,786 | 12,924 | 11,213 | 12,697 | 8,648 | 10,438 | 9,226 | 9,204 |
| Sheep [2] | 8,404 | 8,070 | 7,736 | 6,753 | 5,771 | 4,788 | 4,142 | 3,456 | 2,674 | 2,142 |
| Goats [2] | 8,929 | 8,873 | 8,816 | 8,063 | 7,311 | 6,558 | 5,144 | 3,684 | 3,947 | 4,348 |
| Poultry | 212,659 | 301,017 | 243,107 | 516,333 | 546,659 | 361,328 | 560,710 | 567,852 | 825,031 | 569,987 |

**Sources**: [1] Veterinary and Livestock Services Division Quarterly and Yearly Reports. Communication by email on 5-Dec-2014 and 14, Jan 2015 from MSDEST in excel spreadsheet.

[2] For the year 2000 the population of sheep and goats were based on year 2000 inventory and for the year 2000 on the 2007 Agriculture Census. Data was linearly interpolated between 2000 and 2007 and 2007 and 2010.

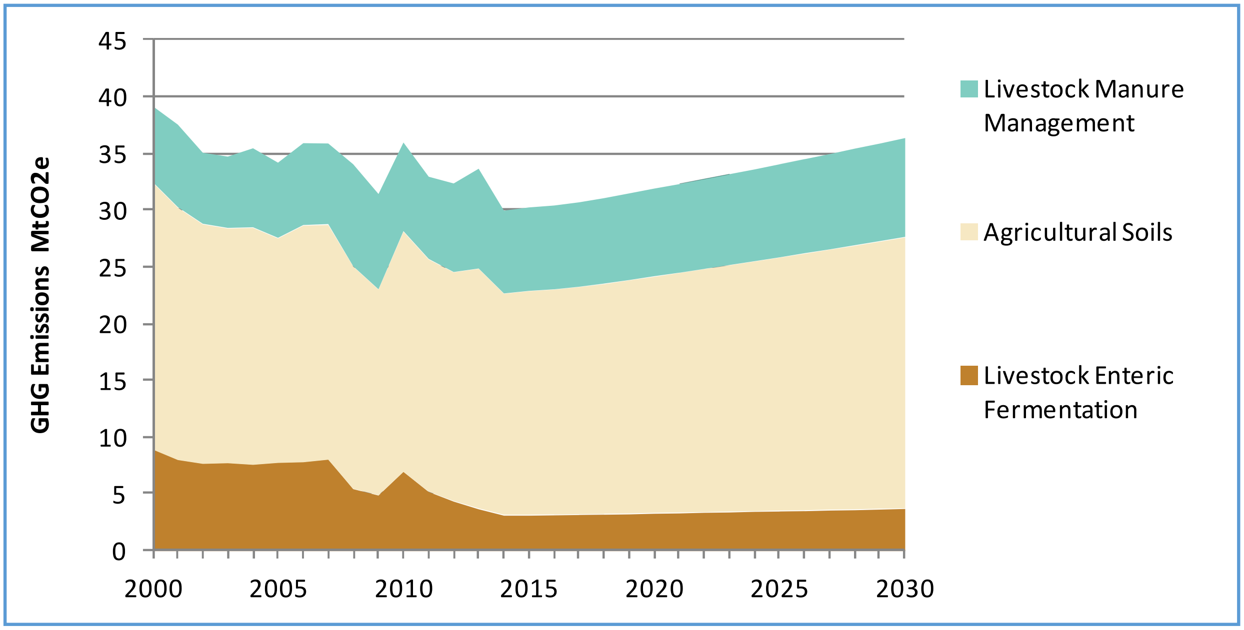
Assumptions regarding the change in agricultural activity data that impacts emissions is summarized in Table 3.21.

**Table 3.21: Projected Growth in Agricultural Outputs (%)**

| Agriculture Output | Change in Stock and Demand | Change in Related Emission Intensity or Efficiency |
|---|---|---|
| Synthetic Fertilizer | Based on projected long-term IMF GDP Growth rate (1.8% rising to 2.2% in 2030) | -0.5% in emission intensity due to improved application and delivery |
| Crop Production | | 0% (No change) |
| All Livestock | Adjusted projected long-term IMF GDP growth rate to account for slower historic growth in this sector (0.8% rising to 1.2% in 2030) | 0% (No change) |

Total agriculture emissions are projected to rise from 30 GgCO2e in 2014 to 36 GgCO2e in 2030. Figure 3.23 illustrates the emission projections of major agriculture sources between 2000 and 2030.

**Figure 3.23: Agricultural Emission Projections by Major Source (GgCO2e)**




## Land-Use, Land-Use Change and Forestry

The LULUCF Sector includes estimates of emissions and removals of greenhouse gases associated with increases or decreases of carbon in living biomass as land-use changes occur over time, for example, in the conversion of a forest area to cropland, or when establishing new forest lands through reforestation or afforestation.

Saint Lucia's forest cover has increased since 2000 as the proportion of cropland under the classification of densely vegetated farming croplands has increased significantly over the last fifteen to twenty years. In addition, the total area of forest reserve increased by 18% from the year 2000 to 9,415 ha in 2009. The national GHG inventory estimated that Saint Lucia's LULUCF Sector was a net sink (net gain in carbon pools) between 2000 and 2009. The average annual $CO_2$ removal over this time period was 123 Gigagrams (Gg) per year.

summarizes the change in carbon stocks related to Forest Land (FL), Cropland (CL), Grassland (GL), Wetlands WL), Settlements (SL) and Other Lands (OL). More details on these estimates are provided in the National GHG Inventory Report (Stiebert Consulting, 2015).

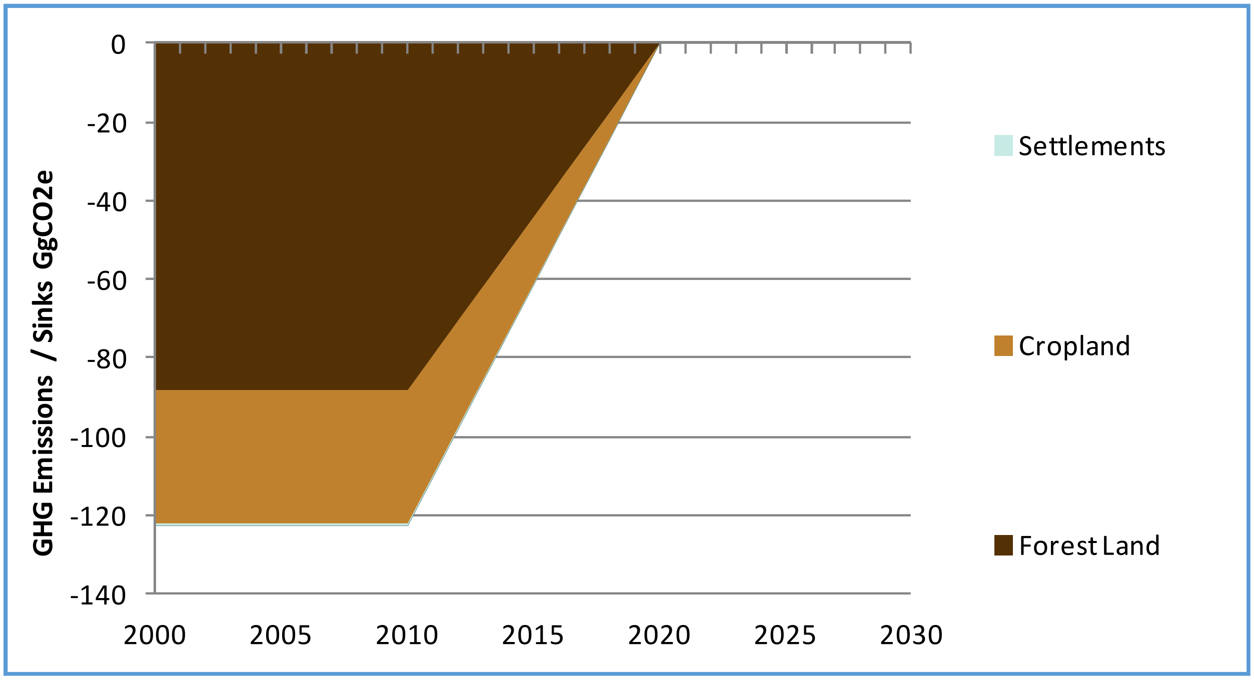
The findings are consistent with the observed increase in forest cover on croplands over the time period. Projections into the future for land-use change and forestry are very difficult to make. While the trends towards reforestation of croplands and an increase of area under forest reserve may continue to increase in the future, forests still face many threats including; degradation from illegal harvesting, storm events and urban development. Without additional protection it can be expected that forests may not continue to be a major net sink over the next 15 years. The baseline projection takes the view that by 2020 Saint Lucia's forests will no longer be a net sink and that emissions and sinks will remain in balance until 2030.

**Table 3.22: Total LULUCF $CO_2$ Emissions (Gg)**

| Land-Use Category [3] | | Carbon Pool | Sector in IPCC Guidelines [1] | Annual Change in Carbon Stocks $CO_2$ (Gg) 2000 – 2009 [2] |
|---|---|---|---|---|
| Initial Land Use | Land Use during Reporting Year | | | |
| FL | FL | Living Biomass | 5A | -54.39 |
| | | Soil | 5D | 0 |
| CL | FL | Living Biomass | 5A | -29.19 |
| GL | FL | Living Biomass | 5A | -14.41 |
| Sub-Total For Forest Land | | | | **-98.00** |
| CL | CL | Living Biomass | 5A | -37.78 |
| | | Soil | 5D | +0.005 |
| Sub-Total For Cropland | | | | **-37.78** |
| GL | GL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| Sub-Total For Grassland | | | | **0** |
| WL | WL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| Sub-Total For Wetlands | | | | **0** |
| SL | SL | Living Biomass | 5A | -0.66 |
| | | Soil | 5A | 0 |
| CL | SL | Living Biomass | 5A | 0 |
| Sub-Total For Settlements | | | | **-0.66** |
| OL | OL | Living Biomass | 5A | 0 |
| | | Soil | 5A | 0 |
| FL | OL | Living Biomass | 5B | 7.91 |
| CL | OL | Living Biomass | 5E | 5.67 |
| GL | OL | Living Biomass | 5B | 0 |
| Sub-Total For Other Land | | | | **13.58** |
| **TOTAL** | | | | **-122.9** |

Notes: [1] Headings from the IPCC Guidelines Reporting Instructions p.1.14-1.16: 5A - Changes in Forest and Other Woody Biomass Stocks; 5B - Forest and Grassland Conversion; 5C - Abandonment of Managed Lands; 5D - Emissions and Removals from Soils, and 5E - Other.

**Figure 3.24: LULUCF Projections by Major Sink ($GgCO_2e$)**




### 3.4.6 Waste

There are two major waste-related sources of greenhouse gases in Saint Lucia, solid waste disposal to land and wastewater treatment. Solid domestic or municipal waste received at solid waste disposal sites in Saint Lucia is summarized in Table 3.23.

**Table 3.23: Waste Disposal in Saint Lucia at Deglos and Vieux Fort Landfills (2004-2010) and Vieux Fort (2000-2003) (tonnes received)** (Sources: [1] Disposal between 2004 and 2012 provided by Saint Lucia Solid Waste Management Authority in an email communication November 3, 2014.
Disposal between 2000 and 2003 from SLSWMA (2003) Annual report for the Period April 2002 to March 200)

| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 83,177 | 73,664 | 67,085 | 71,501 | 73,012 | 81,617 | 78,097 | 84,526 | 84,230 | 82,054 | 82,332 | 78,021 | 74,819 |

The fraction of domestic sewage treated by different wastewater treatment systems is shown in Table 3.24. The calculation of methane emissions from Solid Waste Disposal Sites (SWDS) was completed using the Tier 2 First Order Decay Model methodology from the *2006 IPCC Guidelines*. The 2006 Waste Model spreadsheet developed by the IPCC was employed to estimate emissions between 2000 and 2010, but also can be easily manipulated to estimate future emissions based on projections of total solid waste disposed that are estimated to increase in step with projected population growth (GoSL, 2013).

**Table 3.24: Wastewater Treatment Systems for Domestic Wastewater in Saint Lucia**

| Wastewater Treatment Systems | Fraction of Total Sewage (%) | | |
|---|---|---|---|
| | 1991 | 2001 | 2010 |
| Sea discharge | 5.0% | 3.5% | 3.6% |
| Septic system | 27.3% | 41.4% | 51.7% |
| Latrine | 44.6% | 31.7% | 19.0% |
| Other | 11.5% | 8.9% | 6.2% |
| Beausejour Stabilisation Pond | 7.2% | 9.5% | 12.0% |
| Hotel Aerobic treatment plants | 4.6% | 6.3% | 8.8% |
| | **100%** | **100%** | **100%** |

Note: Fraction of wastewater produced by hotels and tourists based on average tourist population compared to total population (approximately 18% of total population in 2010).
Fraction of sewage to Beausejour estimated based on assumption of reception of 50% of total sewer wastewater in Saint Lucia and 50% of hotel sewage wastewater.

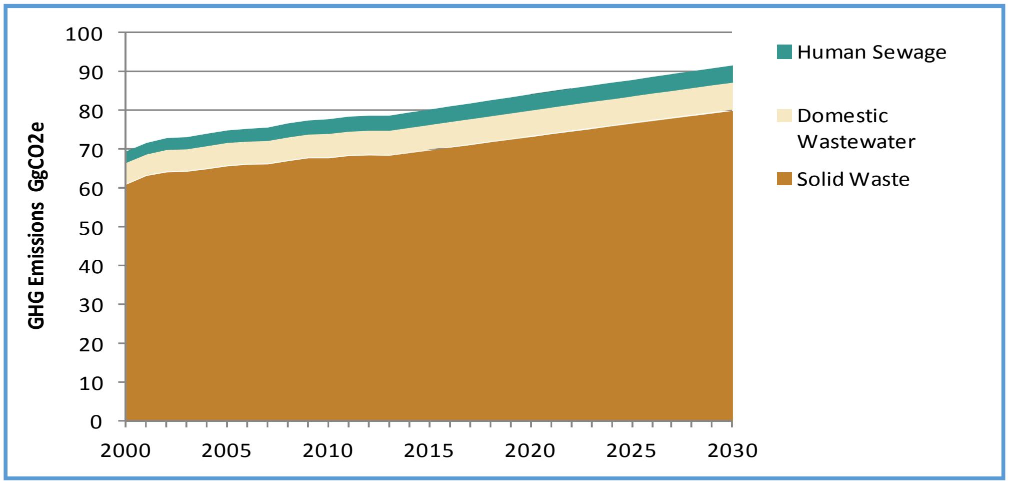
A summary of the projected growth rates in domestic solid waste production and wastewater production is provided in Table 3.25.

**Table 3.25: Projected Growth Rates in Waste Activity and Emissions Data (%)**

| Source | Change in Activity (i.e., Volume Produced) | Annual Change in Emission Intensity |
|---|---|---|
| $CH^4$ from Solid Waste Disposal | Based on population growth rate projections (0.9% to 0.7% by 2030)<br><br>(GoSL, 2013) | Emission Intensity increases overtime as more waste is accumulated in landfill. By 2030 emission intensity is 0.1% above population growth. |
| $CH^4$ from Domestic Wastewater | | 0% (no change) |
| N2O Emissions Related to Human Sewage | | 0% (no change) |

Total waste emissions are projected to increase from 78 $GgCO_2e$ in 2010 to 92 $GgCO_2e$ in 2030. Figure 3.25 illustrates the waste emission projections by major source category.

**Figure 3.25: Waste Emission Projections by Major Source (Gg$CO_2$e)**



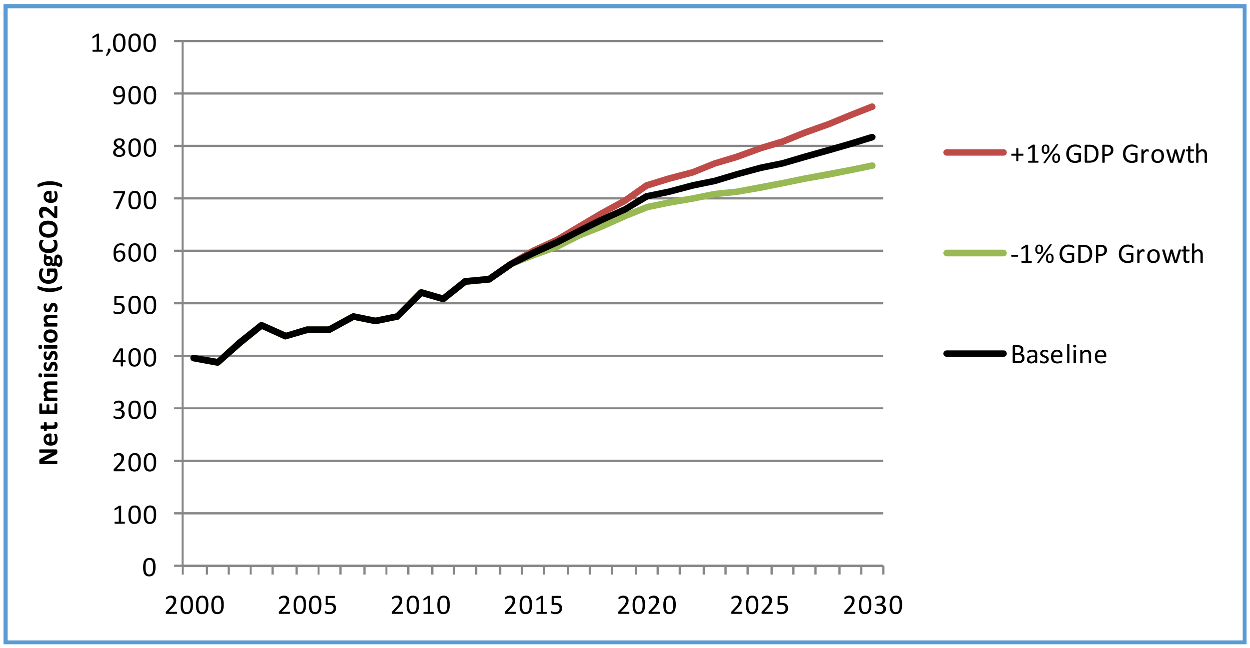

### 3.4.7 Uncertainty

There are significant sources of uncertainty in developing emission projections. There are uncertainties associated with estimating greenhouse gas emissions that are summarized in the National Greenhouse Gas Inventory Report 2010 (Stiebert Consulting, 2015) and there are also uncertainties related to the future drivers of emissions. The main drivers of emissions are related to economic activity and growth, changes in population, energy supply and prices as well as the adoption of new technologies and the impact of government policies and measures.

A detailed examination of different drivers cannot be conducted for this emission baseline projection; however, it is possible to consider different rates of economic growth on emissions to estimate how total emissions might look under different scenarios. A high economic growth scenario that considers annual GDP growth 1% higher than the baseline (3.2% in 2030) and a low economic growth scenario that considers annual GDP growth 1% lower than the baseline is considered (1.2% in 2030).

Figure 3. 3.26 illustrate the impact of these scenarios relative to the baseline.

**Figure 3.26: Saint Lucia Net Emissions Under three different Scenarios ($GgCO_2e$)**




## 3.5 MITIGATION ASSESSMENT

### 3.5.1 Introduction

As described in detail in the methodology (Section 3.3) the mitigation assessment identifies key mitigation actions that align with government priorities, provide significant abatement potential and have relatively low barriers to implementation. Most of the actions also contribute substantially to sustainable development.

Prioritized mitigation actions are organized in this section by five key sectors that align closely to the sectors identified in the baseline. The main difference is that Agriculture and Land-Use, Land-Use Change and Forestry are combined into one sector and that mitigation options that target the Industrial Processes sector is considered in the waste sector.

Note that it is difficult to separate the impact of existing government actions with the prioritized mitigation actions presented here. In most cases the government of Saint Lucia has undertaken considerable preparation and introduced key legislation that are necessary to achieve the emission reduction potential of the mitigation actions assessed. For example, the 35% renewable energy target has been set and key legislation and plans introduced; however, very little renewable energy has been installed and approvals, tenders and capital financing for projects have not been secured.

The prioritized mitigation actions are bundled or combined where there are obvious synergies to manage and implement the action as a single programme. A total of 10 mitigation action programmes, two in each of the key sectors, are identified and reviewed in the relevant sub-sections below.

Each of the five subsequent sections (Section 3.5.2 through 3.5.6) starts by defining the sources of emissions and sinks that are considered under the sector and identifies the relevant actions that have been taken by the Government of Saint Lucia to date. A long-list of potential mitigation actions are then presented along with the ones that were prioritized in workshops with stakeholders. Finally detailed summaries of the mitigation action programmes are presented including information on the specific interventions undertaken by the government, abatement potential, sustainable development benefits and costs.

The last section (Section 3.5.7) summarizes the impact if all measures were fully implemented.

### 3.5.2 Energy Demand

**Introduction**

The energy demand sector includes the consumption of energy for residential, commercial, tourism, industry and agriculture sub-sectors. It includes the consumption of electricity, although it excludes the production of electricity and its emissions which are handled in Section 5.3. It also excludes all transportation demand which is handled in Section 5.4. Considering this definition and in the context of Saint Lucia, the energy demand sector primarily relates to fossil fuel, biomass and electricity end-uses that include space heating, water heating, space cooling, refrigeration, cooking, steam and heat generation for industrial processes.

The government has several important initiatives related to energy demand. The government currently has a draft revised building code that specifically targets building energy efficiency and the Saint Lucia Bureau of Standards (SLBS) is working on labelling standards for different appliances having recently published labelling standards for air-Conditioning units, incandescent lamps and tubular and compact fluorescent lamps. The revised building code is expected to be enacted in 2016 and the Saint Lucia Bureau of Standards is actively introducing labelling of different appliances. Additional interventions are required to achieve significant emission reductions.

A review of government policies, plans, strategies and targets identified a total of 8 mitigation actions related to energy demand. These mitigation options were reviewed in stakeholder workshops held in August 2015 and are identified with their qualitative ranking of five different criteria in Table 3.26. The last column summarizes the overall ranking on a scale of 1 to 3 where 3 denotes the highest prioritization. Mitigation options were found to primarily target either the building envelope (i.e., how buildings are constructed to minimize energy use from buildings) or target appliances. Two bundled programmes were proposed; energy efficient buildings and energy-efficient appliances.

**Table 3.26: Energy Demand Mitigation Actions**

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Energy Efficient Building Codes | 2.5 | 3 | 2 | 2 | 2 | 2.42 |
| Government Buildings | 3 | 3 | 2 | 2 | 2 | 2.33 |
| LED Lighting | 3 | 2 | 2 | 2 | 2 | 2.17 |
| Minimum Efficiency Standards | 3 | 2 | 2 | 2 | 2 | 2.17 |
| Solar Water Heaters | 2 | 1 | 3 | 1 | 3 | 1.83 |
| Urban Planning | 2 | 2 | 1 | 3 | 1 | 1.83 |
| ESCOs | 2 | 2 | 1 | 1 | 1 | 1.40 |
| Energy Audits | 2 | 1 | 1 | 1 | 1 | 1.17 |

**Energy Efficient Buildings**

***Summary:*** The Ministry of Physical Development is working on a Revised Building Code that is intended to increase the energy efficiency of commercial and residential buildings. No specific targets for improvements in energy efficiency have been estimated but a reduction in space cooling, ventilation and lighting energy consumption are targeted. In the analysis below, the measure considers a target of 15% reduction in space cooling and ventilation demand for new construction from the baseline and a 10% reduction in lighting demand. The Ministry of Sustainable Development, Energy Science and Technology has also launched a comprehensive program to increase energy efficiency in government buildings that targets a 20% increase in efficiency by 2025.

***Current Status:*** The Ministry of Physical Development finalized a draft building code in June 2015 that amends building codes for commercial and institutional buildings. Amendments target wall and roof insulation, passive cooling, ventilation and natural lighting requirements and recommendations. Provisions in the revised building code that impact energy efficiency include:

- **Light and Ventilation**: (a) All efforts shall be made to provide natural lighting and natural ventilation to each space in the building in such a kind that artificial lighting and/or ventilation is not necessary or reduced to a minimum. (c) In the case of buildings provided with mechanical ventilation systems, artificial cooling or air conditioning then the envelope of the treated air space shall be well sealed and be constructed as an air barrier to provide infiltration of warm resp. not conditioned air. Fully air conditioned buildings shall be considered to be tested with regard to the air leakage rate of the building envelope.
- **Windows:** a) Windows shall be located in an external wall and in such a position that light and fresh air are not substantially excluded by adjacent walls of the building or by the walls of adjoining buildings. c) All Windows or glazed parts of vertical walls not oriented within 45 degrees of True North shall be either (preferred) protected from direct sun by an overhang, eave, or permanently attached shading device or providing spectrally selective low-E (low-emissivity) or reflective coating on glazing or tinted glass. d) Windows in rooms provided with mechanical ventilation systems, artificial cooling or air conditioning shall be well sealed, double glazed and providing an U-factor not less than 0.5 $Btu/h*ft^2*F = 2.839\ W/m^2*K$.

REDiv is in the process of designing a program to increase energy efficiency in government buildings by 20% by 2025. REDiv has entered into negotiations with building owners and ESCOs but have not issued RFPs for the work.

### *Proposed Interventions and Timeframe*

Four major interventions are proposed in order to effectively implement the Revised Building Code and program to increase energy efficiency in government buildings. These interventions and the proposed timeframes for implementation are summarized in Table 3..

**Table 3.27: Description of Interventions and timeframe for Implementation of energy efficiency in buildings**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Enact building code, support governance | Draft of building code finalized. | **2016 – 2017** |
| | Educate decision makers on benefits of new strengthened code and enforcement. | |
| | Improved enforcement activity | |
| Capacity training for building code | Effectiveness of the building code in increasing energy efficiency will be largely impacted by how well builders understand new requirements and recommendations. Training should be provided. | **2017 – 2018** |
| Enforcement of building code | For effective deployment of new more energy efficient buildings enforcement officers will be required to evaluate new construction with respect to energy efficiency and ensure that code is met. | **2017 - 2030** |
| Government Building RFPs | Government will need to issue RFPs to ESCOs for the implementation of energy efficiency measures and will need to negotiate with building owners to determine investment structure. | **2017 - 2020** |

### *Emission Reduction Potential*

The revised building code would impact new construction of residential and commercial buildings between 2017 and 2030. Baseline energy consumption (electricity) of new buildings for space cooling, ventilation and lighting are summarized in Table 2.28. Energy consumption (electricity) related to government buildings is estimated in Table 3.29.

**Table 3.28: Estimated Lighting, Space Cooling and Ventilation Building Energy Demand (MWh) in New Construction (2017-2030)**

| End-Use Demand | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Lighting | 589 | 1,249 | 1,980 | 2,691 | 3,396 | 4,095 | 4,786 |
| Space Cooling | 1,429 | 3,040 | 4,840 | 6,625 | 8,428 | 10,250 | 12,090 |
| Ventilation | 442 | 905 | 1,390 | 1,872 | 2,353 | 2,834 | 3,313 |
| **End-Use Demand** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| Lighting | 5,468 | 6,142 | 6,911 | 7,690 | 8,478 | 9,276 | 10,083 |
| Space Cooling | 13,947 | 15,822 | 17,800 | 19,812 | 21,858 | 23,939 | 26,054 |
| Ventilation | 3,790 | 4,264 | 4,808 | 5,363 | 5,928 | 6,505 | 7,093 |

**Table 3.29: Estimated Energy Demand (MWh) of Government Buildings (2017-2030)**

| End-Use Demand | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Government Buildings | 12,506 | 12,691 | 12,903 | 13,113 | 13,328 | 13,545 | 13,767 |
| **End-Use Demand** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| Government Buildings | 13,992 | 14,221 | 14,454 | 14,691 | 14,931 | 15,176 | 15,425 |

Emission reductions are calculated by multiplying the energy demand in Table 3.29 by the expected decrease in demand and by the emission factor for electricity generation. The average emission factor for existing diesel generation has been calculated as 0.623 $tCO_2e$/MWh. This factor is used as it is assumes that any decrease in demand will result in new diesel generation not being built as opposed to displacing new and yet to be implemented renewable energy projects.

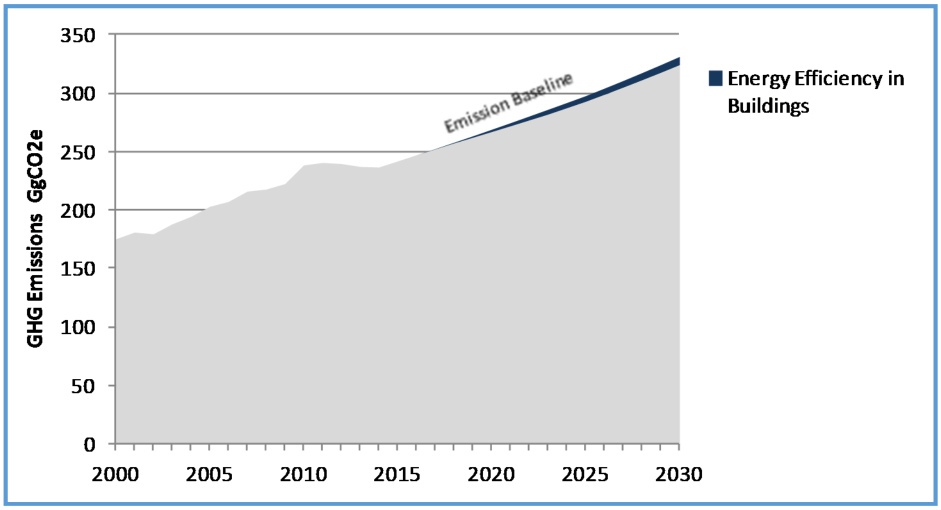
Estimated emission reductions are summarized in Table 3. and are expected to grow to a total of 7.0 $GgCO_2e$ by 2030.

**Table 3.30: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Building Code Energy Efficiency Improvements | 0 | 1.3 | 3.1 | 5.1 |
| Government Building Efficiency Improvements | 0 | 0.65 | 1.7 | 1.9 |
| **TOTAL** | **0** | **2.0** | **4.8** | **7.0** |

Figure 3. 27 illustrates the emission reduction potential compared to total emissions expected from electricity generation in the baseline. Electricity generation is used as the baseline because emission reductions are primarily a result of reduced electricity consumption rather than other fossil fuels such as LPG or diesel.

**Figure 3.27: Emission Reductions for Energy Efficient Buildings (GgCO$_2$e)**




Uncertainty in the emission reduction calculations is associated with two main factors:

- Baseline activity data estimates of new building energy demand for ventilation, space cooling and lighting and overall government building energy demand.
- Degree to which revised building code and enforcement measures improves energy efficiency on average for ventilation, space cooling and lighting end-uses.

***Feasibility and Risk (addressing barriers)***

Figure 3.31 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.31: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Political will to enforce building code standards | Education of decision makers on the benefits of new strengthened code will help to ensure that there is a willingness to enforce the building code standards |
| Resistance of builders to incorporate new building code requirements and recommendations | Capacity building for builders so that they understand the requirements and the overall benefits achieved. |
| Government buildings are primarily held privately and therefore more difficult to negotiate and capitalize energy efficiency actions as there are split incentives | The government will seek to issue RFPs that provide incentive to all parties; ESCOs that will deliver the program, building owners and government tenants. Savings from energy efficiency measures are expected to be sufficient to ensure compensation to all parties over the long-term. |
| Availability of local ESCOs to deliver programme | Local ESCOs operate in Saint Lucia and other ESCOs in the Caribbean have declared interest in the project. |

***Sustainable Development Benefits:***

Sustainable development benefits expected from the implementation of Energy Efficiency in Buildings are summarized in Table 3..32.

**Table 3.32: Sustainable Development Benefits Associated with Energy Efficiency in Buildings**

| Category | Sustainable Development Benefit |
|---|---|
| Commercial and Residential Building Owners | While consumers may pay a small premium for commercial and residential buildings that meet the revised standards of the building code, all of these measures have reasonably short pay-back periods and the consumers will benefit from energy savings in the long-run. |
| Government Building Owners | Building owners that lease their buildings to the government will have lower operating costs that will positively impact their bottom line. |
| Environment / Health | A reduction in electricity demand is correlated directly with a reduction in air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br><br>Based on default IPCC emission factors (1996, IPCC) for diesel generation emissions could be as large as:<br><br>• 19 tonnes of $NO_X$<br>• 1.9 tonnes of CO<br>• 0.5 tonnes of NMVOC<br>• 2.2 tonnes of $SO_2$ |
| Employment | A few long-term private jobs will be created related to management and operation of government building energy efficiency program. |

***Costs:*** Costs for the proposed interventions are related to program costs. While building owners may have higher upfront capital costs these will be offset by long-term energy savings such that they will have reasonably attractive payback periods.

Estimated total net present value program costs that wild be supported by the government are summarized in Table 3.33.

**Table 3.33: Programme Costs for Energy Efficiency in Buildings (NPV EC$ 2015)**

| Programme | Estimated Resources | NPV $EC (million) |
|---|---|---|
| Enact building code, support governance | | $0.2 |
| Capacity Building for building code | 2 | $0.2 |
| Enforcement of building code | 2 officers full-time (10 years) | $1.2 |
| Government Building RFPs | | $0.4 |
| **TOTAL** | | **$2.0** |

**Energy Efficient Appliances**

***Summary:*** This mitigation action envisions the implementation of a comprehensive appliance labelling program in the short-term with a view of introducing minimum efficiency standards in the medium-term. In addition the government of Saint Lucia would actively pursue a LED street lighting replacement programme that captures most of the existing street lighting in Saint Lucia by 2020.

***Current Status:*** Saint Lucia Bureau of Standards has completed development of three National Energy Efficiency Labelling Standards (Air-Conditioning units, incandescent lamps and tubular and compact fluorescent lamps). Four additional standards are now being developed (refrigerators, washing machines, fans and solar panels). Once these standards are completed all imported appliances would be required to have consumer labelling energy efficiency information.

The LED Street Lighting Pilot Project of 2013 has yielded results which suggest a total reduction in energy consumption of 63%. Fifty (50) LED lamps of power rating 120 W were used to replace HPS lamps of power rating 250W along the John Compton Highway, Castries. Similar projected savings are expected to be achieved through the replacement of all street lights to LED street lights, island wide. Funding has been received from the Republic of China (Taiwan) for the Sustainable Energy in Saint Lucia: From Concept to Action project that includes a component for LED Street Lighting. Currently the government is conducting studies to test different street lighting LED fixtures to determine most appropriate technology for a replacement programme.

### *Proposed Interventions and Timeframe*

Three major interventions are proposed for the energy efficient appliances action. These interventions and the proposed timeframes for implementation are summarized in Table 3.Table 3.34.

**Table 3.34: Description of Interventions and timeframe for energy efficient appliances**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Complete labeling program, improve governance | Labeling standards under development should be completed and additional labels for other major household electricity appliances (e.g., televisions, LED lamps, stoves, freezers, and washing machines) should be considered. | 2016 -2018 |
| | Improve enforcement of current and newly published standards, primarily though imports | 2017 - 2020 |
| | Improve standards testing and governance of labelling program | 2017 - 2018 |
| Street Lighting Project | Street lighting consumed about 11,000 MWh in 2014 and cost the government more than $11 million dollars. Replacement of 800 existing high pressure sodium street lighting fixtures by 2020 with LED is proposed. | 2016 – 2020 |
| | Increase maintenance budgets to upgrade street lights when failure detected (avoid replacement with incandescent). | 2016 – 2030 |
| Prioritize and enact new efficiency standards | With appropriate mandatory labeling of appliances in place it is possible to develop new efficiency standards. Options for adoption include:<br>• Standards of minimum efficiency allowed for sale in Saint Lucia<br>• Higher tax rates for inefficient appliances<br>• Rebates or incentives for efficient appliances | 2019 - 2025 |

### *Emission Reduction Potential*

The appliance labelling and efficiency standards would impact new appliances between 2017 and 2030. Baseline energy consumption of new appliances related to residential, commercial and hotel sectors are summarized in Table 3.35.

**Table 3.35: Estimated Energy Demand of New Appliances (MWh 2017-2030)**

| End-Use Demand | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| New Appliances | 2,843 | 5,932 | 9,273 | 12,577 | 15,889 | 19,206 | 22,523 |
| **End-Use Demand** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| New Appliances | 25,839 | 29,150 | 32,829 | 36,572 | 40,381 | 44,255 | 48,197 |

Energy savings for the labelling and efficiency standards is calculated by assuming an overall improvement in energy efficiency in appliances purchased over the baseline. The baseline includes some autonomous energy efficiency improvement over time so the program would have to deliver energy efficiency that is in addition to what is already assumed in the baseline.

The overall energy savings improvement of the program is assumed to increase the energy efficiency of all new appliances by 10% by 2026 after full implementation of the program.

Total Street Lighting energy demand is estimated in Table 3.36.

**Table 3.36: Estimated Energy Demand of Street Lighting (MWh 2017-2030)**

| End-Use Demand | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Street Lighting | 11,109 | 11,139 | 11,164 | 11,181 | 11,191 | 11,194 | 11,189 |
| **End-Use Demand** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| Street Lighting | 11,177 | 11,156 | 11,178 | 11,200 | 11,222 | 11,245 | 11,267 |

The LED street lighting update report (MSDEST, 2014) is used as the basis of estimating the increase in efficiency in street lighting from changing high pressure sodium street lights to LED. 250 W HPS bulbs would be replaced by 150 W LED bulbs, resulting in an overall improvement in energy savings of 60%.

Emission reductions are calculated by multiplying the reduced electricity demand by the emission factor for electricity generation. The average emission factor for existing diesel generation has been calculated as 0.623 $tCO_2e$/MWh. This factor is used as it is assumed that any decrease in demand will result in new diesel generation not been built as opposed to displacing expected renewable energy projects.

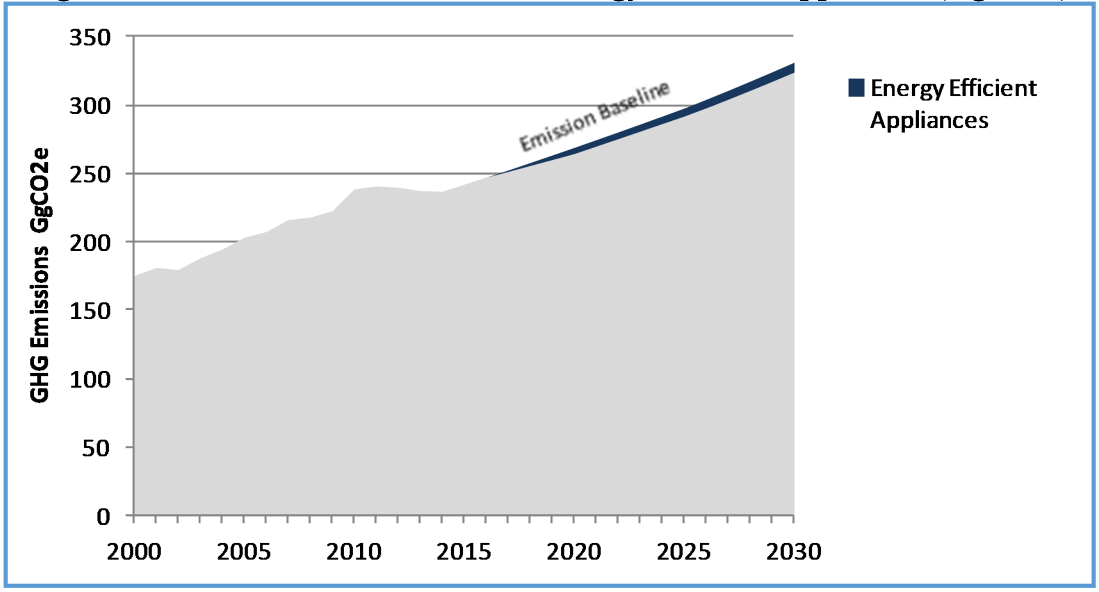
Estimated emission reductions are summarized in Table 3.37 and are expected to grow to 7.0 $GgCO_2e$ by 2030.

**Table 3.37: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Appliance Labelling and Energy Efficiency Standards | 0 | 0.31 | 1.6 | 3.0 |
| Street Lighting Replacement with LED | 0 | 4.2 | 4.2 | 4.2 |
| **TOTAL** | **0** | **4.5** | **5.8** | **7.2** |

Figure 3.28 illustrates the emission reduction potential compared to total emissions expected from electricity generation in the baseline. Electricity generation is used as the baseline because emission reductions are primarily a result of reduced electricity consumption rather than other fossil fuels such as LPG or diesel.

**Figure 3.28: Emission Reductions for Energy Efficient Appliances ($GgCO_2e$)**




Uncertainty in the emission reduction calculations is associated with three main factors:

- Baseline activity data estimates of new appliance energy demand for all major appliances that are expected to have labelling and efficiency standards (i.e., . Air-Conditioning units, incandescent lamps, tubular and compact fluorescent lamps, refrigerators, washing machines, fans televisions, LED lamps, stoves, freezers, and washing machines,).
- Degree to which new appliance energy efficiency standards will improves baseline energy efficiency on average.
- Overall penetration of street lighting replacement (analysis assumes 100% by 2020)

***Feasibility and Risk (addressing barriers)***

Table 3.38 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.38: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Consumer behavior and resistance to spending more upfront capital for efficient appliances | Education of decision makers on the benefits of new strengthened code will help to ensure that there is a willingness to enforce the building code standards |
| Capital costs for street lighting, particularly in maintenance budgets where replacement with incandescent occurs when failure detected | Increasing maintenance budget as proposed will help to address this issue. |
| Technology suitability / reliability for street lighting | Testing of LED options is underway and will help to identify suitable and reliable street lighting options. |
| Political will | Education of decision makers on the benefits of new appliance energy efficiency standards will help to ensure that there is a willingness to enforce the standards. Rolling out of mandatory labelling before energy efficiency standards will introduce consumers |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of Energy Efficiency in Buildings are summarized in Table 3.39.

**Table 3.39: Sustainable Development Benefits Associated with Energy Efficiency in Buildings**

| Category | Sustainable Development Benefit |
|---|---|
| Households and Businesses | While consumers may pay a premium for more energy efficient appliances, operation of these appliances have reasonably short pay-back periods and the consumers will benefit from energy savings in the long-run. |
| Environment / Health | A reduction in electricity demand is correlated directly with a reduction in air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br><br>Based on default IPCC emission factors (1996, IPCC) for diesel generation emissions could be as large as:<br><br>• 20 tonnes of $NO_X$<br>• 2.0 tonnes of CO<br>• 0.5 tonnes of NMVOC<br>• 2.3 tonnes of $SO_2$ |
| Energy Security | Reducing electricity demand in Saint Lucia reduces the demand for diesel fuel for electricity generation by approximately 637,000 n imperial gallons. |

***Costs:*** Costs for the proposed appliance labelling and efficiency standard interventions are related to program costs. While households and businesses may have higher upfront capital costs to purchase these appliances these costs will be offset by long-term energy savings such that have attractive payback periods.

Costs associated with street lighting are significant. Purchase of 800 LED fixtures is estimated to cost $EC 1,400,000 and does not include labour and maintenance costs. However, energy savings are expected to have a payback period of less than four years.

Estimated total net present value program costs that must be supported by the government are summarized in Table 3.40.

**Table 3.40: Programme Costs for Energy Efficiency in Buildings (NPV EC$ 2015)**

| Programme | Estimated Resources | NPV $EC (million) |
|---|---|---|
| Complete labelling program, improve governance | | 0.2 |
| Street Lighting Project | 2 | 0.2 |
| Prioritize and enact new efficiency standards | 2 officers full-time (10 years) | 1.2 |
| **TOTAL** | | **2.0** |

### 3.5.3 Electricity Generation

**Introduction**

The electricity generation sector includes all electricity generated for distribution to the power grid. It does not include off-grid generation. Currently almost all of electricity is generated from diesel fuel in Saint Lucia, although there is a very small level of grid connected solar photovoltaic.

The government has several important initiatives related to electricity generation. The government currently has a target for 35% renewable energy by 2020. A draft Revised Electricity Supply Act has been prepared and a National Utility Regulatory Commission Bill has been drafted.

A review of government policies, plans, strategies and targets identified a total of 9 mitigation actions related to electricity generation. These mitigation options were reviewed in stakeholder workshops held in August 2015 and are identified with their qualitative ranking of five different criteria in Table 3.41. The last column summarizes the overall ranking on a scale of 1 to 3 where 3 denotes the highest prioritization.

Prioritized mitigation actions were bundled under two programs; the 35% renewable energy target and improvements to grid distribution and transmission efficiency.

**Table 3.41: Electricity Generation Mitigation Actions**

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Reduction of transmission and distribution losses | 2 | 3 | 2 | 3 | 3 | 2.67 |
| 35% renewable energy target (electricity portfolio standards) | 3 | 3 | 2 | 3 | 2 | 2.67 |
| Feed-In Plans | 3 | 2 | 3 | 3 | 2 | 2.67 |
| Solar PV Utility Scale | 3 | 3 | 2 | 3 | 2 | 2.67 |
| Distributed Grid tied PV | 3 | 3 | 2 | 3 | 2 | 2.67 |
| 12.6 MW Wind farm | 3 | 3 | 1 | 3 | 1 | 2.33 |
| Geothermal | 3 | 3 | 1 | 3 | 1 | 2.17 |
| Circulating Fluidized Bed Biomass Generation | 2 | 1 | 1 | 1 | 1 | 1.17 |
| Micro Hydro | 1 | 1 | 1 | 1 | 1 | 1 |

## 35% Renewable Energy Target

***Summary:*** The Prime Minister has announced a goal of achieving 35% renewable energy by 2020. This is the equivalent of the installation of 21 MW of renewable energy by 2020, representing 35% of current peak capacity of 60 MW (2014).

While many different combinations of renewable projects could theoretically achieve the target, the exact technology pathway is not yet defined and therefore our mitigation assessment is technologically agnostic (assumes the best projects will move forward and contribute to the target by 2020 but the mix is unknown). As such, we consider three different mitigation actions scenarios that combine wind, utility scale PV, distributed PV and to assess abatement potential and costs of achieving the target.

***Current Status:*** The Revised Electricity Supply Act has been prepared in draft and it is anticipated that it will be published in Gazette I by the first quarter of 2016. The National Utility Regulatory Commission Bill has also been drafted and calls for the development of a Utilities Regulatory Commission to independently oversee electricity production in Saint Lucia. The Commission will have responsibilities related to developing rules for the feed-in of renewable electricity to the grid, net metering and an Independent Power Producer framework. The current status of different renewable technologies that could potentially contribute to the 35% renewable energy target are summarized below.

Wind: LUCELEC is moving forward with a proposal to develop a 12 MW windfarm in Dennery. Measurements of wind potential are currently being conducted on-site which will assist with determining turbine siting. Development remains contingent on negotiations with developers and the potential assessment results. As well, technical difficulties exist, notably moving turbine blades to the proposed site. There is about 40 KW of small wind currently deployed, which could accelerate with clarity under the new Supply Act (up to 50% per year).

PV (utility scale): Advanced stages of establishing a 3 MW solar photovoltaic (PV) plan in Vieux Fort is underway. LUCELEC hopes to set up a one megawatt system by the end of 2015; however, permits must first be issued before the RFP can be published which may delay installation. 2016 therefore looks more likely.

PV (distributed small scale): Approximately 190 kW of small scale residential or commercial grid connected projects have been installed to date. Larger scale implementation is delayed due to regulatory limits on the supply of electricity into the grid.

Geothermal: Surface exploration is in its final stages with technical assistance provided by the Government of New Zealand aimed at boosting capacity to engage in commercial negotiations. Preliminary proposals have considered a 30 MW facility to be completed in two 15 MW stages. A report on feasibility is forthcoming, identifying the energy potential and sitting options.

Waste to Energy: A current project is examining the potential for an integrated waste to energy project at the Deglos Landfill.

### *Proposed Interventions and Timeframe*

Three major interventions are proposed in order to meet the 35% renewable energy target. These interventions and the proposed timeframes for implementation are summarized in Table 3.42.

### *Emission Reduction Potential*

A summary of the assumed commissioning and operation of different renewables under the three mitigation scenarios is provided in Table 3.43.

**Table 3.42: Description of Interventions and timeframe for Implementation of 35% renewable energy target**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Create necessary regulatory environment to enable large scale renewable integration | Bring into force revised Electricity Supply Act. | First quarter of 2016 |
| | Support to Utility Regulatory Commission | From 2016 |
| | Favourable feed-in tariffs and tax conditions for renewable technologies, equipment and installation. | 2017 – 2030 |
| | Development and operation of an Independent Power Producer framework | 2017 – 2030 |
| | Better coordination across Ministries to address overlapping jurisdictions and challenges | From 2016 |
| Capacity Building | Study to determine amount of renewable that can be added to the grid while allowing for grid stability. | 2016 |
| | Certification and training for installers to ensure efficient deployment. | 2017 to 2020 |
| | Capacity building on PPA negotiation. | 2017 |
| Connect 21 MW of renewable power | Three mitigation scenarios are proposed to consider a range of possible outcomes:<br>• 12 MW wind, 3 MW utility scale PV, 6 MW grid connected distributed residential/commercial PV.<br>• 15 MW geothermal, 3 MW utility scale PV, 3 MW grid connected distributed residential/commercial PV<br>• 5 MW wind, 12 MW utility scale PV, 4 MW grid connected distributed residential/commercial PV | Assumes that 21 MW of renewable energy will be fully commissioned and operating by 2020. While this is ambitious it is possible if the government is able to move forward quickly on tendering and approval of renewable energy projects. |

**Table 3.43: Total Capacity of Renewables under each Mitigation scenario (2016-2025)**

| Mitigation Scenario | Renewable Technology | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Scenario 1 | Wind | - | 3 | 6 | 9 | 12 | 12 | 12 | 12 | 12 | 12 |
| | Utility PV | - | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Distributed PV | 0.3 | 0.5 | 1 | 3 | 6 | 6 | 6 | 6 | 6 | 6 |
| Scenario 2 | Geothermal | - | - | - | - | 15 | 15 | 15 | 15 | 15 | 15 |
| | Utility PV | - | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Distributed PV | 0.3 | 0.5 | 1.0 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| Scenario 3 | Wind | - | - | - | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | Utility PV | - | 1 | 3 | 6 | 12 | 12 | 12 | 12 | 12 | 12 |
| | Distributed PV | 0.3 | 0.5 | 1.0 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |

The three mitigation scenarios vary considerably in overall emission reduction potential. This is a result of the different capacity factors that are associated with different renewable energy technologies. The capacity factor is equal to the total electricity that is expected to be generated in a given year (MWh divided by the rating (MW) and the total number of hours in the year (8,760). Capacity factors for the four renewable energy technologies considered are provided in Table 3.44 below and are based on industry averages and what is known about potential in Saint Lucia.

**Table 3.44: Description of Interventions and timeframe for Implementation of 35% renewable energy target**

| Renewable Energy | Average Capacity Factor (%) |
|---|---|
| Wind | 28% |
| Utility Scale Solar PV | 24% |
| Distributed Solar PV | 20% |
| Geothermal | 85% |

Emissions are calculated by multiplying the expected capacity in a given year by the average capacity factor by the number of hours in the year and finally by the emission factor for existing diesel generation. The average emission factor for existing diesel generation has been calculated as 0.623 $tCO_2e/MWh$.

Emission reductions for each scenario are summarized in Table 3.45 and vary between 26.6 $GgCO_2e$ to 76.8 $GgCO_2e$ in 2020.

**Table 3.45 Emission Reductions (2016-2025)**

| Mitigation Scenario | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Scenario 1 | 0 | 28.8 | 28.8 | 28.8 |
| Scenario 2 | 0 | 76.8 | 76.8 | 76.8 |
| Scenario 3 | 0 | 26.6 | 26.6 | 26.6 |

Figure 3.29 illustrates the emission reduction potential compared to total emissions expected from electricity generation in the baseline. The first wedge illustrates the emission reductions from Scenario 3, the second wedge illustrates the additional emission reductions from implementing Scenario 1 and all three wedges represent the total emission reductions that could be expected from implementing Scenario 2.

**Figure 3.29: Emission Reductions for 35% Renewable Target ($GgCO_2e$)**

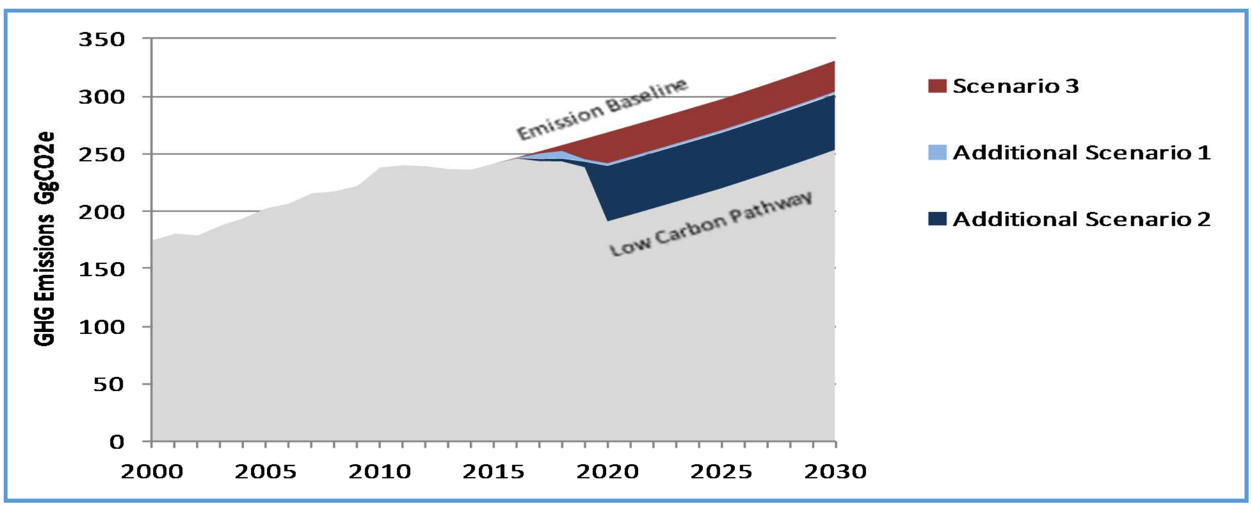



Figure 3.29 illustrates that there is considerable variability in emission reductions depending on the renewable technology that is operationalized. Because of the lower capacity factors for wind and solar, an equivalent capacity of operating geothermal produces more than twice the emission reductions for the same MW rating. While there is some uncertainty associated with capacity factors the figure clearly

illustrates that an option that includes 15 MW of geothermal power could reduce emissions in 2030 so that they are in line with current emissions.

***Feasibility and Risk (addressing barriers)***

Table 3.46 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.46: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Grid stability / infrastructure | A study to determine amount of renewable that can be added to the grid while allowing for grid stability is proposed to be carried out. |
| Securing capital Investment, address misconceptions in the banking sector leading to financing barriers (need to de-risk investment through education). | |
| Acquiring technical capacity for installations, operation and maintenance | Certification and training for installers to ensure efficient deployment is proposed. |
| Governance needs to be improved, notably better coordination between Ministries. Better education on technical issues and opportunities. | A program to coordinate ministries and address overlapping jurisdictions is proposed. |
| Some options may not reduce electricity costs, notably geothermal. | Alternative renewable mitigation options are assessed and the most cost effective and expedient options can be selected with appropriate feed-in tariffs and tax conditions for renewable technologies, equipment and installation. |
| Implementation issues associated with slow timelines related to supply chains | Successful implementation by 2020 will rely on ample time available for the tendering process. |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the 35% renewable energy target are summarized in Table 3.47.

**Table 3.47: Sustainable Development Benefits Associated with 35% Renewable Energy Target**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| GDP / Macro-economy | The main boost to the economy would be that foreign exchange is reduced as a result of the reduced demand for diesel fuel importation for electricity generation. At 2014 average diesel prices for LUCELEC (EC$9.81), that translates to between EC$23 and EC$62 million per year depending upon the mitigation scenario. |
| Energy Security | Production of renewable energy in Saint Lucia reduces the demand for diesel fuel by between 2.4 to 6.3 million imperial gallons. |
| Environment / Health | Diesel generation results in the release of air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br>Based on default IPCC emission factors (1996, IPCC) for diesel generation emissions could be as large as:<br>• 210 tonnes of $NO_X$<br>• 21 tonnes of CO<br>• 5.5 tonnes of NMVOC<br>• 24 tonnes of $SO_2$ |
| Households and consumers | It is unclear whether households, commercial and industrial consumers may benefit from lower electricity prices over the long-term.<br>Residential and commercial consumers that install grid connected solar are expected to have short paybacks on the order of 3 – 5 years for installed systems. |

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| Employment | Some local job creation is expected during construction and operation, but these jobs are mostly offset by reduced jobs from the displaced construction and operation of diesel generation plants. So the net result is not expected to be significant. |

***Costs:*** Costs for renewable energy tend to be dominated by capital costs of construction and commissioning. Overall costs are typically expressed as levelized costs of electricity (LCOE) that considers average total costs to build and operate a power generating asset over its lifetime divided by the total power output of the asset over that lifetime. Average levelized costs expected in Saint Lucia for the renewable technologies considered in the mitigation scenarios are summarized in Table 3.. The range of costs reported in the literature are in brackets. These are not similar to retail costs as there are additional costs associated with transmission, distribution and marketing. These costs also don't consider the considerable costs of exploration, sitting and permitting.

**Table 3.48: Levelized Costs of Electricity by Renewable Technology**

| Renewable Energy Technology | Average Levelized Cost of Electricity $EC/MWh (Low – High Range) |
|---|---|
| Wind | 180 (100 -220) |
| Utility Scale PV | 210 (190 – 230) |
| Distributed PV | 510 (340 – 675) |
| Geothermal | 330 (240 – 380) |
| Diesel | 800 (800 – 900) |

Source: High and low ranges of costs from (Lazard, 2014).

Total investment costs for each mitigation scenario including an estimate of 2% government administrative costs are estimated in Table 3.49.

**Table 3.49: Total Investment Costs (NPV millions EC$2015)**

| Mitigation Scenario | NPV millions EC$2015 | | |
|---|---|---|---|
| | Capital and Operating Costs | Government Administrative Costs | Total |
| Scenario 1 | EC$145 | EC$2.9 | EC$148 |
| Scenario 2 | EC$454 | EC$9.1 | EC$463 |
| Scenario 3 | EC$110 | EC$2.2 | EC$112 |

Relative to baseline diesel generation there appears to be significant costs savings in the order of EC$300 to EC$600 million for the mitigation scenarios; however, additional costs associated with connecting renewables, distribution and financing are not included, and the savings are likely to be substantially less.

**<u>Improvements to Grid Distribution and Transmission Efficiency</u>**

***Summary:*** LUCELEC currently sets targets to reduce grid distribution and transmission losses. This mitigation action includes accelerating existing capital investments to reduce system losses to 6% by 2020 and 5% by 2030. The new Utilities Regulatory Commission will have powers to set policies to encourage improved grid distribution and transmission efficiency.

***Current Status:*** LUCELEC has reduced distribution and transmission losses to 8.85% in 2013 from 9.67% in 2010 and has programmes in place to investigate and replace aging meters and update transmission lines to further reduce system losses. LUCELEC sets targets for system losses and has set a target of 8.61% for 2014 (LUCELEC Annual report). While this is significantly lower than the Caribbean average of 11.6%, additional progress could be made to reduce system losses.

### *Proposed Interventions and Timeframe*

Two major interventions are proposed in order to meet the grid distribution and transmission efficiency improvement target. These interventions and the proposed timeframes for implementation are summarized in Table 3.50.

**Table 3.50: Description of Interventions and timeframe for Implementation of improvements to grid distribution and transmission efficiency**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Negotiate new targets with LUCELEC for system losses | Utilities Regulatory Commission engages LUCELEC to determine appropriate targets for system losses. | 2017 |
| Provide appropriate incentives for capital investment in grid efficiency | Capital investments are required in transmission equipment and meters. Tax rebates or other financial incentives could be offered for this type of equipment to encourage investment. | 2018-2030 |

### *Emission Reduction Potential*

Transmission and distribution losses expected in the baseline from 2017 to 2030 are presented in Table 3.51.These losses account for the changes in expected energy demand as a result of the energy efficiency in buildings and appliance energy efficiency mitigation actions.

**Table 3.51: Baseline Transmission and Distribution losses MWh (2017-2030)**

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Transmission and Distribution Losses | 35,588 | 36,117 | 36,587 | 37,055 | 37,696 | 38,335 | 38,973 |
| | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| Transmission and Distribution Losses | 39,668 | 40,363 | 41,114 | 41,914 | 42,732 | 43,569 | 44,425 |

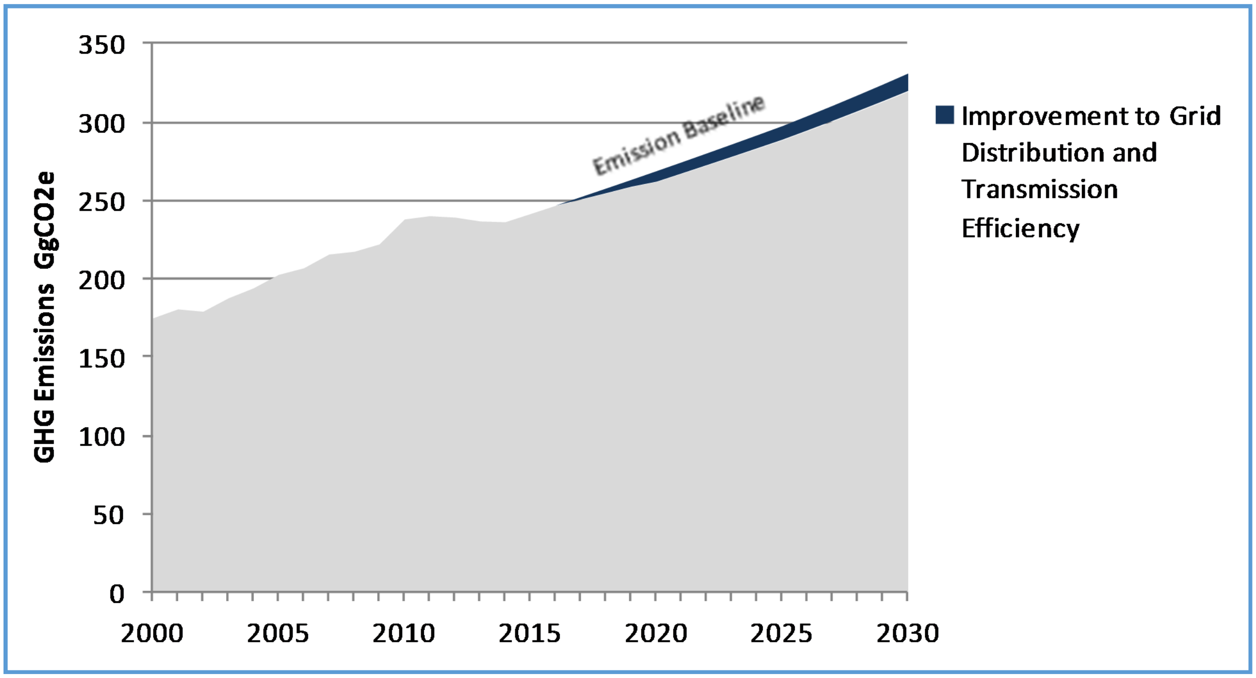
Emission reductions are calculated by multiplying the existing losses in Table 3.51 by the ratio of target system losses to baseline system losses and the emission factor for electricity generation. The average emission factor for existing diesel generation has been calculated as 0.623 $tCO_2e$/MWh in 2014. However, this emission factor falls in time if we assume that the new renewable energy target of 35% is achieved. The emission factor in 2030 is assumed to fall to 0.569 tCO2e/MWh. Estimated emission reductions are summarized in Table 3.52 and are expected to grow to 11 $GgCO_2e$ by 2030.

**Table 3.52: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Improvements to Grid Distribution and Transmission Efficiency | 0 | 6.6 | 8.6 | 11.0 |

Figure 3.30 illustrates the emission reduction potential compared to total emissions expected from electricity generation in the baseline. Electricity generation is used as the baseline because emission reductions are primarily a result of reduced electricity consumption rather than other fossil fuels such as LPG or diesel.

**Figure 3.30: Emission Reductions for Improvements to grid distribution and transmission efficiency ($GgCO_2e$)**




Uncertainty in the emission reduction calculations is associated with two main factors:

- Evolution of the grid and the generation capacity of different technologies in the future that impact expected average emission factor
- Whether targets for improvement in grid distribution and transmission can be met.

### *Feasibility and Risk (addressing barriers)*

Table 3.53 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.53: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Securing required capital investment | Government could provide tax rebates or other financial incentives to encourage LUCELEC to make necessary investments as proposed. |
| Political will to implement change | New Utilities Regulatory Commission will have authority and influence to determine appropriate targets for system losses |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the improvements to grid distribution and transmission efficiency are summarized in Table 3.54.

**Table 3.54: Sustainable Development Benefits Associated with improvement to grid distribution and transmission efficiency**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| GDP / Macro-economy | The main boost to the economy would be that foreign exchange is reduced as a result of the reduced demand for diesel fuel importation for electricity generation. At 2014 average diesel prices for LUCELEC (EC$9.81), that translates to EC$10 million per year by 2030. |
| Energy Security | Improvements to grid distribution and transmission efficiency reduces demand for diesel fuel by 1.1 million imperial gallons. |
| Environment / Health | Diesel generation results in the release of air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br><br>Based on default IPCC emission factors (1996, IPCC) for diesel generation emissions could be as large as:<br><br>30 tonnes of $NO_X$<br>3 tonnes of CO<br>0.8 tonnes of NMVOC<br>3.5 tonnes of $SO_2$ |
| Households and consumers | Lower electricity prices for consumers are only possible if investments have an attractive return on investment and LUCELEC is able to pass on savings. |

### 3.5.4 Transport

The transportation sector includes passenger road, freight road and marine transport modes. Aviation is excluded as there virtually no domestic air travel in Saint Lucia. Diesel and gasoline fuels used in road transport are the main source of emissions.

A review of government policies, plans, strategies and targets identified a total of 9 mitigation actions related to transport. These mitigation options were reviewed in stakeholder workshops held in August 2015 and are identified with their qualitative ranking of five different criteria in Table 3.55. The last column summarizes the overall ranking on a scale of 1 to 3 where 3 denotes the highest prioritization.

Mitigation options were found to primarily target either vehicle efficiency or public transit. Two programmes were proposed; Efficient Vehicles and Improvements to Public Transit.

**Table 3.55: Transport Mitigation Actions**

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Taxation/subsidies to encourage efficient vehicles | 3 | 2 | 2 | 3 | 3 | 2.5 |
| Improve and Expand Public Transit | 3 | 3 | 2 | 3 | 1 | 2.5 |
| Mandatory efficiency standards | 3 | 3 | 1 | 3 | 2 | 2.5 |

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Improve traffic management | 3 | 2 | 1 | 3 | 1 | 2.17 |
| Vehicle Maintenance Programs | 3 | 1 | 2 | 2 | 2 | 2.17 |
| Road Charges | 1 | 2 | 1 | 2 | 2 | 1.58 |
| Bio-ethanol | 1 | 2 | 1 | 3 | 1 | 1.5 |
| Ferry Transport Passenger | 1 | 2 | 1 | 2 | 1 | 1.33 |
| Ferry Transport Freight | 1 | 2 | 1 | 2 | 1 | 1.33 |

## Efficient Vehicles

***Summary:*** The mitigation action considers a programme of initiatives to first encourage and then require imported new and used vehicles that are purchased to meet minimum fuel efficiency standards and require that existing vehicles are properly maintained to ensure optimal vehicle fuel efficiency.

***Current Status:*** There have been minimal government interventions to date in regard to vehicle fuel efficiency. Exemptions of excise tax and duty for importers has been recently announced on fuel-efficient vehicles such as hybrids and electric vehicles.

### *Proposed Interventions and Timeframe*

Three major interventions are proposed in order to improve the fuel efficiency of both the existing and future fleet of on-road vehicles. These interventions and the proposed timeframes for implementation are summarized in Table 3.56.

**Table 3.56 Description of Interventions and timeframe for efficient vehicles**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Labelling of vehicle fuel economy for all new and imported vehicles, strengthen governance | In the short-term imported vehicles would be required to display their relative fuel economy based on an adopted standard | 2018 |
| | Support governance, demonstrating benefits of program. Capacity building to classify cars imports and review options for tax shifting and efficiency standards. | 2017-2019 |
| Vehicle Maintenance Program | Existing mandatory inspections are expanded to ensure regular checks of fuel emission and ignition systems and power-train systems that can improve vehicle fuel efficiency. Training is provided to mechanics and inspectors. Accompanying public awareness campaigns are provided to convey benefits of program to public. | 2019-2030 |
| Measure enacted to encourage/require all imported vehicles (new or used) to meet minimum fuel efficiency standards | The measure could take on one of three different forms: Regulatory minimum efficiency requirements outlined for most types of passenger and freight vehicles<br>Tax shifting for fuel efficient vehicles within classes of imported cars. Registration costs already in place for cars provide the basis for tax changes based on fuel efficiency. | 2020 |

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| based on size and class of vehicle. | Financial rebates for fuel efficient vehicles or hybrid / electric vehicles.<br>It is anticipated that 80% of imported new and used vehicles would be covered by the measures by 2020. | |

### *Emission Reduction Potential*

Baseline emissions from all on-road vehicles and for new vehicles imported starting in 2017 are indicated in Table 3.57.

**Table 3.57: Baseline Greenhouse Gas Emissions from On-Road Vehicles $GgCO_2e$ (2017-2030)**

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| All Road Vehicles | 210,285 | 211,681 | 213,504 | 215,260 | 217,032 | 218,820 | 220,624 |
| New Road Vehicles | 3,869 | 8,292 | 13,334 | 18,475 | 23,811 | 29,349 | 35,096 |
| | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| All Road Vehicles | 222,443 | 224,279 | 226,132 | 228,001 | 229,886 | 231,789 | 233,708 |
| New Road Vehicles | 41,057 | 47,241 | 53,653 | 60,303 | 67,197 | 74,342 | 81,749 |

Maintenance programs have significant potential to increase vehicle fuel efficiency and as a result decrease greenhouse gas emissions. Performing regular power-train maintenance including changing the air filter, changing lubricants with the recommended grade of oil, and keeping tires properly inflated can improve fuel efficiency by as much as 19% (US Department of Energy, 2015). While some programs report fuel efficiency improvement potential as high as 10%, implementation of maintenance programs is likely to deliver much lower results and an assumption is made that only an average 3% increase in fuel efficiency for all vehicles can be achieved and maintained over the program period.

Fuel efficiency standards are proposed that can achieve a fuel efficiency for new vehicles that is 15% above the fuel efficiency assumed in the baseline for new vehicles. This may sound like a significant requirement; however, it corresponds only to an increase in average annual fuel efficiency of 0.4% over the implementation period from an assumed baseline fuel efficiency improvement of 1.75% for passenger vehicles and 1.25% for freight vehicles.

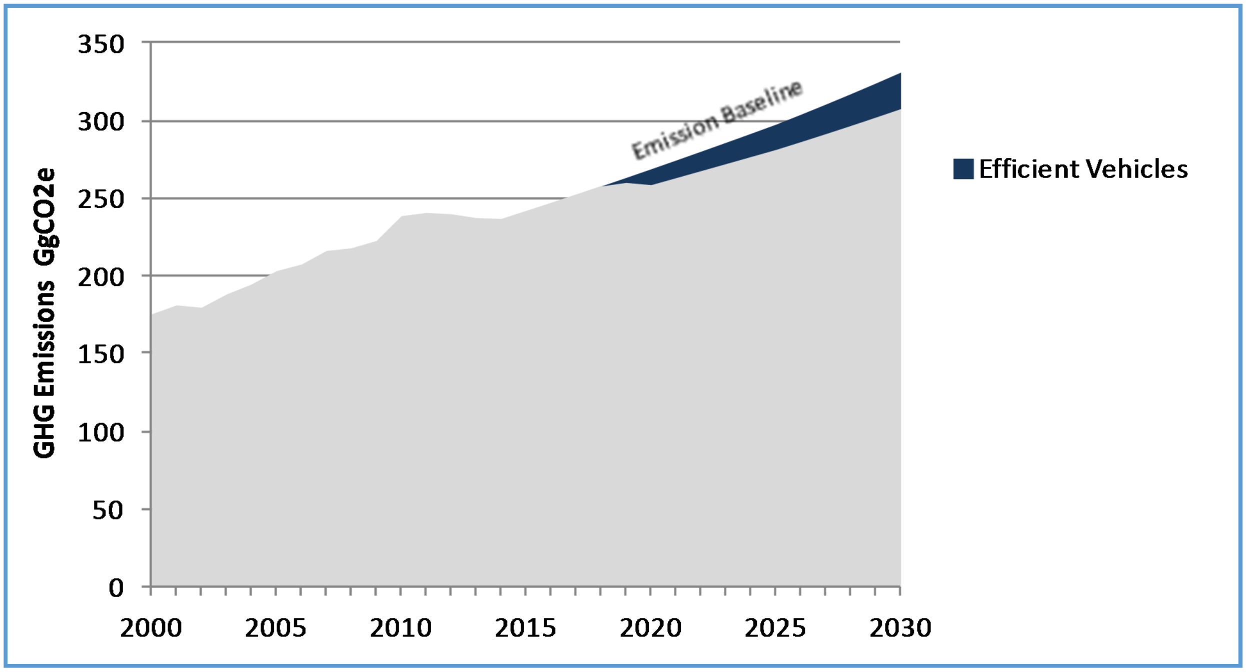
Emission reductions are calculated by multiplying baseline on-road vehicle emissions by 3% per year to estimate emission reductions from maintenance programs and new vehicle emissions by 15% per year to estimate emission reductions from new vehicle efficiency standards. Estimated emission reductions are summarized in Table 3.58 and are expected to grow to 23 $GgCO_2e$ by 2030.

**Table 3.58: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Maintenance Program | 0 | 6.5 | 6.7 | 7.0 |
| Vehicle Efficiency Standards | 0 | 3.7 | 9.5 | 16.4 |
| **TOTAL** | **0** | **10.2** | **16.2** | **23.4** |

Figure 3.31 illustrates the emission reduction potential compared to total emissions expected from transportation in the baseline.

**Figure 3.31: Emission Reductions for efficient vehicles ($GgCO_2e$)**




Uncertainty in the emission reduction calculations is associated with two main factors:

- Performance of maintenance program in terms of average fleet wide fuel efficiency improvements achieved
- Future average vehicle fuel efficiency of new and used vehicles purchased in Saint Lucia, in the baseline and in the mitigation scenario.

***Feasibility and Risk (addressing barriers)***

Table 3.59 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.59: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| High incremental capital costs for new efficient vehicles | Some proposed measures to encourage fuel efficiency (i.e., tax shifting, financial rebates) would address higher capital costs |
| Consumer preferences for existing inefficient vehicles | Vehicle labelling program and public awareness campaigns would raise awareness among consumers of benefits |
| Physical infrastructure for electric vehicles | The intervention does not rely on electric vehicles to achieve fuel efficiency targets. Infrastructure investment would only make sense if significant penetration was expected and may be financed by vehicle producers. |
| Political will, reflecting cultural barriers. | Supporting governance and demonstrating benefits of programs to policy makers and the public will help to reduce this barrier. |
| Governance challenges, classifying cars by fuel type. | The proposed intervention provides for governance support and capacity building. |

### *Sustainable Development Benefits:*

Sustainable development benefits expected from the implementation of the efficient vehicles mitigation action and are summarized in Table 3.60.

**Table 3.60: Sustainable Development Benefits Associated with efficient vehicles mitigation action**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| GDP / Macro-economy | The main boost to the economy would be that foreign exchange is reduced as a result of the reduced demand for diesel and gasoline fuel importation. At 2014 average wholesale gasoline and diesel prices that translates to approximately EC$230 million per year by 2030. |
| Energy Security | Improvements to vehicle efficiency reduces demand for diesel fuel by 170 million litres and gasoline by 64 million litres. |
| Environment / Health | Transport fuel combustion results in the release of air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br><br>Based on default IPCC emission factors (1996, IPCC) for transport emission reductions could be as large as:<br><br>220 tonnes of $NO_X$<br>1,920 tonnes of CO<br>360 tonnes of NMVOC<br>3.8 tonnes of $SO_2$ |
| Households and vehicle purchasers | Households may in some cases leverage higher upfront capital costs for reduced long-term operating costs that have reasonable payback periods. |

## Improve and Expand Public Transit

***Summary:*** The action envisions measures implemented that ultimately increase the number of trips that Saint Lucians make by public transit and reduce the number they make in their private vehicles. This is generally achieved through a combination of promotion, public awareness campaigns and making public transit more efficient and convenient. The main features of public transit that can be improved include frequency, reliability, comfort, speed, cost effectiveness and safety.

***Current Status:*** While the National Energy Policy calls for promotion of public transit and a more efficient public transportation system there has been limited work completed to date to identify the most effective means of achieving these goals. The establishment of regional routes to meet local demand and national carriage routes linked by centres in individual quarters of the island to meet inter-village demand has been proposed.

### *Proposed Interventions and Timeframe*

Three major interventions are proposed in order to improve public transit in Saint Lucia. These interventions and the proposed timeframes for implementation are summarized in the Table 3.61.

**Table 3.61: Description of Interventions and timeframe for improvement and expansion of public transit**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Develop regional and national plans for | Once it is determined what features are most likely to get Saint Lucians to switch to public transit | 2016-2018 |

| | | |
|---|---|---|
| public transit system (cohesive transit strategy) | (e.g., frequency, reliability, comfort, speed, cost effectiveness, safety), a national strategy and regional strategies would be developed (develop cohesive transport strategy) | |
| | Reinforce modernization, especially cashless bus passes to aid with data collection. | 2018-2020 |
| Implement appropriate measures to increase efficiency of public transit | There are many potential measures that could be implemented including:<br>Increase service<br>Improve coordination amongst transport modes<br>Priority for public transit vehicles on roadways<br>Improved comfort and convenience of stops and stations<br>Lower fares or convenient payment systems<br>Public transit vehicle comfort (reduced crowding, better seats, cleaner vehicles)<br>Real-time scheduling information<br>Improved security<br>Improvement in vehicle fuel efficiency | 2019-2025 |
| Promote public transit | Comprehensive public awareness campaign to promote benefits of public transit and new features. | 2018-2025 |

### *Emission Reduction Potential*

Improvement in the efficiency of public transit vehicles is captured in the previous vehicle energy efficiency mitigation action. The emission reduction calculation for improvements and expansion of public transit vehicles focuses on the shift of demand from private passenger vehicles to public transit vehicles. This demand is represented by the passenger vehicle km travelled metric. Table 3.62 below summarizes the estimated baseline total passenger vehicle km travelled by private passenger vehicles and by public transit vehicles in Saint Lucia.

**Table 3.62: Baseline Greenhouse Gas Passenger km travelled Private Cars and Public Transit (millions 2017-2030)**

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Million Passenger km Private Cars | 380 | 388 | 398 | 407 | 417 | 427 | 438 |
| Million Passenger km Public Transit | 160 | 164 | 168 | 172 | 176 | 180 | 185 |
| | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
| Million Passenger km Private Cars | 448 | 459 | 470 | 482 | 494 | 505 | 518 |
| Million Passenger km Public Transit | 189 | 194 | 198 | 203 | 208 | 213 | 218 |

Emission reductions can be calculated by considering the shift in total passenger km travelled that can be achieved and then considering the differential emissions by these different modes of travel. The estimated difference in $gCO_2e$/passenger km travelled between private cars and public transit is 45.8 gCO2e/passenger km (difference between 71.8 and 26.0 $gCO_2e$/passenger km).

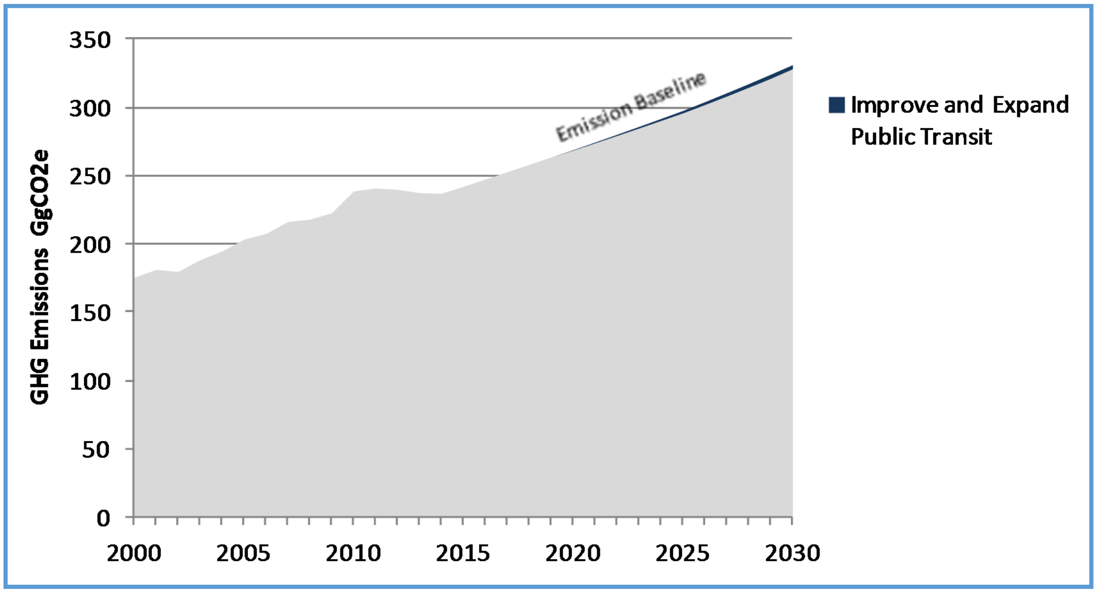
Setting a target of a 30% expansion in public transit demand by 2030 would result in the following emission reductions summarized in Table 3.63. This shift would decrease private car passenger km by 65 million passenger km travelled by 2030 and increase public transit ridership by the same amount.

**Table 3.63: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Improvement and Expansion of Public Transit | 0 | 0.3 | 1.8 | 3.0 |

Figure 3.32 illustrates the emission reduction potential compared to total emissions expected from transportation in the baseline.

**Figure 3.32: Emission Reductions for improvement and expansion of public transit (Gg$CO_2$e)**




Uncertainty in the emission reduction calculations is associated with two main factors:

- Baseline emission intensities of passenger cars and passenger buses
- Proposed target for shifting passengers from cars to public transit (i.e. 65 million passenger km by 2030).

***Feasibility and Risk (addressing barriers)***

Table 3.64 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.64: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| High capital costs for public transit infrastructure (vehicles, stations, stops, priority lanes) | Some proposed measures to encourage fuel efficiency (i.e., tax shifting, financial rebates) would address higher capital costs |
| Consumer preferences for personal vehicles | Promotion of public transit and benefits and adoption of new services that provide comfort and convenience will encourage adopters |

| | |
|---|---|
| Resistance to change from existing mini-bus drivers that may impact revenues, costs. | The cohesive strategy developed should consider potential impacts of plan on existing mini-bus drivers and should seek to limit negative impacts on this group. |
| Low standards of service given range of private owner/operators (reliability etc.). | The cohesive strategy developed should account for this barrier and provide the necessary support or training to ensure a high level of service |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the efficient vehicles mitigation action and are summarized in Table 3.65.

**Table 3.65: Sustainable Development Benefits Associated with improvements and expansion of public transit**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| GDP / Macro-economy | The main boost to the economy would be that foreign exchange is reduced as a result of the reduced demand for diesel and gasoline fuel importation. At 2014 average wholesale gasoline and diesel prices that translates to approximately EC$30 million per year by 2030. |
| Energy Security | Improvements to vehicle efficiency reduces demand for diesel fuel by 8 million litres and gasoline by 22 million litres. |
| Environment / Health | Transport fuel combustion results in the release of air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality<br>Based on default IPCC emission factors (1996, IPCC) for transport emission reductions could be as large as:<br><br>28 tonnes of $NO_X$<br>247 tonnes of CO<br>47 tonnes of NMVOC<br>0.5 tonnes of $SO_2$ |
| Public Transit and Other Road Users | Improvement in mobility options, reduction in traffic congestion and time savings as congestion is reduced. The measure would remove an estimated 5,700 passenger cars from the road by 2030. |

### 3.5.5 Agriculture and Land-Use, Land-Use Change and Forestry

The Agriculture and Land-Use, Land-Use Change and Forestry sector includes anthropogenic greenhouse gas emissions and removals by sinks that occur on managed lands including the following:

- $CO_2$ emissions and removals resulting from C stock changes in biomass, dead organic matter and mineral soils, for all managed lands;
- $N_2O$ emissions from all managed soils;
- $CO_2$ emissions associated with liming and urea application to managed soils;
- $CH_4$ emission from livestock (enteric fermentation); and
- $CH_4$ and $N_2O$ emissions from manure management systems.

A review of government policies, plans, strategies and targets identified a total of 7 mitigation actions related to agriculture and land-use, land-use change and forestry. These mitigation options were reviewed in stakeholder workshops held in August 2015 and are identified with their qualitative ranking of five different criteria in Table 3.66. The last column summarizes the overall ranking on a scale of 1 to 3 where 3 denotes the highest prioritization.

**Table 3.66: Agriculture, Land-Use, Land-Use Change and Forestry Mitigation Actions**

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Sustainable Agroforestry | 3 | 3 | 2 | 3 | 3 | 2.83 |
| Reforestation | 3 | 3 | 2 | 3 | 2 | 2.5 |
| Watershed and Flood Management | 3 | 2 | 2 | 3 | 2 | 2.33 |
| Biogas Digesters | 2 | 2 | 2 | 2 | 3 | 2.33 |
| National Land Use Policy | 2 | 3 | 2 | 3 | 2 | 2.17 |
| Carbon Storage in Soil | 2 | 1.5 | 2 | 3 | 2 | 2.08 |
| Solar Dryers | 1 | 1 | 1 | 1 | 1 | 1 |

Prioritized mitigation actions were bundled under two programs; agroforestry and forestry management and reforestation.

**<u>Sustainable Agroforestry</u>**

***Summary:*** Agroforestry refers to land use practices in which trees and other woody perennials are spatially or temporally integrated with crops and livestock on a given unit of land. The cultivation of fruit trees alongside traditional crops and planting of trees for shade result in an increase in forest cover and increase in biomass density that sequesters carbon. In this action 500 ha of additional agricultural lands are converted to agroforestry practices by 2030.

The measure considers implementation on existing agricultural lands that are currently cleared of trees and does not involve deforestation of existing forests.

***Current Status:***

***Proposed Interventions and Timeframe***

Two major interventions are proposed in order to implement agroforestry projects in Saint Lucia. These interventions and the proposed timeframes for implementation are summarized in table 3.67.

**Table 3.67: Description of Interventions and timeframe for Agroforestry**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Capacity building for farmers, extension services | Implement an extension program to enhance the knowledge and skills of farmers related to agroforestry and undertake studies to ensure the productivity and profitability of agroforestry projects. | 2017-2020 |
| Implementation of agroforestry projects, improve governance | Agroforestry including the planting of fruit and trade trees on 500 ha of land. Build on demonstration projects currently underway. | 2020-2025 |
| | Develop a more coordinate and cohesive governance approach. | 2016-2018 |
| | Finalize Watershed Management Guidelines | 2016-2017 |

### *Emission Reduction Potential*

The emission reduction potential for agroforestry is related to the growth of biomass of fruit and shade trees. Cocoa-based agro-forestry systems can achieve high levels of carbon sequestration in the range of 34 to 96 tC per ha (Oke, D., & Olatiilu, A., 2011). The Cocoa adaptation pilot establishment and expansion of diversified cocoa based agro-forestry systems in Saint Lucia estimated 50 to 80 tCO per ha (Paul, C. I. M., .2015).

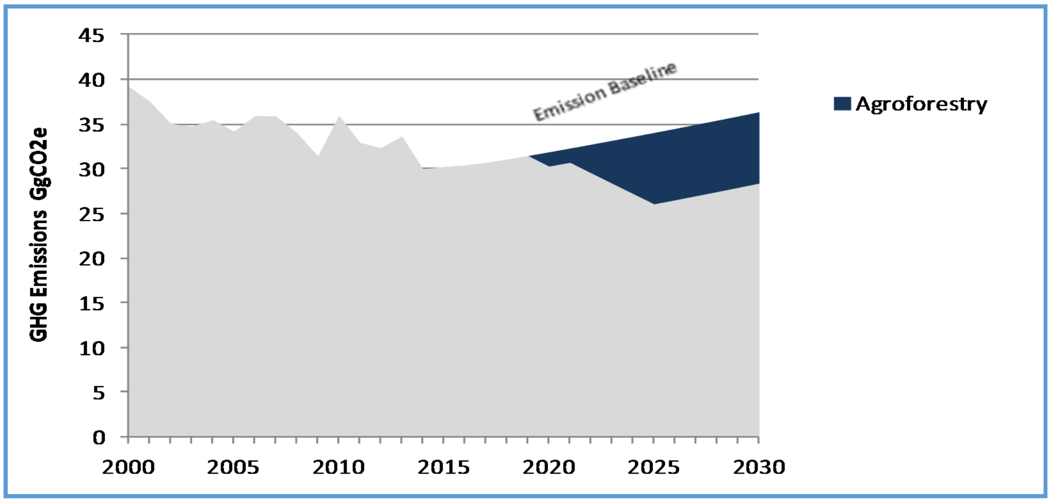
For this measure which proposes the implementation of agro-forestry systems on 500 ha of land in Saint Lucia. An average carbon sequestration potential of 15.9 $tCO_2e$ per hectare per year is employed. Emission reductions in agroforesty are estimated to be 7.9 GgCO2e in 2030 and are summarized in Table 3.68.

**Table 3.68: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Agroforestry | 0 | 1.6 | 7.9 | 7.9 |

Figure 3.33 illustrates the emission reduction potential compared to total emissions expected from agricultural emissions in the baseline.

**Figure 3.33: Emission Reductions for Agroforestry Mitigation Action ($GgCO_2e$)**




Uncertainty in the emission reduction calculations is primarily associated with the carbon sequestration potential of the agro-forestry systems put in place (i.e., cocoa based agroforestry, mango trees etc.).

### *Feasibility and Risk (addressing barriers)*

Table 3.69 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.69: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Reluctance of farmers to change practices and adopt new systems (risk aversion) | Capacity building is proposed to enhance the skills and knowledge of farmers related to agroforestry and also to demonstrate the productivity and profitability of agroforestry before it is implemented. |
| Agroforestry practices can require additional labour that is expensive | The proposed agroforestry program should identify labour requirements and costs |
| Access to market infrastructure can inhibit farmers from exploiting benefits of fruits, nuts and timber generated by trees | The government should undertake studies to determine what market infrastructure is available or required. |
| Initial capital investment in trees and delay before income is available | For a number of years farmers may not have substantial yields and returns. The proposed agroforestry program should include low-cost loans or grants to ensure viability of farms during this transition. |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the agroforestry mitigation action and are summarized in Table 3.70.

**Table 3.70 Sustainable Development Benefits Associated with Agroforestry**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| Food Security | Increased productivity and diversity of products on farm lands will increase food security in Saint Lucia and the country will be less reliant on imports |
| Environment / Health | Agroforestry has a number of important environmental benefits including increasing soil nutrient and water retention and reducing soil erosion through increased tree cover and root systems. Nitrogen-fixing trees and shrubs can also increase soil fertility and crop yields. |
| Farmers | Agroforestry products can enhance food security, diversify farmers' income and typically have higher profitability than other food crops. Agroforestry can also be a source of sustainable wood fuel, on-farm timber and livestock fodder. |
| Adaptation | Agroforestry can enhance local adaptive capacity, for example by using trees to create living barriers to support nutrient cycling and counter soil erosion. Agroforestry can increase water infiltration and retention in the soil profile, and help adapt to climate change since perennial crops are better able to cope with droughts and floods than annual crops. |

***Costs:*** The cocoa-based project was estimated to have an earning potential value of $EC420,000 for 130 participating families based on expected dry cocoa bean, and fruit production and value (, 2015). The project was over 45 ha and if we scale up the potential value if the agroforestry mitigation action the earning potential for a 500 ha project would be in the range of $EC 4.7 million per year.

In general, agroforestry systems can be implemented at relatively low cost. Mitigation costs based on reported values from two available studies (Tennigkeit, 2012, Lager and Nyburg, 2010) indicate an average mitigation cost of $13.25 per tonne of $CO_2$ reduced. This cost estimate would put the agroforestry project total cost at around EC$ 2.3 million.

**<u>Forestry Management and Reforestation</u>**

***Summary:*** The action considers the reforestation of over 1,000 ha of degraded forests and protection of other forests under threat of deforestation. Reforestation involves foresting lands that were once forests, but have been depleted or converted to non-forest land over the last 30 to 50 years.

***Current Status:*** Deforestation in Saint Lucia is still occurring for urban areas, but over the last decade the rate of deforestation has been slowed and even reversed for agricultural lands. Significant tracts of underutilized agricultural lands have been allowed to regain tree cover and the forest reserve area has increased by 18% to 9,415 ha between 2000 and 2010. The government of Saint Lucia is undertaking a number of reforestation efforts primarily in selected degraded areas or areas of high risk from storms and flooding. The IYANOLA natural resource management project has been initiated in the north-east part of Saint Lucia with the aim of providing protection and regulating services including water purification and carbon sequestration. Stated aims include rehabilitating and restoring degraded natural forest areas, restoring forest cover along riparian buffer zones and reaching an agreement with local private landowners to enlarge the effective area under protection. The successful implementation of the IYANOLA project could provide a template of land management for other regions in Saint Lucia.

Guidelines for developing watershed management plans are being developed through the DVRP as well as one watershed management plan.

***Proposed Interventions and Timeframe***

Three major interventions are proposed in order to implement a large scale forestry management and reforestation mitigation action in Saint Lucia. These interventions and the proposed timeframes for implementation are summarized in Table 3.71.

**Table 3.71: Description of Interventions and timeframe for Forestry Management and Reforestation**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Reinforce IYANOLA Project | Rehabilitation of ~1,000 ha of degraded natural forest areas. Protection of additional 500 ha of forest area (forest reserve or other agreements for protection). | 2016-2020 |
| Development and implementation of national forest strategy based on regional plans | Based on experience from IYANOLA project develop regional forest management plans with targets for forestry rehabilitation and protection. | 2018-2022 |
| Enforcement of zoning and forestry regulations | Increase the level of enforcement to ensure that zoning and forestry regulations are adhered to and that forests are protected. | 2022-2030 |

***Emission Reduction Potential***

Rehabilitation of degraded natural forest areas and protection of existing forest areas can substantially reduce the level of carbon released or enhance the sinks from forests. This measure proposes the rehabilitation or reforestation of 1,000 ha of land and the protection of 500 other ha of forest reserve that is under direct threat from degradation.

The assumption is that degradation of forests can be reversed through the implementation of these measures. The net increase in biomass for these forests (i.e., additional growth in biomass and decrease in wood removal) is assumed to be the equivalent of 2.8 tonnes of biomass/ha annually. This is equivalent to 4.9 $tCO_2e$/ha.

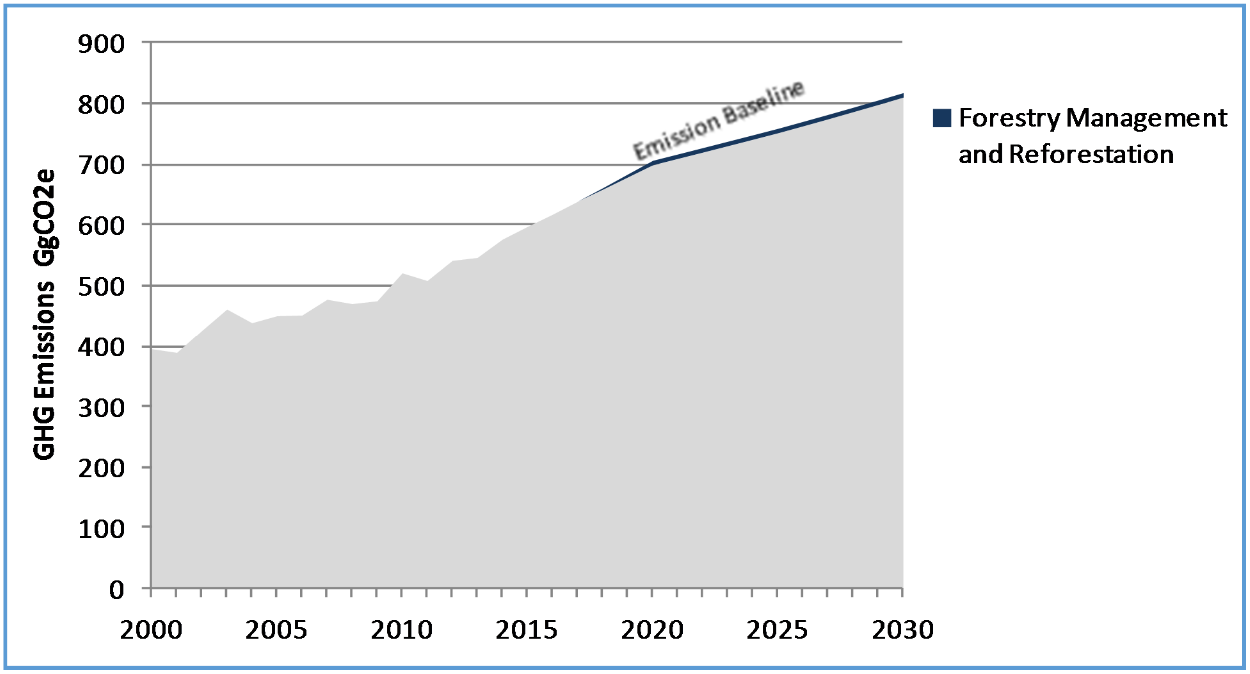
Assuming full protection and reforestation efforts are in place by 2020 the estimated net emission reductions relative to the baseline is provided in Table 3.72.

**Table 3.72: Net Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Forestry Management and Reforestation | 0 | 7.35 | 7.35 | 7.35 |

Figure 3.34 illustrates the emission reduction potential compared to total emissions expected from the overall emissions in the baseline.

**Figure 3.34: Emission Reductions for forestry management and reforestation ($GgCO_2e$)**




Uncertainty in the emission reduction calculations is primarily associated with the level of existing degradation of forests in Saint Lucia and the extent to which protection will allow these forests to regenerate (i.e., accumulate biomass).

***Feasibility and Risk (addressing barriers)***

Table 3.73 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.73: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Impact on current users (charcoal producers, timber producers, farmers) | Current users that remove wood from the forest reserve and other protected forests for charcoal production, timber production or firewood may be doing so illegally; however, they because this is a long standing practice restricting them from doing so will have negative impacts on their livelihoods. The proposed intervention should seek ways to provide income in other ways to these users. |
| Programme costs for ongoing management and protection are substantial, lack of capacity to monitor | Increasing the level of enforcement as proposed will require long-term funding. Climate financing may be one way to secure these funds. |

| Barriers | Proposed Interventions and Comments |
|---|---|
| Private land ownership | The proposal will require that agreements between regulators and private land-owners to ensure protection. |
| Weak governance structures, overlapping jurisdictions | The ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development must provide an overall governing structure for all local governments that are impacted under the plan. |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the forestry management and reforestation mitigation action and are summarized in Table 3.74.

**Table 3.74: Sustainable Development Benefits Associated with forestry management and reforestation**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| Environment / Health | Reforestation and protection efforts will reduce soil erosion and increase water availability by reducing run-off and can increase water quality. |
| Land-Owners | Land-owners will ultimately benefit from the protection of forests as reduced degradation will increase the sustainable wood supply available. |
| Protection of Biodiversity | Forests provide important wildlife habitat and reducing human disturbance of these habitats will increase the level of fauna biodiversity Increasing protection of forests can also lead to increased flora biodiversity. |

***Costs:*** Cost estimates for initiatives to reduce forest degradation and increase protection are estimated to be under $EC26 per tonne of emissions reduced. This cost estimate would put the Forestry Management and Reforestation program at a total cost at around EC$ 2.1 million.

### 3.5.6 Waste

The waste sector discussed under the mitigation assessment includes three major sources of emissions. Solid waste disposal, wastewater treatment and the release of hydrofluorocarbons (HFCs). HFCs are considered under the industrial processes category when conducting emission inventories.

A review of government policies, plans, strategies and targets identified a total of 5 mitigation actions related to waste. These mitigation options were reviewed in stakeholder workshops held in August 2015 and are identified with their qualitative ranking of five different criteria in Table 3.75. The last column summarizes the overall ranking on a scale of 1 to 3 where 3 denotes the highest prioritization.

**Table 3.75: Waste Mitigation Actions**

| Mitigation Action | Existing Action / Government Priority | Emission Reduction Potential | Ease of Implementation | Sustainable Development Benefits | Costs | Overall Ranking (1) |
|---|---|---|---|---|---|---|
| Water distribution / Network Efficiency | 3 | 2 | 2 | 2 | 2 | 2.16 |
| HFCs phase-out | 3 | 3 | 2 | 1 | 2 | 2.16 |
| Waste to Energy | 3 | 2.5 | 1 | 2 | 1 | 2.08 |
| Effective Systems for Liquid Waste Treatment | 1 | 1.5 | 2 | 2 | 1 | 1.42 |
| Waste Management (3Rs) | 1 | 1 | 2 | 2 | 1 | 1.33 |

Mitigation options were found to primarily target either wastewater, HFC or solid waste disposal emissions. Two programmes were proposed; water distribution and network efficiency and HFCs phase-out. Waste to energy projects are potentially considered under the 35% renewable energy target.

**Water Distribution / Network Efficiency**

***Summary:*** The action considers improvements in the water distribution network operated by the Water & Sewerage Company Saint Lucia (WASCO). Measures include the replacement of existing inefficient pumps with high efficiency pumps and reducing leakage through repair and replacement of pipes and through pressure modulation.

***Current Status:*** WASCO is responsible for the provision of potable water and sanitation services for the whole of Saint Lucia. Water supply is very constricted and hurricane and storm events can cause severe damage to water supply infrastructure and disrupt supply. Currently it has been estimated that the non-revenue water distribution loss is at least 56% (Saint Lucia Water Partners, 2013). The National Water and Sewerage Commission (NWSC) has proposed to establish a unit that will be tasked with monitoring; compliance and enforcement of regulations, service standards; efficiency and other critical areas that are necessary to cause improvement and increase efficiency at WASCO.

A partnership programme is being implemented by the Environmental Health and Sustainable Development Dept. of Caribbean Public Health Agency (CARPHA) and the Deutsche Gesellschaft für Internationale Zusam-menarbeit (GIZ) and WASCO to assist in identifying feasible options for improved utility management and reducing high water distribution losses. The project will provide support for training, utility expertise in network management, repair and detection and identify appropriate actions that could be taken to reduce water distribution losses and increase efficiency.

A road map for improved Water Distribution and Network Efficiency Management is provided in Figure 3.35 below.

***Proposed Interventions and Timeframe***

The proposed intervention and timeframe for implementation for the water distribution and network efficiency mitigation action is summarized in table 3.76.

**Figure 3.35: Road Map for improved Water Distribution and Network Efficiency Management** (GIZ, 2014)

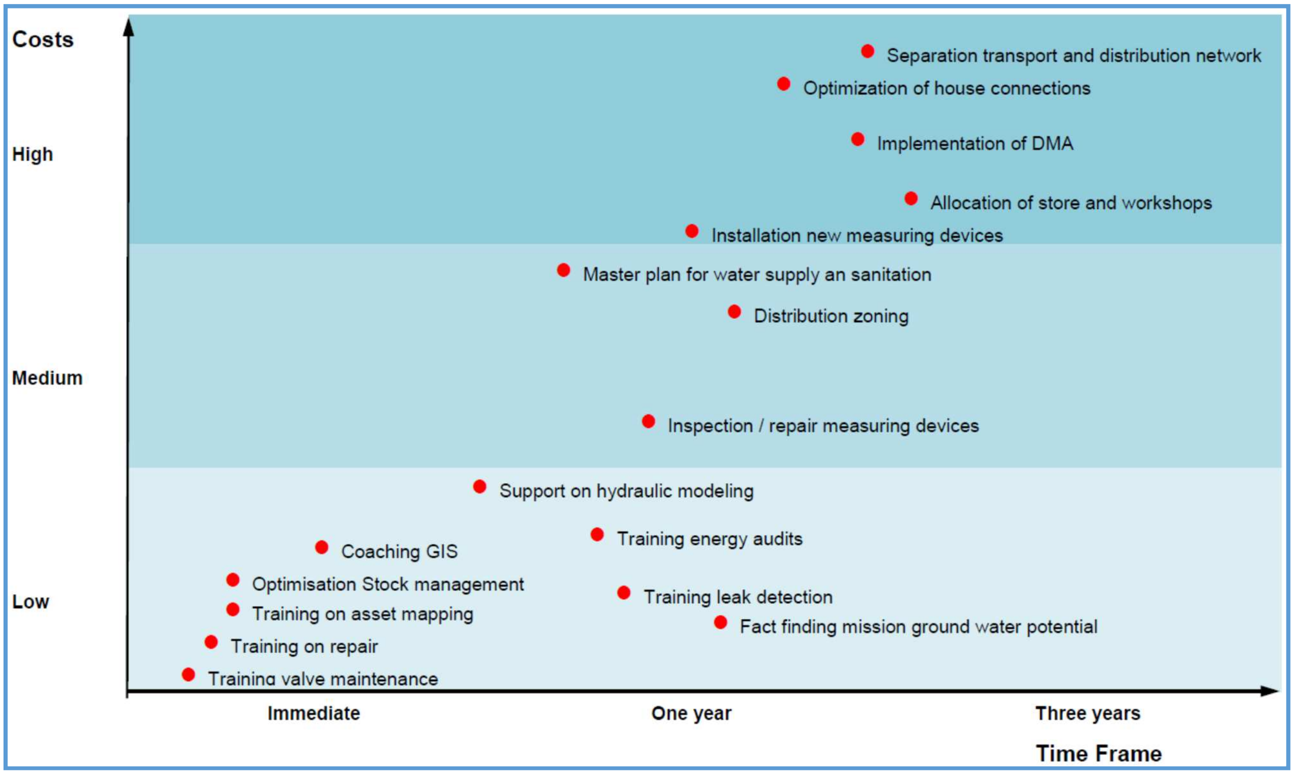



**Table 3.76: Description of Interventions and timeframe for Water Distribution and Network Efficiency**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Implement pump replacement and maintenance and repair of valves, appurtenances and pipes | Installation of high efficiency variable speed pumps that offer flexibility and operational efficiency. Replacement and repair of existing water distribution network, targeting a reduction in system water losses from as high as 56% (Saint Lucia Water Partners, 2013) to less than 20%. | 2018-2025 |

### *Emission Reduction Potential*

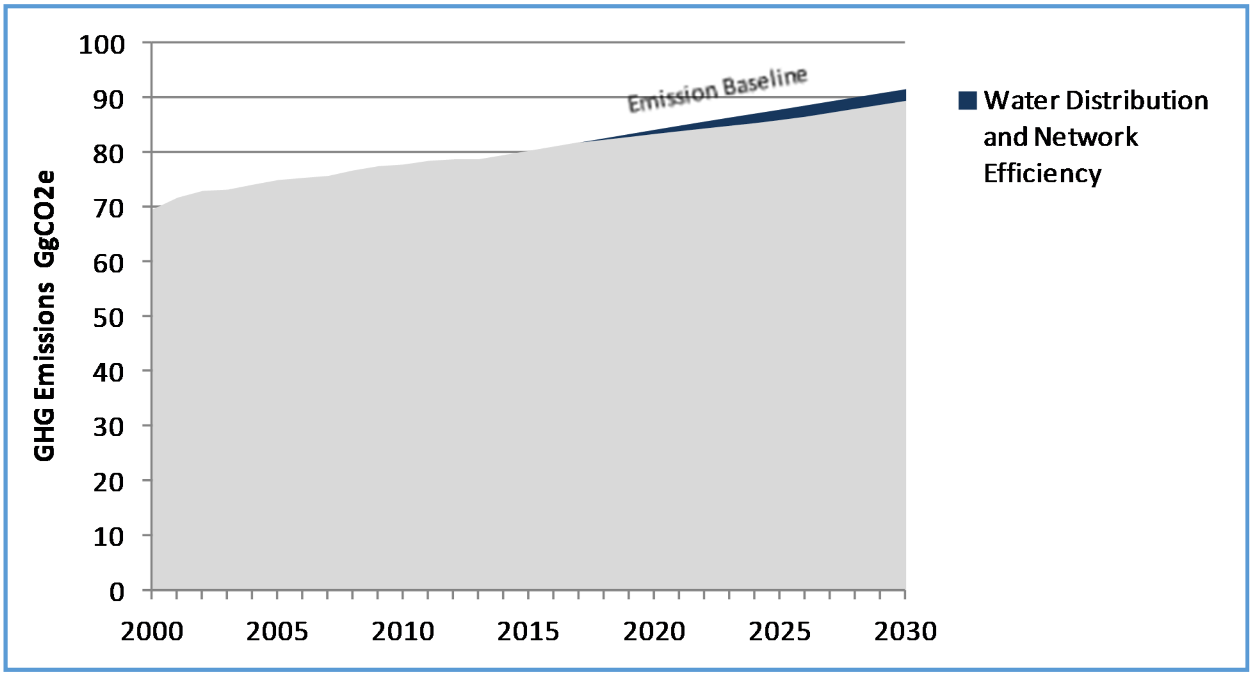
It is estimated that baseline emissions from water and wastewater distribution in 2015 are roughly 6.1 $GgCO_2e$, based on total electricity consumption of over 10 million kWh. Approximately 393 million imperial gallons of water are delivered to customers by WASCO annually. Emission reductions are based on two factors, the reduction of overall water losses from approximately 56% in 2015 to 20% by the year 2025 and an increase in average pump efficiency of 14% from the baseline. Based on these assumptions the estimated emission reductions relative to the baseline are provided in Table 3.77.

**Table 3.77: Net Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Water Distribution and Network Efficiency | 0 | 0.76 | 1.9 | 2.1 |

Figure 3.36 illustrates the emission reduction potential compared to waste emissions expected from the water distribution and network efficiency mitigation action.

**Figure 3.36: Emission Reductions for Water Distribution and Network Efficiency (GgCO2e)**




Uncertainty in the emission reduction calculations is associated with two main factors:

- Level of efficiency improvement that can be achieved by pump replacement, maintenance and repair
- Estimations of overall current water network system losses and the degree to which repairs can reduce these losses

***Feasibility and Risk (addressing barriers)***

Table 3.78 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.78: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Capital investment for replacement and repair of existing infrastructure | WASCO has been operating at a deficit for many years, and does not have available capital or financing to address efficiency and water system losses. It is likely that funding will need to come from climate finance or other sources for this mitigation action to be fully implemented. |

***Sustainable Development Benefits:*** Sustainable development benefits expected from the implementation of the forestry management and reforestation mitigation action and are summarized in Table 3.79.

**Table 3.79: Sustainable Development Benefits Associated with water distribution and network efficiency**

| Sustainable Development Benefit | Proposed Interventions and Comments |
|---|---|
| Environment / Health | Increased efficiency reduces systems losses and conserves water. By 2030 it is estimated that the action will reduce overall water usage by nearly 100 million gallons annually.<br><br>Electricity generated primarily from diesel results in the release of air pollutants including nitrogen oxides ($NO_X$), sulphur dioxide ($SO_2$), particulate (PM and $PM_{2.5}$) and carbon monoxide (CO). These pollutants have been closely related to a large number of health risks including increased mortality and morbidity associated with corresponding changes in ambient air quality.<br><br>Based on default IPCC emission factors (1996, IPCC) for diesel generation emissions could be as large as:<br><br>5.8 tonnes of $NO_X$<br>0.6 tonnes of CO<br>0.2 tonnes of NMVOC<br>0.7 tonnes of $SO_2$ |
| Water Consumers | Operating costs for water and wastewater distribution can be substantially reduced through the mitigation action. It is estimated that in 2030 energy expenditures for water and wastewater pumping can be reduced by EC$3.5 million annually. However, it is unclear how these future savings may be returned to consumers through reduced tariffs, as initially WASCO may have to increase tariffs to pay for capital investments. |

***Costs:*** Water distribution and network efficiency improvements tend to have short paybacks and reasonably quick returns on investment (Alliance to Save Energy, 2007). The initial cost of buying and installing a pump is typically only around 10% of life cycle costs, where energy and maintenance costs dominate.

**HFC Phase-Out**

***Summary:*** HFCs were introduced to replace ozone depleting substances commonly used in refrigeration and air-conditioning equipment. Most HFCs are potent greenhouse gases. Low carbon alternatives exist such as ammonia (R-717) or carbon dioxide (R-744). Some progress has been made in refrigerated trucks and trailer systems, but cost effective options for passenger vehicles remain limited. In the domestic and commercial refrigerant and air conditioning sector significant progress has been made in adopting hydrocarbon (HC) refrigerants (e.g., R-600a). For example, the domestic refrigeration market in Japan is now dominantly using R-600a. It is expected that within 10 years 75% of new refrigerator units in Japan will use HC refrigerants. Some European countries have already banned most uses of HFCs, US/Mexico/Canada committed to 70% reduction by 2029.

***Current Status:*** A Code of Practice for Refrigerant and Air Conditioners has been developed in draft form by MSDEST. There is also a movement towards a mandatory phase-out on some HFCs.

***Proposed Interventions and Timeframe***

The proposed intervention and timeframe for implementation for the HFC phase-out mitigation action is summarized in Table 3.80.

**Table 3.80: Description of Interventions and timeframe for HFC Phase-Out**

| Action | Description of Intervention | Proposed Time-frame for Implementation |
|---|---|---|
| Improved Management and Repair Program, improved governance. | Public awareness campaign to increase the capture of HFCs from refrigeration and air-conditioning equipment before they are released. Improved training of technicians to maximize capture of HFCs from equipment during repair and disposal. | 2016-2020 |
| | Improve licensing and training, including for customs personnel. Improve enforcement. | 2016-2020 |
| HFC phase-out, governance | Encouraging alternatives to HFC refrigerants through regulatory or economic instruments, import bans | 2020-2025 |

***Emission Reduction Potential***

The emission reduction potential is related to the replacement of imported HFCs in bulk and in products by alternative refrigerants with a substantially lower global warming potential. The mitigation action assumes a replacement rate of 20% over the baseline can be achieved by 2030. It also considers that alternatives have on average a global warming potential that is 90% lower than baseline HFC consumption. Total emission reductions expected from the HFC phase-out are expected to reach 8.5 GgCO2e by 2030 and are summarized in Table 3.81.

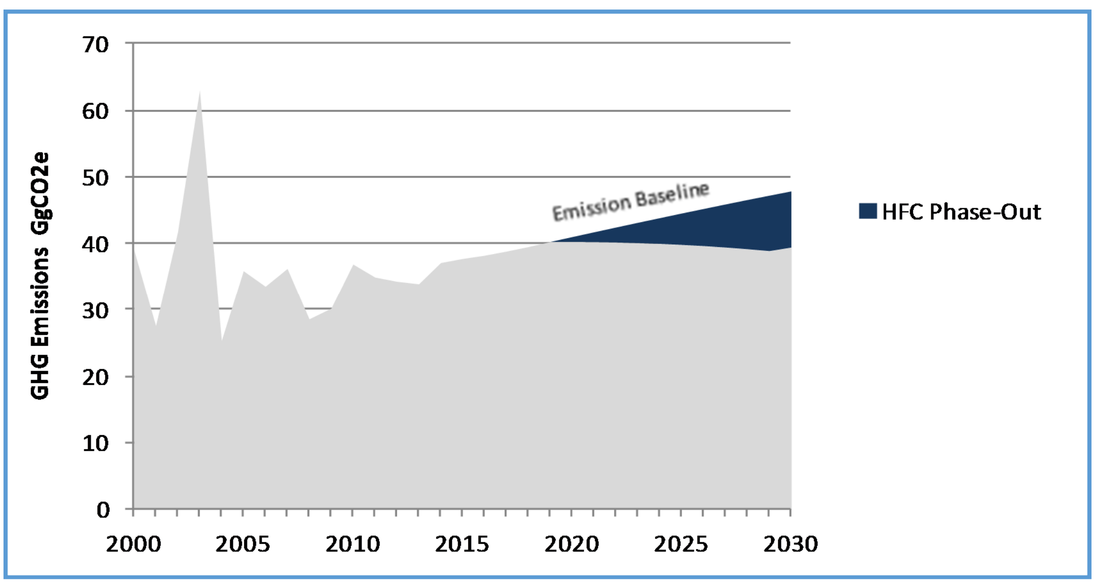
**Table 3.81: Emission Reductions (2015-2030)**

| Mitigation Action | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| HFC Phase-Out | 0 | 0.7 | 4.7 | 8.5 |

Figure 3.

Figure 3.37 illustrates the emission reduction potential compared to total HFC emissions expected from the HFC Phase-out mitigation action.

**Figure 3.37: Emission Reductions for HFC Phase-out ($GgCO_2e$)**



Uncertainty in the emission reduction calculations is associated with three main factors:

- Availability of alternatives to HFCs for residential, commercial and vehicle air conditioning.
- Cost feasibility of alternatives to HFCs for residential, commercial and vehicle air conditioning.
- Baseline estimates of HFC emissions in Saint Lucia

***Feasibility and Risk (addressing barriers)***

Table 3.82 indicates the main barriers that were identified in stakeholder consultations and how these barriers might be addressed by the proposed interventions.

**Table 3.82: Main Barriers to Implementation**

| Barriers | Proposed Interventions and Comments |
|---|---|
| Availability of alternatives | A clear identification of alternatives available to consumers needs to be conducted. |
| Cost effectiveness and performance of alternatives | A study of cost impacts on consumers needs to be conducted |
| Difficulty in regulating HFCs contained in imported air-conditioning and refrigeration products | Better tracking of HFCs through customs by providing improved training and better licensing of agents that handle HFC refrigerants is proposed. |
| Stakeholder acceptance | The proposed public awareness campaign and training for technicians can help to address stakeholder acceptance. |

***Costs:*** Some alternatives in the marketplace cost more than 10 times that of common refrigerant systems (e.g., HFC-134a). However, overall refrigerants represent a fairly small portion of the overall cost of an air conditioning appliance. Overall abatement costs for HFC phase-out program in Europe are estimated at EC$ 121 per $tCO_2e$ reduced. However, this proposed phase-out is significantly less ambitious (greater than 50% reduction versus 20%) and lags nearly a decade behind. Because of the significant growth in market of alternatives and reduced ambition total costs are based on EC$60 per $tCO_2e$ reduced. This is equivalent to EC$3.1 million of which at least 20% would be program costs.

### 3.5.7 Summary of Mitigation Assessment

The mitigation assessment identified a total of 10 prioritized mitigation actions. These mitigation actions and expected emission reductions are summarized in Table 3.83.

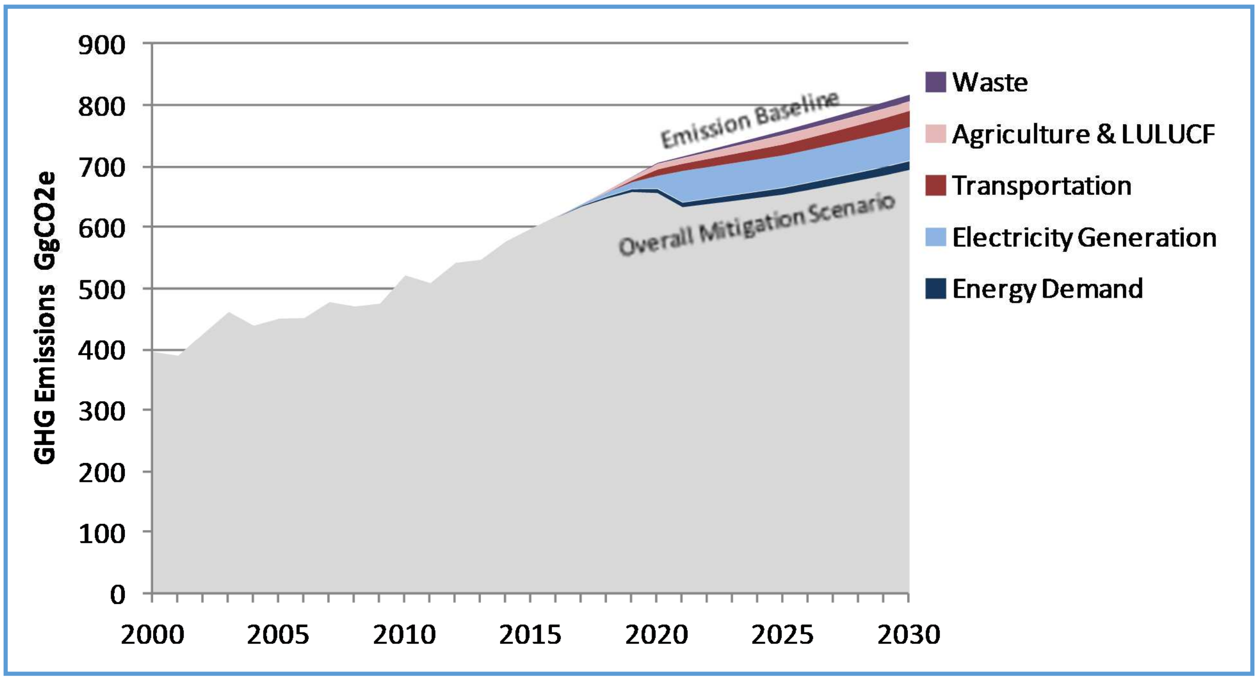
**Table 3.83: Main Barriers to Implementation**

| Sector | Prioritized Mitigation Actions | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Energy Demand | Energy Efficient Buildings | 0 | 2.0 | 4.8 | 7.0 |
| | Energy Efficient Appliances | 0 | 6.5 | 10.7 | 7.2 |
| Electricity Generation | 35% Renewable Energy Target by 2020 (Average of 3 scenarios) | 0 | 44.1 | 44.1 | 44.1 |
| | Improvements to Grid Distribution and Transmission Efficiency | 0 | 6.6 | 8.6 | 11.0 |
| Transportation | Efficient Vehicles | 0 | 10.1 | 16.2 | 23.3 |
| | Improved and Expanded Public Transit | 0 | 0.3 | 1.8 | 3.0 |
| Agriculture and Land-Use, Land-Use | Agroforestry | 0 | 1.6 | 7.9 | 7.9 |
| | Forestry Management and Reforestation | 0 | 7.4 | 7.4 | 7.4 |

| Sector | Prioritized Mitigation Actions | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Change and Forestry | | | | | |
| Waste | Water Distribution and Network Efficiency | 0 | 0.8 | 1.9 | 2.1 |
| | HFC Phase-Out | 0 | 0.7 | 4.7 | 8.5 |
| TOTAL Emission Reductions | | 0 | 48.0 | 103 | 122 |

If all 10 prioritized mitigation actions were implemented the following emission reductions could be achieved. The total emission reductions represent a decrease in baseline emissions of 7% from 2020, 14% from 2025 and 16% from 2030. This decreases overall emissions by 121 GgCO2e in 2030 from 816 GgCO2e in the baseline to 695 GgCO2e in the mitigation scenario. Relative to 2014 the growth in emissions declines from an average emission growth rate of 2.2% per year to 1.2% per year. Emission reductions of the mitigation actions relative to the baseline are illustrated in Figure 3.38.

**Figure 3.38: Emission Reductions for all Mitigation Actions ($GgCO_2e$)**



## 3.6 REFERENCES

Alliance to Save Energy (2007). *Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment*. Cost-Effective Savings of Water and Energy.

ECELP (2013). *Report on the Household Survey about Electrical Appliances and Energy Efficiency Awareness in Low- and Middle-income Households in St. Luica, Grenada and Antigua and Barbuda*. Eastern Caribbean Energy Labeling Project. Sophie Benthin and Johanna Carstens. March 2013.

US Department of Energy (2015). Federal Energy Management Program.

GoSL (2013). *Economic and Social Review*.

GoSL (2015). *Draft State of the Environment Saint Lucia*.

IMF (2015). World Economic Outlook Databases. Saint Lucia. Accessed August 7, 2015 at: http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/weoselgr.aspx

IPCC (1996). *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Reference Manual. Intergovernmental Panel on Climate Change. Geneva.

IPCC (2000). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change. Geneva.

IPCC (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Volume 1 through Volume 8. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

King-Joseph, A. (2010). Vulnerability and Adaptation Study for Saint Lucia's Second National Communication – Critical Infrastructure. Prepared for Ministry of Physical Development and the Environment.

Lager, B. and Nyberg, Y. (2010). Climate change mitigation and agriculture: How to make carbon finance work for smallholders. In Wollenberg, E., Tapio-Bistro, M., Grieg-Gran, M., and Nihart, A. (eds.). Climate Change Mitigation and Agriculture. Routledge.

Latin American Energy Organization (2014). *Energy Balances of Saint Lucia*. OLADE – CELAC. Paola Carrera. Castires, Saint Lucia. August 22, 2014

Lazard (2014). Lazard's *Levelized Cost of Energy Analysis – Version 8.0*. Accessed on September 22, 2015 at: https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf

LUCELEC (2014). *Annual Report 2014*. Saint Lucia Electricity Services Limited.

Paul, C. I. M., (2015). The Cocoa Adaptation Pilot Establishment and Expansion of Diversified Cocoa Based Agro-forestry Systems in Saint Lucia.

Saint Lucia Solid Waste Management Authority (2003) *Annual report for the Period April 2002 to March 2003.*

Stiebert Consulting (2015). *Saint Lucia National Greenhouse Gas Inventory Report 2010*. Prepared for Ministry of Sustainable Development, Energy, Science and Technology of Saint Lucia. March 2015.

Tennigkeit, T. 2010. “Land-based agricultural carbon finance: Potential, operations and economics.” African Carbon Forum Workshop session on: *How to implement agricultural carbon projects in Africa*. Nairobi, 3-5 March.

Veterinary and Livestock Services Division (2015). *Quarterly and Yearly Reports*. Communication by email on 5-Dec-2014 and 14, Jan 2015 from MSDEST in excel spreadsheet format.

World Bank (2014). World Development Indicators. Retrieved from World Bank website: http://data.worldbank.org/country/Saint Lucia

# CHAPTER 4. MEASURES TO FACILITATE ADEQUATE ADAPTATION TO CLIMATE CHANGE

## 4.1 OVERVIEW

Saint Lucia's economy has evolved over the years from being heavily dependent on Agriculture, primarily banana production, to an economy dependent on Tourism and Other Services, in particular Financial Services. The development of various key sectors, especially Tourism, Agriculture and Fisheries, are critical to the continued economic growth of the country. The economy can be considered as fragile and therefore any impact of climate change on these sectors could have far reaching repercussions on the economic and social dimensions in particular, livelihoods especially of the poor and other vulnerable groups including women and children.

Sensitive ecosystems, infrastructure and settlements on Saint Lucia's coast would be highly susceptible to climate change, climate variability and climate extremes including and sea level rise. Furthermore, ocean encroachment may lead to significant and irreversible damage to natural habitats, agricultural lands, built infrastructure and associated livelihoods.

Numerous studies (e.g. IPCC, 2014; Singh, 1997) expect significant shifts in regional climates and sea levels in the coming decades because of the increasing concentrations of greenhouse gases in the atmosphere. In the Southern Caribbean, mean annual surface air temperature is expected to rise by over 2°C, and sea levels by over half a meter by the middle of this century (IPCC, 2014). Rainfall amounts and patterns are projected to decrease slightly in annual amounts but increase in variability, and evapotranspiration (ET) rates are expected to increase by about 15 %, based on warmer temperatures. Further, more variable and extreme weather conditions, which can lead to severe weather, squalls and surges, especially during the hurricane season and the periods of neap and spring tides, are likely (IPCC, 2014).

Poor land use planning, deforestation, squatter developments and developments in disaster prone areas have exacerbated vulnerabilities while the absence of approved building codes and standards has resulted in a housing stock prone to damage by floods, landslides and high winds. Coral bleaching due to warming ocean waters, physical damage from anchors, suffocation from silt carried in river runoffs and storm damage have reduced the area of coral reefs, with associated increased vulnerability of the coastline to storm activity. This condition is exacerbated by the significant loss of valuable resources such as mangroves for tourism development and charcoal production.

This V&A assessment focuses on the fact that climate change impacts are being superimposed on an already vulnerable environment as reported in Saint Lucia's SNC V& A assessment. The TNC V& A assessment focuses on key socio-economic sectors of Saint Lucia namely:

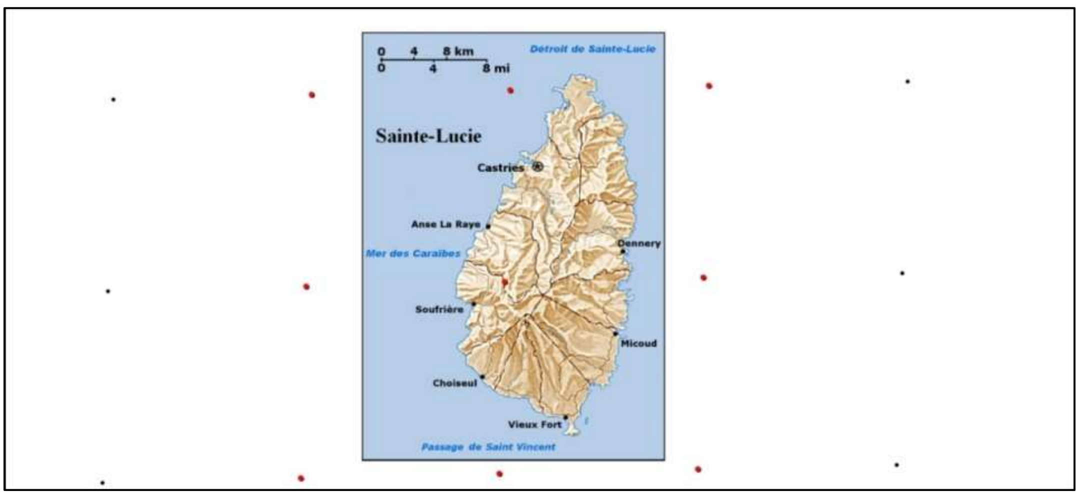
- Coastal Development,
- Agriculture, including Livestock and Fisheries,
- Water,
- Tourism,
- Health,
- Financial Services Sector, and
- Vulnerable Settlements.

The various sectoral V&A assessments are based on the scenarios of two of the more highly ranked downscaled global climate models. Two regional downscaled climate change scenarios provided the requisite data on an annual, monthly and daily basis for the current period (1981-2015) and two future 30-year time slices (2040-2068 and 2070-2098). The pertinent climate variables including:

1. air temperature,
2. rainfall,
3. solar radiation and
4. evaporation,

Data for Saint Lucia for the period 1961 to 2100 was provided by INSMET (Instituto de Meteorologia de Cuba) via the 5Cs (Caribbean Community Climate Change Centre). The data was PRECIS-downscaled scenarios of a version of the HadCM3 (British) and ECHAM5 (European) climate models forced by the SRES A1B forcing scenario and recast on a 25 x 25 km grid spacing. Nine (9) grid points in and around Saint Lucia were used for the mapping of minimum temperature (Tmin), maximum temperature (Tmax), mean temperature (Tmean), precipitation (rainfall) and water excess and deficits (P-E) for the entire island. For V&A analysis in the coastal zone, water resources, agriculture and livestock, tourism, human health, financial and vulnerable groups, the lone land-based grid point that lies about 5 km north-east of Soufrière in the Forest Reserve was used (Figure 4.1).

**Figure 4.1: Climate Scenarios: Projected Changes in Air Temperature, Rainfall and Water Deficits**




## 4.2 CLIMATE SCENARIOS/ANOMALIES

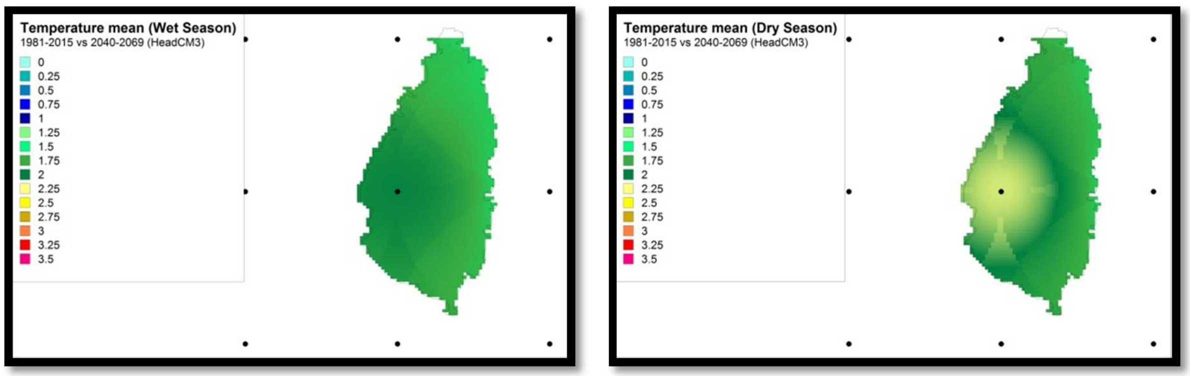
Although scenarios and mapping were done for current (1981-2015) minimum, maximum and mean air temperature (Singh et al., 2016), for purposes of brevity, only the results for mean Air Temperature and Rainfall for the Dry and Wet seasons of Saint Lucia according to the HadCM3 climate scenario are presented.

### 4.2.1 Climate Scenarios/Anomalies – Mean Air Temperature: HadCM3 (2040-2069)

For the mean air temperature anomalies for the wet season, when comparing 1981-2015 to 2040-2069, it is evident that the cooling influence of the ocean causes mean temperature increases to be ~1.75 $^{0}$C. But the mean air temperature increases tend to be slightly higher (~2.0 $^{0}$C) in the vicinity of the land-based grid point (Figure 4.2a).Similarly the mean air temperature anomalies for the dry season, when comparing

1981-2015 to 2040-2069, it is again evident that the increased heat capacity of the land-based point north-east of Soufrière pushes the mean air temperature increase to ~2.5 $^{0}$C (Figure 4.2b).

**Figure 4.2: Mean Temperature – Wet season, (a) and Mean Temperature – Dry season, (b) anomalies 1981-2015 vs 2040-2069 for Saint Lucia according to the PRECIS downscaled HadCM3 global climate model**




a　　　　b

### 4.2.2 Climate Scenarios/Anomalies – Seasonal Precipitation: HadCM3 (2040-2069)

As for precipitation anomalies (1981-2015 vs 2040-2069) during the wet season, the PRECIS-downscaled HadCM3 model projects slight decreases in seasonal (June to December) rainfall in the future (2040-2069), especially along the west coast and ranging from ~ - 25 mm/season near Castries to ~ - 20 mm/season near Soufrière. For the rest of the island, decreases in seasonal rainfall range from ~ - 60 mm/season along the east coast to ~ - 35 mm/season in the interior (Figure 4.3a)

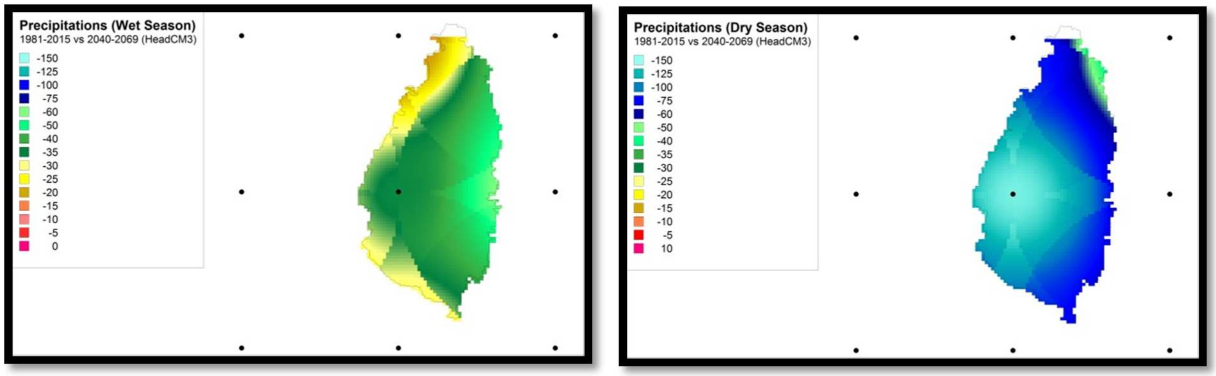
On the other hand, precipitation anomalies (1981-2015 vs 2040-2069) during the dry season, the PRECIS-downscaled HadCM3 model projects greater decreases in seasonal (January to May) rainfall in the future (2040-2069), especially along the eastern coast and of the order of ~ - 75 mm/season except near Cotton Bay. For the rest of the island, covering most of the west coast and the central regions, decreases in seasonal rainfall range from ~ - 100 mm/season to ~ - 125 mm/season in the interior (Figure 4.3b).

### 4.2.3 Climate Scenarios/Anomalies – Mean Air Temperature: ECHAM5 (2081-2100)

When comparing 1981-2015 to the second future period of 2081-2100, for the wet (June to December) season, mean air temperature increases are again very similar, with the eastern half of the island showing an increase in mean air temperatures by ~ 2.75 $^{0}$C by the end of the century, an amount lower than the rest of the island due to the cooling influence of the oceans. On the other hand, for the rest of the island that includes the land-based grid point, the mean air temperature is expected to increase by > 3.0 $^{0}$C by 2100 according to the PRECIS downscaled HadCM3 model (Figure 4.4a).

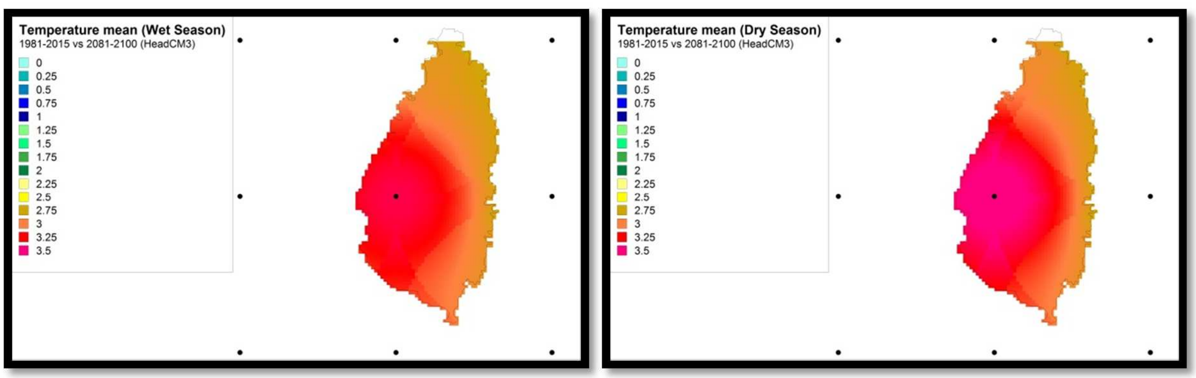
For the same reasons, it is not surprising to see that when comparing 1981-2015 to 2081-2100, for the dry (January to May) season, mean air temperature increases are again very similar, with mean air temperatures on the eastern half of the island expected to rise by ~ 2.75 $^{0}$C by the end of the century. This is lower than the rest of the island due to the cooling influence of the oceans. For the rest of the island that includes the land-based grid point, the mean air temperature is expected to increase by > 3.0 $^{0}$C by 2100 according to the PRECIS downscaled HadCM3 model (Figure 4.4b).

**Figure 4.3: Precipitation anomalies (1981-2015 vs 2040-2069) during the wet season, (a) and during the dry season, (b) for Saint Lucia according to the PRECIS downscaled HadCM3 global climate model**




a b

**Figure 4.4: Mean air temperature anomalies 1981-2015 vs 2081-2100) during the wet season (June to December), (a) and during dry season (January to May), (b) for Saint Lucia according to the PRECIS downscaled HadC3 global climate model**



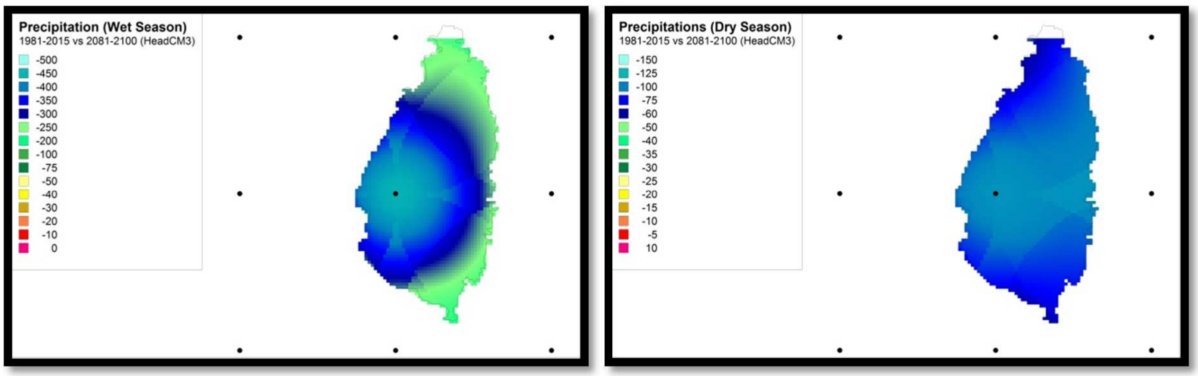

a b

### 4.2.4 Climate Scenarios/Anomalies – Seasonal Precipitation: ECHAM5 (2081-2100)

Two distinct patterns emerge for precipitation anomalies (1981-2015 vs 2081-2100). During the wet season, the PRECIS-downscaled HadCM3-AEXM model projects important decreases in seasonal (June to December) rainfall in the future (2081-2100), especially along the western and central parts of the country with decreases in seasonal rainfall ranging from ~ - 350 mm/season to ~ - 400 mm/season. For the rest of the island, concentrated along the east coast and the northern and southern extremities, decreases in seasonal rainfall average ~ 250 mm/season (Figure 4.5a).

For precipitation anomalies (1981-2015 vs 2081-2100) during the dry season, the PRECIS-downscaled HadCM3 model projects lesser decreases in seasonal (January to May) rainfall in the future (2081-2100). For most of the central (including coastal regions of the country) rainfall is expected to fall by ~ 100 mm/season. But for the rest of the island, covering most of the northern and southern regions, decreases in seasonal rainfall are expected to average ~ 75 mm/season (Figure 4.5b).

**Figure 4.5: Precipitation anomalies (1981-2015 vs 2081-2100) during the wet season, (a) and during the dry season, (b) for Saint Lucia according to the PRECIS downscaled HadCM3 global climate model**




a b

## 4.3 COASTAL ZONE

Saint Lucia as a Small Island Developing State (SIDS) is highly vulnerable to climate change because of its small size and low elevation in some coastal areas, which increases sensitivity to climate change and limits the ability to adapt. The IPCC (2007; 2014) reports note that adaptive capacity of human systems is generally low in Small Island Developing States as Saint Lucia. Small Island Developing States are therefore likely to be among the countries most seriously affected by climate change and its impacts. Among the most important consequences of climate change, especially for small islands, are sea level rise and storm surge events (IPCC, 2007; IPCC 2014), which can severely impact coastal waters, coastal ecosystems and coastal infrastructure including ports, harbours, access roads, bridges and buildings, well into the future.

### 4.3.1 Methodology

Data representing future sea level changes for the 2040-2069 and the 2081-2100 future time slices are derived from the latest IPCC (2014) Climate Change Report (Olsson et al., 2014). However, sea level rise values of the IPCC (2013) are rather conservative when compared to other recent studies that integrate the land ice contribution to sea level rise (Rahmstorf, 2007, 2010; Horton et al., 2008; Vermeer and Rahmstorf, 2009; Grinsted et al., 2009). In view of this conservativeness, the extreme values of the IPCC (2014) based on the Representative Concentration Pathway (RCP) forcing scenarios were selected: 0.38 m for the 2046-2069 period (RCP 8.5) and 0.82 for the 2081-2100 period (RCP 8.5).

As for the vulnerabilities of the coastal zone to projected future (2040-2069 and 2081-2100) climate change and sea levels, this was done through data on sea level rise and storm surges gleaned from climate models (A-OGCM: Atmosphere-Ocean General Circulation Models) (IPCC,2014) and the Caribbean Disaster Mitigation Project (2005).

Furthermore for the coastal zone of Saint Lucia under threat to sea level rise and storm surges, current (1986-2014) and future (2060-2069 and 2081-2100) sea levels and storm surges were coupled to digital terrain mapping (DTM) using GIS techniques (Singh and El Fouladi, 2005, 2007). These analyses allowed identification of ecosystems (e.g. mangroves, sea grass, coral reefs), infrastructure (e.g. buildings, roads, ports) and communities (e.g. fishing villages, coastal agricultural land) that are likely to be at high risk to climate change and variability.

Finally, based on the foregoing analyses, adaptations options and barriers to adaptation to climate change were identified for the coastal zone sector: possible opportunities and priorities (coastal infrastructure and development, coastal zoning changes, setback limits) for enabling effective and proactive adaptation to climate change and sea level rise in the coastal zone.

### 4.3.2 Future Sea Level and Storm Surge Scenarios and Impacts

Table 4.1 presents the future (2040-2069 and 2081-2100) sea level and storm surge scenarios for a Category 2 and a Category 5 Hurricane for Saint Lucia. The final values of sea level rise for 2040-2069 is 0.47 m and the total land area in the coastal zone that are likely to be inundated is 0.097 $km^2$. The final values of sea level rise for 2081-2100 is 0.91 m and the total land area in the coastal zone that are likely to be inundated is 0.386 $km^2$. The areas that will be most impacted by sea level rise, especially in 2081-2100 are towns and villages along the east coast like Micoud and Dennery, and Castries, Gros Islet and Anse de La Raye along the west coast (Table 4.1 and Figure 4.6).

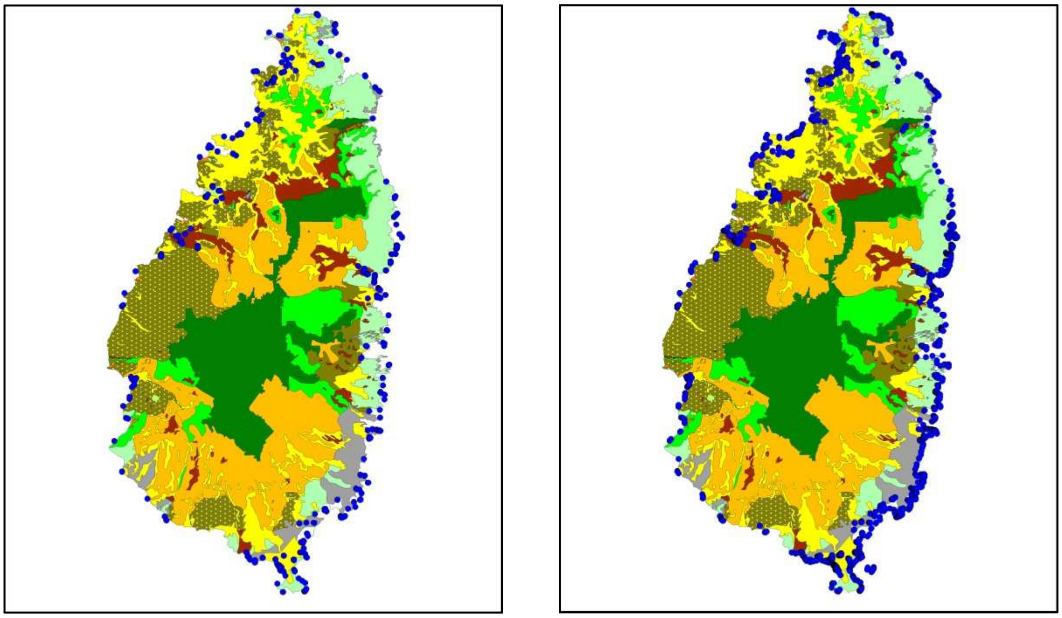
When combining sea level rise in 2040-2069 (0.47 m) with a the storm surge generated by a category 2 hurricane (2.47 m), the total land area in the coastal zone that is likely to be inundated is 3.575 km $^2$ (Table 4.1 and Figure 4.7). When combining sea level rise in 2040-2069 (0.47 m) with a the storm surge generated by a category 5 hurricane (5.87 m), the total land area in the coastal zone that is likely to be inundated increases to 19.474 $km^2$ . Again, the areas that will be most impacted by sea level rise, especially in 2081-2100 are towns and villages like Micoud and Dennery along the east coast, Castries, Gros Islet and Anse de La Raye along the west coast, and Vieux Fort on the south coast (Table 4.1 and Figure 4.8).

**Table 4.1: Future Sea Level and Storm Surge Scenarios for a Category 2 and a Category 5 Hurricane: Saint Lucia**

| | Sea Level Rise (RCP 8.5) (m) | Contribution of MHHW (Mean Higher High Water) (m) | **Final Values of Future Sea Levels** | *Storm Surge Scenarios Category 2 Hurricane Mid Value | **Final Storm Surge Scenarios Category 2 Hurricane: Mid Value plus Sea Level Rise** | *Storm Surge Scenarios (m) Category 5 Hurricane (Minimum Value) | **Final Storm Surge Scenarios Category 5 Hurricane: Minimum Value plus Sea Level Rise** |
|---|---|---|---|---|---|---|---|
| | | | (m) | (m) | (m) | (m) | (m) |
| **2040-2069** | 0.38 | 0.09 | 0.47 | 2.00 | 2.47 | 5.40 | 5.87 |
| Inundated *($km^2$)* | 0.065 | < 0.00 | **0.097** | 2.209 | **3.575** | 17.199 | **19.474** |
| **2081-2100** | 0.82 | 0.09 | 0.91 | 2.00 | 2.91 | 5.40 | 6.31 |
| Inundated *($km^2$)* | 0.313 | < 0.00 | **0.386** | 2.209 | **5.191** | 17.199 | **21.541** |

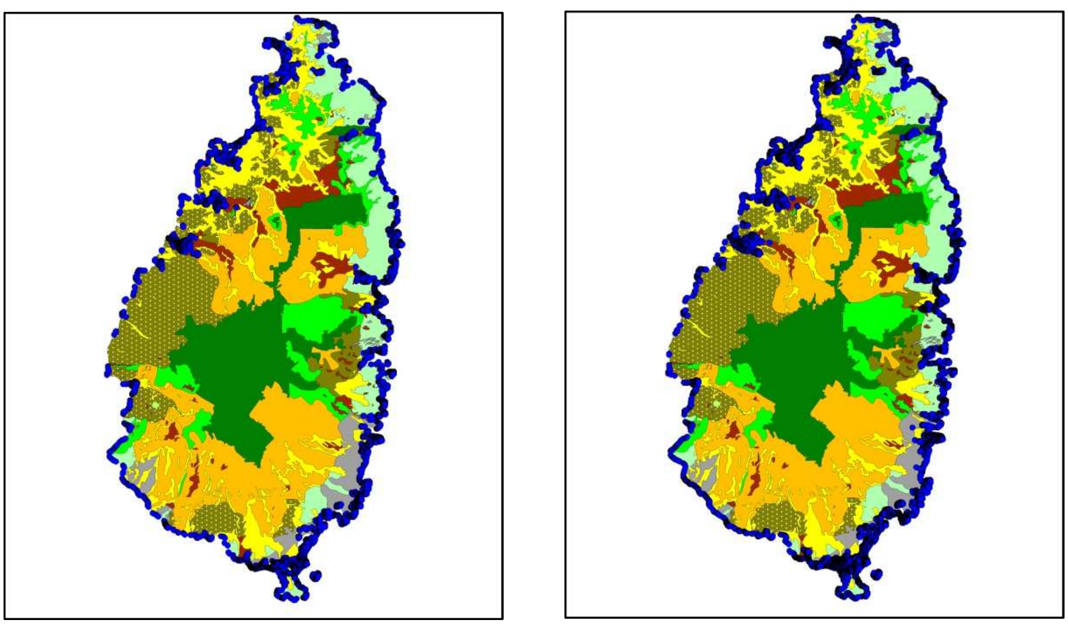
*By adding the sea levels to the mid-value storm surges

**Figure 4.6: Future Sea Level Scenarios for 2040-2069 (a): 0.47 m) and 2081-2100 (b): 0.91m) showing the coastal zones of Saint Lucia that will be inundated**



a b

**Figure 4.7: Future Sea Level Scenarios for 2040-2069 (a: 0.47 m) and 2081-2100 (b: 0.91m) combined with a Category 2 Hurricane (c: 2.47 m: 2040-2069) and (d: 2.91 m: 2081-2100) combined with a Category 2 Hurricane showing the coastal zones of Saint Lucia that will be inundated**

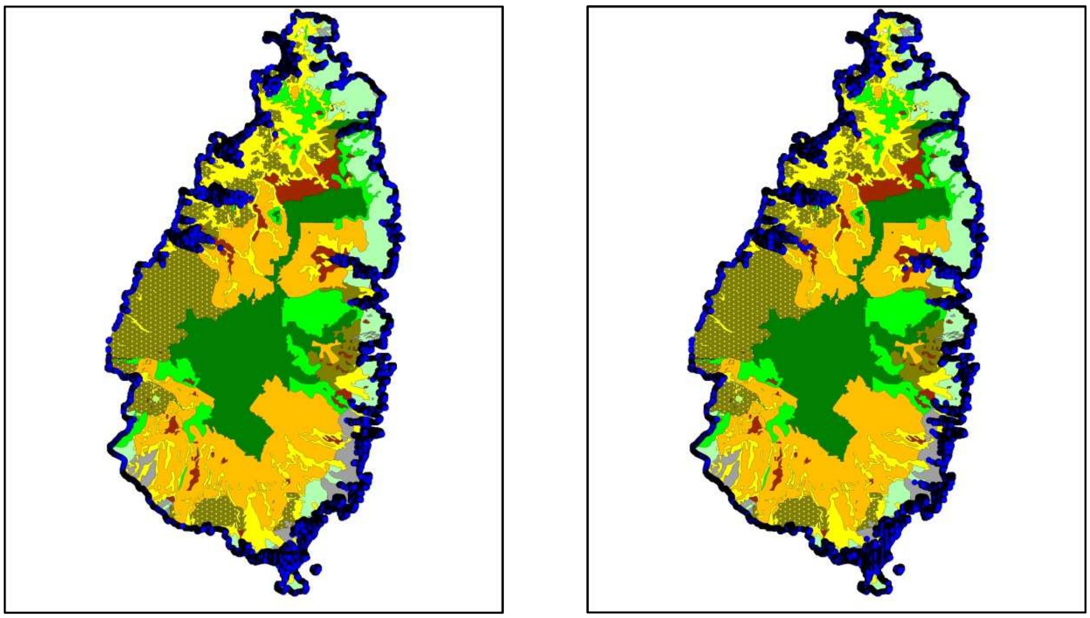


c d

Finally when combining sea level rise in 2040-2069 (0.91 m) with the storm surge generated by a category 2 hurricane (2.91 m), the total land area in the coastal zone that are likely to be inundated is 5.191 $km^2$ (Table 4.1 and Figure 4.8). Furthermore when combining sea level rise in 2081-2100 (0.91 m) with the storm surge generated by a category 5 hurricane (6.31 m), the total land area in the coastal zone that is likely to be inundated increases to 21.541 km $^2$ (Table 4.1 and Figure 4.8).

For the category 5 hurricane, the areas that will be most impacted by sea level rise and storm surges, especially in 2081-2100, are towns and villages along the east coast like Micoud and Dennery; Castries, Gros Islet and Anse de La Raye along the west coast; and Vieux Fort on the south coast (Table 4.1 and Figure 4.8).

**Figure 4.8: Future Sea Level Scenarios for 2040-2069 (a: 0.47 m) and 2081-2100 (b: 0.91m) combined with a Category 5 Hurricane (e: 5.87 m: 2040-2069) and (f: 6.31 m: 2081-2100) combined with a Category 5 Hurricane showing the coastal zones of Saint Lucia that will be inundated**



e

f

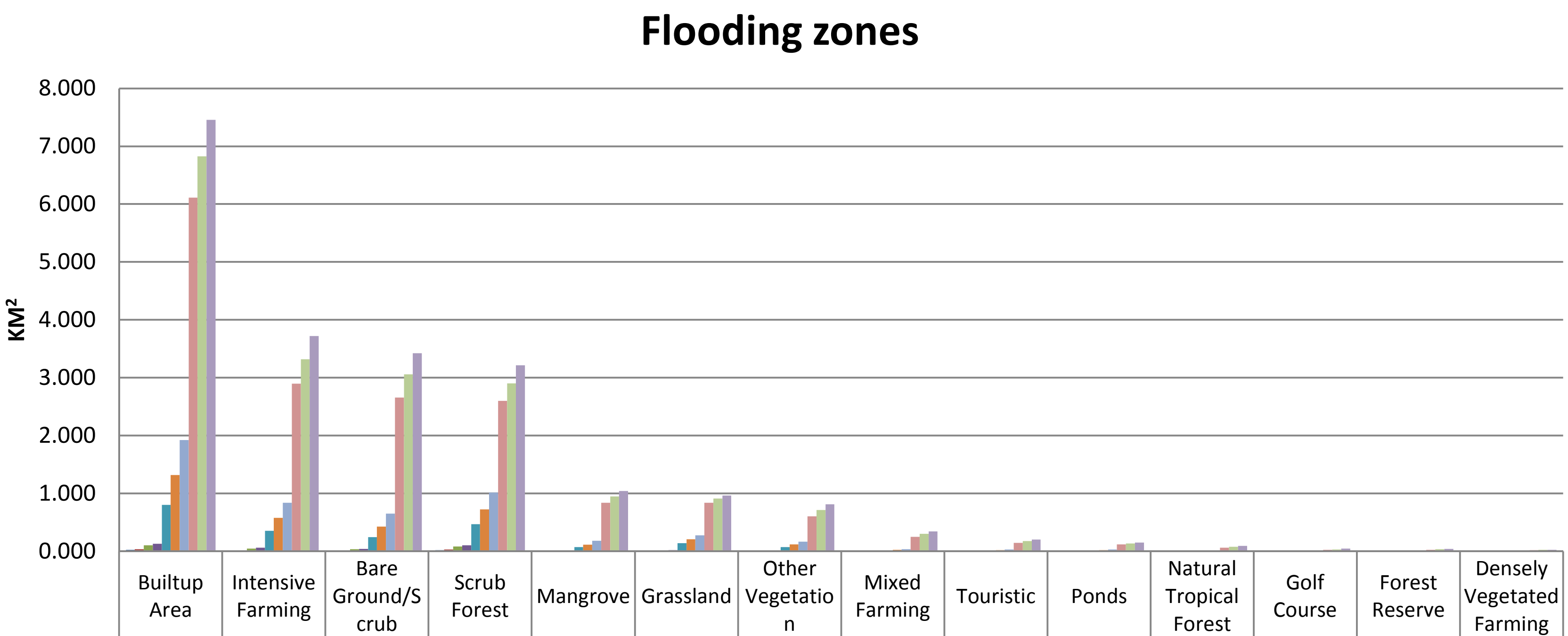
The land use classes most likely to suffer inundation from sea level rise and storm surges, especially from sea level rise combined with hurricane-driven storm surges are: built-up areas in the larger cities and towns such as Castries, Anse La Raye, Canaries, Vieux Fort and Micoud; intensive farming areas, bare ground and scrub forests all along the coast of Saint Lucia (Table 4.1 and Table 4.2).

As a matter of fact, the city of Castries, especially Central Castries that is aready close to or below sea level will be inundated by sea levels and storm surges produced by a Category 2 and a Category 5 (especially) hurricane. The rainfall that normally accompanies these storms will further aggravate the flooding (See Financial Sector: Figures 4.21 and 4.22).

### 4.3.3 Coastal Erosion and Setback Benchmarks

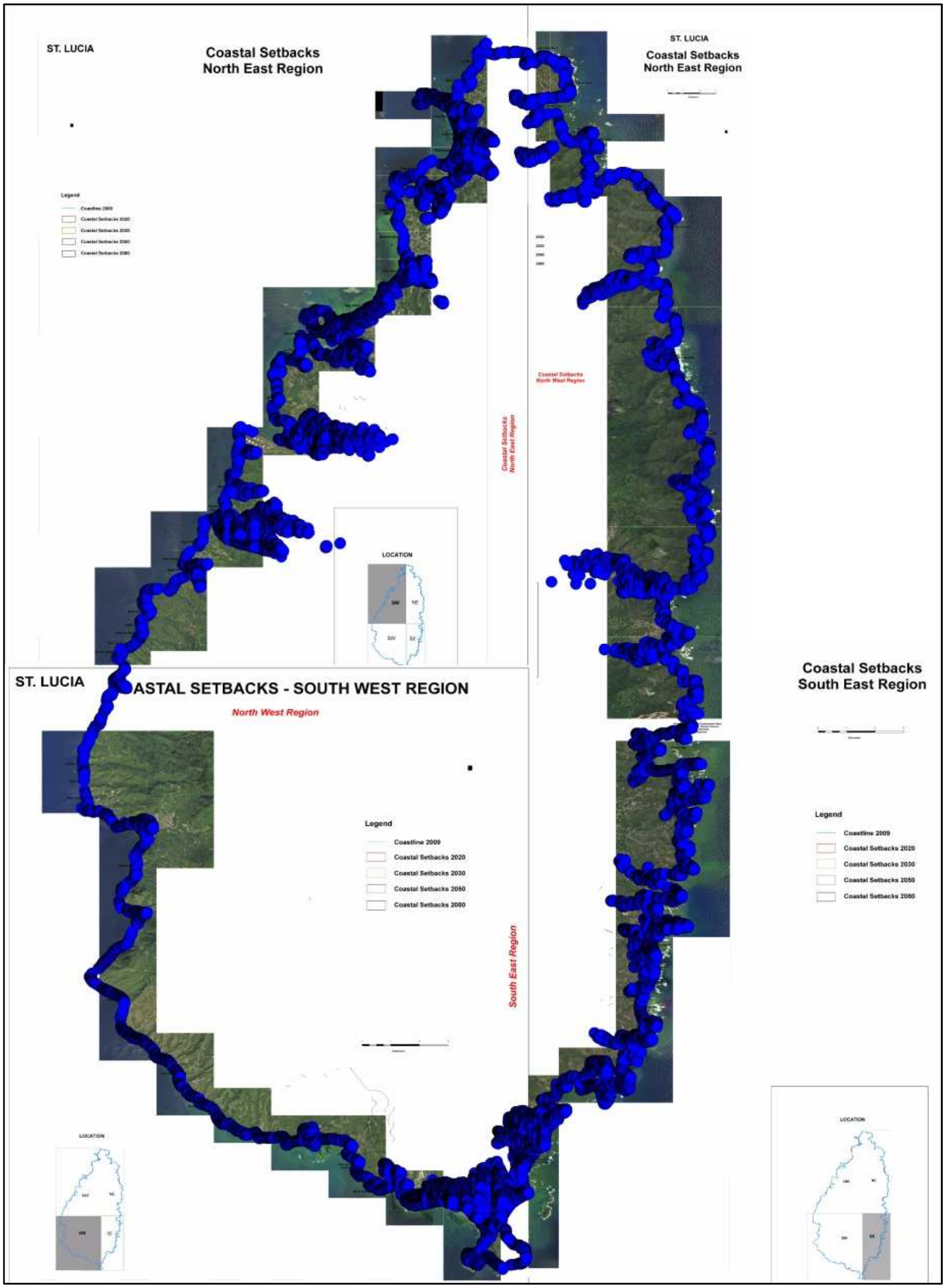
Much of the coastal zone of Saint Lucia is characterised by high-density tourism and these areas already face pressure from natural forces (i.e. wind, waves, tides and currents) and human activities (i.e. beach sand removal and inappropriate construction of shoreline structures). The areas of Pigeon Island, Pigeon Island Causeway, Rodney Bay and Soufrière have been identified as some of the most vulnerable to SLR and include notable resorts (CARIBSAVE, 2012).

**Table 4.2: Major Land Use Classes subject to inundation by Future Sea Level and Storm Surge Scenarios for a Category 2 and a Category 5 Hurricane: Saint Lucia**




| | Builtup Area | Intensive Farming | Bare Ground/Scrub | Scrub Forest | Mangrove | Grassland | Other Vegetation | Mixed Farming | Touristic | Ponds | Natural Tropical Forest | Golf Course | Forest Reserve | Densely Vegetated Farming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.38 | 0.024 | 0.009 | 0.005 | 0.022 | 0.000 | 0.004 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.47 | 0.035 | 0.013 | 0.008 | 0.031 | 0.002 | 0.006 | 0.002 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.82 | 0.105 | 0.049 | 0.035 | 0.086 | 0.009 | 0.018 | 0.007 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| 0.91 | 0.130 | 0.062 | 0.044 | 0.104 | 0.011 | 0.022 | 0.009 | 0.001 | 0.001 | 0.002 | 0.001 | 0.000 | 0.000 | 0.000 |
| 2.00 | 0.804 | 0.353 | 0.243 | 0.469 | 0.073 | 0.139 | 0.075 | 0.015 | 0.012 | 0.015 | 0.007 | 0.000 | 0.003 | 0.002 |
| 2.47 | 1.318 | 0.576 | 0.425 | 0.725 | 0.116 | 0.208 | 0.121 | 0.024 | 0.022 | 0.023 | 0.010 | 0.000 | 0.004 | 0.003 |
| 2.91 | 1.924 | 0.840 | 0.651 | 1.016 | 0.181 | 0.277 | 0.169 | 0.039 | 0.032 | 0.032 | 0.014 | 0.000 | 0.005 | 0.010 |
| 5.40 | 6.114 | 2.897 | 2.655 | 2.601 | 0.837 | 0.840 | 0.604 | 0.250 | 0.145 | 0.120 | 0.065 | 0.024 | 0.028 | 0.020 |
| 5.87 | 6.825 | 3.320 | 3.058 | 2.904 | 0.950 | 0.914 | 0.716 | 0.301 | 0.177 | 0.136 | 0.080 | 0.034 | 0.034 | 0.025 |
| 6.31 | 7.458 | 3.722 | 3.422 | 3.214 | 1.044 | 0.964 | 0.814 | 0.342 | 0.204 | 0.151 | 0.093 | 0.045 | 0.042 | 0.029 |

**Figure 4.9: Coastal Setbacks (Soomer et al, 2009) compared to inundation that would occur in the event of Seal Level Rise (SLR) and a storm surge caused by a category 5 hurricane for the entire coastal zone of Saint Lucia**



In a previous study, (Soomer *et al.,* 2009: In World Bank/LAC, 2012), juxtaposed projected sea level rise of 0.24m on a model utilized by Cambers (1996) for Saint Lucia and scenarios for 2020, 2050 and 2070 sea level rise were generated. The objective of using this model was to calculate the minimum building line or setback within which construction should be permitted. The results of this study suggested that sea level rise will cause the shoreline to recede.

This study superimposed sea level rise scenarios coupled with a category 2 and a category 5 storm surge (See Table 4.1) to generate the coastal areas of Saint Lucia that would be subject to inundation and erosion based on current estimates of sea level rise coupled with a category 5 hurricane storm surge (See Table 4.1 and Table 4.2).

It is evident in Figure 4.9 that the projection lines and benchmarks of the previous study (Soomer *et al.,* 2009: In World Bank/LAC, 2012) for the four quadrants (NW, NE, SW and SE) covering the entire coastline of Saint Lucia grossly underestimate the extent of the impacts of sea level rise combined with a category 5 hurricane storm surge (Figure 4.8). It is therefore recommended that these benchmarks be updated and placed at higher elevations.

### 4.3.4 Adaptation Strategy for the Coastal Zone

From the foregoing sections it is very evident that climate-driven sea level rise and storm surges are expected to have far reaching consequences on the coastal zone of Saint Lucia. These flooding events would certainly cause damage to human settlements; infrastructure including roads; mangroves ecosystems that stabilize the coast, purify runoff water and serve as an invaluable habitat for various flora and fauna; and agricultural land and crops. These resources and activities are extremely sensitive to climate change because, in the event of sea level rises and storm surges, inundation and flooding, erosion, saline intrusion into surface and ground water sources would very likely occur.

Adaptation options, guided by policy changes and legislation that may warrant immediate short-term consideration would include (Leary et al, 2008):

- The formulation and implementation of land-use planning policies to address people and settlements and agricultural lands at risk to inundation deriving from sea level rise and storm surges;
- Fortification of sea and river defenses in accordance with sea level rise and storm surges in vulnerable areas;
- Further implementation of early warning systems (EWS) in the event of tropical storms and hurricanes and storm surges (NEMO);
- The building of more shelters on higher ground either near the coast or inland to house people in the event of inundation due to tropical storms and hurricanes and storm surges.

Longer-term policy changes and adaptation strategies to address sea level rise and storm surges should be integrated with economic development policies, disaster mitigation and management plans and integrated coastal zone management (ICZM) plans, to include:

- Adoption of more proactive mitigation measures such the use of building set-backs legislation to limit buildings and other major developmental work on the coast and encouragement of gradual retreat to higher grounds by making land available in the interior, in an effort to decentralize economic activities and settlement on the coast;

- Undertaking detailed field surveys to identify most vulnerable areas along the coast, such as Castries, Gros Islet, Anse La Raye, Vieux Fort, Micoud and Dennery and determining appropriate adaptation strategies;
- Undertaking evaluation of agricultural lands, coastal surface waters and drainage and irrigation systems.

The costs of coastal protection works are enormous, ranging from 0.1 % to 10 % of GDP for most SIDS, depending on the sensitivity of the coastal zone and the extent of sea level rise and storm surges (IPCC, 2007). These huge costs, which are very likely to be applicable to Saint Lucia, could be prohibitive, unless funding can be leveraged through, for instance, the Adaptation Fund or the Green Climate Fund.

Given that tourism is the lynchpin of Saint Lucia's economy, every effort should be made to devise and implement plans and policies to protect vital coastal resources such as beaches and fisheries (coral reefs etc.) upon which tourism is highly dependent.

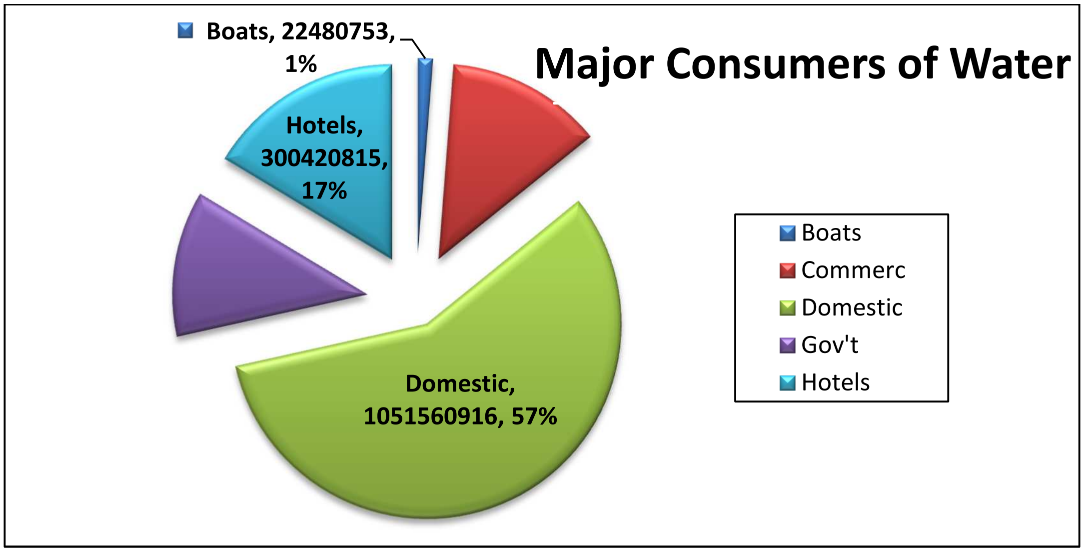
## 4.4 WATER SECTOR

The water sector is one of the most important sectors of Saint Lucia, and the sector most likely to be affected by the adverse effects of climate change. The water sector is cross-cutting, with critical cross-linkages with other key sectors of Saint Lucia. It supports water for domestic purposes and industry, as well as other critical sectors, most notably agriculture but also tourism, human health, financial services and vulnerable groups.

As Saint Lucia is of volcanic origin, water resources derive predominantly from surface sources in rivers, wetlands, streams and springs, and these are exploited for municipal and agricultural purposes. Surface water catchments (sub-watershed areas that are water supply areas for potable water) are relatively small in area and characterized by steep terrain over which run-off occurs fairly rapidly resulting in limited ground percolation. Surface water yields for potable water purposes vary due to increased abstraction and in some cases there is soil and chemical contamination (GEF-IWCAM Project, 2008).

In Figure 4.10, it is apparent that the domestic sector is the largest consumer of water accounting for 57% of water used. Apart from household water use for cooking, showering and washing, it is highly likely that a significant proportion of domestic water use is applied to garden crops. The second largest class of consumer is the hotel sector that accounts for 17 % of water used. The commercial sector consumes 13% of water used. The other notable consumer is Government (buildings and staff) which uses 12% (Figure 4.10).

**Figure 4.10: Major sectors of the consumption (%) of water for the year 2015 for Saint Lucia**




However, there is a significant level of non-revenue water which accounts for approximately 42% of the water produced, resulting in the company (Water and Sewerage Company Inc.) not recovering as much revenue as it should. This is a major contributor to the ongoing financial constraints. Non-revenue water results from, among others:

- Leakage on distribution systems;
- Authorised unbilled consumption (e.g. mains flushing, water used for fire- fighting purposes and other operational uses);
- Meter errors;
- Errors in the estimate of unmetered use; and
- Illegal use (e.g. illegal connections).

### 4.4.1 Climate Change Impacts

Climate change is very likely to have a significant impact on the water sector of Saint Lucia. Rainfall is projected to decrease slightly and become more variable leading to intense rains and flooding as well as droughts. Warmer temperatures would also exacerbate drought conditions (McSweeney *et al*, 2009, 20010; IPCC, 2007; 2013).

There are critical implications for the economy of Saint Lucia. Apart from the risks of flooding from excessive rainfall in the low-lying coastlands, agricultural production, a key contributor to GDP and generator of employment, would be subject to the alternating conditions of excessive rainfall and flooding with drought.

Sea level rise and storm surges, by-products of climate change, will also affect the water sector through saline intrusions into coastal surface waterways and agricultural soils and flooding of coastal lowlands and towns, where a large number of the population of Saint Lucia is located.

Human health is also at risk of being directly affected through loss of life due to flooding, or indirectly though the impacts on food supply and the proliferation of disease-spreading vectors.

#### *4.4.1.1 Changes in Rainfall Variability*

This section examines changes in rainfall variability, namely how the different ranges of daily rainfall may change according to both the downscaled HadCM3 and ECHAM5 global climate models for two future decadal periods (2040-2050 and 2070-2080) compared to a current decadal period (1990-2000).

##### 4.4.1.1.1 Changes According to the Downscaled HadCM3 Global Climate Model

According to the downscaled HadCM3 model for the 2040-2050 decadal period, when compared to the current decadal period of 1990-2000, there will be a significant increase from 14.67 % to 23.79 % in the number of days with insignificant (~ 0.0 mm/day) rainfall amounts (+361 episodes). The total counts of rainfall amounts between ~ 0 to 10 mm/day drops by – 275 counts (from 65.71 % to 58.76 %) and the total counts of rainfall amounts between ~ 10 to 20 mm/day drops by – 121 counts (from 15.05 % to 11.97 %). The more intense rainfall episodes of 20 to 30 mm/day increases by 15 counts (from 3.94 % to 4.32 % and the even more intense rainfall episodes of 30 to 40 mm/day increases to 16 counts (from 0.61 % to 1.01 %) for the future decadal period (2040-2050) when compared to the current decadal period (1990-2000) (Table 4.3).

For the 2070-2080 decadal period when compared to the current decadal period 1990-2000, there is a significant increase in the number of days with insignificant (~ 0.0 mm/day) rainfall amounts (from 14.67 % to 26.31 %). The total counts of rainfall amounts between ~ 0 to 10 mm/day also drops by – 343 counts (from 65.71 % to 57.05 %); the total counts of rainfall amounts between ~ 10 to 20 mm/day drops by – 114 counts (from 15.03 % to 12.15 %). The more intense rainfall episodes of 20 to 30 mm/day also decreases by -13 counts (from 3.94 % to 3.61 %). It is only for the more intense rainfall episodes of 30 to 40 mm/day that the count increases modestly to 5 episodes (0.61 % to 0.73 %) for the future decadal period (2070-2080) when compared to the current decadal period (199--2000 (Table 4.4).

**Table 4.3: Changes in the range of daily rainfall (mm/day) according to the downscaled HadCM3 model: 2040-2050 vs 1990-2000**

| **Range of Daily Rainfall (mm/day)** | **1990-2000** | | **2040-2050** | | □ |
|---|---|---|---|---|---|
| | Count | % of all | Count | % of all | |
| x = 0.0 | 581 | 14.67 | 942 | 23.79 | +361 |
| 0.0 < x <= 10.0 | 2602 | 65.71 | 2327 | 58.76 | -275 |
| 10.0 < x <= 20.0 | 595 | 15.03 | 474 | 11.97 | -121 |
| 20.0 < x <= 30.0 | 156 | 3.94 | 171 | 4.32 | +15 |
| 30.0 < x <= 40.0 | 24 | 0.61 | 40 | 1.01 | +16 |
| 40.0 < x <= 50.0 | 2 | 0.05 | 5 | 0.13 | +3 |
| 50.0 < x <= 60.0 | 0 | 0.00 | 1 | 0.03 | +1 |
| 60.0 < x <= 70.0 | 0 | 0.00 | 0 | 0.00 | 0 |
| 70.0 < x <= 80.0 | 0 | 0.00 | 0 | 0.00 | 0 |

**Table 4.4: Changes in the range of daily rainfall (mm/day) according to the downscaled HadCM3 model: 2070-2080 vs 1990-2000**

| Range of Daily Rainfall (mm/day) | 1990-2000 | | 2070-2080 | | □ |
|---|---|---|---|---|---|
| | Count | % of all | Count | % of all | |
| x = 0.0 | 581 | 14.67 | 1042 | 26.31 | +461 |
| 0.0 < x <= 10.0 | 2602 | 65.71 | 2259 | 57.05 | -343 |
| 10.0 < x <= 20.0 | 595 | 15.03 | 481 | 12.15 | -114 |
| 20.0 < x <= 30.0 | 156 | 3.94 | 143 | 3.61 | -13 |
| 30.0 < x <= 40.0 | 24 | 0.61 | 29 | 0.73 | +5 |
| 40.0 < x <= 50.0 | 2 | 0.05 | 2 | 0.05 | 0 |
| 50.0 < x <= 60.0 | 0 | 0.00 | 2 | 0.05 | +2 |
| 60.0 < x <= 70.0 | 0 | 0.00 | 1 | 0.03 | +1 |
| 70.0 < x <= 80.0 | 0 | 0.00 | 1 | 0.03 | +1 |

##### 4.4.1.1.2 Changes According to the Downscaled ECHAM5 Global Climate Model

For the 2040-2050 decade when compared to the current 1990-2000 decade, there is a significant increase in the number of days with insignificant (~ 0.0 mm/day) rainfall amounts (+254 episodes: from 11.2 % to 17.45 %). The total counts of rainfall amounts between ~ 0 to 10 mm/day also drops by – 108 counts (from 55.08 % to 52.39 %) and the total counts of rainfall amounts between ~ 10 to 20 mm/day drops by – 66 counts (from 20.16 % to 18.52 %). The more intense rainfall episodes of 20 to 30 mm/day also decreases by -67 counts (from 10.88 % to 9.21 %), and the rainfall counts of 30 to 40 mm/day also decreases by 26 counts (from 2.41 % to 1.77 %). Like the HadCM3 model, it is only for the more intense rainfall episodes of 30 to 40 mm/day and 50 to 60 mm/day that the counts increase by 5 episodes (from 0.30 % to 0.42 % and from 0.05 % to 0.17 % respectively) for the future decadal period (2070-2080) when compared to the current decadal period (1990-2000) (Table 4.5).

**Table 4.5: Changes in the range of daily rainfall (mm/day) according to the downscaled ECHAM5 model: 2040-2050 vs 1990-2000**

| Range of Daily Rainfall (mm/day) | 1990-2000 | | 2040-2050 | | □ |
|---|---|---|---|---|---|
| | Count | % of all | Count | % of all | |
| x=0.0 | 447 | 11.12 | 701 | 17.45 | 254 |
| 0.00<x<=10.0 | 2213 | 55.08 | 2105 | 52.39 | -108 |
| 10.0<x<=20.0 | 810 | 20.16 | 744 | 18.52 | -66 |
| 20.0<x<=30.0 | 437 | 10.88 | 370 | 9.21 | -67 |
| 30.0<x<=40.0 | 97 | 2.41 | 71 | 1.77 | -26 |
| 40.0<x<=50.0 | 12 | 0.30 | 17 | 0.42 | +5 |
| 50.0<x<=60.0 | 2 | 0.05 | 7 | 0.17 | +5 |
| 60.0<x<=70.0 | 0 | 0.00 | 1 | 0.02 | +1 |
| 70.0<x<=80.0 | 0 | 0.00 | 0 | 0.00 | 0 |
| 80.0<x<=90.0 | 0 | 0.00 | 1 | 0.02 | +1 |
| 90.0<x<=10.0 | 0 | 0.00 | 0 | 0.00 | 0 |
| 10.0<x<=110.0 | 0 | 0.00 | 0 | 0.00 | 0 |

| Range of Daily Rainfall (mm/day) | 1990-2000 | | 2040-2050 | | □ |
|---|---|---|---|---|---|
| | Count | % of all | Count | % of all | |
| 110.0<x<=120.0 | 0 | 0.00 | 0 | 0.00 | 0 |
| 120.0<x<=130.0 | 0 | 0.00 | 0 | 0.00 | 0 |
| 130.0<x<=140.0 | 0 | 0.00 | 1 | 0.02 | +1 |

Finally, according to the downscaled ECHAM5 model for the 2070-2080 decade when compared to the current 1990-2000 decade, there is an even more significant increase in the number of days with insignificant (~ 0.0 mm/day) rainfall amounts (+425 episodes: from 14.67 % to 21.70 %). The total counts of rainfall amounts between ~ 0 to 10 mm/day also drops by – 217 counts (from 65.71 % to 49.68 %) and the total counts of rainfall amounts between ~ 10 to 20 mm/day drops by – 151 counts (from 15.03 % to 16.40 %). The more intense rainfall episodes of 20 to 30 mm/day also decreases by -80 counts (from 3.94 % to 8.89 %) However, the rainfall counts of 30 to 40 mm/day increase by 07 counts (from 0.61 % to 12.59 %). For the more intense rainfall episodes of 30 to 40 mm/day and 50 to 60 mm/day the counts increase by 7 episodes (from 0.61 % to 2.59 % and from 0.05 % 0.67 % respectively) for the future period (2070-2080) compared to the current period (1990-2000) (Table 4.6).

**Table 4.6: Changes in the range of daily rainfall (mm/day according to the downscaled ECHAM model: 2070-2080 vs 1990-2000**

| Range of Daily Rainfall (mm/day) | 1990-2000 | | 2070-2080 | | □ |
|---|---|---|---|---|---|
| | Count | % of all | Count | % of all | |
| x=0.0 | 447 | 14.67 | 872 | 21.70 | +425 |
| 0.00<x<=10.0 | 2213 | 65.71 | 1996 | 49.68 | -217 |
| 10.0<x<=20.0 | 810 | 15.03 | 659 | 16.40 | -151 |
| 20.0<x<=30.0 | 437 | 3.94 | 357 | 8.89 | -80 |
| 30.0<x<=40.0 | 97 | 0.61 | 104 | 2.59 | +7 |
| 40.0<x<=50.0 | 12 | 0.05 | 27 | 0.67 | +15 |
| 50.0<x<=60.0 | 2 | 0.00 | 1 | 0.02 | -1 |
| 60.0<x<=70.0 | 0 | 0.00 | 1 | 0.02 | +1 |
| 70.0<x<=80.0 | 0 | 0.00 | 1 | 0.02 | +1 |

#### 4.4.1.2 Climate Change and Droughts

Drought is a condition of insufficient moisture caused by deficit in precipitation over some time period (McKee, Doesken et al, 1993). There are many different methodologies for drought monitoring. In this study, the *Standardized Precipitation Index (SPI)* was used (Table 4.7). The SPI is a powerful, flexible index for which precipitation is the only required input parameter. SPI can be calculated for both dry and wet seasons. Ideally, a continuous period of at least 30 years monthly precipitation is required for the calculation (McKee et al., 1993; Doesken et al. 1993; M. Svoboda, M. Hayes and D. Wood; Edwards et al.,1997).

**Table 4.7: Classification system based on SPI calculation to define drought intensity**

| 2.0+ | Extremely wet |
|---|---|
| 1.5 to 1.99 | Very wet |
| 1.0 to 1.49 | Moderately wet |
| -0.99 to 0.99 | Near normal |
| -1.0 to -1.49 | Moderately dry |
| -1.50 to -1.99 | Severely dry |
| -2 and less | Extremely dry |

### 4.4.2 Methodology

The main purpose of SPI calculation, in this study, is to find the drought intensity for the current period (1973-2015) based on available observed data and two future time slices (2040-2068 and 2070-2098) based on modeled data. Data from Hewanorra station was used for the current period (1973-2015) and two PRECIS-downscaled climate models (EACHAM5 and HadCM3) were used to model future climate for the afore-mentioned periods.

### 4.4.3 Results and Discussion

#### *4.4.3.1 Current period (1973-2015)*

SPI calculations for both dry and wet season for the current period (1973-2015) using data from the Hewanorra station show that for the Dry Season, although all values fall in the near normal category, the SPI index is lowest (driest) for the month of March. For the wet season, again, all values fall in the near normal category, but the SPI index is lowest (driest) for the month of September.

In order to have a better comparison between historical and current droughts "probability of recurrence", Tables 4.8a and 4.8b have been developed for each season and each period. They show the probability of recurrence of drought, though still in the near normal SPI category, for the dry season (Table 4.8a) and wet season (Table 4.8b), respectively for the current (1973-2015) period.

During the 42-year period (1973-2015), the probability of recurrence of drought is highest (151 times/months) in the dry season and 216 times/months in the wet season for SPI Category -.99 to 0.99 (near normal).

**Table 4.8: Probability of recurrence: a) Dry Season (1973-2015), b) Wet Season (1973-2015)**

(a)

| **SPI** | **Category** | **Number of times (month) in 42 years** |
|---|---|---|
| 2.0+ | Extremely wet | 7 |
| 1.5 to 1.99 | Very wet | 6 |
| 1 to 1.49 | Moderately wet | 20 |
| -0.99to 0.99 | Near normal | 151 |
| -1.0 to -1.49 | Moderately dry | 18 |
| -1.5 to -1.99 | Severely dry | 6 |
| -2.0 and less | Extremely dry | 18 |

(b)

| **SPI** | **Category** | **Number of times (month) in 42 years** |
|---|---|---|
| 2.0+ | Extremely wet | 0 |
| 1.5 to 1.99 | Very wet | 12 |
| 1 to 1.49 | Moderately wet | 19 |
| -0.99to 0.99 | Near normal | 216 |
| -1.0 to -1.49 | Moderately dry | 29 |
| -1.5 to -1.99 | Severely dry | 9 |
| -2.0and less | Extremely dry | 16 |

### 4.4.3.2 SPI: Downscaled HadCM3 and ECHAM5 models (2040-2068)

SPI histograms representing the dry season and the wet season respectively for the 2040-2068 time period for both the HaDCM3 and ECHAM5 climate models show that for the dry season, although all values fall in the near normal category, the SPI index is lowest (driest) for the month of January according to the HadCM3 mode,l and lowest (driest) for the month of May according to the ECHAM5 model. For the wet season, all values fall in the near normal category, but the SPI index is lowest (driest) for the month of December according to both the HadCM3 and ECHAM5 climate models.

Table 4.9a and Table 4.9b show the probability of recurrence of drought, though still in the near normal SPI category, for the dry season (102 times/months for HadCM3 and 124 times/months for ECHAM 5) and the wet season (102 times/months for HadCM3 and 124 times/months for ECHAM 5), respectively for the 2040-2068 time period according to both downscaled climate models.

During the 28-year period (2040-2068), the probability of recurrence of drought, though still in the SPI near-normal range is highest (102 times/months for HadCM3 and 124 times/months for ECHAM 5) in the dry season and (143 times/months for HadCM3 and 159 times/months for ECHAM 5) in the wet season for SPI Category -.99 t0 0.99 (near normal).

**Table 4.9: Probability of Recurrence: a) Dry Season (2040-2068), b) Wet Season (2040-2068)**

(a)

| SPI | CATEGORY | Number of times (months) in 28 years | |
|---|---|---|---|
| | | **HADCM3** | **ECHAM5** |
| 2.0+ | Extremely wet | 8 | 7 |
| 1.5 to 1.99 | Very wet | 2 | 4 |
| 1 to 1.49 | Moderately wet | 16 | 7 |
| -0.99 to 0.99 | Near normal | 102 | 124 |
| -1.0 to -1.49 | Moderately dry | 16 | 8 |
| -1.5 to -1.99 | Severely dry | 1 | 0 |
| -2.0 and less | Extremely dry | 16 | 0 |

(b)

| SPI | CATEGORY | Number of times (months) in 28 years | |
|---|---|---|---|
| | | **HADCM5** | **ECHAM5** |
| 2.0+ | Extremely wet | 4 | 2 |
| 1.5 to 1.99 | Very wet | 7 | 13 |
| 1 to 1.49 | Moderately wet | 20 | 13 |
| -0.99 to 0.99 | Near normal | 143 | 159 |
| -1.0 to -1.49 | Moderately dry | 15 | 13 |
| -1.5 to 1.99 | Severely dry | 9 | 2 |
| -2.0 and less | Extremely dry | 15 | 8 |

### 4.4.3.3 SPI: Downscaled HadCM3 and ECHAM5 models (2070-2098)

SPI histograms representing the dry season and the wet season for the 2070-2098 time period for both the HaDCM3 and ECHAM5 climate models show that for the dry season (Table 3.7a), although all values fall in the near normal category, the SPI index is lowest (driest) for the month of January according to both the HadCM3 model and the ECHAM5 model. For the wet season, again, all values fall in the near normal category, but the SPI index is lowest (driest) for the month of November according to the HadCM3 and for the month of June according to the ECHAM5 climate model.

Table 4.10a and Table 4.10b show the probability of recurrence of drought, though still in the near normal SPI category, for the dry season (102 times/months for HadCM3 and 124 times/months for ECHAM5) and the wet season (135 times/months for both the HadCM3 and ECHAM5 models) respectively, for the 2070-2098 time period. During the 28-year period (2070-2098), the probability of recurrence of drought, though still in the SPI near-normal range is highest (102 times/months for HadCM3 and 124 times/months for ECHAM5) in the dry season and (135 times/months for both the HadCM3 and 159 ECHAM5 models) in the wet season for SPI Category -.99 t0 0.99 (near normal).

**Table 4.10: Probability of Recurrence: a) Dry Season (2070-2098), b) Wet Season (2070-2098)**

(a)

| SPI | CATEGORY | Number of times (month) in 28 years | |
|---|---|---|---|
| | | HADCM3 | ECHAM5 |
| 2.0+ | Extremely wet | 6 | 5 |
| 1.5 to 1.99 | Very wet | 3 | 11 |
| 1 to 1.49 | Moderately wet | 14 | 5 |
| -0.99 to 0.99 | Near normal | 117 | 124 |
| -1.0 to -1.49 | Moderately dry | 4 | 0 |
| -1.5 to -1.99 | Severely dry | 0 | 0 |
| -2.0 and less | Extremely dry | 1 | 0 |

(b)

| SPI | CATEGORY | Number of times (month) in 28 years | |
|---|---|---|---|
| | | HADCM5 | ECHAM5 |
| 2.0+ | Extremely wet | 3 | 5 |
| 1.5 to 1.99 | Very wet | 14 | 10 |
| 1 to 1.49 | Moderately wet | 17 | 18 |
| -0.99 to 0.99 | Near normal | 135 | 135 |
| -1.0 to -1.49 | Moderately dry | 19 | 20 |
| -1.5 to 1.99 | Severely dry | 12 | 7 |
| -2.0 and less | Extremely dry | 3 | 8 |

### 4.4.3.4 Water Excess and Deficits (P-E)

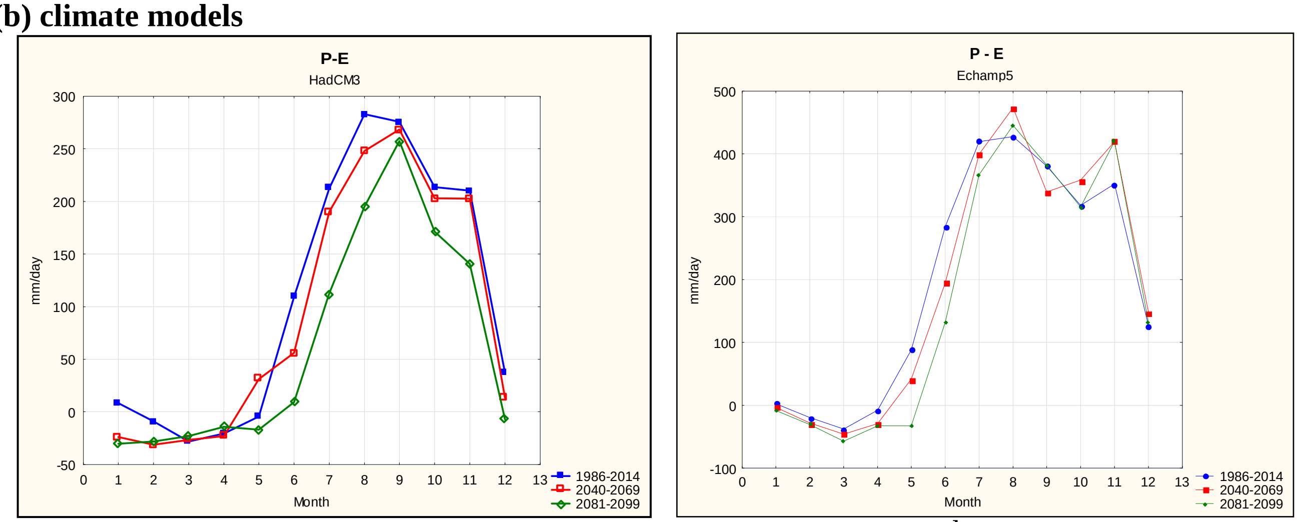
Changes in water excess (+ P-E) and water deficits (- P-E) are compared for the current (1986-2014) and the two future periods (2040-2069 and 2081-2099) as deduced from the downscaled HaDCM3 and ECHAM5 global climate models, based on the outputs of the single grid point that lies on the Saint Lucia land mass.

In the case of the HadCM3 model, P-E is slightly lower, except for May in the Dry season, for the 2040-2069 period (Figures 4.11a and 4.11b). Similarly, for the 2081-2099 period, except for March and April in the Dry season, P-E is consistently lower when compared to the current (1986-2014) throughout the year (Figures 4.11a and 4.11b).

Similarly for the ECHAM5 model, P-E is slightly lower, except for August and November in the Wet season, for the 2040-2069 period (Figures 4.11a and 4.11b). The same is true for the 2081-2099 period except for September and November season, where P-E is consistently lower when compared to the current (1986-2014) throughout the year (Figures 4.11a and 4.11b).

These generally increasing water deficits for the future periods are evidently due to the fact precipitation (P) does not change significantly, but the warmer temperatures should push the evaporation rate upwards thereby leading to water deficits and more severe drought conditions.

**Figure 4.11: Trends in water excess (+ P-E) and Deficits (- P-E) for the 1986-2014; 2040-2069 and 2081-2099 and the tendencies of P-E, (d) according to the downscaled HadCM3 (a) and ECHAM5 (b) climate models**




a b

### 4.4.4 Adaptation Strategy for the water sector

'Towards the Preparation of an Integrated Water Resources Management (IWRM) Plan – Roadmap (GEF-IWCAM, 2008) identifies the impacts of Climate Change on the water resources of the Saint Lucia and the need to ensure that Saint Lucia has the capacity to conserve and efficiently use this most critical resource. This Strategy is guided by the principles inherent in Integrated Water Resources Management (IWRM).

Water can become scarce especially in localized areas. Scarcity of this resource will lead to conflict. The nature of conflict will have to be understood and appropriate conflict resolution mechanisms put into place. Communication with stakeholders is required from the outset for those sub-sectors of the economy that are directly affected such as: food producers and processors, manufacturers, the domestic sector and tourism.

Although there are various water management institutions in existence, the country lacks the complete range and integration of responses required for adaptation to climate change.

The following recommendations can be made in regards to adapting to climate change, by enabling and enacting measures aimed at a more rational and efficient use of water resources:

#### *4.4.4.1 Water Conservancy Management Systems and Protection of Watersheds*

Water Conservancy Management Systems and Protection of Watersheds should:

- Enhance the protection and restoration of ecosystems;
- Adopt forest management plans to prevent and control soil erosion;
- Encourage water harvesting;
- Protect the water environment, prevent and control water pollution;
- Raise awareness to promote the effective and efficient use of water.

#### *4.4.4.2 Efficient Use of Water in Agriculture*

The Banana Industry relies heavily on surface water for irrigation and processing. Likewise the agriculture and aquaculture industries use surface water for their ponds and processing. To minimize costs and to conserve water, farmers should:

- Develop drip and sprinkle irrigation practices to increase water efficiency;
- Improve management practices;
- Select and cultivate stress-resistant varieties.

Furthermore, in order toreduce excess soil water when there is increased precipitation; the following options can be implemented:

- Improve drainage infrastructure and harvesting practices to maintain quality of crop;
- Develop/Identify new cultivars with higher resistance to soil anaerobiosis;
- Enhance national capacity to test new cultivars and to conduct genetic improvement;
- Change management practices such as planting dates to compensate for crop cycle modifications;
- Use technology to enhance management practices to improve crop yield;
- Research pest/disease resistant crop varieties.

#### *4.4.4.3 Hydroelectricity*

For hydroelectricity, the following adaptation measures are proposed:

- Improve hydrology and meteorology observation network and data collection;

- Improve flood and drought forecasting;
- Promote energy efficiency;
- Promote alternative sources of energy.

#### 4.4.5 Summary and Conclusion

The impacts of Climate Change will challenge Saint Lucia's capacity to respond. The impacts of Climate Change are already being manifested, and Saint Lucia must be prepared to adapt to this challenge. Further development of the Water Sector Adaptation Strategy to Climate Change should be a priority. The implementation of the Water Sector Adaptation Strategy to Climate Change will require a concerted effort by all the stakeholders from both the private and public sectors and the mobilization of national, bilateral and international resources.

### 4.5 AGRICULTURE SECTOR

Saint Lucia, like most small islands developing states in the Caribbean, is attempting to address different issues posed by climate variability and change. In doing this type of assessment, three main components, namely exposure, sensitivity, and adaptive capacity, are taken directly or indirectly into consideration.

There is a widespread agreement about the impacts of climate change and variability on economic sectors such as agriculture, especially for a small island country such as Saint Lucia whose economy is limited by low land resources and an increased dependence on tourism as a major economic activity.

The main factor contributing to the decline of the agriculture sector is the change in land use, characterised by the removal of productive agricultural land for high economic return development such as residential use, commercial buildings, hotels and golf courses. This change in land use has increased the coverage of hard surfaces, resulting in an increase in surface run-off and flash flooding. The situation is exacerbated by inappropriate agricultural practices that use herbicides that kill ground cover and promote soil runoff; and planting systems that encourage runoff instead of water retention in the topsoil and surface waters. Other characteristics include periods of severe drought and flooding, and the frequent occurrence of extreme events such as tropical storms, that pose serious challenges for the local agriculture industry (Singh et al., 2005).

The Government of Saint Lucia has made provisions for stimulating growth in the agricultural sector since agriculture has had to compete for scarce resources such as land, labour and capital. Some aspects are attractive prospects to young people, such as greenhouse technology, organic farming and farming of certain crops, particularly vegetables because of the quick turnover cycle. In terms of livestock, pig, sheep, goat and chicken rearing have also captured interest amongst youth because of their profitability and guaranteed local market (Mangal, 2009).

#### 4.5.1 Crop Yields Changes under Climate Change

This section focuses on the indicators of how climate change may affect the yields of the three crops chosen, namely, taro or tanya (a root crop), tomato (a vegetable crop) and banana (a commercial crop).

##### *4.5.1.1 Data and Methods*

Climate data is drawn from the single grid point which lies on the land mass of Saint Lucia and extracted from the downscaled HadCM3 and ECHAM5 global climate models in order to assess agricultural production for taro and tomato, using biophysical models, namely the Decision Support System for Agrotechnology Transfer (DSSAT, version 4.6). On account of a sufficiently long period of yearly data yields and the absence of a crop model for bananas, a crop modelling methodology based on artificial intelligence modelling software was used.

#### *4.5.1.2 Impacts of Climate Change on Crop Yields*

The differences observed between the simulated and the reported or estimated yields in the figures below can be explained by several factors, notably quality of input data, consideration of yield determinants, and reliability of estimated or reported yields (Ritchie et al,. 1998).

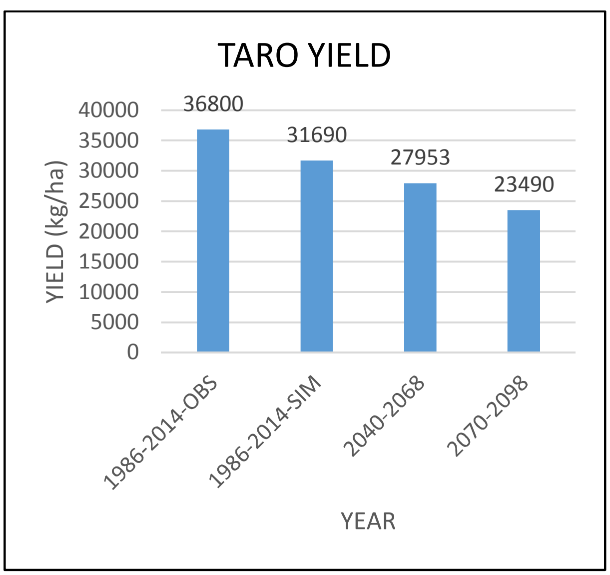
##### 4.5.1.2.1 Taro (Tanya)

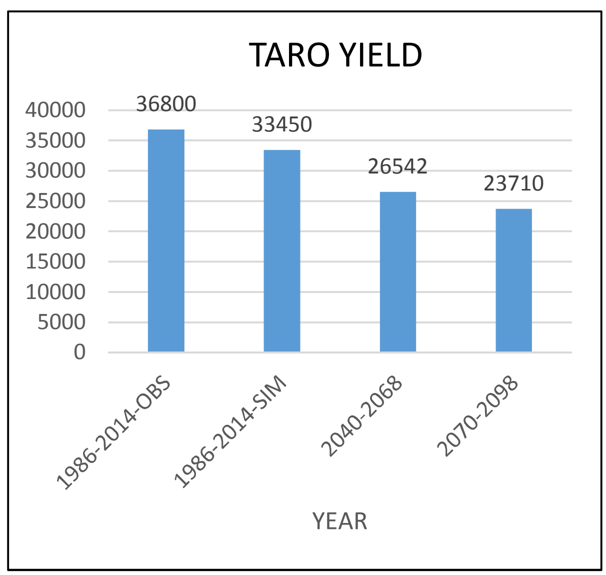
At first, when comparing yearly observed yields (36,800 kg/ha) with DSSAT simulated yields (31,690 kg/ha) of Taro for the current period (1986-2014), it is evident that observed and simulated yields are within the recommended +- 15 % range (Ritchie et al, 1998). However following climate change, Taro yields are projected to fall to 27, 953 kg/ha by 2040-2060 (~ 12 %) and by 23, 490 kg/ha by 2070-2098 (~ 25 %) according to the HadCM3 climate model (Figure 4.12).

Next, when comparing yearly observed yields (36,800 kg/ha) with DSSAT simulated yields (33,450 kg/ha) of Taro for the current period (1986-2014), it is again evident that observed and simulated yields are within the recommended +- 15 % range (Ritchie et al,. 1998). However following climate change, Taro yields are also projected to fall to 26, 542 kg/ha by 2040-2060 (~ 20 %) and by 23, 710 kg/ha by 2070-2098 (~ 29 %) according to the ECHAM5 climate model (Figure 4.12).

These anticipated yield decreases could be explained by a warmer and drier climate in the future, especially the 2070-2098 period. The projected yield decreases are also mainly due to water deficit and high night temperatures during critical phonological stages of the crops. The optimal temperature range for most root crops, including Taro, is ~ 18 $^0$ C to ~24 $^0$ C. The increases in mean temperature by ~ 2 $^0$ C to ~3 $^0$ C beyond the annual average of ~26 $^0$ C (under the HadCM3 and ECHAM5 future climate scenarios) would further depress Taro yields (University of Kentucky College of Agriculture Cooperative Extension Service, 2011).

**Figure 4.12: Histogram of difference between Observed (1986-2014) and Simulated (1986-2014) Yields and future yields (2040-2068 and 2070-2098) of Taro following Climate Change according to the downscaled HadCM3 (Left) and ECHAM5 (Right) climate models**



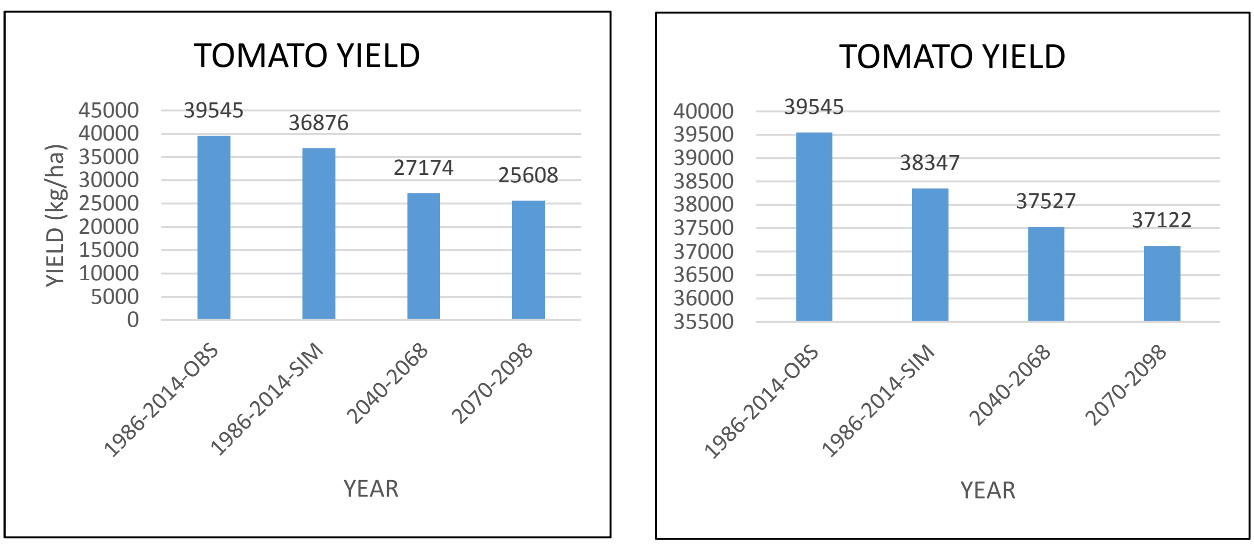
### 4.5.1.2.2 Tomatoes

When comparing yearly observed yields (39,545 kg/ha) with DSSAT simulated yields (36,876 kg/ha) of tomatoes for the current period (1986-2014), it is again evident that observed and simulated yields are within the recommended +- 15 % range (Ritchie et al, 1998). However following climate change, tomato yields are projected to fall to 27, 174 kg/ha by 2040-2060 (~ 25 %) and by 25, 608 kg/ha by 2070-2098 (~ 30 %) according to the HadCM3 climate model (Figure 4.13).

Next, when comparing yearly observed yields (39,545 kg/ha) with DSSAT simulated yields (38,347 kg/ha) of tomatoes for the current period (1986-2014), observed and simulated yields are within the recommended +- 15 % range (Ritchie et al, 1998). However, unlike the HadCM3 climate model, following climate change, tomato yields are projected to fall only slightly to 37, 527 kg/ha by 2040-2060 (~ 02 %) and by 37, 122 kg/ha by 2070-2098 (~ 03 %) according to the ECHAM5 climate model (Figure 4.13).

The anticipated yield decreases may be explained by a warmer and drier climate in the future, especially the 2070-2098 period. Further, tomatoes unlike taro, being essentially an above-ground crop, would be more sensitive and susceptible to the warmer and drier climate. Independently of the climate scenarios considered, the average minimum temperature during emergence to stalk elongation is estimated at > $25^0$ C. This anticipated increase in night temperatures is detrimental to tomatoes growth and yield. The optimal night temperature for tomatoes is between 10 and $20^0$ C (FAO, 2014b).

**Figure 4.13: Histogram of difference between Observed (1986-2014) and Simulated (1986-2014) Yields and future yields (2040-2068 and 2070-2098) of Tomatoes following Climate Change according to the downscaled HadCM3 (Left) and the ECHAM5 (Right) model**




### 4.5.1.2.3 Banana

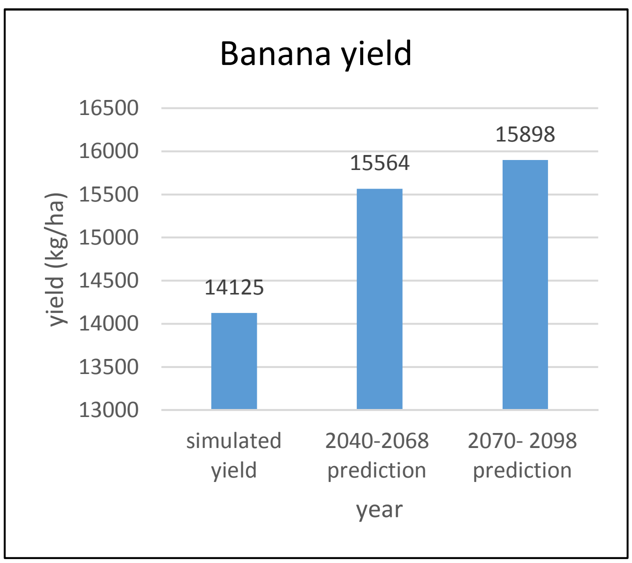
Since there are no known crop models for simulating the response of banana yields to climate change, we used an artificial intelligence model, namely Gene Expression Programming (GEP), was used (Shoaib et al., 2015).

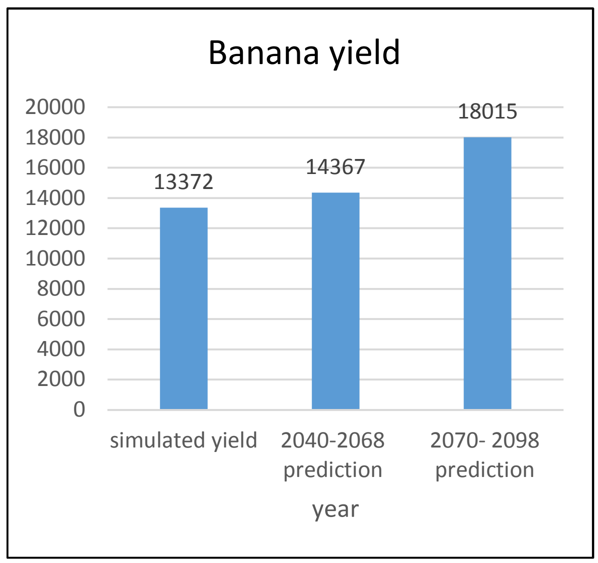
Observed and simulated banana yields generated by the Gene Expression Programming for observed period (1986-2014) and the two future periods (2040-2068 and 2070-2098) are presented in Figure 4.14. In Figure 4.14, it is evident that banana yields are expected to increase from 14, 125 kg/ha (simulated) for the current period, 1986-2014, to 15, 564 kg/ha in 2040-2068 (10.2 %) and to 15, 898 kg/ha in 2070-2098 (12.6 %) according to the downscaled HadCM3 climate model (Figure 4.14).

The downscaled ECHAM5 climate model provides more variable yields for the future periods. In Figure 4.14, it is evident that banana yields are expected to increase from 13, 372 kg/ha (simulated) for the current period, 1986-2014, to 14, 367 kg/ha for the period 2040-2068 (7.4 %) and to 15, 898 kg/ha for the period 2070-2098 (34.7 %).

The reasons for these higher yields for bananas in Saint Lucia for the two future periods (2040-2068 and 2070-2098), especially according to the downscaled ECHAM5 climate model, is that the optimal temperature for banana growth and yield is ~ 31.0 $^{0}$ C to ~32.0 $^{0}$ C, which are above the current average temperature of ~ 26.0 $^{0}$ C of Saint Lucia and the increase of ~ 2.0 $^{0}$ C to ~3.0 $^{0}$ C projected by both climate models would bring thermal conditions for banana into a more optimal range. However, one has to assume that the current rates of fertilizer use and irrigation requirements are met or even increased and that rainfall does not decrease and drought does not increase substantially under the future climate scenarios (Elbehri, 2015).

**Figure 4.14: Observed and Simulated banana yields for the current period (1986-2014) and predicted banana yields for the two future periods (2040-2068 and 2070-2098) according to the downscaled HadCM3 (Left) and the ECHAM5 (Right) climate models**




### 4.5.2 Vulnerability Assessment and Adaptive Capacity

Stakeholders attending the Inception Workshop were given a questionnaire aimed at identifying factors responsible for the vulnerability of the agriculture sector of Saint Lucia to climate change. Based on the feedback of twenty five respondents, it was found damages caused by extreme weather systems (hurricanes, storms, intense rainfall and strong winds) and changing and unpredictable weather systems were the most important factors affecting the vulnerability of the agriculture sector to climate change in Saint Lucia. Surprisingly, water supply systems and government programs were rated much lower. Other factors that may affect adaptive capacity are the greater incidence of pests and diseases under the warmer climate and the level of poverty in some rural areas.

The same stakeholders were then given a second questionnaire aimed at identifying constraints to adaptive capacity of the agriculture sector of Saint Lucia to climate change. The factors that emerged as most important in affecting the Adaptive Capacity of the agriculture sector of Saint Lucia were:

- Social Capital and Institutions;
- Changing and Unreliable and Unpredictable Weather and Climate Conditions and
- Financial Resources.

Surprisingly, Market Conditions, Policies and Programs and Human Capital and technology were rated much lower. However, the uncertainty relating to climate change scenarios has to be factored in.

### 4.5.3 Adaptation and Adaptive Capacity

It is expected that the agricultural sector of Saint Lucia will be seriously affected by future climate change. The following is a preliminary list of actions and policies (CCSI) with support from current literature (Smit and Skinner, 2002; Bárcena et al. 2013) that can be mainstreamed into the Government of Saint Lucia plans for addressing climate change vulnerabilities and adaption in agriculture. There is need to carry out adaptations in the sector, industry and markets, in producer strategies and in rural development strategies, with the objective of reducing social and economic costs. At the centre of climate change adaptation efforts are interventions aimed at enhancing adaptive capacity and stimulating adaptive actions. Policies focusing on sensitization of the farming community to the risks associated with climate change will therefore be of great benefit. Adaptation to climate change must be seen as an iterative process, where the likely state of the climate will not be at a stable equilibrium, but rather an ongoing transient process (Stafford Smith et al. 2011). The addition of communication and information strategies should be given serious consideration in regards to adaptation recommendations:

- Rebates encouraging the use of renewable energy production and technology in farming operations should be promoted in order to offset operations.
- Development of more water catchment areas managed by the Government to assist with storage and distribution of water.
- The use of renewable energy technologies should be encouraged for pumping and distributing water and cooling systems (for chicken pens for instance).

Agricultural adaptation options can be grouped according to four main categories that are not mutually exclusive:

(1) technological developments,
(2) government programs and insurance,
(3) farm production practices, and
(4) farm financial management.

These adaptation options may face a variety of challenges and barriers in Saint Lucia, including economic resources, technical knowledge, and adaptive capacity in the agriculture sector. Climate change may actually present opportunities for the modernization of agriculture in Saint Lucia by enabling effective and proactive adaptation to climate change.

#### *4.5.3.1 Livestock*

Climate change is expected to have both direct and indirect impacts on livestock. Direct impacts will be related mainly to heat stress, while indirect impacts will be related to the deterioration of pasture for grazing and water. These impacts could lead to a reduced feed intake, reduced fertility levels, increased sweating and panting, weight loss and increased mortality of certain species. Also, rising temperatures would mean greater investment in mitigating measures such as ventilation fans for poultry and improved infrastructure (J.M. Rust and T. Rust, 2013).

##### 4.5.3.1.1 Potential Impacts on Climate Change on Livestock in Saint Lucia

Based on consultations with stakeholders at the Inception Workshop, it was found that the most important commercially livestock in Saint Lucia that are likely to be affected by climate change are swine, ruminants (sheep and goats) and poultry. Consequently, both egg and meat production are expected to decline, negatively impacting on food and nutrition in Saint Lucia. Larger animals such as goats, sheep and pigs tend to be a more resistant to heat stresses, although in recent times, high daily temperatures have been responsible for the death of several mature pigs and young piglets.

Heat stress reduces both meat and milk production in ruminants. As most of these animals graze in the sun for much of the day, local meat and milk production are expected to decrease as daily temperatures increase. Reduced availability of local meat and meat-products will impact negatively on food quality, quantity, and ultimately, on human nutrition. There will also be associated economic problems, since local meat producers would have to either alter existing farm buildings or construct new ones to provide adequate shelter for animals, in order to maximise their production. This would obviously increase the overall production cost and could possibly wipe out traditional small farmers and entire farming communities. In addition, meat and other livestock products would have to be imported to supplement expected shortfalls, impacting negatively on foreign reserves.

Furthermore, low rainfall and increasing drought impact negatively on biomass growth in most, if not all, plants and that includes grasslands upon which animals and ruminants feed. Certainly, the quality and quantity of grasses will be affected by climate change which in turn will affect the dietary requirements of livestock. To ensure that farm animals receive an adequate amount of food and nutrition, farmers may either have to increase the sizes of their grasslands or consider other food supplements, both of which will require additional funds. There are already problems with respect to very high operational costs, which is certainly expected to increase in the very near future and could see several livestock farmers going out of production either temporary or permanently. Some livestock tolerate heat better than others. Sheep and goats tend to be less susceptible to heat stress than swine.

##### 4.5.3.1.2 Adaptation Measures

Plenty of clean, cool, and fresh water is paramount to preventing heat stress in livestock. On average, a sheep or goat will drink 1 to 2 gallons of water per day. During periods of extended heat and humidity, it may be necessary to provide extra water, and clean and change waterers more often.

Access to shade is another important aspect of managing livestock during hot weather. Livestock shelters do not need to be complicated or elaborate. Simple shade structures can be constructed from shade cloth, mesh fabric, tarps, canvas or sheet metal. Movable shade structures are suitable for intensive rotational grazing systems. All livestock should be able to lie down in the shade structure or area at the same time. Lying down in a cool spot provides additional relief from the heat. Mature trees provide excellent shade and shelter, and are usually the least-cost alternative (http://www.sheepandgoat.com/#!heatstress/).

The temperatures predicted for the mid-term (2040-2069) period and latter part (2081-2100) of this century are expected to severely affect the local poultry industry of Saint Lucia. At present, poultry birds have shown the greatest vulnerability to increasing temperatures, as tens of thousands of these animals die each year as a result of heat related illnesses. However cooling fans are now being used in several chicken farms/pens to counter this heat stress in Saint Lucia and other Caribbean countries (Singh et al, 2014).

#### *4.5.3.2 Fisheries and Aquaculture*

##### 4.5.3.2.1 Impacts

The fisheries industry is extremely important in Saint Lucia as it is the livelihood of over 3,000 persons, contributes to GDP (~5.5 %) and supports other important industries such as tourism (James, 2001).

Climate change may lead to a number of physical stressors to the marine environment, which in turn may result in a range of biological/ecological responses affecting coastal fisheries. The main potential physical stressors are: sea surface temperature, currents, stratification and upwelling; ocean acidification; sea level rise; ultra violet radiation; and rainfall patterns. The main biological/ecological stressors are: phytoplankton and primary production; zooplankton and larval supply; changes in species ranges and abundances; changes to habitats that support fisheries production; calcification rates of reef organisms; physiological responses of organisms to climate change; and timing of life history events (MRAG. 2010),

Rising sea levels could also affect important fishery nursery areas such as along the coast of Choiseul, Dennery, Gros Islet and Vieux Fort. Warming can increase disease transmission and increase numbers of marine pathogens. Because of its comparatively small economy, Saint Lucia, while highly dependent on fish for food and tourism, has low capacity to adapt to climate change (Calvosa, 2010).

Despite the resilience of many species of fishery resources, their ability to overcome changes in weather patterns, including increased frequency and severity of extreme events such as hurricanes, are at best uncertain (Olsson et al., 2014). Many fisheries however, have throughout history, shown an ability to adopt migration and livelihood diversification strategies in an effort to adapt to climate change and variability. However, the ability to adapt may be lessened in the realm of present day experience given the multiple stresses associated with coastal urbanization, changes in frequency and intensity of extreme weather events and the impacts of climate change on sensitive coastal ecosystems such as corals and mangroves. The primary concern is therefore with the impacts of climate change on marine habitats with the subsequent impacts on fisheries (Olsson et al., 2014). Coral reefs provide the habitat for a wide variety of reef fishes that are exploited in Saint Lucia. Over the past two to three decades, there has been widespread deterioration of corals reefs in the Caribbean. Much of the deterioration has been attributed to exploitation, pollution, disease, coastal development and more lately coral or thermal bleaching caused by increasing Sea Surface Temperature (SST). Predictions are that ocean acidification will have further negative impacts on corals and coral reefs (Olsson et al., 2014). Increase in sea temperatures may also affect seagrass beds that serve as nursery areas for many species of fish (Olsson et al., 2014).

##### 4.5.3.2.2 Adaptation

The Fisheries Division of Saint Lucia needs to set up a Strategic Plan for the Fisheries sector which focuses on protecting and strengthening the assets of fishers, creating an enabling environment to pursue sustainable livelihoods and mitigating the impact of vulnerabilities through a holistic approach to managing and developing the fisheries sector and empowering the fishers. The approach should be based on the fact that fisheries in Saint Lucia normally have five (5) major assets, namely:

1. Physical assets – boat, equipment, gear, infrastructure, etc.;

2. Natural assets – fishery resources, land, waters, bio-diversity, etc.;

3. Financial assets – savings, credit, debt income, pensions, insurance, etc.;

4. Social assets – formal or informal support groups and relationships, networks, etc.;

5. Human assets – skills, knowledge, ability to work, health, nutrition, education.

Specific adaptation actions could include actions such as: incorporating uncertainty into decision-making and management process; supporting transitions to alternative species, production and post-harvest processes; supporting the development of alternative or diversified livelihoods; enhancing natural barriers, protecting fish habitats through adaptive spatial management; and incorporating climate change into transboundary water and natural resource planning across sectors (Brugère and De Young, 2015).

## 4.6 TOURISM SECTOR

### 4.6.1 Contribution of Tourism to the Economy of Saint Lucia

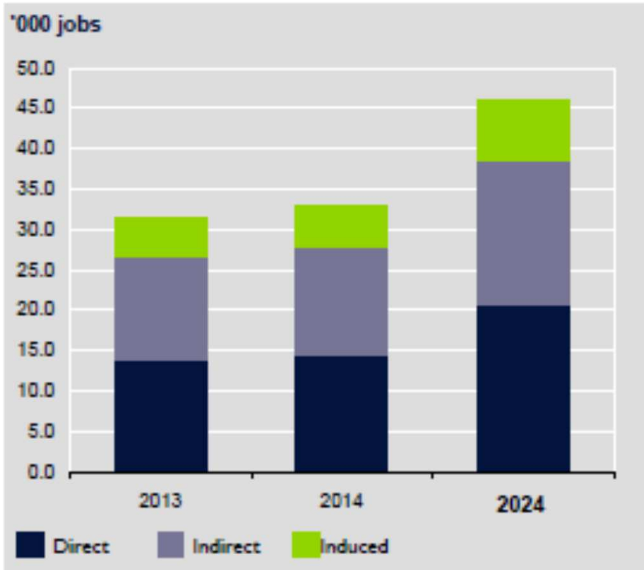
#### *4.6.1.1 GDP and Employment*

The tourism industry in Saint Lucia is developing at a fairly fast rate, engaging a wide range of tourism operators and employing significant numbers of the population. The tourism sector in Saint Lucia is one of the most important for the country's economy. The tourism industry is the largest contributor to the gross domestic product and the largest source of foreign exchange. The total contribution of Travel and Tourism to GDP was XCD 1, 404.2mn (38.8% of GDP) in 2013, and is forecast to rise by 4.6% in 2014, and to rise by 5.5% pa to XCD 2,520.4mn (50.6% of GDP) in 2024 (The World Travel and Tourism Council (WTTC), 2014).

Travel and Tourism generated 14,000 jobs directly in Saint Lucia in 2013 (18.6% of total employment) and this is forecast to grow by 5.0% in 2014 to 14,500 (19.1% of total employment). This includes employment by hotels, travel agents, airlines and other passenger transportation services (excluding commuter services). It also includes, for example, the activities of the restaurant and leisure industries directly supported by tourists. According to WTTC (2014), by 2024, Travel and Tourism will account for 21,000 jobs directly, an increase of 3.6% per annum over the next ten years.

The total contribution of Travel and Tourism to employment (including wider effects from investment, the supply chain and induced income impacts, was 31,500 jobs in 2013 (42.1% of total employment). This is forecast to rise by 4.5% in 2014 to 33,000 jobs (43.1% of total employment). By 2024, Travel and Tourism is forecast to support 46,000 jobs (51.9% of total employment) in Saint Lucia, an increase of 3.4% per annum over the period (WTTC, 2014). The total contribution of Travel and Tourism to employment (including wider effects from investment, the supply chain and induced income impacts) was 31,500 jobs in 2013 (42.1% of total employment). This is forecasted to rise by 4.5% in 2014 to 33,000 jobs (43.1% of total employment) (Figure 4.15).

**Figure 4.15: Direct, Indirect and Induced Contributions to Employment ('000 jobs) by the Travel and Tourism Sector of Saint Lucia (2013-2014) and projections to 2024** (Source: WTTC (2014))




#### *4.6.1.2 Tourism-based Activities in Saint Lucia*

Crowned by the towering twin volcanic peaks of the Pitons, St Lucia is the beauty queen of the Caribbean. Crescent shaped beaches, small fishing villages, rainforests, reefs, waterfalls, geothermal attractions, and lush mountains are just some of Saint Lucia's many attractions. Castries, the island's capital and cruise ship port, offers a colorful slice of Saint Lucian life at its lively market, as well as some fascinating historic landmarks. At Morne Fortune and Pigeon Island National Park, visitors can learn about the history of the island. Adventure seekers will find plenty to do on Saint Lucia. Zip lining on a working plantation, climbing the Pitons, hiking the many marked nature trails, horseback riding, sightseeing cruises, and exploring the island's active volcano are popular island activities. Diving is excellent on the west side of St Lucia with a rich diversity of corals, sponges and reef fish. After all the action, visitors can relax under rustling palms on Saint Lucia's golden sands or soak in the island's healing hot springs (http://www.planetware.com/tourist-attractions/st-lucia-stl.htm).

There are a myriad of affordable and fun activities that tourists that can enjoy in Saint Lucia. These include:

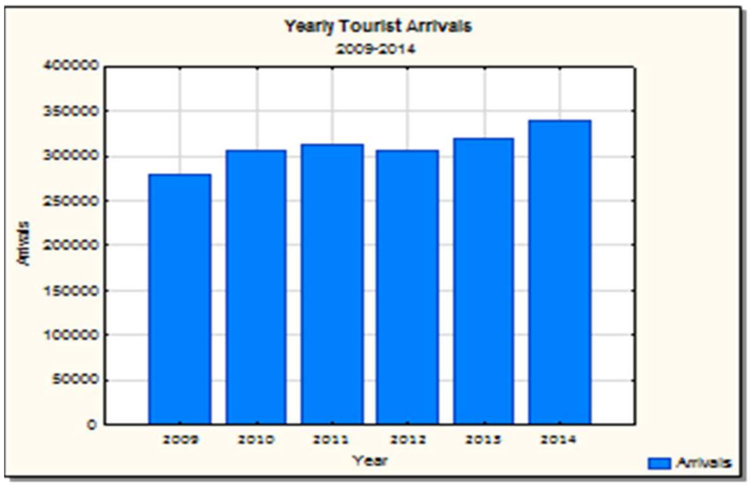
- Swimming and sun bathing on some of the most beautiful beaches in the Caribbean (e.g. Rodney Bay, Humming Bird Beach Resort);
- Yachting and sailing (e.g. Marigot Bay, Rodney Bay);
- Diving and snorkeling (e.g. Anse Chastanet National Park);
- Nature and adventures (e.g. the Pitons, Soufrière, Sulphur Springs Park, Mount Soufriere, Diamond Botanical Gardens, Waterfall and Mineral Baths, Soufrière Estate, Pigeon Island National Park, Tet Paul Nature Trail, Edmund Rain Forest Reserve – En bas Saut Waterfall Trail, Morne Fortune);
- Shopping (e.g. Castries market and a variety of local stores);
- Health and wellness (e.g. Royal Saint Lucia Suite and Spa, the Body Holiday);
- Night Life (e.g. Irie Bar, Q Bar, Turbulence Auto Sport Bar and Grill).

#### *4.6.1.3 Tourist Arrivals and Countries of Origin*

Tourists arrive in Saint Lucia by several means, mostly by air and cruise ship, but also by yacht. For the period of available data (2001-2015), visitor arrivals of tourists and expenditures have been increasing steadily except for the economic downturns in 2006 and in 2009 in North America and Europe In fact total visitor arrivals exceeded 1,000,000 in 2015.

The vast majority of tourists from North America and Europe arrive in Saint Lucia during the Northern hemisphere winter, namely from November to March. Also, this is the dry season in Saint Lucia when the weather is beautiful and the threat of tropical storms and hurricanes are minimal. The peak in July and August represent Saint Lucians living abroad and other Caribbean peoples visiting Saint Lucia for the summer holidays. Also there is the famous jazz festival during late April- early May (Figure 4.16).

**Figure 4.16: Total monthly stay-over passengers arriving in Saint Lucia (2012)** (Source: Saint Lucia Tourist Board)




##### 4.6.1.3.1 Cruise Ship Arrivals

The total number of passengers arriving by large cruise ships is higher than those arriving by air, but their stay in Saint Lucia is minimal (1 to 2 days). The cruise ship season runs between November and March, when tropical storms and hurricanes are unlikely.

##### 4.6.1.3.2 Yacht Arrivals

Table 4.11 presents monthly arrivals of Yachts at Rodney Bay and Marigot Bay (the two most used docking stations in Saint Lucia) in a typical year (2014). Like cruise ships, the highest arrival rates are during the northern hemisphere (North America and Europe) winter, from November to April (Table 4.11).

**Table 4.11: Monthly arrivals of yachts at Rodney Bay and Marigot Bay in 2014** (Source: Saint Lucia Tourist Board)

| Month | Rodney Bay | Marigot Bay |
|---|---|---|
| **January** | 3,663 | 1,134 |
| **February** | 3,620 | 1,317 |
| **March** | 4,203 | 1,443 |
| **April** | 3,618 | 962 |
| **May** | 2,957 | 515 |

| | | |
|---|---|---|
| **June** | 2,160 | 188 |
| **July** | 2,504 | 275 |
| **August** | 4,786 | 296 |
| **September** | 1,572 | 75 |
| **October** | 2,793 | 195 |
| **November** | 2,282 | 601 |
| **December** | 5,107 | 930 |
| **Yearly Total** | 39,265 | 7,931 |

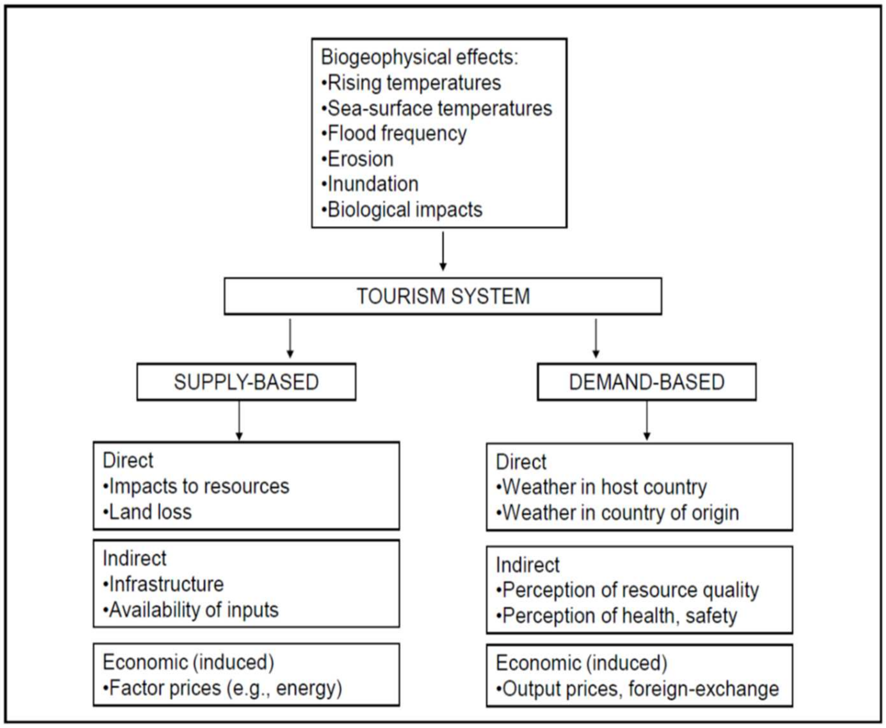
### 4.6.2 Impacts of Climate Change on Tourism Sector of Saint Lucia

Climate change, along with sea level rise, would very likely result in loss of beaches, properties and public infrastructure and will make Saint Lucia less attractive as a tourist destination. The loss of beaches and coastline due to erosion, inundation and coastal flooding and loss of tourism infrastructure, natural and cultural heritage would reduce the amenity value for coastal users (IPCC, 2007; Olsson et al., 2014). Additionally, some low-lying coastal areas in Saint Lucia will experience high levels of saltwater intrusion and rising water tables, thereby reducing water quality of surface waters. The overall effect of a changing climate on Saint Lucia's tourism industry would be a loss of employment and higher insurance costs for properties in vulnerable areas (The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis, February 2007).

An assessment of the economic vulnerability of Saint Lucia's tourism industry to climate change suggested that perceptions of reef quality may be an important factor in the assessment of the vulnerability of tourism demand to climate change in Saint Lucia (Richardson, 2007). Climate change and climate-driven sea level rise will, in most likelihood, have important and severe impacts on the tourism industry of Saint Lucia. Increases in air temperature (2 $^{0}$C to 3 $^{0}$ C) towards the end of the century may make conditions unbearable, especially for the elder retired tourist population, the most common age group of tourists. Variability in precipitation that is also projected will very likely lead to extreme conditions, namely increasing drought in the dry season and torrential rains and flooding in the rainy season and to water and food shortages, or higher prices if imported. Tropical storms and hurricanes, compounded by sea level rise, are also likely to increase in numbers and intensity, and apart from flooding and erosion of recreational beaches they will also very likely cause flooding and damage to transport and other infrastructure.

These projected changes in climate will have indirect secondary and tertiary effects on supply-based and demand-based systems upon which the tourism industry of Saint Lucia is dependent: loss of beaches, loss of coral reefs due to temperature-induced bleaching, loss of food supply chains and loss of coastal infrastructure. Demand-based systems on the other hand include weather conditions in country of origin of tourists (mainly North America and Europe), perception issues such as security from extreme weather events and pricing policies for transport, lodging and entertainment (See Figure 4.17).

**Figure 4.17: Framework for Tourism Sector Vulnerability Assessment** (Source: Richardson, 2007)




Indirect contribution represents the contribution to GDP and jobs of the following three factors:

1. *Capital investment* which includes capital investment spending by all sectors directly involved in the Travel and Tourism industry. This also constitutes investment spending by other industries on specific tourism assets such as new visitor accommodation and passenger transport equipment, as well as restaurants and leisure facilities for specific tourism use;
2. *Government collective spending* which includes general government spending in support of general tourism activity. This can include national as well as regional and local government spending. For example, it includes tourism promotion, visitor information services, administrative services and other public services;
3. *Supply-chain effects* which include purchases of domestic goods and services directly by different sectors of the Travel and Tourism industry as inputs to their final tourism output.
4. *Induced contribution* which relates to the broader contribution to GDP and employment of spending by those who are directly or indirectly employed by Travel and Tourism.

### 4.6.3 Tourism Sector Adaptation to Climate Change

It is incumbent on the managers of the tourism industry in Saint Lucia to begin to shape policies and integrate them into Government plans to adapt to the impacts, mostly negative, of climate change. There are plans to further promote and grow the tourism sector of Saint Lucia through promotional policies, but a greater focus on adaptation to climate change is required.

There are certain adaptation measures being taken, such as the construction of sea defenses to protect against beach losses and coastal erosion. For instance sea walls are being erected haphazardly at Reduit beach. But their design and integrity leave much to be desired: they are generally about one meter high. So they would be easily overtopped by storm surges. Furthermore, these hard structures eventually lead to the loss of beaches as seen at Reduit beach. This is because these rigid structures lead to scouring of beach sand through backwash of waves. Other efforts include the installation of soft defenses such as the planting of mangroves. But one of the most effective sea defenses is the use of tree limbs (e.g. bamboo) that allow for some dissipation of wave energy while at the same time retaining most of the sand during back wash and thereby maintains the integrity of the beach.

Adaptation planning should also incorporate the expansion and diversification of tourism activities, such as the further promotion of ecotourism, supported by appropriate fiscal incentives.

## 4.7 HEALTH SECTOR

Climate change has wide ranging consequences for human health. Public health depends on sufficient food, safe drinking water, secure shelter, good social conditions and a suitable environment for controlling infectious diseases. All of these factors can be affected by climate and climate change is expected to exacerbate adverse conditions (Haines et al. 2000; Heslop-Thomas et al. 2009; Leary et al (2008); Martens, 1996). Climate change will lead to higher levels of some air pollutants, an increasing number of extreme weather events and increased outbreaks and transmission of diseases through unclean water and contaminated food, and will threaten agricultural production in some developing countries such as Saint Lucia. Climate change will also bring new challenges to the control of infectious diseases. Many of the major killer diseases are highly sensitive to temperature and rainfall, including diarrhoeal diseases, as well as vector borne diseases, especially dengue, but also chikungunya and zika (WHO, 2015).

### 4.7.1 Climate and Health

Globally, the number of reported weather-related natural disasters is increasing. Climate disasters are partly due to population growth in high-risk areas, such as the coastal zones of Saint Lucia where large numbers of the population are to be found. Climate change has also driven extreme high temperatures and has probably contributed to more frequent and extreme precipitation events and more intense tropical cyclone activity. Together, these trends will increase weather-related hazards to human health.

#### *4.7.1.1 Extreme heat*

Daily temperatures above a locally specific threshold result in higher mortality rates, particularly among the elderly population (Lindsay and Birley, 1996; Martens, 1996). Heat stress and cardio- and cerebro-vascular conditions resulting from extreme temperature are therefore likely to increase in the future (Sookdeo, 2008). Higher temperatures associated with heat waves also alter the geographical distribution of the mosquito species that transmit deadly diseases as dengue. Outbreaks of dengue, transmitted by mosquitoes, have been known to increase in warmer temperatures.

#### *4.7.1.2 Floods and droughts*

Although total annual and seasonal rainfalls are not projected to change significantly, extremes of rainfall events that cause either flooding or drought, both of which can impact upon human health either directly or indirectly, are expected to increase in occurrence. Floods can cause drowning and physical injuries; heighten the risk of diseases transmitted through water, insect vectors and rodents; damage homes and infrastructure and disrupt the supply of essential medical and health services. Conversely, droughts can increase the risk of water and food shortages and malnutrition, necessitate greater reliance on contaminated water, and lead to diminished health among vulnerable members of the population.

#### *4.7.1.3 Vector-borne diseases: Dengue*

By far, the most important vector-borne disease for which information is available is Dengue, transmitted from person to person by the bite of the *Aedes Aegypti* mosquito (Table 4.12). As such, this section focuses on Dengue and how the incidence may change with climate change. Table 4.12 shows that of all the notifiable diseases, Dengue is by far the most prevalent vector-borne disease in Saint Lucia. The incidence rate was highest in 2011 (749 cases), followed by 2013 (282 cases) and 2008 (105 cases).The only other major disease of note is Leptospirosis, an infectious bacterial disease that occurs in rodents, dogs, and other mammals and can be transmitted to humans.

**Table 4.12: Major Notifiable Diseases in Saint Lucia**

| Notifiable Disease | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| **Dengue** | **105** | **19** | **97** | **749** | **35** | **282** | **90** | **34** |
| **Rotavirus** | 1 | 0 | 62 | 4 | 6 | 1 | 0 | 17 |
| **MRSA** | 3 | 3 | 1 | 26 | 15 | 7 | 5 | 9 |
| **Klebsiella** | 7 | 20 | 1 | 3 | 3 | 2 | 0 | 6 |
| **Leptospirosis** | 4 | 4 | 17 | 30 | 11 | 29 | 14 | 9 |
| **HMPV** | 0 | 0 | 0 | 0 | 5 | 0 | 3 | 3 |
| **RSV** | 0 | 0 | 15 | 37 | 5 | 1 | 0 | 3 |
| **E. Coli** | 3 | 17 | 4 | 0 | 6 | 0 | 0 | 2 |
| **Adenovirus** | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 2 |
| **Malaria** | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| **Shigellosis** | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 |
| **Schistosomiasis** | 1 | 3 | 2 | 1 | 1 | 0 | 0 | 0 |

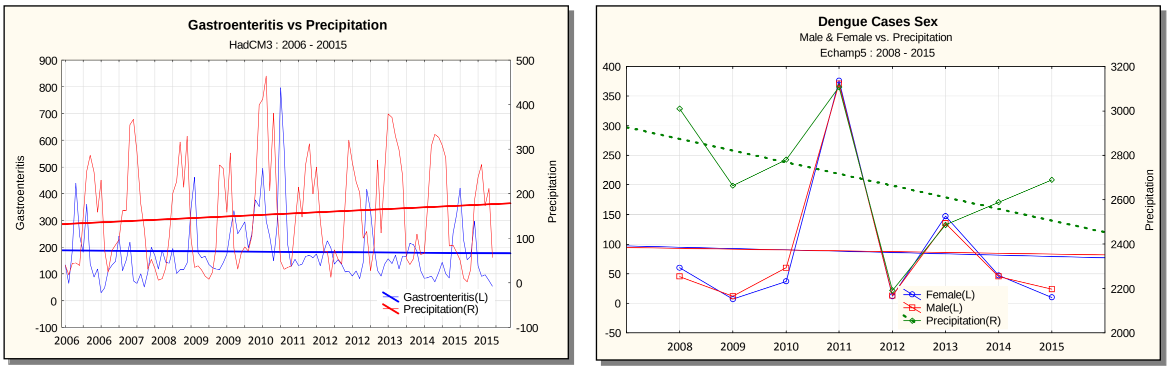
A good indication of the rate of incidence is the Breteau Index (%). The Breteau Index is measured by the number of containers containing *Aedes aegypti* larvae per 100 premises or households, and is correlated with the incidence of Dengue. When the Breteau index is 50 or more then the risk of transmission is high and when it is 5 and less the risk of transmission is low (Chadee et al., 2007; WHO, 2012). For the period of data availability (2015-2016), the Breteau Index for Saint Lucia was less than 50 % (varying from 19 % in June, 2015 to 38 % in February, 2016), and the risk of transmission of Dengue can be considered as moderate. There is no significant relationship between the incidence of Dengue and the age or sex of individuals affected, for the data available (2008-2015).

### 4.7.2 Statistical Relationships between Dengue and mean Temperature and Rainfall

An attempt is made to relate the incidence of Dengue to mean temperature and rainfall under current conditions so as to attempt to predict future incidences (2040-2069 and 2081-2100) of Dengue, according to sex and age group, so as to be able to project future incidences of Dengue based on future changes (2040-2069 and 2081-2100) in mean monthly air temperature (Tmean) and monthly rainfall.

When examining the relationship between Tmean and Dengue cases (both sexes), the correlations are quite weak (- 0.22: female) and (- 0.16: male) according to the downscaled HadCM3 data for 2008-2015 (Figure 4.18a). Similarly, when examining the relationship between Precipitation (Mean Precip) and Dengue cases (both sexes), the correlations are quite weak (- 0.20: female) and (- 0.21: male). The only year in which there is a direct correlation is 2013 according to the downscaled HadCM3 data for 2008-2015 (Figure 4.18b).

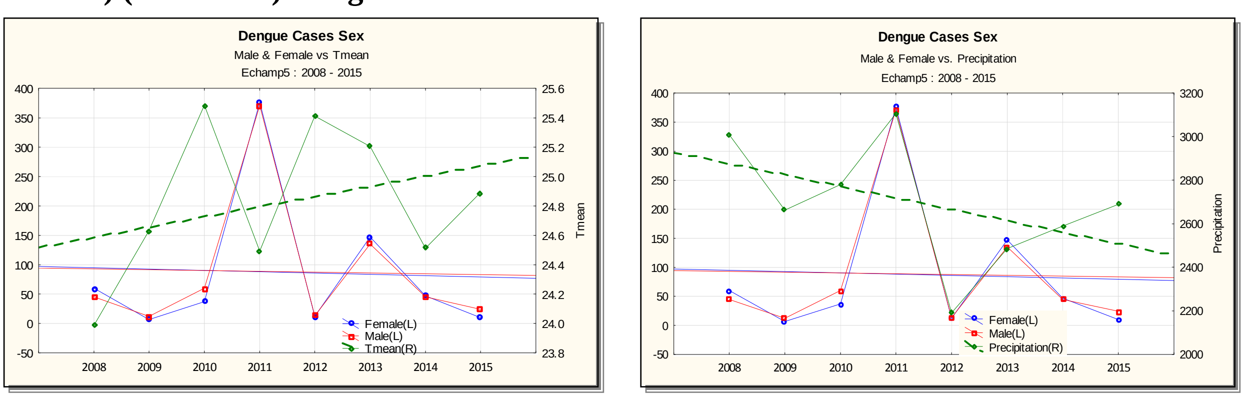
**Figure 4.18: The relationship between Tmean (a) and Precipitation (b) and the incidence of Dengue (both sexes) (2008-2015) using the downscaled HadCM3 climate data**




a b

When using the ECHAM5 data for 2008-2015 for examining the relationship between Tmean and Dengue cases (both sexes), the correlations are again quite weak (- 0.23: female) and (- 0.17: male) according to the downscaled ECHAM5 data for 2008-2015 (Figure 4.19a). When examining the relationship between Precipitation (Mean Precip) and Dengue cases (both sexes), the correlations are stronger, but still not statistically significant (0.55: female) and (0.56: male). There is a direct correlation between the incidences of Dengue (both sexes) and Precipitation in 2011, 2012 and 2013 according to the downscaled ECHAM5 data for 2008-2015 (Figure 4.19b). It is evident then as found elsewhere (Chadee et al., 2007), that there is a strong link between rainfall and the incidence of dengue. The additional impetus that will in all likelihood be provided by increasing temperatures will accelerate larvae formation and maturation and a proliferation of the *Aedes aegypti* mosquitoes that would call for a variety of adaptation measures (IPCC, 2007, Olsson et al., 2014).

**Figure 4.19: The relation sip between Tmean (a) and Mean Precip (b) and the incidence of Dengue (both sexes) (2008-2015) using the downscaled ECHAM5 climate data**




a b

### 4.7.3 Other Diseases influenced by Climate Change

Other diseases that may be influenced by climate change are Gastroenteritis, a water borne disease, affected by rainfall and sanitation conditions and respiratory diseases that may be influenced by rising air temperatures and air quality, including the increased ambient air concentration of pollen and spores in response to increasing temperatures. Based on the limited data set available, the highest incidence of Gastroenteritis occurred in 2010 while the highest incidence of Respiratory Diseases occurred in 2011 (Table 4.13).

**Table 4.13: Other diseases that are likely to be influenced by climate change in Saint Lucia (2008-2015)**

| Disease/Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Gastroenteritis | 2092 | 2245 | **3626** | 2901 | 1676 | 2158 | 1487 | 2305 |
| Respiratory Disease | 2849 | 7343 | 2163 | **3226** | 2202 | 1793 | 1794 | 1327 |

However, attempts at developing statistical relationships between mean annual air temperature (Tmean) and Gastroenteritis, and mean annual precipitation (Mean Precip) and Gastroenteritis, for the limited period of available data (2008-2015) using downscaled data for the HadcM3 model, produced very poor correlations (-0.29 for mean annual air temperature) and (-0.15 for mean annual rainfall). Using the downscaled data for the ECHAM5 model also produced poor correlations (-0.25 for mean annual air temperature) and (-0.26 for mean annual rainfall).

### 4.7.4 Chronic stresses: water shortages, malnutrition and psychosocial stress

In the long run, the greatest health impacts may not be from acute shocks such as disasters or epidemics, but from the gradual increases in pressure on the natural, economic and social systems that sustain health which are already under stress. These gradual stresses include reductions and seasonal changes in the availability of fresh water, regional drops in food production, and rising sea levels, all of which apply to Saint Lucia. Pressures on agriculture threaten to increase the burden of malnutrition. It is projected that climate change will cause decreases in agricultural production in many tropical developing regions as Saint Lucia.

### 4.7.5 Solutions: health governance and the climate change agenda

Climate change will affect the health and well-being of all populations, with impacts escalating into the foreseeable future in many different ways. The extent to which these risks translate into increased numbers of deaths and burdens of injury and disease will depend on the effectiveness of mitigation and adaptation policies. Strengthening public health systems and health emergency management systems in Saint Lucia is necessary, particularly to safeguard the health of the most vulnerable population groups and respond effectively to emergencies when they arise.

Special attention should be paid to the control and eradication of vector-borne diseases, such as dengue and water-borne and respiratory diseases that may become more prominent with climate change.

## 4.8 FINANCIAL SECTOR

The Financial Services Sector (FSS) of Saint Lucia is a growing activity, and contributed 7.8 % to Saint Lucia's GDP in 2012 through Financial Mediation (IADB, 2013).The role of the financial services sector in supporting all sectors during their development stages as well as the post–disaster recovery and reconstruction phases underscores both its importance and its vulnerability (NC2-Saint Lucia, 2011). These vulnerabilities relate to possible over-exposure to risks due to climate change and climate-driven sea level rise and storm surges.

In Saint Lucia, the FSS can be categorized into two main sub-sectors namely the banking sub-sector (Commercial Banks; Indigenous Banks; Credit unions and offshore banks) and the insurance sub-sector (Insurance Companies). The Banking sub-sector depends on the Insurance sub-sector to support it by providing indemnity for the range of services which they provide. Regulation of the FSS agents is divided between the Financial Services Regulatory Authority26 (FSRA) (formerly the International Financial Services Sector Office (IFSSO) of the Ministry of Finance) and the Eastern Caribbean Central Bank. The IFSSO encourages product innovation and sees climate change as stimulating innovative product packaging which new entrants could consider as an option to give them a competitive edge in the almost saturated Saint Lucian market.

### 4.8.1 Climate Change Impacts on the Financial Services Sector

The direct and indirect impacts of climate change on FSS in Saint Lucia are summarized in Table 4.14. The table acknowledges the following climate change and climate-driven events:

(1) Sea level rise and storm surges;
(2) Increased intensity and frequency of extreme weather events: hurricanes and droughts;
(3) Increased temperatures and heat related illnesses and vector borne diseases;
(4) Changes in rainfall patterns and increases in vector and water borne and vector borne disease

The Financial Sector of Saint Lucia will in all likelihood also suffer from the adverse effects of future climate change and climate-driven sea level rise and tropical storms and hurricanes. A recent study by the Special Programme for Adaptation to Climate Change (SPACC) for Saint Lucia paints a bleak picture by revealing that climate change will result in 3 to 4 Category 4 and 5 hurricanes on an annual basis by 2025. This is a significant increase over the previous longer term average of 1.4 Category 4 and 5 hurricanes on an annual basis in the Atlantic Basin.

[26] In 2014, the International Financial Services Sector office (IFSSO) transitioned to the Financial Services Regulatory Authority (FSRA), a statutory body, and is no longer a department in the Ministry of Finance.

**Table 4.14: Links between Climate Change and Direct and Indirect Impacts on the Financial Services Sector of Saint Lucia (Source: Maurice et al., 2010)**

***FSS and Climate change link-Table 3***

| Sector | Which climate variable (s) impact sector | Impact | |
|---|---|---|---|
| | | **Direct** | **Indirect** |
| ***Financial Services Sector***<br>• Insurance<br>• Banking<br>• Micro-credit institutions<br>• Credit union | 1. Sea level rise<br>2. Storm surge | FSS in order to reduce their risk will have to either abide to nationally approved setback when approving loans and insuring properties are in conformity with them. | Critical infrastructure and hotel development located near shores will come under direct threat as a result of sea level rise. |
| | 3. Increased intensity and frequency of extreme whether events;<br>• hurricanes<br>• droughts | The sector may increase premiums which will be passed on to consumers. This will be a direct cost impact to the various sectors.<br><br>As clients become more aware of the impacts of climate change and they attempt to reduce their vulnerability the FSS will see increased requests for insurance coverage and bank loans to address adaptation concerns.<br><br>As a result of government's inclination to foster climate resilience at a national level FSS will be required to shift their portfolios to cater to those need that this will create. | Damage to critical infrastructure, housing and beachfront property can result in increased insurance claims.<br><br>Because of the direct threat which livestock and crops will come under as a result of increased intensity and frequency of hurricanes and droughts, a government response will be required to help the sector in adapting. The FSS will therefore most likely be required to scale up financing and over coverage for agriculture infrastructure such as greenhouses to protect crops etc. |
| | 4. Increased temperatures<br>• more heat related illnesses<br>• increase in vector borne diseases | Increased payouts to clients<br><br>Broadening of portfolio to cater to new needs of clientele | Increase in the number of medical claims filed.<br><br>Possible increase in the number of clients as people seek redress with increasing health costs |

The majority of the FSS is located in the capital city of Castries on the west coast of the island. The methodology of the study therefore focused on the coastal zone in the vicinity of Castries. Through literature search (IPCC, 2007; 2014; CARIBSAVE, 2012; Maurice et al, 2010) and focus group meetings with pertinent stakeholders, the current (1985-2014) vulnerabilities of the FSS in Castries and neighbouring areas to existing weather and climate variability, including sea level rise and storm surge scenarios are examined.

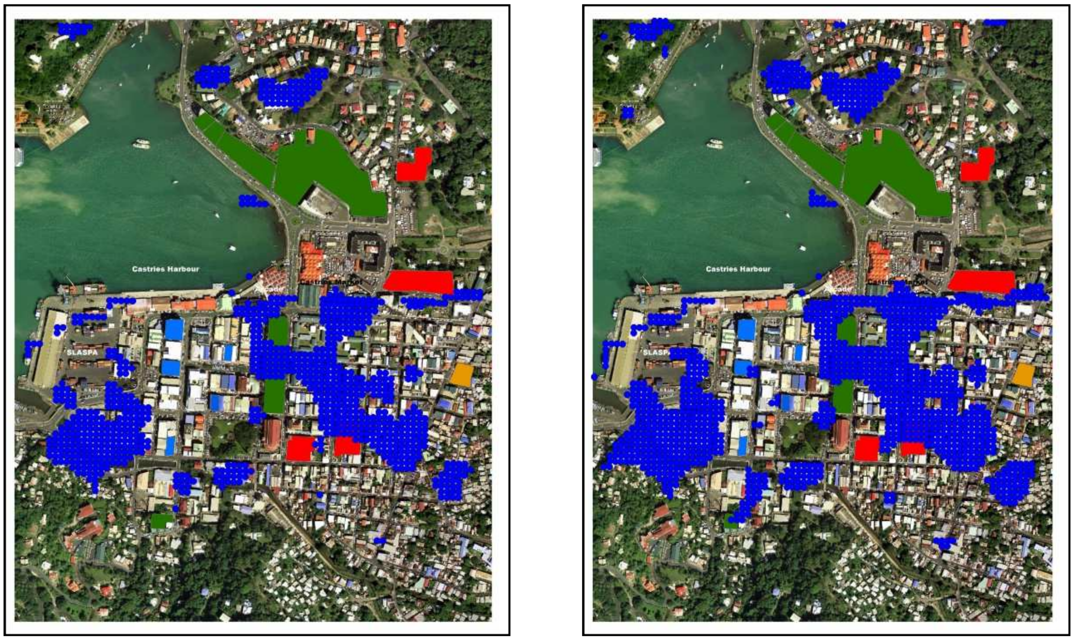
As for the vulnerabilities of the critical infrastructure related to the FSS within the coastal zone in the vicinity of Castries, the methodology of Section 3 (Coastal Zone) was used, with a focus on the current (2003-2012) and projected future (2046-2065 and 2081-2100) flooding of the coastal zone near Castries due to sea levels and storm surges. These analyses examine infrastructure pertaining to the FSS (e.g. buildings, airport, ports and harbours, roads and bridges, electricity and telephone and telecommunication lines) that are likely to be at high risk to climate-driven sea level rise and storm surges. Other climate change factors that may affect infrastructure pertaining to the Financial Services sector that were examined included high winds during storms and hurricanes, excessive rainfall and flooding and extended droughts affecting water supply to financial institutions.

### 4.8.2 Vulnerability of Critical Infrastructure

It was noted in Section 1 that the city of Castries, especially Central Castries is already close to or below sea level, and will be at risk of inundation by sea level rise and storm surges produced by a Category 2 and a particularly a Category 5 hurricane. The rainfall that normally accompanies these storms will further aggravate the flooding (Figure 4.20 and Figure 4.21).

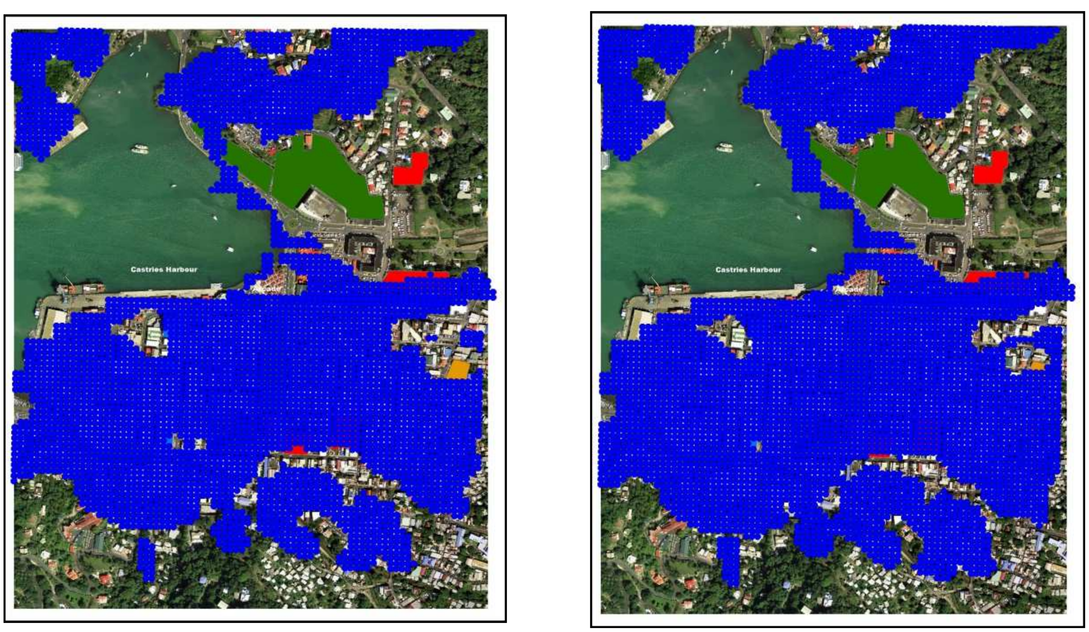
Critical institutions identified in red may be marginally affected by flooding due to a Category 2 Hurricane (Figure 4.20), but will seriously affected by flooding from a Category 5 hurricane (Figure 4.21).

**Figure 4.20: Future Sea Level Scenarios for 2040-2069 (a: 0.47 m) and 2081-2100 (b: 0.91m) combined with storm surges produced by a Category 2 Hurricane (a: 2.47 m: 2040-2069) and (b: 2.91 m: 2081-2100) showing the areas of Castries affected by inundation**




**a** **b**

**Figure 4.21: Future Sea Level Scenarios for 2040-2069 (a: 0.47 m) and 2081-2100 (b: 0.91m) combined with storm surges produced by a Category 5 Hurricane (a: 5.87 m: 2040-2069) and (b: 6.31 m: 2081-2100) showing the areas of Castries affected by inundation**




**a** **b**

**Climate Change Adaptation of the Financial Services Sector**

Based on the foregoing impacts analysis, adaptations options and barriers to adaptation to climate change for the coastal zone in the vicinity of Castries are identified. Possible opportunities and priorities (e.g. coastal infrastructure and development, coastal zoning changes, setback limits) for enabling effective and proactive adaptation to climate change and sea level rise in the coastal zone in the vicinity of Castries are also identified.

Codes and regulations relating to construction design and practices will need to be developed and adequately enforced so as to minimise the possible impacts of climate change and sea level rise. These may include risk reduction by adherence to nationally approved setbacks when approving loans and insuring properties and ensuring that these are in conformity (Maurice et al., 2010).

Damage to critical infrastructure, housing and beachfront property can result in increased insurance claims. There is likely to be an adverse impact on farmers. Because of the direct threat which livestock and crops will come under as a result of increased intensity and frequency of hurricanes and droughts, a government response will be required to help the sector in adapting. The FSS will therefore most likely be required to scale up financing and offer coverage for agriculture infrastructure such as greenhouses to protect crops. Insurances will also likely see increased payouts to clients: an increase in the number of medical claims filed and a possible increase in the number of clients as people seek redress with increasing health costs.

In its National Climate Change Policy and Adaptation Plan, the Government of Saint Lucia duly recognised the potential effects of climate change on the financial sector including (Saint Lucia National Climate Change Policy and Adaptation Plan, 2003):

1. The effects of catastrophic events such as severe hurricane damage on lending institutions, insurers, reinsurers and property owners;
2. The diversion of financial resources from productive investment to restorative activities.

The National Climate Change Policy and Action Plan (NCCPAP, 2002) recognized that in order "to ensure appropriate approaches to adaptation in the financial sector, the government, in collaboration with other agencies will, where feasible:

1. Implement fiscal and financial measures in order to achieve equitable distribution of the economic burden among stakeholders;

2. Ensure the adoption and implementation of building codes and other standards in order to minimize risk from climate change;

3. Sensitize stakeholders about the effects and implications of climate change;

4. Collaborate with the financial sector to develop appropriate risk management measures and regimes to address the impacts of climate change."

Since critical infrastructure (such as buildings, roadways, bridges, data storage facilities) that are located in the near shores will very likely come under direct threat as a result of sea level rise and storm surges, the insurance sector may increase premiums which will be passed on to consumers. As clients become more aware of the impacts of climate change and they attempt to reduce their vulnerability the FSS will see increased requests for insurance coverage and bank loans to address adaptation concerns; this will require a broadening of portfolio to cater to new needs of clientele.

Other factors that may affect the FSS will very likely include safety and security concerns, evacuation measures and plans (against hurricanes, droughts, etc.), comfort levels for workers in buildings (air conditioning under very hot conditions) economic and governance issues relating to the security of investments. With the increased intensity, and possibly increased frequency, of extreme events anticipated as a consequence of climate change, not only will the claim payout of insurance companies increase, but so, too, will insurance premiums (Maurice et al., 2010). Adaptations options to climate change in the FSS will face several barriers: economic resources, technical knowledge and adaptive capacity.

Possible opportunities and priorities for enabling effective and proactive adaptation to climate change and sea level rise in the coastal zone are identified. Insurers in Saint Lucia propose response measures which could be implemented over the short to medium term under three broad headings:

1. **Risk avoidance**: moving people and assets out of areas likely to suffer heavy climate impacts through strategic, risk-based land use policies including those on housing, and critical infrastructure.
2. **Risk reduction**: addressing vulnerabilities to weather damage effects by enacting a building code, flood and coastal defenses, infrastructure performance, technological resilience and healthcare regimes.
3. **Risk management**: taking pro-active measures to ensure the most vulnerable people and social and economic functions are given additional protection, and providing more assured responses to events by improving contingency planning by government, business and communities.

Some of the policy measures proposed by the insurers included the following;

1. Ensuring flood and coastal defense investments keep pace with development and climate change;
2. Avoiding unnecessary damage by having a risk-based planning system and building codes with climate change considerations;
3. Evaluating the health and social costs of failing to provide adequate housing for the poor and marginalized groups in society;
4. Requiring economic regulators to take account of climate risks in reviewing utility investment plans and pricing premiums;
5. Setting climate resilient standards for the public property and new property developments;
6. Investing in scientific and technological innovation.

### 4.8.3 Summary and Recommendations

The following section presents key recommendations for the FSS to integrate climate change considerations into their planning and operations. Most of the recommendations center on creating an enabling environment for the FSS (Maurice et al, 2010):

1. Sensitization, policy and legislative framework and enforcement by government officials. For their part, the sector recognized the need to be proactive and to take collective and decisive action in order to ensure a wider impact by broadening their suite of services.
2. More extensive insurance coverage for agricultural sector: This will allow on the one hand greater coverage for agricultural crops and will also aid the sector's competitiveness.
3. Financing for agricultural research: The FSS must begin to embrace and support agricultural research more fully. This will be critical to finding solutions to the emerging needs of the agricultural sector, such as drought-resistant crops.

4. Develop, implement and enforce climate change-sensitive building guidelines: This was seen as paramount in ensuring that buildings do not become hazards in the face of climate change impacts such as sea level rise and increased intensity and frequency of hurricanes.
5. Risk-based pricing: This is perceived as critical in discouraging construction in areas likely to suffer severe climate impacts such as developments which do not conform to setback zones along the beach front. Furthermore, risk-based pricing for insurance policies and loan approvals for projects will compensate developers and home owners for incorporating climate resilience into building design and construction.
6. Customer education and sensitization: an understanding of future climate related risks will assist customers in beginning to plan financially for these future risks.
7. Sector education and sensitization: some segments of the FSS also need greater exposure on what climate change is and how it will impact their business.
8. The FSS needs to develop and employ strategies to minimize its risks and/or maximize opportunities including broadening the suite of its offerings in the Saint Lucian market.
9. Implementation of Stress Tests for the financial institutions. For all intents and purposes, Government of Saint Lucia (GoSL) and the institution (the Eastern Caribbean Central Bank - ECCB) mandated to maintain the stability and integrity of the Eastern Caribbean banking system will now have to give due consideration to the periodic implementation of Stress Tests to determine the ability of the individual financial institutions to deal with the economic crisis (and possible financial crisis) that can be brought about by climate change related events.
10. The roles and responsibilities of the department of the Director of Finance, or more specifically, the evaluation and monitoring arm of the department should be reviewed with a view to determining whether this department is competent to evaluate and monitor the position of financial institutions (that are registered and approved), to ensure that no fly-by-night institutions operate to the detriment of the customers. (Refer to Schedule 1 and 3 of the FSRA Act attached and also the SLDB Act).
11. Health coverage: With the anticipated increase in vector-borne diseases, the FSS must begin to consider the diseases which have already been identified as likely to increase with the anticipated effects of climate change. The extent to which those are incorporated as part of the suite of products offered by the FSS either for loans or insurance must be examined.

## 4.9 VULNERABLE GROUPS SECTOR

Vulnerable groups such as women, children and the elderly are already beset by a number of socio-economic and psycho-social problems, such as abject poverty, food insecurity and lack of proper diets, poor shelter and housing, inadequate hygienic conditions and water quality, lack of education and labour skills and poor housing  and shelter. It is very likely that these living conditions would be exacerbated by climate change and climate-driven sea level rise and storm surges. Observed evidence suggests that climate change and climate variability worsen existing poverty, exacerbate inequalities, and trigger new vulnerabilities (Olsen, L. et al., 2014). Generally, the data reveal that poverty in Saint Lucia has been primarily a rural phenomenon as predominantly rural districts such as Anse-la-Raye, Soufriere, Choiseul, and Micoud (43.6%) have exhibited prevalence rates for poverty in excess of 35 percent (Saint Lucia Country Poverty Assessment 2006/2006 Volume 1).

Poor and indigent (people whose daily average consumption is too low to guarantee adequate nutrition to maintain good bodily health) population frequencies are presented in Table 4.15.

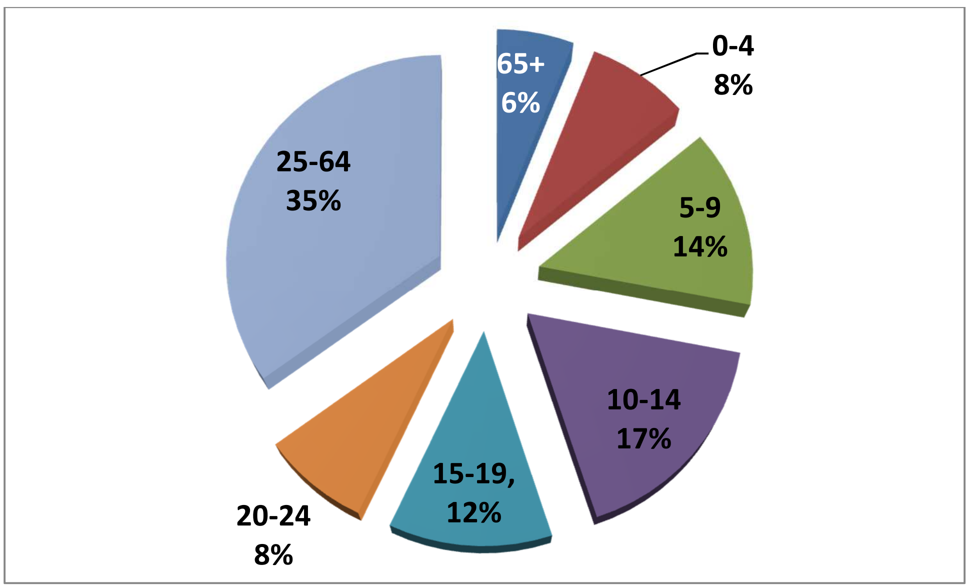
**Table 4.15: Indigence, Poverty and Inequality in Saint Lucia (2005-2006)** (Source: Saint Lucia Country Poverty Assessment 2006/2006 Volume 1)

| Segment of the population | Prevalence (%) |
|---|---|
| Poor Households | 21.4 |
| Poor Population | 28.8 |
| Indigent Households | 1.2 |
| Indigent Population | 1.6 |

In regards to the age distribution of persons living below the poverty line in Saint Lucia, the proportion is disproportionately young. Children aged 0 - 14 represented ~ 40 percent of all poor persons, while the elderly aged 65 years and above, represented ~7 percent of the poor population. Figure 4.22 shows the distribution of the poor by age group (Saint Lucia Country Poverty Assessment 2006/2006 Volume 1; UNICEF, 2012).

The long term consequences for indigent children in Anse- la-Raye, Vieux Fort and Micoud and for poor children in other communities include negative impacts on their self-esteem, their physical and intellectual development and their ability to access and benefit from educational and other opportunities, and ultimately their life chances (Saint Lucia Country Poverty Assessment 2006/2006 Volume 1; UNICEF, 2012).

**Figure 4.22: Distribution of Poor Population by Age Groups in Saint Lucia** (Source: Saint Lucia Country Poverty Assessment 2006/2006 Volume 1)




Gender also plays a role in the poverty dynamics of vulnerable groups (Alston et al., 2013). Notwithstanding the recent overall decline in fertility rates, there are pockets of poor women in the population that still evince high levels of fertility. These women are often the victims of chronic or inter-generational poverty. They are usually educated to primary school level only, lack employable skills and face bleak economic prospects. Poverty impels the poor woman into casual relationships in an attempt to acquire material gain and sustenance. Micoud, Vieux Fort and Sub-Urban Castries have the largest proportions of adult females (15 years and over) who were classified as indigent (Saint Lucia Country Poverty Assessment 2006/2006 Volume 1; UNICEF, 2012).

It is widely believed that the precipitous decline of the banana industry and the shrinking of the export-oriented light manufacturing and assembly sector created severe unemployment. Under pressure from large banana producers in Latin America, the European Union has been gradually dismantling preferential trade barriers over the past decade or so. Successive tariff reductions, which were initially put in place to protect Britain's former colonies, have hit the Saint Lucia severely. In the early 90s, Saint Lucia controlled about 40% of the UK conventional banana market. Today, the share is in single figures. Along with increased competition, banana farmers in Saint Lucia have had to contend with lower prices due to over-supply on the international market. Changes to the European Marketing Regime, the 2008 Global Financial Crisis, and Hurricane Tomas in 2010 all led to the erosion of Saint Lucia's access to the UK markets, enjoyed since 1975 (Panosian, 2013). This was followed by an outbreak of black sigatoka, a leaf spot disease caused by ascomycete fungus. About two-thirds of farms in St Lucia were destroyed as a result.

Climate-related hazards exacerbate other stressors, often with negative outcomes for livelihoods, especially for people living in poverty. The following interactions (Olsen et al., 2014) are typical:

1. Climate-related hazards, including subtle shifts and trends to extreme events, affect poor people's lives directly through impacts on livelihoods, such as losses in crop yields, destroyed homes, food insecurity, and loss of sense of place, and indirectly through inaccessibility to food and increased food prices;
2. Changing climate trends lead to shifts in rural livelihoods with mixed outcomes, such as from crop-based to hybrid livestock-based livelihoods or to wage labor in urban employment;
3. Urban and rural transient poor who face multiple deprivations slide into chronic poverty as a result of extreme events, or a series of events, when unable to rebuild their eroded assets;
4. Many events that affect poor people are weather-related and remain unrecognized by standard climate observations in many low-income countries as Saint Lucia owing to short time series and geographically sparse, aggregated, or partial data (short periods of extreme temperature, minor changes in the distribution of rainfall, and strong wind events), thereby inhibiting detection and attribution;
5. Existing gender inequalities are increased or heightened by climate-related hazards: gendered impacts result from customary and new roles in society, often entailing higher workloads, occupational hazards indoors and outdoors, psychological and emotional distress, and mortality in climate-related disasters;
6. Insurance schemes, social protection programs, and disaster risk reduction may enhance long-term livelihood resilience among poor and marginalized people, if policies address multi-dimensional poverty;
7. Climate-resilient development pathways will have only marginal effects on poverty reduction, unless structural inequalities are addressed and needs for equity among poor and non-poor people are met.

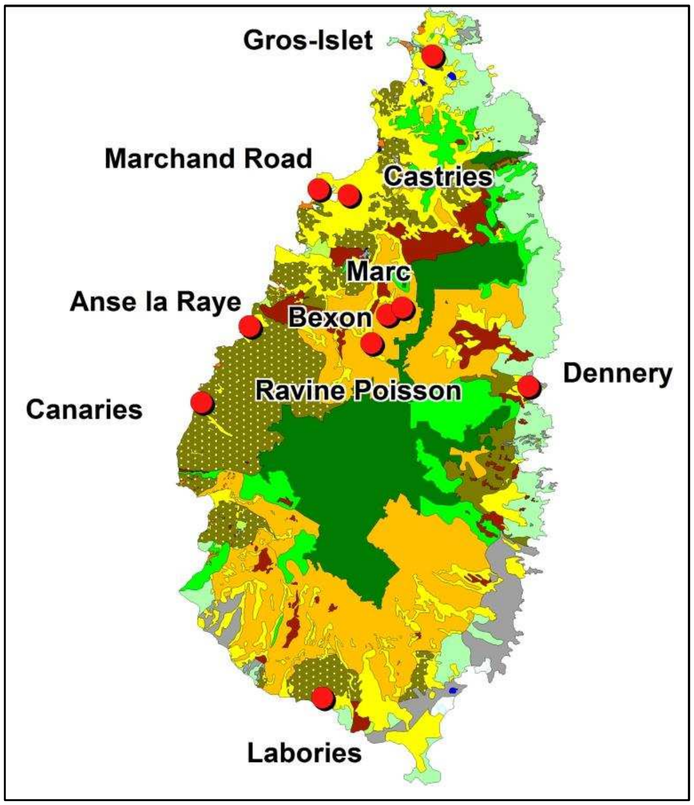
Furthermore, the adverse impacts of weather events and climate change will increasingly threaten and erode basic needs, capabilities, and rights, particularly among poor and disenfranchised people, in turn reshaping their livelihoods. Some livelihoods are directly climate sensitive, such as rain-fed small-holder agriculture, seasonal employment in agriculture, fishing, pastoralism, and tourism. Climate change also affects households dependent on informal livelihoods or wage labor in poor urban settlements, directly through unsafe settlement structures or indirectly through rises in food prices (Adger, 2010; Quinn et al., 2011).

### 4.9.1 Climate Change Impacts on Livelihoods and Poverty

Damage to physical assets due to weather events and climate is common for poor urban and rural settlements, often built in risk-prone floodplains and hillsides susceptible to erosion and landslides during intense rainfalls as is the case in several locations including Dennery Village, Micoud, Gros-Islet, Canaries, Anse La Raye, Vieux Fort, Laborie, Marchand Road, Ravine Poisson and Central Castries in Saint Lucia. During these episodes, homes are destroyed by flood water and sanitation services are disrupted. Loss of physical assets in these poor areas after disasters is often followed by displacement due to loss of property (Hardoy and Pandiella, 2009) (Figure 4.23 and Table 4.16).

These settlements would be subject to a number of factors deriving from climate change and extreme weather conditions. Sea level rise and surges, heavy rainfalls and extremely high winds that usually accompany these stormy conditions will most likely cause severe flooding, loss of crops and livestock, loss of homes not built according to approved building codes, and even loss of lives.

**Figure 4.23: Location of towns and villages where vulnerable groups are located in Saint Lucia**




Erosion of financial assets as a result of climatic stressors includes losses of farm income and jobs and increased costs of living such as higher expenses for purchasing food. Equally important, albeit frequently overlooked, is the damage to human assets as a result of weather events and climate, such as food insecurity, under-nourishment and chronic hunger due to failed crops or spikes in food prices most severely felt among poor urban populations (Morton, 2007; Hertel and Rosch, 2010; Alderman, 2010; Alston, 2011).

Future climate change will continue to affect poor people in rural and urban areas in SIDS such as Saint Lucia, further alter their livelihoods and make efforts to reduce poverty more difficult. Anticipated impacts on the poor and vulnerable to climate change are expected to interact with multiple stressors, most notably social vulnerability, low adaptive capacity and subsistence constraints under chronic poverty, weak institutional support, lower levels of education, population increases and natural resource dependence (Iglesias et al.,2011; Skoufias et al., 2011).

**Table 4.16: Towns and villages that are likely to be affected by sea level rise and storm surges in Saint Lucia**

| Villages | Sea Level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.38 | 0.47 | 0.82 | 0.90 | 2.00 | 2.47 | 2.91 | 5.40 | 5.87 | 6.31 |
| **Anse La Raye** | - | - | - | - | - | x | x | x | x | x |
| **Bexon** | - | - | - | - | - | - | - | - | - | - |
| **Canaries** | - | - | - | - | - | - | x | x | x | x |
| **Central Castries** | - | - | - | x | x | x | x | x | x | x |
| **Dennery** | - | - | - | x | x | x | x | x | x | x |
| **Gros-Islet** | x | x | x | x | x | x | x | x | x | x |
| **Laborie** | - | - | - | - | x | x | x | x | x | x |
| **Marc** | - | - | - | - | - | - | - | - | - | - |
| **Marchand Road** | - | - | - | x | x | x | x | x | x | x |
| **Ravine Poisson** | - | - | - | - | - | - | - | - | - | - |

### 4.9.2 Climate Change Adaptation for Vulnerable Groups

Climate change will slow down the pace of poverty reduction, jeopardize sustainable development, and undermine food security (Skoufias et al., 2011b). Already poor and food insecure regions will continue to be disproportionately affected into the future. Less endowed countries such as Saint Lucia will experience declining adaptive capacity which will hamper development (Skoufias et al., 2011; Iglesias et al., 2011; Pielke et al., 2007).

Public and private insurance systems have been proposed by the World Bank and UNFCCC as an adaptation strategy to reduce, share, and spread climate change-induced risk and smooth consumption, especially among poor households (Mechler et al., 2006; Hertel and Rosch, 2010; Stern, 2009). Formal insurance schemes can potentially provide a way out of poverty traps (Benson et al., 2012) caused by a household's process to rebuild assets after climate shocks over years. Given the multiple challenges at the climate-poverty-development nexus, debates increasingly focus on transforming the development pathways themselves toward greater social and environmental sustainability, equity, resilience, and justice, calling for a fundamental shift toward near- and long-term climate-resilient development pathways (UNDP, 2011).

Other adaptation measures that may be deployed to protect vulnerable groups from the adverse effects of climate change and sea level rises would include, but not limited to (NEMO-Personal Communication):

1. Early warning systems that would alert these vulnerable groups to weather impending disasters so that they can secure their meagre belongings (homestead, crops, animals) including women, children and the elderly;

2. Provision for the delivery of food and clothing and even medicines and medical equipment where required during weather-induced disasters to ensure the safety and health of the affected peoples;
3. Provision of temporary shelters (schools, churches, community centres…) during heat waves for members of vulnerable groups (asthmatics…) that may be at risk to heat stroke and cardiovascular and cerebral attacks;
4. Restoration of proper hygienic conditions (overflows from pit latrines…) and supply of adequately treated water for domestic uses (cooking, bathing….);
5. Psychosocial counselling to comfort vulnerable peoples who may be overwhelmed by the climate disaster.

As for adaptation measures, looking at the future (2040-2069 and 2081-2100), the Government of Saint Lucia should vigorously pursue funding from international bi-lateral and multi-lateral donor agencies (Adaptation Fund, Green Climate Fund…) so as to design and implement further adaptation measures that would lessen the burden of the adverse effects of future climate change and climate-driven sea level rise, including, but not limited to:

1. Sensitization and education with respect to the potential impacts of climate change on their communities;
2. The strict adherence to the Government-recommended building codes so as to secure their households against future adverse climate events;
3. The promotion of the practice of proper hygiene, water quality, proper toilets, and an environment that minimizes the proliferation of vectors (mosquitoes, rodents) that cause diseases;
4. Agricultural diversification and modernization so as to avoid over dependence with the negative consequences as with the banana industry;
5. The development of a safety net of income in times of need with a view to protect the groups at risk;
6. Creation of employment through Government-assisted make work programs and the promotion of entrepreneurial initiatives (e.g. handicrafts) that may find a market in the tourism industry;
7. Behaviour change in attitudes to education and training and to health;
8. Local government reform aimed at encouraging fuller participation and involvement of people in their communities.

## 4.10 References


Adger, W.N., 2010. Climate change, human well-being and insecurity. New Political Economy, 15(2), 275-292.

Alderman, H., 2010. Safety nets can help address the risks to nutrition from increasing climate variability; The Journal of Nutrition, 140(Suppl. 1), 148S-152S.

Alston, M. and K. Whittenbury, 2013. Research, Action and Policy: Addressing the Gendered Impacts of Climate Change; Springer Science, Dordrecht, Netherlands, 281 pp.

Amarakoon, D, Chen, A.A. and Taylor, M.A., 2003. Climate variability and patterns of dengue in the Caribbean. AIACC Notes, Vol. 2, No. 2, p8, Assessment of Impacts and Adaptation to Climate Change, International START Secretariat, Washington, DC.

Bárcena, Alicia, Antonio Prado Hugo E. Beteta and Julie Lennox, 2013. Impactos Potenciales del Cambio Climático sobre los Granos Básicos en Centroamérica, CEPAL Publication, 139 p.

Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.

Benson, C., M. Arnold, A. de la Fuente, and R. Mearns, 2012. Financial Innovations for Social and Climate Resilience: Establishing an Evidence Base. Social Resilience and Climate Change Brief, The World Bank, Washington, DC, USA, 2 pp.

Brugère, C. and De Young, C, 2015. Assessing climate change vulnerability in fisheries and aquaculture, FAO Technical Paper No. 597, 98 p.

Calvosa, Chiara, 2010. Livestock and climate change, IFAD Thematic Paper, 20 p.

Cambers, G., 1996. The Impact of Hurricane Luis on the Coastal and Marine Resources of Anguilla: Beach Resources Survey, March 1996. Report prepared for the British Development Division, Overseas Development Administration, Government of the United Kingdom. 92p.

Caribbean Disaster Mitigation Project, 2005.

CARIBSAVE, 2012. Climate Change Risk Profile for Saint Lucia, 21p.

Chadee D.D., Shivnauth B., Rawlins S.C. and Chen A.A., 2007. Climate, mosquito indices and the epidemiology of dengue fever in Trinidad (2002-2004). Ann Trop. Med. Parasitol. Jan., 101 (1): 69-77.

CREDP, 2013. Hydropower Potential Analysis, Saint Lucia, 117 p.

Dairy Australia, 2014. Dealing with Heat Stress in Australian Dairy Herds. Cited on 2014/11/17. Available from: http://www.coolcows.com.au/go-on-alert/thi.htm

Diaz, H and Pulwarty, R. (Editors), 1997. Hurricanes: Climate and Socio-impacts.

Economic Perspectives and Policy, 32(3), 355-385.

Edwards, C., et al., 1997. Historical analysis of drought in the United States. 7th conference on climate variations, 77th AMS annual meeting.

Elbehri, A., 2015. CLIMATE CHANGE AND FOOD SYSTEMS, FAO, 2015, 356p.

FAO (Food and Agriculture Organization of the United Nations), IFAD (International Fund for Agricultural Development) and WFP (World Food Programme). 2013. The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security. Rome..

Ferreira, C., 2002. Gene expression programming in problem solving. Soft Computing and Industry, Springer: 635-653.

Gatrell, Anthony C. and Elliot, Susan J., 2009. Geographies of Health: an introduction, 2nd Ed., Wiley-Blackwell, Chichester, West Sussex, UK, 282 p.

GEF_IWCAM Project, 2008. Towards the Preparation of an Integrated Water Resources Management (IWRM) Plan – Roadmap Saint Lucia, 97 p.

Government of Saint Lucia, 2015. Review of the Economy, 2015, 122 p.

Government of Saint Lucia, 2002. The National Climate Change Policy and Action Plan (NCCPAP).

Government of Saint Lucia, 2011. Second National Communication on Climate Change for Saint Lucia, 2011, 244 p.

Grinsted, A., Moore, J. C. and Jevrejeva, S., 2009. Climate. Dynamics: 34, 461–472.

Haines, A., McMichael A.J. and Epstein P.R., 2000. Environment and health: 2. Global change and health. Canadian Medical Association Journal, 163, 729-734.

Hardoy, J. and G. Pandiella, 2009. Urban poverty and vulnerability to climate change in Latin America. Environment and Urbanization, 21(1), 203-224.

Hertel, T.W., M.B. Burke, and D.B. Lobell, 2010. The poverty implications of climate induced crop yield changes by 2030. Global Environmental Change, 20(4), 577-585.

Hertel, T.W. and S.D. Rosch, 2010. Climate change, agriculture, and poverty. Applied

Heslop-Thomas, C., Baily, W., Amarakoon, D., Chen, A., Rawlins, S., Chadee, D.D., Crosbourne, R., Owino, A., Polson, K., Rhoden, C., Stennet, R. and Taylor, M., 2008. Vulnerability to Dengue Fever in Jamaica. In: Leary N., Conde, C., Kulkarni J., Nyong, A. and Pulhin, J. (Eds.) (2009); Climate Change and Vulnerability. Earthscan, UK, 431 p.

Horton, R. et al., 2008. Sea level rise projections from current generation CGCMs based on the semi empirical method. Geophys. Res. Lett. 35.

IADB, 2013. Private Sector Assessment of Saint Lucia, 33p.

Iglesias, A., S. Quiroga, and A. Diz, 2011. Looking into the future of agriculture in a changing climate. European Review of Agricultural Economics, 38(3), 427-447.

IPCC Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

IPCC, 2012b. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.)]; Cambridge University Press, Cambridge, UK and New York, NY, USA, 582 pp.

IPCC, 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

IPCC, 2007. Climate Change, 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

IPCC, 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

James, C., 2001. National Report of Saint Lucia, Fisheries Department, 3 p.

Jevrejeva, S., Moore, J. C. & Grinsted, A., 2010. Geophys. Res. Lett.doi:10.1029 /2010GL042947.

Leary N., Adejuwon A., Barros V., Burton I., Kulkarni J. and Lasco R. (Eds.), 2008b. Climate Change and Adaptation, Earthscan, London, UK, 384 p.

Leary N., Conde C., Kulkarni J., Nyong A. and Pulhin J. (Eds.), 2008. Climate Change and Vulnerability, Earthscan, London, UK, 431 p.

Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.

Lindsay S. W. Birley, M.H., 1996. Climate change and malaria transmission. Annals of Tropical Medicine and Parasitology, 90, 573-588.

Mangal, Henry, 2009. Final Report On Best Practices for Youth in Agriculture: The Barbados, Grenada & Saint Lucia Experience Submitted to the Co-ordinator of the United Nations Development Programme (UNDP) Office for Barbados and the Organisation of Eastern Caribbean States. 15th September, 2009.

Martens, P., 1996. Health and Climate Change; modelling the impacts of global warming and ozone depletion, Earthscan Publication, London, UK.

Maurice, Neranda, John Calixte and Joralia St. Louis, 2010. Report on the Vulnerability and adaptation to Climate Change in Saint Lucia's Financial Services Sector.

McKee, T. B., et al., 1993. The relationship of drought frequency and duration to time scales. Proceedings of the 8th Conference on Applied Climatology, American Meteorological Society Boston, MA, USA.

McSweeney C., M. New and G. Lizcano, 2009. UNDP Climate Change Country Profiles Documentation: Draft Report: 18 p.

McSweeney, C., M. New, G. Lizcano, and X. Lu, 2010. The UNDP Climate Change Country Profiles: Improving the Accessibility of Observed and Projected Climate Information for Studies of Climate Change in Developing Countries; Bulletin Of the American Meteorological Society, February 2010:157-166.

Mechler, R., J. Linnerooth-Bayer, and D. Peppiatt, 2006. Micro insurance for Natural Disaster Risks in Developing Countries. ProVention Consortium, Geneva, Switzerland, in collaboration with the International Institute of Applied Systems Analysis (IIASA), Laxenburg, Austria, 31 pp.

Morton, J.F., 2007. The impact of climate change on smallholder and subsistence agriculture. Proceedings of the National Academy of Sciences of the United States of America, 104(50), 19680-19685.

MRAG, 2010. Monitoring the Vulnerability and Adaptation of Pacific Coastal Fisheries to Climate Change, 85 p.

Nash, J. E. and J. V. Sutcliffe, 1970. "River flow forecasting through conceptual models part I - A discussion of principles." Journal of Hydrology 10(3): 282-290.

Olsson, L., M. Opondo, P. Tschakert, A. Agrawal, S.H. Eriksen, S. Ma, L.N. Perch, and S.A. Zakieldeen, 2014. Livelihoods and poverty. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.

Olsson, L., M. Opondo, P. Tschakert, A. Agrawal, S.H. Eriksen, S. Ma, L.N. Perch, and S.A. Zakieldeen, 2014. Livelihoods and poverty. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N.

Taylor, M.A., Chen, A., Rawlins, S. Heslop-Thomas, C., Amarakoon, D., Baily, W., Chadee, D.D., Huntley, S., Rhoden, C. and Stennet (2008). Adapting to Dengue Risk in the Caribbean. In: Leary N., Adejuwon A., Barros V., Burton I., Kulkarni J. and Lasco R. (Eds.), 2008, Climate Change and Adaptation; Earthscan, London, UK, 384 p.

Pierre-Nathoniel, D, 2010; SPACC-Implementation of Adaptation Measures in Coastal zones Project: Northern Sub-Continent Critical Infrastructure in the Castries Area, Renovation and Retrofitting of the Marchand Community Centre.

Nature, 445, 597-598.

Panosian, K., 2013. The Decline of the Saint Lucian Banana Industry.

Pielke Jr, R., G. Prims, S. Rayner, and D. Sarewitz, 2007. Lifting the taboo on adaptation.

Rahmstorf, S., 2007. A semi-empirical approach to projecting future sea level rise: Science 315: 368.

Quinn, C.H., G. Ziervogel, A. Taylor, T. Takama, and F. Thomalla, 2011. Coping with multiple stresses in rural South Africa. Ecology and Society, 16 (3), 2, www.ecology and society.org/vol16/iss3/art2/.

Richardson, Robert B., 2007. Economic Vulnerability to Climate Change for Tourism-Dependent Nations; Sir Arthur Lewis Institute of Social & Economic Studies (SALISES) 8th Annual Conference, The University of the West Indies, St. Augustine, 26-28 March 2007, 23p.

Ritchie, J.T., U. Singh, D.C. Godwin and W.T. Bowen, 1998. Cereal growth, development and yield. In Tsuji, G.Y., G. Hoogenboom and P.K. Thornton (Eds.). Understanding options for agricultural production. Kluwer Academic Publishers, Netherlands, pp 79-88.

Rust, J.M. and T. Rust, 2013. Climate change and livestock production: A review with emphasis on Africa; South African Journal of Animal Science 2013, 43 (No. 3), pp 255-266.

Saint Lucia Financial Services Regulatory Act, 2011. No.13, 48 p.

Saint Lucia Development Bank Act, 2008. No. 12, 35 p.

Saint Lucia National Climate Change Policy and Adaptation Plan, 2003, 33p.

Saint Lucia Country Poverty Assessment 2006/2006 Volume 1: Main Report, 189 p.

Samadianfard, S., 2012. "Gene expression programming analysis of implicit Colebrook–White equation in turbulent flow friction factor calculation." Journal of Petroleum Science and Engineering 92: 48-55.

Sharife, Khadija, 2010. Climate Changes secret weapon.

Shoaib, M., et al., 2015. "Runoff forecasting using hybrid Wavelet Gene Expression Programming (WGEP) approach." Journal of Hydrology 527: 326-344.

Singh, B., C. Obretin and M. Ghasri, 2016. Full V&A-TNC Report for Saint Lucia, 153 p.

Singh, B., K Délusca, C. Obretin and O Daouda, 2014. A Vulnerability and Capacity Assessment of the Food Zone of Barbados, Special Report, 195 p.

Singh, R.H, L.B. Rankine and G. Seepersad 2005. A Review of Agricultural Policies: CASE STUDY OF BARBADOS. Report prepared for the CARICOM Secretariat, 20 p.

Singh, B. and A. El Fouladi, 2007. Detailed Vulnerability Assessment Survey and Storm Surge Modeling of the West Coast of Trinidad: Vessigny to Cap-de-Ville Quadrant. Final Report, Climate Change Institute, Health, Safety and Quality Division: PETROTRIN, Pointe-a-Pierre, Trinidad, February, 2007, 462 p.

Singh, B. and A. El Fouladi,, 2005. Phase 11 Vulnerability Assessment Study for Exploration and Production Development Works in the Oropuche Field. Final Report, Climate Change Institute, Health, Safety and Quality Division: PETROTRIN, Pointe-a-Pierre, Trinidad, February, 2005, 222 p.

Skoufias, E., M. Rabassa, S. Olivieri, and M. Brahmbhatt, 2011b. The Poverty Impacts of Climate Change. Economic Premise Note Series No. 51, Poverty Reduction and Economic Management (PREM) Network of the World Bank, The International Bank for Reconstruction and Development/The World Bank, Washington, DC, USA, 5 pp., siteresources worldbank org / EXTPREMNET / Resources / EP51_v4.pdf.

Smit, B. and Mark W. Skinner, 2002. Adaptation options in agriculture to climate change: a typology. Mitigation and Adaptation Strategies for Global Change 7: 85–114, 2002.

Stafford Smith, M., I. Horrocks, A. Harvey and C. Hamilton, 2011. Rethinking adaptation for a 4°C world. Philosophical Transactions of the Royal Society 369: 196–216.

Stern, N., 2009. Managing Climate Change and Overcoming Poverty: Facing the Realities and Building a Global Agreement. Centre for Climate Change Economics and Policy (CCCEP) and the Grantham Research Institute on Climate Change and the Environment, London, UK, 28 pp.

Taylor, 2008. Saint Lucia: Current Climate, Future Projections

The Impact of Sea Level Rise on Developing Countries, 2007. A Comparative Analysis, February 2007).

The World Travel and Tourism Council (WTTC), 2014, 24 p.

UNDP, 2011. Human Development Report (2011): Sustainability and Equity: A Better Future for All. United Nations Development Programme (UNDP), Palgrave Macmillan, Houndmills, Basingstoke, Hampshire, UK and New York, NY, USA, 185 pp.

UNFCCC, Investment & Financial Flows to address climate change; an update, Technical Paper: 2008, 5.

United Nations Children Fund (UNICEF), 2012. Saint Lucia Multiple Indicator Cluster Survey: monitoring the situation of children and women, 216 p.

Vermeer, M. and Rahmstorf, S., 2009. S. Proc. Natl. Acad. Sci. USA, 106, 21527–21532.

Working Group I Contribution to the IPCC Fifth Assessment Report Climate Change 2013. The Physical Science Basis: Summary for Policymakers, 36 p.

World Bank/LAC, 2012. Climate Change Adaptation Planning in Latin American and Caribbean Cities, 156 p.

World Health Organization (WHO), 2015. Climate change and health. Fact sheet N°266, October 2015.

World Meteorological Organization, 2012. Standardized Precipitation Index User Guide (M. Svoboda, M. Hayes and D. Wood), WMO-No., 1090: Geneva:

Yifru, J., 2015. National Scale landslide Hazard Assessment along the road corridors of Dominica and Saint Lucia, 79 p.

www.agric.nsw.au

http://drought.unl.edu/MonitoringTools/DownloadableSPIProgram.aspx.

http://www.sheepandgoat.com/#!heatstress/

http://www.omafra.gov.on.ca/english/crops/facts/info_tomtemp.htm

http://www.omafra.gov.on.ca/english/crops/facts/info_tomtemp.htm

Banana production battered by market pressures – and the Caribbean weather: http://www.theguardian.com/sustainable-business/future-banana-production-windward-islands.

http://www.atimes.com/atimes/Global-Econonomy/LB26Dj02.html

http://eccb-centralbank.org/About/ leg-agreement.asp, accessed August 2010

## CHAPTER 5. OTHER RELEVANT INFORMATION TO THE ACHIEVEMENT OF THE OBJECTIVES OF THE UNFCCC

### 5.1 OVERVIEW

This chapter provides Other Relevant Information (information considered relevant to achievement of the objectives of the convention) on:

a. Technology Transfer
b. Research and Systematic Observations
c. Education, Training and Public Awareness
d. Capacity Building
e. Information and Networking; and
f. Challenges, Opportunities, Emerging Issues, and Recommendations.

The chapter is expected to capture information on actions undertaken under climate change initiatives as well as other activities of relevance to the national climate change response building upon what was reported in Saint Lucia's SNC.

### 5.2 APPROACH AND METHODOLOGY

In order to gather the required information a number of actions were taken. An inception meeting held with staff of the Sustainable Development & Environment Division (SDED) who form part of the climate change team and other key government officials within the Department of Sustainable Development. A desk review of critical documents was also conducted. Relevant public and private agencies and national experts, were consulted. Stakeholders selected for consultation were:

1. entities with sectoral responsibilities in the areas of adaptation and mitigation,
2. entities which support climate change initiatives in the country and/or region;
3. entities with a relevant education or public awareness role;
4. entities with a capacity to significantly influence the success of proposed initiatives and;
5. entities that stand to benefit from proposed initiatives.

### 5.3 STEPS TAKEN TO INTEGRATE CLIMATE CHANGE CONSIDERATIONS INTO NATIONAL DEVELOPMENT AND POLICY FORMULATION

Saint Lucia has made a number of efforts to mainstream climate change into national development planning and sectoral policy processes through the NC process incorporation National Development Priorities, the its integration in social, economic and environmental policies, plans and strategies, projects and programmes and by establishing requisite institutional arrangements. Information on these efforts are elaborated in the sections below.

#### 5.3.1 Linkages between the NC process and national development priorities

The various components of the NC provide several linkages for integrating climate change considerations in national development planning. The national circumstances chapter summarizes the geography, history, governance, climate, demography, economy and climate response in the country, and ties together the various factors which affect the national approach to development and how they interact with climate change. The Greenhouse Gas Inventory chapter provides information on emissions from GHG sectors based on the UNFCCC guidelines, and identifies key mitigation actions which align with government priorities, provide significant abatement potential and have relatively low barriers to implementation. These include the energy demand sector, electricity generation and transportation, the industrial processes sector, agriculture, land use, land use change and forestry, waste and solvent and other product use. The V&A assessment examines the climate vulnerability of key socio-economic sectors, critical to Saint Lucia's continued economic growth and the well-being of its people. It also identifies measures that can be taken to mitigate risks posed by climate change and adaptation measures which can be implemented.

The NC process, focuses on the required sectoral and national responses to the very significant threat of climate change, in order to assure a sustainable future. It imposes a requirement on sectoral and national planners to evaluate available data and other information and to consider how development can be sustainable in the context of climate change threats. The mitigation and adaptation measures identified in this way are intended to inform national and integrated sectoral development priorities and programming. The data generated in the production of the NC becomes a valuable reference for planners, and is used to justify or defend proposed development initiatives.

Reports are made on all projects, including the NC project, to the Ministry of Finance on activities conducted, resources spent, etc. All resources spent under NC are to be approved by the Ministry of Finance. Through the recommendations emanating from the NC process, a funding for a number of programmes and projects (e.g. PPCR/DVRP) have been sourced and implemented. Some of these are managed by the lead governmental agency for Economic Planning.

### 5.3.2 Efforts to integrate climate change considerations into social, economic and environmental policies and actions

Saint Lucia is a member of the United Nations (UN), Caribbean Community (CARICOM) and the Organisation of Eastern Caribbean States (OECS), and is bound by commitments enshrined in climate-relevant international and regional Conventions and agreements.

The global, regional and national policy environment is described in Section 1.10 of this TNC, and summarized in the box opposite.

#### *5.3.2.1 National Framework for Climate Change*

##### 5.3.2.1.1 National Policy

The regional and international policy imperatives drive the formulation of national and sectoral policies. A number of Saint Lucia's recent policy and strategy documents have now integrated climate change issues and concerns.

Over the years *Budget Addresses* and *Throne Speeches* have addressed climate change issues. Box 5.1 highlights some of these since 2010.

**International** — **Efforts to integrate social, economic & environmental polices and actions**

- United Nations Environment Assembly
- United Nations General Assembly
- United Nations Framework Convention on Climate Change

**Regional** — **Efforts to integrate social, economic & environmental policies and actions**

- CARICOM Revised Treaty of Chagaramas
- St. George's Declaration of Principles for Environmental Sustainability in the OECS (2001, 2006)
- CARICOM Liliendaal Declaration on Climate Change and Development (2009)
- Regional Framework for Achieving Development Resilient to Climate Change Caribbean (2009-2015)
- Implementing the CARICOM Regional Framework for Achieving Development Resilient to Climate Change (2011-2021)
- Caribbean Catastrophe Risk Insurance Facility

**National** — **Efforts to integrate social, economic & environmental policies and actions**

- National Environmental Policy/National Environmental Management Strategy (2015)
- Climate Change Adaptation Policy (2015)
- State of the Environment Report (2015)
- Climate Finance Readiness Programme 2014-2015
- Environmental Management Bill (2014)
- Climate Change Public Education and Awarenss Strategy and Implementation Plan (2014)
- Impact Assessment and National Adaptation Strategy and Action Plan for the Tourism Sector (2015)

**Box 5.1. Climate Change in National Budgeting 2010/11-2017/18[27]**

**2010/11:** ***Climate change, energy security and sustainable development*** were central to Government's policies, and this was substantiated with reference to the installation of three (3) new photo-voltaic or solar-electric units to generate electricity at various locations around the island.

**2012/13:** ***Climate change and water resource management***, where water availability was noted as a resource that will be negatively impacted by climate change in the Caribbean, based on CCCCC research in region. The Prime Minister emphasized the need to put measures in place to improve the business operations of WASCO, repair infrastructure damaged by Hurricane Tomas, address long standing problems with rural water supplies, and encourage households and commercial operations to better manage scarce water resources.

**2012/13:** ***Facilitating energy efficiency,*** where Government provided a tax concession for one year, effective September 2012, to any business house that undertook a comprehensive energy audit of its operations, with a view to improving the energy efficiency of its operations.

**2013/14:** O***pportunities for funding for climate change mitigation and adaptation***, where the Governor General spoke of the reality of climate change and its impacts on Saint Lucia, a small and vulnerable island state, in the context of renewable energy and energy efficiency. She went on to emphasize the need to mitigate the impacts where practicable and adapt to the effects where possible, through among other things, the pursuit of a sustainable energy agenda.

**2014/15:** ***Budget address- debt for nature swaps,*** where an opportunity for debt-for-nature swaps and other funding mechanisms that capitalise on climate change adaptation were identified, and the public informed that the Ministry of Sustainable Development was pursuing such matters.

**2015/16:** ***Advancing Sustainable Development and Fiscal Stability***, where the DVRP project was presented as a mechanism to reduce vulnerability and increase resilience in the long term. The project included Technical Assistance for Improved Assessment and Application of Disaster and Climate Risk Information in Decision-Making, the Climate Adaptation Financing Facility, and the Contingent Emergency Response.

**2017/18:** ***Addressing climate change and Initiatives in energy***, where the Governor General spoke of loss and damage, meeting of targets in Saint Lucia's Nationally Determined Contribution under the 2015 Paris Agreement, engagement of every citizen, and promotion of renewable energy for investment and job creation.

The *National Climate Change Policy and Adaptation Plan* (NCCPAP) (2002) was revised in 2011 and replaced with the *Climate Change Adaptation Policy* (CCAP). The CCAP was endorsed by the Cabinet of Ministers in 2015 and builds on many of the principles and elements of the NCCPAP, including the cross-sectoral approach to adaptation. The CCAP theme "Adapting, one individual, one household, one community, one enterprise and one sector at a time" recognizes the roles of all in society. The CCAP envisions that Saint Lucia and her people, their livelihoods, social systems and environment are resilient to the risks and impacts of climate change, with the following objectives:

1. Creating the strategic direction and process for on–going climate adaptation and resilience-building;
2. Creating the appropriate enabling policy, legislative and institutional environment;
3. Mainstreaming climate change and climate variability into development processes, strategies and plans;
4. Engaging in and supporting capacity and awareness building activities that promote climate change adaptation and mitigation responses;

[27] There was no budget address for the FY 2016/17

5. Providing the necessary incentives and economic instruments for on-going adaptation and resilience-building; and
6. Identifying, establishing and accessing mechanisms for on-going adaptation and resilience-building.

The CCAP recognizes that successfully adapting to climate change involves three interconnected processes:

- **Adaptation Facilitation**, which entails creating the appropriate policy, legislative and institutional environment;
- **Adaptation Financing**, which involves putting in place measures to ensure adequate and predictable financial flows; and
- **Adaptation Implementation**, which entails taking concrete actions on the ground to prepare for or respond to the impacts of climate change.

Many sectoral policies now have climate change issues enshrined (see Box 5.2). Agencies responsible for social transformation, physical planning, tourism, emergency management, agriculture, fisheries and forestry all incorporate climate change into their programmes.

Under the PPCR, a **Strategic Programme for Climate Resilience (SPCR)** Investment Plan was developed and approved, comprising a suite of projects with a climate change adaptation (CCA) focus, representing various sectors, themes, levels and areas of society, involving the public, private sectors and civil society – a "blueprint" for national investment in climate change resilience-building, well into the future (GOSL, 2014). Phase 1 of the PPCR process developed the five year *Strategic Program for Climate Resilience* (SPCR) that aims to build the country's resilience to climate change impacts, by prioritizing the following areas (Ibid.):

1. Human Welfare and Livelihood Protection;
2. Integrated Natural Resource Protection, Conservation and Management to Promote Sustainable Development;
3. Building Resilience through Business Development, Innovation and Productivity Enhancement;
4. Capacity Development/Building and Institutional/ Organizational Strengthening;
5. Reducing Risk to Climate-Related Disasters.

### 1.1 Box 5.2 Sectoral Policies and Strategies with Climate Change considerations enshrined

- National Environment Policy (NEP) and National Environmental Management Strategy (NEMS) (2014)
- Proposed Revised National Land Policy for Saint Lucia (2015)
- National Water Policy for Saint Lucia (NWP) (2004)
- National Emergency Management Plan (2014)
- Coastal Zone Management (CZM) in Saint Lucia: Policy, Guidelines and Selected Projects (2004)
- Towards the Development of a Coastal Zone Management Strategy and Action Plan for Saint Lucia ( 2005)
- Revised 2nd National Biodiversity Strategy and Action Plan (Second NBSAP) (2014)
- Saint Lucia Country Report on the State of Biodiversity for Food and Agriculture (2015)
- Policy Brief. National Agricultural Policy 2009 – 2015 (2009)
- Agricultural Policy Framework and Strategy (2016-2021) Draft Final Report (2016)
- National Action Plan and Strategic Action Plan (NAPSAP) to Combat Desertification and Drought in Saint Lucia (2008)
- Saint Lucia Forests and Lands Resources Department Strategy 2015 to 2025 (2015)
- National Fisheries Management Plan (2013)
- Impact Assessment Report and National Adaptation Strategy and Action Plan NASAP Saint Lucia (2015)
- Policy and Strategy for Environmental Health in Saint Lucia, with a Focus on the Department of Environmental Health (2016 – 2021)

The projects/programs that are approved under the SPCR Investment Plan are being implemented in Phase 2 of the PPCR now underway, along with a wider set of CCA and DRR initiatives, under the rubric of the DVRP. The activities are being implemented using the three modalities (Adaptation Facilitation; Adaptation Implementation and Adaptation Financing) identified in the CCAP (Ibid.).

Outcomes of a regional **Japan-Caribbean Climate Change Partnership (JCCCP) project** include formulation and institutionalization of NAMAs and NAPs for alternative low-emission and climate-resilient technologies that can support energy transformation and adaptation in economic sectors (UNDP, 2015). Work in Saint Lucia will support the design and development of the NAMA to increase renewable energy and energy efficiency solutions and technologies in schools (pers. Comm, SDED, 2017). Saint Lucia's NAP process includes (pers. Comm, SDED, 2017):

- Prioritisation of sector plan development and adaptation actions according to national needs, development priorities and climate vulnerabilities.
- Development of a national adaptation roadmap.
- Development of a NAP and monitoring and evaluation (M&E) plan for adaptation, building on the existing SPCR.
- Development of one sector specific adaptation strategy and investment plan.

Under another initiative with NAP-GSP that will be implemented in parallel with JCCCP-NAP, another prioritised sectoral strategy and action plan will also be developed in 2017.

###### 5.3.2.1.2 Climate Financing

The financing categories and options proposed in the CCAP (GOSL, 2015) are:

1. **A Climate Adaptation Financing Facility CAFF** (funds provided to a Development Bank and Credit Unions, as appropriate, for on-lending to their customers, based on the results of a feasibility study. The Saint Lucia Development Bank (SLDB) has been selected for this financing. The facility is expected to make targeted groups more climate-resilient).
2. **Private sector Financing** (encouragement and incentivisation to finance adaptation interventions such as goods, services and risk management tools such as insurance that reduce vulnerability).
3. **Regional and International Funding** (bilateral and multilateral sources including the UNFCCC framework such as the Adaptation Fund (AF) and the Green Climate Fund (GCF); the Global Environmental Facility (GEF), the Caribbean Development Bank (CDB), as well as other existing and newly emerging sources).
4. **A Climate Adaptation Trust Fund** Government proposed to establish a Climate Adaptation Trust (CAT) Fund as a national funding entity to:
   - develop innovative ways to link international financing sources with national investment strategies aimed at climate adaptation;
   - act as a catalyst to attract investment and to implement a range of alternative financing mechanisms for climate mitigation and adaptation programmes; and
   - provide grants to support climate related interventions, capacity development and institutional strengthening.

A **Caribbean Biodiversity Fund (CBF)** was established as a United Kingdom-based charitable organization, composed of five individual sub-accounts (one for each participating OECS country) of US$2.94 million each, with US$1.44 million from the GEF and the remainder from KfW and The Nature Conservancy (TNC). These sub-accounts will be invested jointly (Ibid.). The inaugural ministerial meeting for the CBF was held in 2016. Bye-laws have been passed and a Board has been appointed (pers. Comm., SDED, 2017). In 2014, Saint Lucia was operationalising the **Saint Lucia National Conservation Fund (NCF)** to undertake biodiversity management activities in the long term, and legislation and Bye-laws had been developed and approved by Cabinet. The NCF is associated with the CBF (pers. Comm. SDED, 2017).The *Feasibility Study for the Establishment of a Dedicated Environmental Fund* (GOSL, 2014) assessed the feasibility of establishing a dedicated **Environmental Fund (EF)** for Saint Lucia. The study supported establishment of a dedicated EF for Saint Lucia to supplement existing government support to Ministries, Departments and Agencies or subventions to NGOs. The government is now considering the Environmental Fund as a window under the NCF (pers. Comm., SDED, 2017).

***Proposed Focus areas for Environmental Fund***

- Effects of climate change
- Air quality
- Pollution; particularly waste management and solid waste
- Land use, degradation and deforestation
- Habitat & resource loss

Funds for the **Climate Adaptation Financing Facility (CAFF)** identified under the CCAP have been provided to the Saint Lucia Development Bank, and the facility became operational in the first quarter of 2017, with an introductory rate between four and seven point five percent. Loan terms are up to 10 years, but other conditions are similar to other commercial loans, and the loans must be secured in accordance with normal practice (i.e. guarantees, bill of sale, lien, hypothec). Potential investments under CAFF are tabulated below.

**Table 5.1: Loan Categories for Climate Adaptation Financing Facility-Saint Lucia**

| **Agriculture** | **Housing** | **Manufacturing, Tourism & Services** |
|---|---|---|
| • Drought-resistant crops<br>• Rain water harvesting<br>• Water holding facilities<br>• Drainage<br>• Soil stabilization<br>• Retrofitting of Greenhouses<br>• Retrofitting of Storage Facilities | • Guttering and fittings<br>• Retaining walls<br>• Drainage<br>• Rain water harvesting<br>• Water holding facilities<br>• Retrofitting of roofs<br>• Retrofitting of houses<br>• Structural reinforcement | • Energy efficient equipment<br>• Rain water harvesting<br>• Water holding facilities<br>• Alternative technologies<br>• Retrofitting of Facilities |

Concern was expressed by a few of the stakeholders engaged that intended beneficiaries such as small farmers, already on the margin, may be unable to access the funds under the terms and conditions set (Pers. Comms., Ministry of Agriculture, 2017). Fishers have been encouraged by the Department of Fisheries to engage in value added activity but many are risk averse or have been unable to access available funds (Pers. Comms., Department of Fisheries, 2017). The SLDB is optimistic about uptake as there has been interest from all sectors. See Table 5.1 for loan categories. SLDB has had experience with a similar line of credit for renewable energy and other green projects from the CARICOM Development Fund (CDF), and prospective borrowers indicated that the interest rate at between 6% and 8% was too high (pers. Comm., SLDB, 2017).

Saint Lucia participated in the **Climate Finance Readiness Programme** which assisted members of the Caribbean Development Bank (CDB) to assess the status of climate change programming and their level of preparedness for accessing climate change financing (Charles, 2015). The programme identified some of the impediments to effective climate change programming and worked with the Economic Planning Department as the National Designated Authority for the Green Climate Find to develop a Climate Finance Readiness Action Plan to address those. National agencies proposed to be National Implementing Entities (NIE) must meet certain fiduciary requirements in order to access the GCF. The selected entity will require technical assistance to satisfy accreditation criteria (Charles 2015).

#### 5.3.2.1.3 Insurance against Climate Change Impacts

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a regional catastrophe fund for Caribbean and Central American governments, designed to limit the financial impact of devastating hurricanes, earthquakes and extreme rainfall events by quickly providing financial liquidity when a policy is triggered. The facility was originally structured as an insurance instrument to provide coverage in the event of losses from tropical cyclones or earthquakes but in 2013 CCRIF began offering coverage for excess rainfall as well (CCRIF, 2015).

**Box 5.3. CCRIF payments to Saint Lucia between 2007 and 2016**
Source: CCRIF SPC, 2016. About Us. Downloaded from http://www.ccrif.org/content/about-us

| Event | Payout (US$) |
|---|---|
| Tropical Cyclone Tomas, 2010 | 3,241,613 |
| Tropical Cyclone Matthew, 2016 (Excess rainfall policy) | 3,781,788 |
| **Total (2007 – 2016)** | **7,023,401** |

CCRIF offers parametric insurance which disburses funds based on the occurrence of a pre-defined level of hazard and impact without having to wait for an on-site loss assessment. Payouts are made on the basis of exceeding a pre-established trigger event loss which is estimated in a model in which hazard inputs are generated (wind speed and storm surge in the case of tropical cyclones, ground shaking for earthquakes and rainfall amount for excess rainfall events) from independently-provided input data. These hazard levels are then applied to pre-defined government exposure to produce a loss estimate. Policies are triggered if the modelled loss is above a minimum value sspecified in the contract. Payouts above the trigger level increase with the level of modelled loss, up to a pre-defined coverage limit (Ibid.). CCRIF payments to Saint Lucia over 2010 to 2016 are provided in Box 5.3.

The Livelihood Protection Policy (LPP) (available through various financial institutions including credit unions) offers insurance to individuals. It is designed to help protect the livelihoods of vulnerable low-income individuals by providing swift un-bureaucratic cash payouts following extreme weather events (i.e. high wind speed and heavy rainfall). This support is intended to reduce poverty and vulnerability by enabling these groups to recover quickly following a disaster (EC Global, 2012). Small farmers and other individuals in Saint Lucia benefited from quick insurance payouts on their LPPs in the wake of Tropical Cyclone Matthew; thirty-one individuals received payouts totaling US$102,000. This micro-insurance product was developed under the Climate Risk Adaptation and Insurance in the Caribbean Project implemented by the Munich Climate Insurance Initiative (MCII) in collaboration with CCRIF, MicroEnsure and Munich Re (CARICOM, 2016). This programme has not been very successful as the *modus operandi* causes farmer disenchantment, and they stop paying premiums after a few years of disaster avoidance (pers. Comm., Ministry of Agriculture, 2017).

Building insurance available to the general public does not adequately integrate climate change considerations. Premiums have been decreasing, and climate-vulnerable buildings that previously would not have been insured (such as a building on the beach) are now being insured at premiums that are considered to be too low. The Insurance Council is currently in discussion with the regulator regarding the setting of minimum rates (pers. Comm., Insurance Council, 2017).

The Development Policy Loan with a Catastrophe Deferred Drawdown Option (Cat DDO) is a contingent credit line that provides immediate liquidity to International Bank for Reconstruction and Development (IBRD) member countries in the aftermath of a natural disaster, as part of a broad spectrum of risk financing instruments available from the World Bank Group to help borrowers plan efficient responses to natural disasters. The Cat DDO gives a government immediate access to funds after a natural disaster at a time when liquidity constraints are usually highest, and serves as bridge financing while mobilizing funds from other sources. It is most effective as part of a broader risk management strategy in countries highly exposed to natural disasters (World Bank Treasury, 2011). Saint Lucia has taken steps to participate in this facility.

#### *5.3.2.2 Research and Systematic Observation*

The CCAP (GOSL, 2015) included Research and Systematic Observation as a facilitating adaptation measure required for adaptation measures to be implemented effectively and efficiently. The St. George's Declaration of Principles for Environmental Sustainability commits governments of the Organisation of Eastern Caribbean States (OECS) to ensure that scientific and technical knowledge on environmental management is adequate for informed decision-making. A Draft National Policy on Environmental Research and Monitoring, Data Management and Research Procedures, and the Human and other Institutional Resource needs for Environmental Research, Monitoring and Data Management was developed in 2008, which included climate change as a priority area for research. The draft policy goals were to (Simmons and Associates, 2008):

1. ensure that Saint Lucia is equipped with environmental research management systems that can provide rigorous, scientifically-based information to improve the process of decision making, thereby ensuring that national economic, political and social development will occur in a sustainable manner; and
2. increase knowledge of the environment and of the biological, physical, social, economic and cultural factors that affect it in order to establish and maintain a healthy environment that sustains nature and people.

The NEP/NEMS (2014) includes knowledge as one of its values, noting that environmental management must be based on sound research and information, with appropriate monitoring of issues, trends and impacts. It notes further that the Draft National Policy on Environmental Research and Monitoring, Data Management and Research Procedures, and the Human and other Institutional Resource needs for Environmental Research, Monitoring and Data Management (2008) is now in need of review.

##### 5.3.2.2.1 Energy Policy and Strategy

Global climate commitments require Saint Lucia to develop energy policy and undertake energy projects to reduce GHG and carbon emissions. The *Saint Lucia Sustainable Energy Plan (2001)* set out the energy sector baseline and projections through 2010, and alternatives through demand reductions and renewable energy systems. The revised *Saint Lucia National Energy Policy (GOSL, 2010)* sets out the government's proposed approach to enhance security of energy supply and use for all sectors of the economy. A key objective of the National Energy Policy is to create an enabling regulatory and institutional environment for the introduction of indigenous renewable energy to the national energy mix for increased energy security and independence, and to take fullest advantage of opportunities under the Clean Development Mechanism of the Kyoto Protocol and any facilities aimed at achieving reductions in greenhouse gas emissions.

REDiv is guided by the 2010 policy which targets a 30% contribution by renewable energy to the energy mix by 2020. However, in 2014, at the “Creating Climate Wealth Summit” hosted by Sir Richard Branson’s Carbon War Room, the then Prime Minister of Saint Lucia, Dr. Kenny D. Anthony signed a Memorandum of Understanding that formalised the island’s participation in the Ten Island Challenge. Following the signing, the Prime Minister requested that the island's renewable energy generation target be increased from 20% to 35% by 2020. REDiv has implemented a number of strategies in order to meet this target. One major accomplishment is the *Developing the Saint Lucia Energy Roadmap* (Torbert *et al*, 2016), published in 2016, which is a summary of the overall *National Energy Transition Strategy (NETS)* (Torbert *et al*, 2016):

The three primary goals of the National Energy Transition Strategy (NETS) in order of importance are:

- Maintained or improved reliability
- Cost containment
- Energy independence (including environmental protection).

The Roadmap recommended a portfolio of solar, wind, energy storage, energy efficiency, and existing diesel generation, to reduce diesel expenditures by 42 percent and carbon emissions by 40 percent by the year 2025. The scenario modeling indicated that the highest degree of utility ownership facilitated the lowest customer rates, and they concluded that future policy directives should be focused on utility ownership, only enabling IPPs in cases where the latter adds more value and less risk to the system, such as in highly specialized ventures such as geothermal. They further noted that under the present electricity tariff structure, energy efficiency on the customer-side negatively impacts the utility’s bottom line, and that other regulatory methods such as decoupling sales from revenues (with performance guarantees) that encourage consumer energy efficiency while guaranteeing profitability to the utility should be explored. In order to leverage the maximum benefit from indigenous, renewable resources, the underlying policy framework must be aligned, robust, and clear (Ibid.).

Equipment and components for the sole purpose of harnessing renewable energy qualify for concessions per Cabinet Conclusion of 1999, which granted 100% waiver of all import duties on systems.

##### 5.3.2.2.2 Energy Legislation

Primary legislation and several pieces of secondary law consistent with the NETS requirements have been drafted. A consultant will be engaged to ensure consistency across these various Bills, but critical pieces of proposed legislation (that is the electricity supply services (ESS) bill, the NURC, appeals and dispute regulations) may be passed by the end of 2017 (Pers. Comms. REDiv, 2017).

- The *Electricity Supply (Amendment) Act No 2 of 2016* amended the *Electricity Supply Act Cap. 9.02 (No 27 of 1964)* to provide for regulation of electricity supply service by the National Utilities Regulatory Commission.
- The *National Utilities Regulatory Commission Act Saint Lucia No 3 of 2016* established the National Utilities Regulatory Commission.
- The *Energy Efficiency Bill* presently in draft would promote energy efficiency and energy conservation.
- The *Geothermal Resources Development Bill* currently in draft would vest rights to all geothermal resources in the Crown, and assign specified responsibilities to the Minister.

The Bureau of Standards has undertaken work on labelling and standards on air conditioning, compact fluorescents and refrigeration, and proposes to develop national standards for electrical appliances, and PV and LED lighting. The energy efficiency aspects of the Building Code are being developed by CROSQ.

The Bureau of Standards is currently assisting the Ministry of Transport with development of standards for vehicle performance. National standards for diesel and gas were developed several years ago. Leaded gasoline was phased out after a policy decision in that regard. The Ministry is formulating a transport policy with World Bank support. Over 2016 the Ministry has been working on vehicle importation standards.

#### *5.3.2.3 Projects*

Section 1.12 of this report describes regional and national projects implemented over the period 2010 to 2017 that support the climate change agenda. Some of these projects commenced before the period, and others are still in the implementation phase. Annex 2 also provides a list and description of major climate change projects since the second national communication.

### 5.3.3 Enhanced institutional arrangements to create a sustainable NC process

Saint Lucia has been producing NC since 2001. The SDED, as the executing agency, houses the **Project Coordination Unit** which consists of a Project Coordinator and a Project Assistant on a full time basis. A part time accountant is also hired under the project. This core team is provided with backstopping support by the Climate Change Team within the Division, and additional administrative support is provided through the Division as needed. The Ministry's Accountant also provides accounting oversight of financial reports and use of funds under the NC (Maurice-George, 2017). The development of the NC including the greenhouse gas inventory and vulnerability assessments is sector driven, as it is based on sectoral information.

In 1998, the Cabinet of Ministers established the **National Climate Change Committee** (NCCC) as an inter-agency coordinating mechanism to facilitate climate change adaptation (SEDE et al, 2015). See Section 1.11.1 and Table 1.6 for further information regarding the NCCC.

The regularity of meetings of the NCCC is adversely influenced by capacity constraints within key agencies, as implementation activities compete for the attention of a limited number of personnel. Accessing funds to host NCCC meetings is a further challenge. The DVRP/PPCR offers the opportunity to bring the coordinating body together to discuss and synergize activities contributing to the implementation of the SPCR (Ibid.). Ideally though, the NCCC should meet more strategically. Timing of meetings should be more reflective of the need to prepare and respond to critical climate change events and activities, whether global (such as the COP) or national, to obtain views and to keep members informed.

The mission statement of the *Strategic Plan (2013 – 2017) for the Ministry for Sustainable Development, Energy, Science and Technology (2013)* was "To achieve sustainable development on a platform of integrated and effective environmental management in order that socio-cultural, economic and environmental goals are realised and collectively contribute to a continuous improvement in the quality of life of all Saint Lucians". Intended outcomes were:

1. An integrated and evidenced-based approach to governance in the area of sustainable development
2. Improved management of the natural environment, with a focus on adapting to, and mitigating the impacts of, climate change
3. Reduction and mitigation of the negative impacts of human activity on the natural environment and human health
4. Demonstration of the value of the green economy and other related concepts to sustainable development, with an emphasis on livelihoods and the quality of life of citizens

**Box 5.4. Composition of National Coordinating Committee for SDGs (NCCSDG)**

1. Ministry of Education, Innovation, Gender Relations and Sustainable Development
    a. Department of Sustainable Development (Chair)
    b. Department of Education
2. Department of Economic Development Transport and Civil Aviation (co-chair)
3. Department of Finance
4. Central Statistics Office,
5. Ministry of Equity, Social Justice, Empowerment, Youth Development, Sports and Local Government
6. Office of the Prime Minister
7. Department of External Affairs
8. Ministry for Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives
9. Non-Governmental Organisation/Civil Society (to be appointed by Cabinet on a rotational basis at intervals to be indicated in the Terms of Reference)
10. Sir Arthur Lewis Community College

5. Significant progress towards the provision of reliable and affordable energy, potable water and wastewater technologies for sustainable development
6. Enhanced application of science, technology and innovation in support of national socio-economic development and environmental management across sectors
7. Enhanced and improved knowledge, attitudes and behaviors among all sectors
8. A rationalized structure for efficient and optimal delivery of government services in pursuit of sustainable development objectives.

The Strategic Plan guided the work of the Ministry which included the Forestry Department, the Biodiversity Office, the Energy Unit, the Sustainable Development & Environment Division, the Piton Management Area office as well as the Water Resource Management Agency, from 2013 to 2016, until the various portfolios were reassigned under the new government. When the government changed in 2016, there was some re-shuffling of portfolios and SDED now falls within the Ministry of Education, Innovation, Gender Relations and Sustainable Development. SDED, which retains responsibility for coordinating the NC, manages the following programme areas:

1. Climate change
2. Coastal zone
3. Chemicals
4. Biodiversity

The **National Environmental Commission (NEC)**, established in 2007, is an advisory body to the Cabinet of Ministers for environmental management in Saint Lucia. The NEC is expected to:

1. address issues including the approval, licensing, permitting, monitoring and enforcement of activities that impact upon the environment or natural resources.
2. assist in the rationalisation and harmonisation of existing institutional structures for environmental management in Saint Lucia. This includes facilitating and supporting the work of other Cabinet appointed Committees including the NCCC.

The existence of the NEC offers some opportunity for fostering increased inter-agency collaboration, better sensitising senior-level public sector decision-makers and facilitating inter- sectoral integration on climate change (Pierre-Nathoniel, 2010) NEC operations were suspended in 2016, to defer to a broader Sustainable Development Council under consideration at that time, but never operationalized. However, Cabinet in early 2017 approved establishment of a **National Coordinating Committee for SDGs (SDGNCC)** (see composition in Box 5.4). The SDGNCC will communicate with relevant line Ministries/agencies without prejudice to the legal authority or responsibility of these agencies with a mandate to include the following:

1. Inform and sensitize on the critical international processes which will impact on national development;
2. Mobilize resources to spearhead roadmap development, data collection, public consultations, monitoring and evaluations;
3. Determine responsibilities for monitoring and collecting data;
4. Identify critical capacity needs to fulfill reporting and data collection requirements;
5. Provide the Ministers with historical information on the systems that were in place for monitoring and reporting of MDGs;
6. Advise/identify on how various projects and activities link to the SDGs;
7. Keep abreast of international and regional processes which may influence implementation;
8. Identify the processes by which implementation can be sustained; and
9. Recommend ways to align the processes with other national processes.

The *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project will address capacity limitations identified in the National Capacity Self-Assessment (NCSA) project, and will implement tools for improved reporting and monitoring. The project will strengthen environmental information systems and better integrate environmental concerns and the value of ecosystems into its broader development frameworks (GOSL, date unknown).

*The OECS Institutional Strengthening for Environmental Management: A Framework for Integrated Environmental Management in Saint Lucia (FIEM)* recommended that GOSL adapt an *Environmental Management Bill (EMB)* based on the OECS Environmental Frame Legislation. A draft bill was produced which, among other things, establishes a Department of Environment to have overarching responsibility for environmental management, consistent with best practice (GOSL, 2014). Further amendments to the Environmental Management Bill (2014) will be undertaken under the OECS GCCA project, to incorporate, among others, references to the NEC and the Department of Sustainable Development (pers. Comm, SDED, 2017). Passage of the proposed legislation was to coincide with the establishment of a dedicated Environmental Fund (EF) to be established under the Act.

SDED also plans to draft a Climate Change Bill to support implementation and compliance with the country's many international obligations in the area of climate change, in particular, the Paris Agreement (pers. Comm., SDED, 2017).

### 5.3.4 Indicators to evaluate the impacts of the NC process

A culture of results-base management is to be inculcated, to among other things, measure the impact of climate change and climate variability. GOSL (2014) promoted improved monitoring indicators and targets to assist sector agencies to track their progress toward the results identified in their various strategies, and most of the sectoral strategies reviewed for this ORI report are results-based. The **PPCR monitoring and reporting system** uses the five core indicators listed below, against which information has been collected since 2012. The first two listed are national level indicators, and progress against these gives an insight into achievements in relation to governance and capacity to integrate climate change:

1. Degree of integration of climate change into national planning

2. Evidence of strengthened government capacity and coordination mechanism to mainstream climate resilience
3. Quality and extent to which climate responsive instruments/investments models are developed and tested
4. Extent to which vulnerable households, communities, businesses, and public sector services use improved PPCR supported tools, instruments, strategies, and activities to respond to climate variability or climate change
5. Number of people supported by the PPCR to cope with the effects of climate change

The **State of the Environment Report** (GOSL, 2015) proposed 28 indicators for monitoring climate change, and these are reproduced in Annex 4. There is so far no formal mechanism for monitoring of these indicators. The Department of Economic Planning is in the process of developing an M&E system for DVRP, and intends to use this approach for all national investments in future.

**Under the JCCCP,** NAPs to promote alternative low-emission and climate-resilient technologies that can support energy transformation and adaptation in economic sectors will be formulated and institutionalized. Outputs will include elements for monitoring the progress of their implementation and their outcomes over the medium to long term.

The **impacts of the NC process** are not formally monitored, but it is reasonable to conclude that the NC process has resulted in a greater awareness across sectors of the impacts of climate change and of the need to implement activities at a sectoral level and across society to adapt and mitigate the impacts. The basis for this conclusion is:

1. It is through the NC process that many projects are identified and justified. Such projects, because of their genesis, are designed to be more climate-resilient and sustainable.
2. Key sectors are represented on the NCCC. However, sector representatives from within the various agencies do not change regularly, and it is common for one or two individuals to be assigned the climate change portfolio within their organization. These persons attend meetings and benefit from exposure at workshops and other events, and may or may not relay information back to their agencies. If they do, it is questionable how much attention is paid by their managers and line staff. As a result, while there may be some awareness of climate change across sectoral agencies, awareness that results in attitudinal and behavioral change is still too low.
3. The presentation of the NC has evolved, and has required sectors to improve on their data collection and management to better inform the process. There is also a greater awareness within sectors of what information is required of them.

More formal monitoring of the impact of the NC is required. Indicators selected to evaluate the impacts of the NC process should ideally require data that already exists, as well as meet requirements of national and international commitments. Recommendations made for indicators in the SNC are valid (Pierre Nathoniel, 2012), and are included among those listed in Table 5.2 below.

**Table 5.2: Indicators to evaluate the impacts of the NC process**

| Indicator | Possible means of verification |
|---|---|
| Change in public and stakeholder awareness of climate change issues through the NC process | Number of persons directly involved in the SNC process<br>Number of press releases, workshops issued/held<br>Comparison of results of successive KAP surveys |
| Change in national capacity through the NC process | Number of persons trained in various aspects e.g. GHG Inventory, V&A Assessment<br>Number of persons engaged in assessments |
| Formal approval of the NC | Approval of NC by Cabinet of Ministers (evidenced by a Cabinet Conclusion) |
| Incorporation of elements/outputs of the NC been into agency work plans, programmes and policies/legal instruments | Statements and references in agency work plans, programmes, policies and legal instruments |
| Changes in policy or practice as a result of the NC | Adaptation measures recommended in the NC implemented<br>Mitigation measures recommended the in NC implemented<br>Capacity-building, data management, research, education and awareness and other measures recommended implemented |
| Relevance of the NC process to the NDC process | Use of data from the NC to inform the NDC<br>Influence of NDC information on NC recommendations and outputs |
| Change in quality of information contained in the NC over successive publications | Quality of data forming the basis of successive NC<br>Soundness of assumptions made to support recommendations in the NC |

### 5.3.5 Challenges and recommendations for integrating climate change considerations into national development and policy formulation

A number of challenges and recommendations were identified in the literature reviewed and by stakeholders consulted, and these are included below.

#### *5.3.5.1 Challenges*

The first *State of the Environment Report* was published in 2006, and the second in 2015. The report considers the human-induced drivers of environmental change and the resulting pressures across nine areas including climate change. Key climate change issues were identified (see Box 5.5).

##### 5.3.5.1.1 Infusing climate considerations into national priorities, policies, planning and budgeting processes

There is no clear and objective process for determining national priorities. A national development plan would facilitate a more systematic and coordinated approach. Although the Economic Planning Department has identified priority areas for action, the absence of a National Development Plan and a formal strategic public sector investment planning process both impede integration of climate change considerations into national planning. A national development planning process is underway and climate change considerations should be fully integrated into this process (Charles, 2016). Some limited efforts are reported to have been made. For example, although the CCORAL tool developed by CCCCC for integrating climate change risks into the planning and budgeting process has not been formally incorporated, senior Ministry of Finance officials are being exposed to the tool. There are plans to further train economists and other finance officers in the government service in the use of the CCORAL tool in 2017.

The NC is an excellent and rigorous planning process with respect to climate change. However, many agencies still view climate change and the NC as being the purview of SDED. Development of sector-specific guides to assist the various Ministries in their screening and mainstreaming efforts is planned under the PPCR-DVRP Public Education and Outreach (PEO) Strategy and Implementation Plan. Climate change considerations must be integrated into the development and policy formulation of all sectors including the built environment (including spatial planning, climate-resilient buildings and communities); infrastructure (e.g. roads, pipelines); agriculture; tourism; health; water; marine and coastal resources, including fisheries; forestry; and biodiversity and natural environment. Climate Support Facility (2014) opined that climate change considerations are still not adequately incorporated into all policies, plans, strategies, etc. Although a number of climate and sectoral policies have been developed, many have not formally adopted by the government. At the time of writing this report in 2017, the following had been endorsed by Cabinet:

- Climate Change Adaptation Policy CCAP of 2015
- Water policy of 2004
- Land policy 2007 (the 2015 revision has not been approved yet)
- Coastal Zone Management Policy 2004
- National Biodiversity Strategy and Action Plan NBSAP 1998 and 2010 (the 2014 revision has not been endorsed yet)
- NEP/NEMS 2004 (the 2014 revision is not yet endorsed)[28]
- Forest Strategy 2015- 2025 (not yet submitted to Cabinet).

***Box 5.5. Key Climate Change issues identified in State of the Environment Report 2015***

- Less-than-adequate understanding of climate change and its ability to affect the entire population and all aspects of socio-economic development;
- **A continued reliance by many on the government, to address all issues pertaining to climate change;**
- A continued reliance on the ministry with responsibility for climate change to address relevant matters, despite the implications for all sectors;
- **The inability, to date, to fully mainstream climate changes into the programmes of the various government and other relevant entities;**
- The absence of a nationally approved mitigation policy and plan for the country;
- **The absence, or inadequacy, of legislation to effectively address climate change matters;**
- The inadequacy of capacity at the institutional level to fully and effectively address all issues relating to climate change adaptation, mitigation, coordination, negotiation, finance and resource mobilization, systematic observation and public education; and
- **Sub-optimal leveraging, to date, of available climate finance.**

[28] SDED proposes to revise the NEP/NEMS to incorporate SDG considerations.

Almost without exception, the policies and strategies reviewed for this report that were drafted within the last decade do include climate change considerations. As seen above though, half of these are not formalized. Even when a government policy is formally articulated, there is inadequate application of these in government's projects (Climate Support Facility (2014).

The legal framework has still not been fully established. The draft Environmental Management Bill which would give authority to the proposed implementation measures in the NEP/NEMS is still in draft.

The annual budgeting process is the mechanism for prioritizing national economic projects. Climate change considerations are not stated in the strategic priorities of the budget process, and there are no clear guidelines to address climate change in the budget process. Budget officials indicate that climate change impacts on the economy are considered in the approval process for projects, and that the Ministry of Finance proposes to formalise this. Budget proposals submitted may be inadequate for any of a number of reasons:

- Persons preparing proposals are not inadequately trained to do so.
- Proposals do not adequately explain or justify the submissions.
- Budget preparations are rushed.
- There is no clearly defined process for communication and collaboration between Budget/Financial Analysts, Economists and technical officers at various line Ministries.
- The Budget Analyst may not relay information on submissions back to the sector.
- Proposals do not adequately address recurrent costs, or if they do, the requests for funding (e.g. for maintenance of equipment procured under an external project) are often not approved.

#### 5.3.5.1.2 Hazard mitigation through land use planning and insurance

Notwithstanding a heightened awareness of the increasing climate hazard risks and the need for DRR, NEMO noted instances of continued public sector development (in particular schools) in hazard prone areas without suitable hazard proofing, and continued private development permitting in the coastal zone (Pers. Comm, NEMO, 2017). Gaps in relation to land management (GOSL, 2014) include the need for:

- More binding requirements for land use planning and physical development initiatives.
- Adequate enforcement and compliance.
- Stronger and more formal linkages between key entities such as the Ministries responsible for National Development, Physical Development and the Development Control Authority (DCA).

Sustainable agricultural development is hampered by lack of access to suitable lands (pers. Comm., MOA, 2017).

The Ministry of Physical Development has a number of policy documents in development. These include the OECS Building Code (2015) that has not yet been adopted; revised draft EIA regulations (2011); and draft planning standards for incorporating climate change into planning. The Ministry of Physical Development has indicated that work is underway to amend the Planning Act and these initiatives must all be integrated (pers. Comm., Physical Planning, 2017).

GOSL insures against crop damage and distributes payouts to farmers to assist their disaster recovery efforts. However, GOSL also uses up considerable resources in the aftermath of an event to support low income homeowners affected.

Although there has been some limited engagement at a national level, and a few local companies are known to use GIS and other tools to take account of climatic factors, insurance companies must better mainstream climate concerns and encourage climate smart practices by homeowners and property developers.

Sustainable management of ecosystem services and biodiversity conservation has not been well presented in terms of its contribution to climate resilience and to development, growth and equity to economists, political leaders and policy makers. There is need to fully embrace the potential opportunities associated with the value of biological resources and natural capital (the Green Economy) (GOSL, 2014). The INDC acknowledged the value of Saint Lucia's forests in carbon sequestration but did not quantify this contribution due to inadequacy of available data. As such, the INDC does not acknowledge that the forest contributes significantly to climate change mitigation. Only if the value of the forest to climate change is recognized will it be protected (pers. Comm., Department of Forestry, 2017).

###### 5.3.5.1.3 Institutional capacity

At the time of revising the NEP/NEMS, GOSL had established the SDED within the MSDEST, and was reportedly committed to building the capacity of SDED to drive the environmental management framework to underpin sustainable development. The revised NEP/NEMS recommended transformation of the SDED into a Department of the Environment (GOSL, 2014).

Absorptive capacity to access available financial resources also needs to be increased. Substantially more human and financial resources than currently allocated are required.

A multitude of studies are commissioned, but several stakeholders lamented the apparent low capacity of the public sector to implement recommendations, noting that there is no effective mechanism to proceed with the execution phase. The revised NEP/NEMS (GOSL, 2014) undertook a gap assessment for the period 2005 to 2013, and concluded that limited implementation of plans and policies has been a major weakness. A private sector representative engaged also cited the slow pace at which legislation to support incentives is developed as a source of frustration for the private sector, stymying interest in investment in mitigation and adaptation measures.

Many important climate change projects are implemented by regional agencies, typically with national components. The evaluators of the *Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project* concluded that the project was well designed and relevant, with high stakeholder participation. However, challenges of delays, inflation and on the ground logistics were frequently reported by persons they consulted to be significant, but these were not predicted in the project risk log. The evaluators indicated that the significant project delays experienced confirmed the need for structured capacity building at a national level and improved communications at both national and regional levels (Chase et al, 2016).

###### 5.3.5.1.4 Information availability and management

The NEP/NEMS (GOSL, 2014) noted the lack of promotion and resulting limited knowledge by public sector agencies as well as the general public, of the many environmental policies and strategies developed by the government. Awareness of the NC outside of the NCCC membership is also low.

Paucity of documented information to substantiate anecdotal information is a major challenge. There is a lack of consistency in the collection and management of data across sectors. More needs to be invested in the studies of the relations between and within the various ecosystems to determine the actual value of these ecosystem services (GOSL, 2015).

There has been some effort to engage in modelling by the Ministry of Physical Development, but issues relate to down-scaling the information. Some modelling is possible at scales of 1:10,000 or 1:25,000, but maps used for development application appraisal are within the scale range of 1:500 to 1:2500. It is difficult to take definitive decisions with the larger scale maps, and so far, the Ministry has been unable to integrate risk maps into the planning approval process. This issue is likely to be addressed under the DVRP project.

#### *5.3.5.2 Recommendations*

*The State of the Environment Report* (GOSL, 2015) considered two future scenarios: one based on business as-usual, and another based on sustainability-first considerations. The Report then presented policy, institutional and programmatic interventions with accompanying indicators to measure progress towards the sustainability-first future. While noting that progress has been made in addressing climate change, the Report called for a higher level national response based on a contemporary, wide-ranging and coordinated approach. This requires (GOSL, 2014):

- appropriate governance systems and processes to guide sectoral management and to ensure inter sectoral and inter agency coordination;
- creation of appropriate partnerships between the public sector, private sector and civil society;
- tools and platforms necessary for creating a suitable repository on information and knowledge.

Sustained sensitization, education and empowerment of all stakeholders were seen as critical. A more proactive approach from Government was promoted, as well as greater responsiveness to the threats posed, through mainstreaming and resilience-building in all sectors. Torbert et al (2016) noted that appropriate policy, legal and regulatory frameworks must be in place to incentivize the right investments at the right time, by the right owner, and at the right price.

##### 5.3.5.2.1 National vision and development plan

It is important to develop a National Vision Plan reflective of national priorities. This plan must integrate climate change considerations as identified in the latest NC. National priorities change so there is a need to convince leaders to permanently retain climate change high on the agenda (Climate Support Facility, 2014); climate change should be a national priority, and should be a consistent part of the national vision. Non-sectoral priorities that are the country's development challenges must be identified and the energies of agencies focused accordingly, so that, among other things, synergies between agencies may be realised. Although many policies and plans exist, the linkages between them are not always made. While the national vision and development plan should be guided by sectoral realities, it should provide the basis for sectoral planning. Within the national plan there should be targets to be met, and the responsibility for monitoring and evaluation of these should rest with the Ministry of Economic Planning.

All agencies should be working to the same goal(s), and agencies should be required to justify new initiatives on the basis of the national development plan. All project justifications should necessarily include a climate change screening process (Climate Support Facility, 2014). Charles (2016) recommended:

1. Development of a National Development Plan through a participatory process;
2. Introduction of a Public Sector Investment Program guided by the National Development Plan; and
3. Establishment of a Central Planning & Priorities Committee chaired by the Minister of Finance, responsible for project coordination and planning and to prioritize projects for inclusion in the Public Sector Investment Program (PSIP). This Committee should comprise representatives of key economic ministries, with other agencies invited to attend when they have projects for consideration.

#### 5.3.5.2.2 Integration of climate considerations into sectoral policies and plans

To address the issue of inadequate integration of climate change considerations requires, *inter alia*, articulation of coherent policies and distinctive mechanisms for coordination among sub-sectors and across sectors (GOSL, 2014). Each Ministry should have a climate change champion. Climate Support Facility (2014) recommended that each Ministry have a focal point for climate change/environmental sustainability, and rotate the role among staff, quarterly or bi annually. The focal point should be responsible for attending climate change meetings and disseminating information within their respective Ministries/Agencies.

Upon finalization of a NC, there should be greater effort to engage sectors and present recommendations contained in the NC and the rational for these, on a sectoral basis. Assessments should be undertaken of the extent to which organisations fully integrate the recommended climate adaptation and mitigation actions into their work programmes in between successive NCs. Prior to the next NC being prepared, there should be a thorough review of achievements since the last communication. A midterm review is also recommended, to review goals, objectives and timelines, and re-set as required. A system of mainstreaming recommendations is required.

Greater consideration should be given to valuing economic benefits of biodiversity and incorporation of biodiversity values into national financial and economic planning and decision making. It provides an opportunity to more meaningfully adopt the ecosystems approach, especially in the realm of sustainable consumption and production of biodiversity goods and services, and deepens linkages amongst Rio Conventions and the related biodiversity conventions such as CITES and Ramsar to derive synergies. The Draft Fisheries Plan already endorses an ecosystems approach (GOSL, 2014). If the contribution of forest to carbon sequestration and climate change mitigation is acknowledged and quantified, then market based mechanisms can be developed to ensure that people retain the forest cover on their private lands, as they can get paid for it. The Forestry Department will receive support from OECS for development of the REDD+ (Reduction in Emissions from Deforestation and Forest Degradation plus Conservation) strategy which would realise payment for ecosystem services, as an addendum to the forest strategy.

#### 5.3.5.2.3 Capacity building

The role of Budget Analysts should be clearly defined, and this should require them to be an effective intermediary between the Ministry of Finance and agencies. Budget Analysts assigned to Ministries should work closely with Ministry personnel to improve their new initiative submissions. Approaches to build capacity could include workshops between Ministry of Finance and Planning and the various line Ministries and strategic planning sessions between assigned analysts and the various Ministries (Climate Support Facility, 2014).

Absorptive capacity to access financial resources may be increased through, among others, training programmes for writing proposals, understanding and costing of climate change, and preparation of cost benefit analyses. In the crafting of projects for the national budget, there is need to properly justify them, and include cost of inaction. New processes to facilitate direct interaction between budget analysts and technical persons preparing projects should be instituted, so there is a clearer understanding of each other's needs (Ibid.).

A brief checklist template can be developed that allows for simple feedback to agencies on budget submissions (approved; approved with modification; not approved - initiative to be undertaken later; not approved - similar initiative with other Ministry; etc.). The template for project submission should include fields that speak to mainstreaming of climate considerations and monitoring and evaluation, and projects that do not adequately address these should be returned by the Ministry of Finance (Ibid.). Capacity building is also required to equip public servants with the skill to be more results-based in their actions.

Recommendations of the evaluators of the *Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project* included (Chase et al, 2016):

1. Establishment of an OECS Desk or Representative to anchor OECS led initiatives.
2. Identification of officers in the Commission's Environment and Sustainable Development Programme as Focal Points to Member States.

###### 5.3.5.2.3.1 Land management and hazard mitigation

Physical development should be in the context of a national land use plan that considers climate issues. Area development plans are already in preparation (e.g. Iyanola and Vieux Fort area plans) and these will inform later development of a national land use plan to examine multiple uses and policy areas (Pers. Comm, PPD, 2017).

It is recommended that NEMO Secretariat be represented on the DCA Board.

Approaches should be devised to encourage landowners with suitable idle lands to lease or make these otherwise available for active agricultural use. Consideration could be given to waiver of property tax as an incentive. Persons also need to be encouraged to grow more at home, as an adaptation measure (pers. Comm., Ministry of Agriculture, 2017).

Even while the scale on the available hazard mapping is too gross to form the basis to impose restrictions on developers, consideration should be given to allowing developers to access the available hazard mapping, if only to inform their further studies that may be warranted.

The various ministries with a responsibility for physical infrastructure projects (including those responsible for physical development, infrastructure, finance, planning, social transformation, health, and education) must devise a mechanism to ensure that government/public buildings and other infrastructure take due consideration of climate change (location, access, ventilation, water storage and conservation, energy efficiency, structural integrity, roofing, windows, etc.).

The Ministry of Physical Development must finalise adoption of the 2015 OECS Building Code, draft EIA regulations, draft planning standards and other Planning Act amendments required.

#### *5.3.5.3 Insurance*

Regional head offices of insurance companies should be engaged in an effort to have them incorporate climate considerations into their operational policies that would effectively encourage climate smart construction by developers.

GOSL may want to consider insurance policies for certain classes of residential development, to help finance the assistance rendered by the government for property repairs, replacement or relocation.

##### 5.3.5.3.1 Communication and public awareness

All strategies call for increased public awareness. The revised NEP/NEMS emphasized the importance of a structured and sustained program for communication to be implemented as integral to implementation of the revised strategy.

The NC should be made more accessible to the public as it contains a wealth of information.

Recommendations of the evaluators of the *Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project* included integrating the projects into the cultural lives of people, as this is a powerful communication tool (Chase et al, 2016).

### 5.3.6 Entry points that are, and can be, utilised by the government and the private sector

The recently approved SDGNCC has great potential to enable more effective inter-agency collaboration on environmental planning and management.

The members of the multi-sectoral National Climate Change Committee (NCCC) provide validation of outputs generated through the NC process and general guidance through their areas of expertise. Committee meetings which may include representatives of other agency co-opted as required, are an opportunity for exchange of ideas and information between representatives of the various sectors. They broaden the exposure of participants to climate and related information from other sectors and provide a deeper insight into inter-sectoral linkages. It is apparent though, that more is required to ensure that knowledge acquired through the NCCC is better disseminated within agencies. Notwithstanding, there is a sense within SDED that decision makers are now a lot more comfortable with the term climate change and use it frequently. Permanent Secretaries accept the reality of climate change. Agencies take advantage of climate resources as they become available. Entities such as the Association of Professional Engineers, NEMO and SLNT initiate climate change activities independent of the SDED. Many policies, strategies and action plans developed since 2010 incorporate climate change considerations. Overall there has been significant progress since the publication of the SNC.

The Ministry of Finance and Planning is currently reviewing the institutional framework required to improve Saint Lucia's capacity to meet GCF requirements. The Ministry advises that in order to improve the integration of climate change considerations, the central planning agency is going to undertake a number of steps under the Green Climate Fund Preparatory Support Programme. CDB has provided some support in this regard, and some of their suggestions have already been incorporated. The following will be undertaken (pers. Comm., Ministry of Economic Planning, 2017):

1. Build capacity to monitor projects to ensure they are climate-resilient
2. Integrate tools such as risk analysis and CCORAL into the PSIP
3. Train department staff in the requirements of the GCF
4. Develop country strategies specific to resilience building under the GCF
5. Train staff in the implementation of the PSIP programme, with capacity building in project appraisal, risk assessment, climate change and other economic and social assessments.

#### *5.3.6.1 Sectoral entry points*

A number of the recommendations below are extracted from the report by Climate Support Facility (2014).

**The Ministry of Finance, Economic Affairs, Planning and Security**

1. Use opportunities of the current process of elaboration of the medium term plans, national planning and vision plans at national and sectoral levels (budget reform) to mainstream climate change.
2. Improve engagement of ministries.
3. Incentivize climate proofing activities (e.g. fiscal incentives for adaptation measures such as including rainwater harvesting tanks in new homes; tax breaks for renewable energy systems in homes and businesses; and incentives for use of wasted fruit (food security).
4. Modify project/budget templates as follows:
    - adjust the template to make it more user friendly, more clearly reflective of "real" costs including costs of climate change impacts, and inclusive of pointers to guide the writers.
    - include fields for monitoring and evaluation.

- create a specific line item for recurrent costs and justify this (including the cost of non-maintenance).

**Department of Sustainable Development**

1. Use opportunities of the current process of elaboration of the medium term plans, national planning and vision plans, at national/sectoral level (budget reform) to make the case for climate change in the following forums:
2. Committee of Permanent Secretaries,
3. Policy Committee,
4. Budget Technical Committee and Parliament;
5. Use the process of the NC and the NCCC members to mainstream climate change into sector policies.
6. Disseminate the toolkit of guidelines on how to mainstream climate change into sectors prepared by MSDEST.
7. Improve collaboration with Ministries and other interests in the climate proofing of their policies, plans and strategies.
8. Include missing key agencies on the National Climate Change Committee (NCCC) by writing to Permanent Secretaries of the different sector ministries to nominate a key representative and an alternate.
9. Time NCCC meetings more strategically, e.g. before and after COP meetings, and hold NCCC meetings more frequently.
10. Provide more support for sectoral NCCC focal points attendance at regional and international training workshops and other meetings.
11. Use the climate change Public Education and Awareness Strategy and Implementation Plan and the CAFF under the PPCR-DVRP to increase awareness and encourage integration of climate change considerations in public and private sectors, and in civil society.
12. Widely disseminate information on climate change online classes/training workshops, and encourage participation by the various sectors.
13. Support further training workshops in collaboration with partners (e.g. ACP GCCA).

**Sector Ministries**

1. Nominate an agency representative and an alternate to attend NCCC meetings, and ensure agency participation.
2. Climate proof policy development at all levels.
3. Develop operational policies that incorporate climate change considerations into all project proposals, and sector and program plans.
4. Use every public awareness effort as an opportunity to make the linkage between the Ministry portfolio and climate change
5. Use the blueprint provided in the SPCR that contains climate change project ideas compiled from discussions with line Ministries to develop sectoral priorities for funding.
6. Develop a package of project concepts in readiness for possible funding, that show due incorporation of climate change (Climate Support Facility, 2014).

**Civil Society**

1. Engage and support the Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia to facilitate more integrated approaches with civil society in relation to the climate agenda.
2. Increase use of GEF Small Grants Programme for climate change mitigation and adaptation at a community level (Ibid.).
3. Access CAFF to prepare business continuity plans and other relevant actions.

## 5.4 ACTIVITIES RELATED TO THE TRANSFER OF ENVIRONMENTALLY SUSTAINABLE TECHNOLOGIES

### 5.4.1 Technology Needs Assessment (TNA)

Article 4.5 of the UNFCCC requires developed country Parties to promote, finance, transfer and create access to environmentally sound technologies by developing country parties. Article 3 paragraph 1480 of the Kyoto Protocol identifies transfer of technology as an issue to be considered in minimising adverse effects of climate change and/or the impacts of response measures on (developing country) Parties (United Nations, 1998). All Parties are expected to cooperate in promoting effective modalities and means to facilitate technology transfer. As part of the Marrakesh Accords (COP 7) (United Nations, 2002), Parties agreed to work together on a suite of technology transfer activities within a framework aimed at enhancing implementation of Article 4.5 of the Convention, to address the following themes:

1. Technology needs & needs assessments
2. Technology information
3. Enabling environments
4. Capacity building
5. Mechanisms for technology transfer

In Article 10 of the Paris Agreement (UN, 2015), "Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions." The Agreement commits Parties to strengthen cooperative action on technology development and transfer, and establishes a technology framework to provide overarching guidance to the Technology Mechanism established under the Convention.

The Draft National Science and Technology Policy, Strategy and Action Plan (St. Aimee, 2013), yet to be formally adopted, envisions a population that is technically and technologically literate and able to use science and technology (S&T) for its developmental needs, providing the citizenry with an increased standard of living that is sustainable, especially in times of growing economic challenges. The aims of the policy are to:

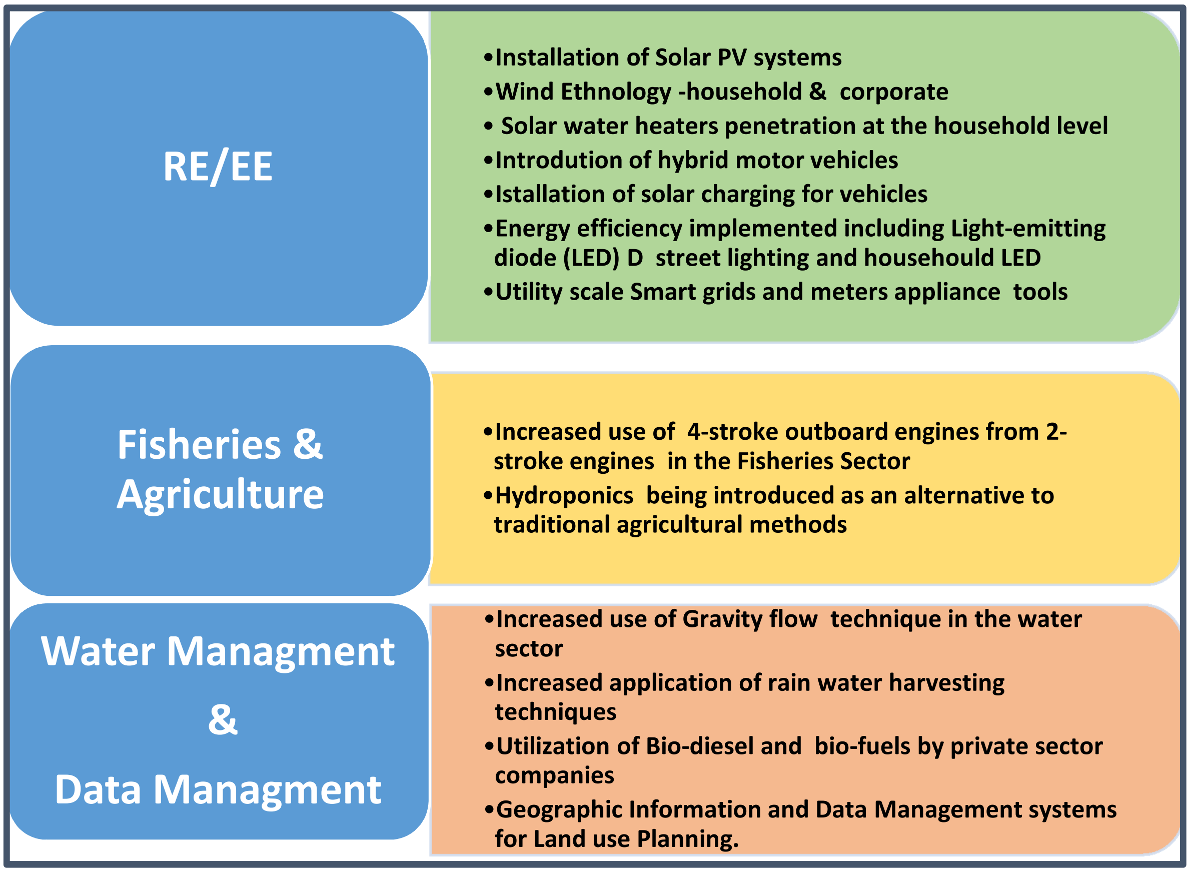
1. promote, encourage and facilitate collaboration between ministries /agencies in the public and private sectors in the use of S&T for development;
2. provide additional resources for the application of S&T in the development equation;
3. make S&T and innovation part of the culture of the population; and
4. increase the pillars of development and eliminate the one sector dependency.

#### *5.4.1.1 Conclusions from TNA*

Another technology needs assessment was conducted in 2017 (GOSL, 2017). The TNA of 2017 identified the following five strategic priorities:

1. Macro-economic stabilization
2. Diversification of the productive sector through private sector development
3. Poverty reduction and promotion of equity
4. Environmental sustainability and
5. Educational Development

The TNA report of 2017 identified technological advances made in Saint Lucia which positively contribute to the national and international climate change mitigation and adaptation agenda (see Box below).




The TNA (GOSL, 2017) identified the following key sub-sectors for low emission and low vulnerability development:

**Adaptation:**

- Coastal Zone
- Fresh Water Resources
- Tourism Sector
- Agriculture Sector
- Health Sector
- Human Settlement
- Disaster Response
- Land Use and Land Use Change

**Mitigation:**

- Energy Generation
- Road Transport
- New and Renewable Energy
- LULUCF and Waste

Stakeholders identified a potential list of technology options for each sector. The following criteria were used to prioritize the options they identified:

1. Potential for development benefits in terms of its relevance to climate change
2. Alignment with national programs, sustainability and capacity to enhance national competitiveness
3. Economic Potential to reduce cost and provide economic benefits resulting in increased value added and improvement in the quality of life for the majority of the population.

The top adaptation options for each sector and the technology needs identified in the TNA are presented in Table 5.3 (GOSL, 2017).

**Table 5.3: Summary of top two adaptation options and selected technology for each priority sector**

| **Coastal Zone Adaptation Options** | **Technology Needs** | **Ranking** |
|---|---|---|
| Climate proofing of key existing developmental infrastructure. | • Groynes, bulkheads and Seawalls.<br>• Information Technologies (including computer hardware and software).<br>• Construction engineering tools and techniques.<br>• Environmental engineering tools and techniques. | 1 |
| Improved data management for enhanced decision making. | • Information technologies.<br>• Technical training.<br>• Environmental monitoring tools (temperature gauges, sediment gauges, etc.)<br>• Citizen science tools (apps for reporting etc.)<br>• GIS Tools<br>• Smart Coastal monitoring and surveillance vehicle and vessel<br>• Under water monitoring equipment and gear | 2 |
| **Fresh Water Adaptation Options** | **Technology Needs** | **Ranking** |
| Water Conservation including reduction in line losses. | • Low flow water Technologies for Domestic uses (e.g. toilets and faucets).<br>• Institutional Strengthening for water conservation including line loss.<br>• Drip and trickle irrigation technologies<br>• New Pipelines.<br>• Water treatment facilities.<br>• Geographic Information Systems. | 1 |
| Maintain high quality water. | • Pollution prevention and control technologies.<br>• Water monitoring equipment.<br>• Public awareness.<br>• "Smart Bacteria" pipelines.<br>• Specially equip Patrol vehicles.<br>• Laboratory Services. | 2 |
| **Tourism Adaptation Option** | **Technology Needs** | **Ranking** |
| Protecting existing tourist facility and infrastructure. | • Hurricane/storm resistant physical structures.<br>• Public Awareness.<br>• Information technologies.<br>• Human resource development. | 1 |
| Diversification of the tourism product. | • GIS tools.<br>• Human resource development. | 2 |

| | | |
|---|---|---|
| | • Information technologies.<br>• Tourism development planning. | |
| **Adaptation Option for Agriculture** | **Technology Needs** | **Ranking** |
| Increased use of heat and drought tolerant plants and animal species. | • Agriculture Diagnostic Adaptive Research for plant & animal species.<br>• Seed and propagation materials.<br>• Agro-Meteorological Monitoring equipment.<br>• Artificial cooling technologies for animal species (air conditioning, fans, etc.).<br>• Modernized artificial insemination equipment. | 1 |
| Improved pest and disease management. | • GIS technologies.<br>• Information technologies.<br>• Environmentally friendly determinants and control materials and equipment. | 1 |
| **Adaptation Options for Health** | **Technology Needs** | **Ranking** |
| Strengthen Development controls. | • Information technologies.<br>• GIS technologies to support EIA.<br>• Public awareness. | 1 |
| Medical Intervention. | • Vaccination equipment and supplies.<br>• Medical facilities. | 2 |
| **Adaptation Option Human settlement** | **Technology Needs** | **Ranking** |
| Improvement of Hazard Mapping/Monitoring. | • Weather stations.<br>• Seismic sensors.<br>• Early warning systems. | 1 |
| Strengthening Development Control | • Technology to enhance Integrity of physical structures.<br>• Technology to improve climate resilience of infrastructure. | 2 |
| **Adaptation Options For Disaster Response** | **Technology Needs** | **Ranking** |
| Hazard and Risk Management. | • Geospatial technologies.<br>• Information technologies.<br>• Human resource development. | 1 |
| Community Response. | • Information technologies - (computers, internet, GIS).<br>• Environmental engineering (e.g. contour terracing, Human resource). | 2 |

The top mitigation options for each sector and the technology needs identified in the TNA are presented in Table 5.4 below (GOSL, 2017).

**Table 5.4: Summary of top 2 mitigation options and selected technologies for each priority sector**

| **Mitigation Options For Energy Sub-Sector** | **Technology Needs** | **Ranking** |
|---|---|---|
| Increased Solar Energy penetration. | • Photovoltaic applications (lighting, cooling, heating, general power).<br>• Informationmanagement technologies.<br>• Grid- Interconnection capabilities.<br>• Storage technology. | 1 |
| Exploring Geothermal Energy Development. | • Geothermal electricity generation, (Surface exploration).<br>• LIDAR studies, geo-chemical studies,<br>• Drilling technology (exploratory slim core drilling, delineation & production. | 1 |

| | | |
|---|---|---|
| | • GIS technologies for mapping.<br>• Information technologies.<br>• Grid- Interconnection capabilities.<br>• Storage technology. | |
| **Mitigation Option for Transportation** | **Technology Needs** | **Ranking** |
| Develop and implement a comprehensive road transport plan (infrastructure network, support facilities etc.). | • Informationmanagement technologies.<br>• GIS Technologies. | 1 |
| Improved Mass transit public system. | • Energy efficient transport system.<br>• (Smart) Public buses.<br>• Human Resource development.<br>• Public awareness.<br>• Ferry system.<br>• Information management technologies. | 2 |
| **Mitigation Option LULUCF and Waste** | **Technology** | **Ranking** |
| Data Collection and analysis. | • Information technology.<br>• Laboratory testing equipment. | 1 |
| Forest Management GHG Mitigation. | • Meteorological measurement technology.<br>• GIS technology for mapping forest cover.<br>• Forest hydrology. | 2 |

### 5.4.2 Database established on environmentally sustainable technologies

The CCAP commits SDED to compile and maintain information on adaptation technologies. To date though, there is no national database on environmentally sustainable technologies. This should be developed as an output of the regional JCCCP now underway. The JCCCP encourages policy innovation for climate technology incubation and diffusion. The aim is to ensure that barriers to the implementation of climate-resilient technologies are addressed, resulting in concrete mitigation and adaption implementation on the ground, in line with the country's long-term strategies (UNDP, 2015).

A number of agencies (such as REDiv, LUCELEC, Bureau of Standards and Ministry of Agriculture) research technologies in support of their work programmes, but there is no national repository for such information. Agencies or officers may retain relevant information in their libraries or computers (assuming they have sufficient capacity), but there is no structured system for storage or retrieval of such information. Neither is there a national database of technologies transferred through the various climate change projects implemented over the years.

### 5.4.3 Technology information networks established

There is no national technology information system, but this gap should be significantly addressed through the *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project presently being implemented by government. This project will strengthen environmental information systems by, among other things, formalizing and sustaining effective mechanisms for the exchange of both general and more specialized technical information among relevant stakeholders. The project seeks to improve inter-agency collaboration and access by public and private sector interests to data for use in their development planning and decision-making. Agencies targeted include:

1. Ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development,
2. Departments of Forestry,
3. Water Resources Management Agency (WRMA),
4. Saint Lucia Solid Waste Management Authority (SLSWA),
5. Ministry of Health, Welfare and Human Services (MOH),
6. Department of Forestry (DOF),
7. Water and Sewage Company (WASCO),
8. Caribbean Public Health Agency (CARPHA)
9. Sustainable Development and Environment Department (SDED),
10. Biodiversity Bio safety Units and
11. Energy Science and Technology Unit in the Ministry of Sustainable Development.
12. Statistics Department, which has a legal mandate to gather socio-economic data and to disseminate information.

An online platform will be designed to enable the public to provide or validate information based on priority environmental themes. Training in the use of the information platform will be undertaken.

The *CCCCC CCAP* is a regional USAID-financed programme designed to strengthen an integrated system for the implementation and financing of sustainable adaptation approaches in the Eastern and Southern Caribbean region. Component 1 promotes the use of climate data and information for use in decision-making. Access to online knowledge resources on climate change and environmental issues will be improved for ten Eastern and Southern Caribbean countries. Each country will have existing node(s) that is connected to the main hub that is housed and maintained at the CCCCC. This will allow the countries to access each other's public data and information via the provided software and also online at http://clearinghouse.caribbeanclimate.bz. Computer equipment and software will be procured to scan/copy, convert, and manage documents and information. Technical assistance and training in the use of the equipment and software will be provided by the CCCCC Clearinghouse technical team to establish and operate the nodes. A Regional Clearinghouse vault will be established at each national data node. This will automatically transmit copies of its contents (in accordance with the participation agreement) to the CCCCC Clearinghouse for archiving purposes (CCCCC, 2017).

World Bank has recently presented a roadmap for optimization of the hydromet services which includes recommendations for a hydomet data network. Work on this will be undertaken under DVRP (pers. Comm, SDED, 2017). There is a MOU between Meteorological Services Department and WRMA that commits each to share data with the other (pers. Comm., WRMA, 2017). The Meteorological Services Department provides technical support to WRMA in the maintenance of their networks under this arrangement. There is some real time sharing of data between WRMA and the Meteorological Services Department, facilitated by the Hydrolynx system recently upgraded with Aus Aid support, but this does not cover the entire network. Further, the Meteorological Services Department does not have real time access to the WRMA data (pers. Comm., Meteorological Services Department, 2017).

Generally, agency staff network and share information as required using the internet, cellular and telephone systems. This requires having knowledge of where information resides.

### 5.4.4 Human, scientific, technical and institutional capacity strengthened

**Climate change projects** typically incorporate an element of capacity building. For example:

- Hydro-meteorological equipment installation projects include a component that demonstrates to prospective users (WRMA and/or Meteorological Services Department) how to install, trouble shoot, use and maintain the equipment.
- The OECS RRACC project provided: 1. Training for WASCO staff on the GIS platform set up for monitoring and managing infrastructure; 2. A demonstration project for cultivation of seedlings and replanting the Mankote mangrove.
- OECS GCCA CCA and SLM project is providing diploma level training in CCA and SLM.
- NAP Global Network training complements work on the JCCCP NAP, to train journalists in adaptation as well as others in sectoral adaptation plan development.
- NURC and REDiv capacity in tariff setting was built with World Bank/OECS support in 2016.
- NEMO staff has received training in Early Warning Systems, Climate Change and DRR in Japan.

Capacity is built under projects through **workshops** and attendance at **conferences** locally, regionally and internationally in all environmental areas. Under the Cartagena Protocol on Biosafety for example, hundreds of public sector workers and members of the general public have been trained in biosafety, risk assessment, GMA detection and administrative systems, in an effort to create a biosafety framework.

Some persons have received **training** up to Bachelors and Masters levels e.g. in biosafety. A number of Ministry of Health staff have benefitted from Master's level training through the EDF, in, among others, various aspects of environmental health. Training available through MEAs and related projects is provided to persons from all Ministries and the MEA focal points. The National Air Conditioning and Refrigeration Association (NARA) and the Customs Department receive training under the Montreal Protocol.

Sectors also collaborate with their **regional counterparts**, for example, when foresters meet at the FAO-hosted COFLAC Conference of Latin America and Caribbean Foresters there is an opportunity to network, develop relationships, and exchange information. The Caribbean Climate Outlook forum is a forum of scientists and civil society that puts out forecasts twice annually before the wet and dry seasons. 3-, 6- and 12-month forecasts are provided. This forum builds Meteorological Services Department staff capacity.

Various agencies engage in **MOU** with technical agencies from developed countries, and benefit from capacity strengthening, e.g. the WRMA MOU with GWP; WRMA proposes to use that relationship to work on revision of the national water policy.

**IICA** puts most of their effort into capacity building within groups from farmers to senior policy makers. The **Ministry of Agriculture** relies heavily on cooperating agencies such as IICA, FAO, CARDI, GIZ, and Taiwan International Cooperation Development Fund (TICDF) to bring in new and appropriate technologies on demonstration plots to build farmer capacity. The Farmer Field School methodology (discovery based learning method) is used to expose farmers to new knowledge.

When community projects are engaged in, there is an element of **capacity building at the community level**. For example:

- Training for civil society is provided in areas such as PV and solar drying.
- V&A assessment training has been undertaken with community-based groups across the country.

Agencies such as WRMA also engage in some level of **community outreach**, working with youth groups and schools, within their resource constraints.

### 5.4.5 Challenges and recommendations related to, transfer of environmentally sustainable technologies

The 2004 TNA (GOSL, 2004) summarized barriers to the transfer of ESTs in the Saint Lucian context, and these barriers still exist today:

1. Costs of purchase and maintenance
2. Financial feasibility at the small scale required
3. Limited institutional capacities
4. Costs of the supporting institutional structures (regulations, personnel, equipment)
5. Inadequate awareness of climate change impacts and of available technologies
6. Limited access to financial resources, especially in low income communities.

These barriers still exist today. The 2017 TNA (GOSL, 2017) noted that the technologies identified are typically imported from large developed countries, and the two main barriers to adopting these in Saint Lucia are cost and scale. Requirements identified to accelerate technology transfer to Saint Lucia included:

1. Skills training and development by technology manufacturers dispatching trainers to regional/national training institutions, so that the requisite skills for maintenance and operation are resident in the country or sub-region.
2. Development of stakeholder networks to facilitate public discussion of technology on the ground before the policy approval level.
3. Creation of regional technology production centres or effective distribution hubs in the country or sub-region be created.
4. Creation of an enabling environment/policy framework through appropriate policies, price regulators and incentives.

The following recommendations are considered important in advancing Saint Lucia's technology development thrust (GOSL, 2017):

1. Equip the Standard Bureau to certify and monitor locally developed technology.
2. Establishing a registry of technology.
3. Petition the GCF for a window to support technology transfer and upgrade in SIDS (this should be a SIDS effort).
4. Establish a government-wide uniform or compatible IT platform.
5. Establish a technology research and development (R&D) Centre to monitor operating technology to identify appropriate technologies and propose modifications, including replacement with local alternatives where possible.

The TNA (Ibid.) identified several regional initiatives by entities such as CARDI, IICA and 5Cs that are examining technology use, development and diffusion, and are developing tools to examine specific climate change impacts, but noted that these are not in tandem with national development priorities or efforts. A similar observation was made in relation to ongoing work by international agencies. Further, new technologies are slowly infiltrating, but this is limited by scarce resources. A coordinated regional approach may be one solution, as has occurred in the application of the 5Cs Caribbean Climate Online Risk Assessment Tool (C-CORAL) and their Vulnerability and Capacity Methodology for V&A Assessment currently under development. These technologies need to be supported with human capacity development and the needed hardware (Ibid.).

It is important that new technologies are screened to ensure they will be appropriate, cost effective and sustainable in the national and local context. Otherwise, scarce investment funds are wasted on costly infrastructure that is underutilized. There are a number of examples of such investments in the agriculture sector. The Ministry of Agriculture noted that the reliance on imported high yielding (genetically selected) seeds is not sustainable as they become progressively less productive with successive generations, original biodiversity is lost, and there is too much reliance on external suppliers. The Ministry recommends development and storage (a gene bank) of indigenous seed supplies for local use. This is not commonly practiced, although there are a few gene banks for cocoa and citrus at the propagation station. The approach should also be considered for vegetables.

Some agencies are required to support adoption of new technologies by specific communities. However, there may be gaps in the capacity of such agency staff. An example of this is found within the Ministry of Agriculture, where technical staff are expected to work with farmers in the field, supporting their new technology implementation efforts. While there are sufficient numbers of such staff (there are between 150 and 200 farmers to every extension officer), some of these technical officers do not possess the requisite knowledge and competencies to transfer appropriate technology to farmers. There is need to assess their competences and enhance their skills. In some instances, the constraint is not the capacity of individuals but their availability. There may be insufficient numbers of persons within the organization to undertake all of the required tasks, as in the Department of Forestry and the Transport Division, for example.

Most capacity building is project-related and externally funded. The government facilitates the participation of public officers in training activities by permitting time off work and providing co-financing that may be required. But there is a challenge to retain staff when they are trained in specialized areas, as their newly acquired skills are highly marketable, locally and beyond. The government must devise incentives to encourage skilled persons to remain in positions that maximize their contributions, through a combination of job satisfaction, salary and other perks, and appreciation for the contribution made.

GIS capacity in many sectors needs to be built. Under the DVRP the **Ministry of Physical Development** is developing the National Spatial Data Infrastructure NSDI. The national coordinating committee and the national technical committee include all major stakeholders including public utilities and the private sector. In order to manage the system the institutional framework of the Ministry of Physical Development will require modification and the capacity of the Ministry's GIS Unit will need to be developed The Ministry will acquire LIDAR under DVRP, and this will yield digital terrain models DTM and digital elevation models DEM, positioning the Ministry to model, pending availability of data inputs from other agencies.

Civil society needs to be exposed to new technologies and how they can be integrated into their daily lives. If communities witness a trial succeed, more persons will become interested. National research capacity needs to be built to fill the gap created by the loss of WINBAN many years ago. There is some hope that VALERI, with support, can begin to fill this gap, possibly supported by regional institutions such as CARDI and IICA.

There are at best, sporadic efforts to build private sector capacity, and there is no coordinated programme for the transfer of technology to that sector. More needs to be done to target the private sector as well as civil society, to encourage broader participation in climate adaptation and mitigation. There is need for a more structured approach for dissemination of technological information to the public.

Conditions must be suitable if investment in new technologies is to be viable. For example, there is great potential for improved energy efficiency in the private sector. The government offers incentives, but the opportunity to connect to the national grid is an issue that still needs to be addressed. Private sector entities will always have an appetite to reduce costs. In the agriculture sector, there is a systemic gap between production and marketing, mainly because there is no functional marketing board. This is a major challenge because farmers may be unable to sell their goods, resulting in losses and disenchantment. The Ministry of Agriculture also identifies lack of access to land as a significant constraint to economic development and employment generation.

The challenge with upscaling pilot projects is the speed at which one can work with community groups. The development process is slow as a cultural shift needs to be inculcated, and there is typically a lower level of education within CBOs.  The process of community learning needs to permit communities to make mistakes and learn from them as they go forward. Their business skills often need to be enhanced. Some groups get help from TEPA. The GEF Small Grants approach is to work business elements into the projects business plan, and co-fund a consultant or mentor. Internships between groups may be feasible. Community groups need to be strengthened, and individuals encouraged to remain in their communities even after their capacities have been built. One way to keep people in their communities is to ensure that there are economic opportunities within the communities for them. To measure achievements through the implementation process, the vulnerability reduction assessment VRA process is useful for self-assessment, at all levels of society.

Projects that target groups with low resources must be of robust and innovative design. The GEF/VALERI home solarisation project was initially planned to target low income households, but the project had to be reconfigured when it was realized that the structures owned by the intended beneficiaries could not physically support the infrastructure. The resolution in this case was to target middle income homes, and requiring them to put a portion of the savings into a community fund to support physical improvements in the originally targeted homes.

The Ministry of Finance and Planning is investigating labour market development options, to determine the skill levels that are required of the labour market to undertake adaptation and mitigation work. They propose to target unemployed persons, attempting in this way to address perennial economic problems using the framework of climate change. The GCF envisions a paradigm shift, and a transformation is required in the basic skills required of workers e.g. in equipment operation, maintenance and repair, development of technologies, packaging of technologies into fundable projects, etc.

The Bureau of Standards is responsible for quality infrastructure- standardisation, metrology and conformity assessment. It is challenged by the high cost of equipment. The new national diagnostic lab at Union will include an agricultural lab with metrology capacity, but available budget was reduced with the devaluation of the Euro. As persons are encouraged to move into renewable energy technologies and power is being sold to the grid, it must be accurately metered, otherwise there is potential for disputes. Capacity within the regulatory agency (Bureau of Standards) needs to be developed to verify such information. The test bench required is expensive and the Bureau hopes the government will fund it.

Consideration should be given to development of an Innovation Policy, as opposed to a Science and Technology Policy.

Saint Lucia has no patent laws, and persons have to travel to other jurisdictions such as Trinidad or the US to patent their ideas. Draft legislation should be finalized and enacted.

Some stakeholders were disappointed that the TNA 2017 focused so extensively on monitoring systems, data collection and knowledge-based systems, rather than identifying technologies needed to address the country's vulnerabilities and the knowledge gaps. This alternative approach should provide the links between technology needs and climate change mitigation and adaptation improvements, and this is what should drive the hardware needs. It is pointless and a waste of resources to install monitoring systems that generate information that will not be used.

### 5.4.6 Opportunities for the transfer of environmentally sustainable technologies

More needs to be done to get technologies into vulnerable communities. The GEF Small Grants Programme supports development of both mitigation and adaptation projects by civil society. The approach builds capacity at the community level. Many of the projects are pilots, and the challenge is to build awareness of their potential, and to replicate and upscale them. GEF Small Grants will in 2017, document its projects, assessing impacts of the projects, lessons learnt and recommending how they should influence policy.

There is promise in the establishment of VALERI at the SALCC in 2016 with support from the GEF Small Grants Programme, to help speed up integration of innovation. The institution is still in the formative stage, and is conducting a needs assessment. It has the potential to become a catalyst for invention, innovation and discussion.

The quantum of forest in the country does not arouse the interest of the Clean Development Mechanism (CDM) or potential buyers on the carbon market (GOSL, 2017). At the FAO-hosted COFLAC Conference of Latin America and Caribbean Foresters in 2016, foresters agreed that there is need for a network of permanent sample forest plots through the Caribbean. If carbon sequestration is assessed at a regional level, it will be possible to achieve a critical mass that gives more negotiating power.

## 5.5 INFORMATION ON CLIMATE CHANGE RESEARCH AND SYSTEMATIC OBSERVATION

Long-term meteorological and hydrological observation is required to detect climate change. Climate change impacts on people and the environment are measured through research on relevant biophysical systems and economic sectors. The UNFCCC (United Nations, 1992) requires Parties to promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and to further the understanding and reduce uncertainties regarding the causes, effects, magnitude and timing of climate change, and socio-economic consequences of response strategies. It requires further development of international and inter-governmental programmes, networks or organisations, and strengthening of capacities and capabilities, particularly in developing countries.

### 5.5.2 Measures and recommendations to improve national programmes for research and systematic observation

#### *5.5.2.1 Agencies with a research responsibility*

National research and data collection is important in meteorology and weather extremes as well as in all environment and economic sectors. Agencies with a responsibility to collect relevant data are many and varied, and include:

1. Meteorological Services Department
2. Water Resources Management Agency

12. Insurance Council of Saint Lucia Ministry of Finance

3. Department of Forestry
4. Department of Fisheries
5. Soufriere Marine Management Area
6. Environmental Health Department
7. Statistics Department
8. Sustainable Development and Environment Department
9. Caribbean Public Health Agency (formerly CEHI)
10. OECS Commission
11. Water and Sewerage Authority
13. Ministry of Tourism
14. Ministry of Infrastructure
15. Department of Agriculture
16. Department of Physical Planning
17. Statistics Department
18. LUCELEC
19. Transport Division
20. SLSWMA
21. Bureau of Standards
22. NEMO
23. SLNT

Work undertaken by some of these agencies, their challenges, and recommendations to address those challenges, are described below.

The **Meteorological Services Department**, although it has no legal mandate, is responsible for forecasting, and has been collecting primary data for several decades now. The Department produces seasonal outlooks and monitors precipitation and drought. It continuously works towards expanding the coverage of the national hydro-meteorological network to improve the reliability and accuracy of data. The **WRMA** is a relatively new institution with a legal mandate to manage water resources and gathers data in support of this. Both agencies provide information to researchers and engineers, and benefit from climate change projects which seek to build capacity in hydro-meteorology. Collaboration between these agencies can be further improved to reduce duplication of effort and improve data sharing. Some further capacity building is required within WRMA to improve reliability of stations and data. WRMA conducts limited data analysis, and attributes this to limited availability and/or capacity of staff. With additional training to maintain the equipment received, the competency of the Meteorological Services Department can also be improved. Currently the Department only employs two technicians although efforts are being made to secure the services of a third.

The **Department of Forestry** conducts research such as preliminary and comprehensive post-event damage assessments of event impacts on forest infrastructure, national and protected forests, wildlife, river lands, critical ecosystems, water intakes, wetlands and migratory species. Department of Forestry's research efforts have been supported by Durrell Wildlife, and Flora and Fauna International. The Eastern Caribbean Marine Management Network (ECMAN) project is supporting restoration of mangroves in Vieux Fort that were dying back as a result of climate change. Significant data collection and research activity are underway through the ongoing Iyanola project.

Mainstreaming of climate change into the work of the Forestry Department is featured in the Department's strategic plan. The unit specialized in spatial ecology and forest MIS is being strengthened as the research arm of the Department, and will be tasked with collection of data and networking between all the Department's units. Additional staff and equipment is required. The Unit will be positioned to, among other things, measure and monitor above ground carbon, with support from other governments. The Forest MIS to support these activities will need to be upgraded, security of information increased, and the staff trained.

The Department recommends that the latest satellite imagery should be procured for each successive national communication, to facilitate their estimates of % cover and assessment of different types of forest.

Several agencies contribute to research on **biodiversity**. Examples include the Departments of Forestry and Fisheries where valuations are at very initial stages to ascertain the values of biological species to combat climate change and protect coastal areas. At the Ministry of Agriculture, there is ongoing research on a small scale in the use of indigenous microfungi as a biological agent for organic agriculture, which has the potential to reduce reliance on imported chemicals if investment can be made in its upscaling.

If access and benefit sharing, a policy objective of CBD, is to be pursued, research is needed to ensure that species are catalogued and claimed as belonging to Saint Lucia. An inventory of traditional knowledge is required. Saint Lucia needs to be positioned to patent intellectual property and genetic resources. There is legal expertise on SDED technical staff, and there has been some training in intellectual property. Skills in biotechnology are required. Although there are a few persons trained in this area, they have not been placed in positions to apply it.

A biosafety testing facility within the new Union Tissue Culture Lab will be compete in March 2017. They will be able to test for genetic modifications in seeds, produce. To optimize on the use of this facility, more technology and continuous capacity building will be required, to build on the foundation provided under the biosafety project.

The **Ministry of Agriculture** has a plant health services unit, but no significant research is being done except for adaptive research (trials with seeds, livestock etc.). There is no creation of new knowledge. There should be a greater effort to connecting tertiary institutions to the agricultural sector to create new knowledge. There is no relationship between the Ministry and the SALCC farm.

UNECLAC (2011) in its assessment of the economic impact of climate change in agriculture identified data needs to support future assessments.

The **Saint Lucia National Trust** maintains data on the Racer snake, beach monitoring, turtle nesting activity, and change in biodiversity on offshore islands.

The **Department of Environmental Health** collaborated in the past with the Department of Fisheries on the coastal water quality programme, and have suggested that the programme be reinstated. It halted when the Department of Fisheries was no longer able to collect samples and the Health lab technician was transferred. The lab equipment is still available. Not enough surveillance is done of water quality parameters such as chemicals, heavy metals and pesticides. The Department has raised this with the NURC which will try to lend support.

A laboratory for vector control is needed to identify species, test for pesticide resistance, to monitor for the possible emergence of new species, and to confirm field surveillance results. Some testing is being done at CARPHA in Trinidad, but the programme can be improved. There are plans to transition the programme to a proposed national public health lab, with CARPHA oversight and intermittent verification. CARPHA will supply some of the required equipment.

The Department of Environmental Health collaborates with the Bureau of Health Education, for example their entomological surveillance informs the education strategy in terms of areas to target and concerns to be addressed. The HMIS is soon to be extended to the Department, and should improve sharing of data within the Ministry, in areas such as epidemiology and water quality.

The **Department of Fisheries** has been conducting data collection in the areas of coral reefs health, beach profile, fish landings (catch and effort) and coastal water quality. Challenges in conducting some of the data collection are due to staff limitations. The Department has a relationship with a number of universities including University of the West Indies, universities in Japan, Iceland and Australia. Students from these universities undertake research, determined on the basis of student qualifications and Department needs, and research outputs are shared. Occasionally, the Department also receives research proposals from research institutions, organisations and individuals for specific fisheries and fisheries-related resources and issues.

The **Transport Division** has no officer responsible for research and development, and little analysis is done of data collected.

**Ministry of Tourism** has a research officer who liaises regularly with the Statistics Department, Ministry of Finance and St Lucia Tourist Board on data matters, but there is not much analysis.

**LUCELEC** does no pure research and development, but there is research in support of planning.

**NEMO** Secretariat does no research beyond post event assessments in collaboration with members of the NEMO Organisation. The NEMO District Disaster Committees and the national Damage and Needs Assessment Committee are responsible for post-event assessments.

Not much research is done by **SLSWMA**. Although a significant quantum of data is collected there is no significant analysis undertaken. It is anticipated that appropriate recommendations will come out of the new waste management strategy presently under development.

**Department of Statistics** has a statutory responsibility to maintain national statistics. The Department developed the first and only *Compendium of Environmental Statistics* in 2001, and intended to continue to collaborate with SDED to continue to publish this report. While this was a useful compilation, the Department advises that it was a mammoth task for them, and that they do not currently have the resources to update it.

The **Ministry of Finance** does not collect climate change-related primary data. The Ministry is interested in quantifying public funding spent on increasing climate resilience as this should be acknowledged as an incremental cost incurred by government.

The **SDED** does not engage directly in research. Rather, the Division as the climate change technical focal point, facilitates, enables and monitors research of other agencies, and supports related projects to build their capacities.

#### 5.5.2.2 National Council for Science and Technology

The Science and Technology Unit within REDiv is the Science and Technology Focal Point for Saint Lucia. Drafting of a Science and Technology Policy commenced, but was not completed. The Council for Science and Technology has not been reactivated, primarily as there is no budget to pay a stipend to members. The Unit was a member of Caribbean Council for Science and Technology (CCST) based in Trinidad, but there is no longer interaction with this agency.

#### 5.5.2.3 PPCR/SPCR project

*Component 1: Climate facilitation* of this project, includes activities intended to build research capacity. These include:

- Sea Level Rise Modelling and Flood and Erosion Risk Mapping
- Capacity Building for Meteorological Services, including design and deployment of a meteorological, hydrological, and monitoring network, training and procurement of equipment
- Design and deployment of a sea level rise monitoring networks to provide high resolution hydrologic data
- Evaluation of the health of coral reef systems and rapid monitoring methods for water quality and coral reef

- Collection of high resolution LiDAR data and creation of a high resolution digital topographic and bathymetric model for Saint Lucia
- Management of the GeoNode
- Development of Landslide Hazard Maps
- Environmental Health Surveillance System with a focus on Climate Change

### 5.5.3 Activities related to participation in global research and observation systems

The government has enacted legislation, and signed and ratified various regional and international laws, conventions and protocols that have a bearing on environmental research. The following describes activities related to participation in global research and observation systems.

#### *5.5.3.1 Meteorological Services Office*

The Meteorological Services Office is a member of Caribbean Institute of Meteorology and Hydrology (CIMH) and affiliated with the World Meteorological Organization (WMO). The CIMH serves, *inter alia*, as a training institute and as a repository for meteorological data for the English-speaking Caribbean. The Meteorological Services Office collects meteorological data in accordance with WMO standards and shares this information with CIMH in accordance with established protocols. CIMH is the designated calibration centre for the region and is working on bringing its services in this regard up to standard.

Most of the available Meteorological Services Office data has been digitised. Much data is collected in Excel, and a more sophisticated programme is required for faster processing, greater efficiency and to facilitate queries.

#### *5.5.3.2 Coastal monitoring*

The original tidal gauge station located at Ganters Bay has not functioned for some time. A new station to measure wave height has been installed at the same location with support of the National Oceanography Centre based in Southampton, UK under Project Neptune. The station transmits data via satellite to Southampton. The Meteorological Services Office can access the information through the project website. The National Oceanography Centre has provided training in the development of tide tables using the available data.

There are plans to establish a CREWS under the CCCCC/ EU Global Climate Change Alliance (GCCA).

#### *5.5.3.3 Caribbean Hydrological Cycle Observing System (CARAIBE-HYCOS)*

The Caribbean Hydrological Cycle Observing System (CARAIBE-HYCOS) is a regional project funded by the INTERREG IV-Caribbean Program of the European Union and the Regional and General Councils of Martinique. It is part of the World Hydrological Cycle Observing System (WHYCOS) of the WMO whose objective is to provide a scientific basis for the assessment of water resources and their development and management in an integrated, intersectoral, and international fashion. The project aims at improving basic observation activities, strengthening International cooperation and promoting free and unrestricted exchange of data in the field of hydrology and meteorology (Rabinit, 2012). The project supported development of technical expertise of the National Hydrological Services (NHS) of eleven Caribbean islands including Saint Lucia on the collection, maintenance, analysis and application of reliable and quality hydrological data to promote better water resource management. It will increase the multi-sectoral exchange of information and experience, particularly during natural disasters, by fostering regional cooperation and providing a regional knowledge base on water flows in terms of quantity and quality. The first phase evaluated hydro-meteorological measurement networks in each member country to ascertain equipment needs. The second phase continued with development of further actions to improve knowledge and data sharing, especially in relation to climate change impacts and adaptation.

#### 5.5.3.4 Scientific Platform for Applied Research and Knowledge Sharing (SPARKS)

A Scientific Platform for Applied Research and Knowledge Sharing (SPARKS) was unveiled in Jamaica in 2016. This high-performance computing and storage system was financed under the Regional Track of the Pilot Programme for Climate Resilience (PPCR), and will significantly advance climate research and the adaptation planning in Jamaica and the Caribbean, through enhanced climate modelling capacities. SPARKS will facilitate, among other things, downscaling of regional models. This has been a major gap in regional capacity (Williams-Raynor, 2016).

#### 5.5.3.5 Energy balance and GHG

The REDiv is required to collect data on imports, transportation, energy consumption, and energy usage. Some of this data is available and for others, proxies are used e.g. figures on charcoal production. A number of agencies do not produce information in the form that is required. REDiv is required to report on energy balances, and this informs energy planning. It should be done continuously, but was last done for 2010 to 2012.

Reporting on the greenhouse gas inventory is the responsibility of SDED, but REDiv is required to collect and contribute energy data. This data is obtained from agencies responsible for forestry, agriculture, solid waste, economic affairs, statistics, Customs, ports, and from business houses and schools. This was previously done every 4 years. The requirement now is for biennial reporting. Although there is a Cabinet Conclusion requiring private companies to provide information, they are under no obligation and are often reluctant or suspicious.

### 5.5.4 Identification of challenges, gaps, needs, options and priorities for climate change research and systematic observations

The Meteorological Services Department has recommended that its MIS be upgraded to Clidata for faster processing, greater efficiency and to facilitate queries. Such a database would ingest data real-time from multiple users and WRMA data could be accommodated. A Roadmap has been developed to guide the significant support to be rendered to the Department under the DVRP project. This will not fully meet needs identified.

WRMA is required to manage a hydro-meteorological system in collaboration with the Meteorological Services Office. To improve the accuracy of flow measurements, the WRMA recommends that stream gauges be mounted on bridges with bases cast. This requires bridge designs at desirable locations to be amended accordingly. Bridge designs should also anticipate the need to permit access to the rivers by WRMA. These requirements necessitate dialogue and agreement between the two agencies.

The DVRP will support significant enhancement of the hydromet network, and it is estimated that operation and maintenance costs in WRMA and Meteorological Services Department will quadruple upon completion, at a time when fiscal constraints are high. There are sustainability concerns in light of this.

There is no national funding available for environmental research programmes. Environmental data collection is usually driven by donor funded project initiatives. Because research is typically not programme oriented, it cannot be maintained due to lack of resources, resulting in data gaps. Project designed to meet requirements of donors may not be completely synchronised with national requirements. Very often projects are tailored to fit available funds which may reduce the utility of the data in the context of national requirements.

Most agencies lack the institutional capacity to collect, store, retrieve and disseminate environmental research data. Even where the agencies generate data, they do not engage in meaningful analysis and the information required is not usually readily available for effective decision making. While some line agencies have a legal mandate to undertake environmental research, many have only an informal mandate. Many agencies do not have staff specifically designated to undertake environmental research. The majority of the staff who actually carry out environmental research responsibilities do so as a secondary function.

Data within the Ministry of Agriculture is managed by the Agricultural Statistics Unit. Officers are sent out to get data, but more needs to be done to require stakeholders to provide information. There should be a requirement for provision of data in exchange for tax holidays and other incentives. Information such as exports, imports, purchases by hotels and supermarkets, is shared with the statistics department.

The Statistics Department uses an online program DevInfo to manage its statistical information online. This is open to the public. This system has the capacity to be integrated into a government-wide MIS. New information systems should be compatible with the one used by the Statistics Department. Development of **national database standards** is recommended in light of this.

Development of a **National Research Policy** is recommended, using the draft national policy on Environmental Research and Monitoring developed by Simmons and Associates (2008) as a point of departure. Such a policy should be premised on research requirements to inform national priorities and to inform decision making. Once research requirements are identified, responsibilities for undertaking and coordinating research can be assigned across relevant agencies.

### 5.5.5 Opportunities for improving climate change research and systematic observation

Students pursuing further studies should be encouraged in fields relevant to national needs. The government should influence research by students at tertiary institutions of learning to better meet national requirements. Student outputs should be accessible.

The *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project will provide a platform for sharing of information and collaboration between agencies, to inform research needs.

The allocation under the DVRP project for support to the Meteorological Services Department should also significantly improve the quality of climate data available. Additionally, the CCCCC CCAP funded by USAID will generate climate data and information for use in decision making, providing an avenue to improve climate change research and systematic observations as well as climate change information.

## 5.6 INFORMATION ON CLIMATE CHANGE EDUCATION, TRAINING, AND PUBLIC AWARENESS

This section provides information on activities undertaken to promote climate change education, training and public awareness and, in so doing, examines:

1. Initiatives to assess the level of awareness and understanding of climate change issues at the national level
2. Initiatives to increase awareness and understanding of climate change issues
3. Initiatives and programmes for education, training and public awareness
4. Cooperation to promote education, training and public awareness
5. Challenges, gaps, needs, options and priorities identified in climate change education, training and public awareness
6. Entry points that are, and can be utilized by the government and the private sector

### 5.6.2 6.1 Initiatives to assess the level of awareness and understanding of climate change issues at the national level

Accela Marketing (2011) was contracted to support the development of strategies for public education and outreach and in 2011undertook a Knowledge Attitude and Practice (KAP) as well as a survey among key stakeholder groups, including regional and international entities/academics, public and private sectors, NGOs and CBOs. In 2013, Kairi Consultants Ltd undertook a KAP survey in six OECS countries, including Saint Lucia. A World Bank mission (World Bank, 2014) conducted 16 FGDs in 8 communities, which provided an opportunity to directly discuss complex and multi-faceted, gender-specific needs in the context of natural disasters and disaster risk management. In 2016, Right Angle Imaging undertook another KAP survey and FGDs. All found that most persons had observed changes in the weather over the past ten years, and were aware of the terms climate change and climate variability. See Box 5.6 for a summary of key findings.

Women feel less informed than men about the causes and consequences of climate change and ways it could be reduced. Older householder respondents (aged 55+) feel significantly less informed than their younger counterparts. The self-perceived level of information on issues related to climate change increases with the level of education of respondents (Kairi Consultants Ltd., 2013). When asked how they felt about climate change, respondents expressed fear (24.2%), hope (35.1%), confusion (17.6%) and even powerlessness (19.1%). However, the dominant feeling among OECS residents was that they need more information on climate change – its causes and effects, and ways to combat (mitigation) or better prepare for it (adaptation) (Ibid.).

While they noted that their findings should not be considered fully representative of all views in Saint Lucia, the World Bank mission found the following (World Bank, 2014):

- Participants did understand the notion of climate change and a majority are able to link the disasters they have suffered to increased climate variability across the globe. Many believe climate events are changing significantly over time, with increasing magnitude and variability of timing.
- Few participants seemed able to articulate medium to long-term needs in terms of adapting to a changing climate. There was a sense that more women than men, in particular elderly women and women living alone with their children, felt extremely helpless in terms of what they could do differently to better prepare for disasters.

Consistent with the earlier work, findings in the 2016 KAP indicated fairly high levels of knowledge about climate change. There was a significant correlation between respondents' education levels and whether they had heard the term "climate change" (Right Angle Imaging, 2016). Some householders felt that the government should be mainly responsible for climate change. Even where persons indicated that all entities (government, business/industry,

**Box 5.6. Some key KAP findings (2011 to 2016)**

Most observed changes in the weather over the past ten years
Most were aware of the terms climate change and climate variability
There was significant correlation between respondents' education levels and whether they had heard the term "climate change"
The majority felt information being relayed on climate change is inadequate
Women felt less informed than men about the causes and consequences of climate change and ways it could be reduced
Older householders felt significantly less informed than their younger counterparts
Many were not convinced of the power of individual action in the collective mitigation effort
Tackling climate change is the responsibility of the government
Many did not believe the government is doing all it can to tackle climate change
There was low awareness of government initiatives to tackle climate change

community organisations, private citizens, industrialised countries, etc.) should be responsible, there was still a feeling that the government should bear the greatest responsibility. Participants identified activities that government can engage in as a response to climate change: education campaigns; greater investment in programmes geared towards research of needs; water management; ventures into renewable sources of energy; heightened disaster preparedness and greater enforcement as it relates to climate change (Ibid.). Government support by way of incentives to those who want to harness alternative energy sources, engage in rain-water harvesting, and tackle waste disposal by way of recycling was very important to FGD participants (Ibid.).

Right Angle Imaging (2016) compared their findings with those of the 2011 KAP study by Accela Marketing. There was a 5% increase in awareness of climate change over the period 2011 to 2016. The explanations of what is understood by climate were similar in both studies with the number one explanation in both being "change in weather patterns". In both studies variables such as increased temperature, global warming, melting of ice, rising sea levels, natural disasters and drought were mentioned. The most significant effects of climate change identified in both studies were similar. There was very little change in whether or not persons felt the information being relayed on climate change was adequate, with the majority of responders continuing to feel this information is inadequate (Right Angle Imaging, 2016).

There has not been much change in opinion on the conditions that bring about climate change. In both the 2011 and 2016 studies, burning of fossil fuels was seen as the number one condition to cause climate change, while land clearing and industry/factories were seen as important as well (Ibid.).

There was no significant change in the total numbers who either felt that the public can not have an impact or who were unsure about whether or not they could make a difference, possibly highlighting that persons are not convinced of the power of individual action in the collective mitigation effort. It also corresponds with the sentiment that tackling climate change is the responsibility of the government, and not so much that of the general public. Emphasis in educational campaigns should be placed on outlining the activities that the everyday person can engage in, to combat climate change (Ibid.). In 2016, awareness of government initiatives to tackle climate change continued to be low (Ibid.). In both the 2011 and 2016 studies, increased education was noted as the number one suggestion that government should pursue as in the response to climate change. A requirement for “greater awareness / education via media” increased from 31.9% in 2011 to 52.5% in 2016 (Ibid.). Respondents’ perception of what constitutes the most serious environmental issue facing Saint Lucia in 2016 remained consistent with findings in 2011, with improper waste disposal trending highest (Ibid.).

**Recommended media**

The following were identified in the studies since 2011:

- Popular local television channels and radio stations shows
- Certain radio and TV personalities
- Internet, providing educational material (both online and offline) that is simple and relates to the everyday lives of individual learners
- Cellular phones/Mobile apps
- Participatory methodologies

Beyond the need for public education and raising awareness of climate change, there is need for other support mechanisms, such as environmental legislation enforcement, introduction of environmental friendly policies such as alternative energy sources, establishment of recycling plants, better infrastructure such as drainage and a robust water supply (Accela Marketing, 2011). Right Angle Imaging (2016) suggested that incentives such as designing buildings with in-built rainwater-harvesting systems to the construction and residential sector, retrieval and safe re-use of plastic receptacles for the packaging of certain non-perishables as well as energy retro-fitting, best village festivals could favourably contribute to the reinforcing of key messages over the long term.

### 5.6.3 Initiatives to increase awareness and understanding of climate change issues

#### *5.6.3.1 Agency and project awareness activities*

Project coordinators and programme managers engage in awareness building activities in relation to their work programmes.

The **National Television Network (NTN**) is the state-owned television station and provides air time for programming developed by government agencies. NTN also hosts panel discussions and call in programmes on topical issues of national interest, and broadcasts (live and re-play) state events. **Radio Saint Lucia (RSL)** performs a similar function via radio, although it also engages in commercial activities and entertainment.

Under the DVRP project, TOR have been developed for **model guidelines for mainstreaming greening into the operations of Ministries**. These will be adapted to each department's needs, and should significantly raise awareness of line staff, and could have a multiplier effect as they interface with the public in the conduct of their business. The DVRP also produces a newsletter *Resilience* which is posted on the government website.

All **GEF Small Grants** projects include a PEO and capacity building component. The international and local GEF websites provide project information and annual reports. A newsletter is produced periodically, and a face book page is maintained.

**Department of Forestry** has an Education and Ecotourism unit responsible for PEA. The Forestry Strategy has PEO goals and targets, and the Department has developed a PEO work programme. The Department engages schools, farmers and other target groups through the year, but notes that policy makers have not been engaged effectively. International days on environmental significance are always commemorated, sometimes in collaboration other agencies. The Department is setting up a Wildlife Conservation and Education Centre WCC with funding from the Association for Protection of Threatened Parrots.

The **Ministry of Agriculture** has a communications unit, which puts on programmes such as A*griculture on the Move* and *Agriculture in Focus* on television and radio respectively. A YouTube video on backyard gardening was recently released. Most projects are designed with PEO and capacity building components. The Ministry of Agriculture, in its extension and engineering programmes, works with farmers in a multitude of relevant areas. Knowledge sharing on climate change impacts occurs through field days and field tours to demonstration plots.

The **Department of Fisheries** has been promoting value added with fishers. With climate change they are expected to catch less, and this adaptation will help them maintain profitability and sustain their livelihoods. The Department airs PSAs on radio and TV, but these are often project-related and as a result, their airing is not sustained. Fisheries Extension Officers and Data Collectors interact regularly with fishers. Workshops are also convened with fishers.

**NEMO**'s community based disaster risk reduction activities, including crisis communication and public awareness, have received Japanese support. NEMO develops PSAs but they are not aired by media houses as often as they should be. The Vieux Fort South District Disaster Committee NEMO will host a youth forum in early 2017 with USAID funding. NEMO hosted Earth Science Week with the UWI Seismic Research Centre in 2016 and hopes to run it again in 2017. NEMO has run the disaster risk reduction caravan twice in the recent past, with support of experts co-opted from other entities, and hopes to attract USAID funding to offer it again in 2017. NEMO makes presentations across the country, to schools, businesses and communities on business continuity plan development and preparedness sensitization. NEMO does not have a PEO programme but the Communications Officer is developing a PEO strategy.

The **Saint Lucia National Trust** collaborates with other agencies in raising awareness. SLNT led celebrations of World Wetlands day in February 2017 in collaboration with Departments of Fisheries and Forestry. The SLNT does not have a climate change education programme, but all projects have an educational component. SLNT has recently received climate funding support for a coastal stabilisation in Pigeon Point and Vieux Fort (climate adaptation) which has a PEO element. The Trust work programme includes programs for schools, the Youth Environment Forum and Youth for Conservation Retreat. These activities build environmental awareness within the youth, including in climate change. SLNT works with communities such as sea moss farmers at Pointe Sables, focusing on livelihoods to build climate resilience.

The **Environmental Health Department** collaborates with others in PEA. The Department supported the Ministry of Sustainable Development in raising awareness in the lead up to the Paris Conference of Parties to sensitise the public on the COP. Under vector control, water and waste management programmes the Department addresses the climate change dimension. The Department collaborates with other agencies such as NEMO, SDED and DoFi in disaster risk reduction and water quality awareness.

The **Meteorological Services Department** responds to school and group requests for visits to facilities or lectures. Many schools are visited in commemoration of World Meteorological Day in March. An essay competition was hosted in 2016. Development of a weather app for Saint Lucia weather is planned. The Department proposes to upgrade its website to provide public access to data with GIS support, but this has been slow.

Climate change is incorporated into the education and public information program of **SLSWMA**. The SLSWMA hosts a website, responds to research requests of students, and issues a quarterly electronic newsletter. Brochures on a variety of topics are published, and house to house visits undertake in critical areas. The PEO programme is more reactive than proactive due to resource constraints. PEO initiatives are often in collaboration with other agencies such as SDED, Environmental Health Department, PROUD and Constituency Councils. The collaborative engagements are better, as people can better make the linkages between the sectors, reduces the number of meetings in the community, and is a more efficient use of agency resources.

Biosafety has a component of public participation, and the **Biodiversity Unit** visits many communities and engages in face to face discussions with residents. The Unit has developed a platform that facilitates public feedback if an application for use of a GMO is received. PEO is mostly project specific. The Unit also collaborates with SDED communications staff as required.

Some agencies do not have a PEO programme, but will accommodate requests to speak in public forums. These include Transport Division, Ministry of Tourism and Bureau of Standards.

**REDiv** incorporates training components into the design of its projects. Training is also made available through other projects, for e.g. the Caribbean Energy Efficiency Lighting Project under which two persons from the Ministry of Infrastructure Electrical Department were trained. The REDiv engages in a range of awareness building activities, the main one being the annual Energy Awareness Month convened since 2005. The Division conduct schools visits, walks to promote renewable energy and energy efficiency (energy kilo-walk), car-pooling initiatives and procures paraphernalia for distribution. In 2016 an electric vehicle roadshow and a park ride activity were held. In addition to the month of activities, there are stakeholder workshops and consultations on specific projects. The Division actively transmits information through the Departments Facebook page "sustaining 411". The National Science fair is organised by the Ministry of Education with the input of the **Science and Technology unit**.

**OECS**, under the RRACC project, engaged the media (including the private sector, and communications officers in government and WASCO) to ensure they understood and could report on climate change issues. A series of OECS climate change symposia were also held across the OECS and documentaries on how to adapt to climate change were produced.

The **Caribbean Community Climate Change Centre** (CCCCC) has provided training to several agencies and private sector representatives on the use of CCORAL, a tool designed to help decision makers to consider activities through a ‘climate’ lens, and to identify actions that minimize climate related loss, take advantage of opportunities and build climate resilient development in their countries. It is intended that CCORAL training will be undertaken for public sector economists (SDED et al, 2016).

#### *5.6.3.2 MOU for delivery of a National Environmental Education Programme*

A MOU was developed in 2012, between:

- The Ministry of Public Service, Sustainable Development, Energy, Science and Technology
- The Ministry of Education, Human Resource Development and Labour
- The Ministry of Agriculture, Food Production, Fisheries and Rural Development
- The Ministry of Tourism, Heritage and the Creative Industries
- The Ministry of Health, Wellness, Human Services and Gender Relations

regarding delivery of a National Environmental Education Programme. It acknowledged the role of each agency in human resource development and public education, whether formal or informal, and the implications of their work programmes for the health of the environment, and set out their respective contributions and responsibilities in the implementation of a national environmental education programme. The MOU has not been effected to date. However, these agencies do have communications officers and/or public education units, and already collaborate quite extensively in awareness activities within the constraints of their resources.

### 5.6.4 Initiatives and programmes for education, training and public awareness

Article 6 of the UNFCCC on Education, Training and Public Awareness calls for governments to promote the development and implementation of educational and public awareness programmes, promote public access to information and public participation, and promote training of scientific, technical and managerial personnel.

#### *5.6.4.1 PPCR/DVRP*

The PPCR/DVRP Programme gives special emphasis to PEO with the objective of empowering the general public to take meaningful action to build resilience. The KAP survey conducted during Phase 1 of the PPCR identified the need to communicate the urgency and importance of the adverse impacts of climate change and implications for Saint Lucia’s economy. The overall goal of PPCR Public Education and Awareness Strategy is to engender a sense of collective and individual responsibility for climate change among the general public that will result in meaningful and effective response/action with respect to adapting to climate change (GOSL, 2014). The entire local population will be targeted with an emphasis on the following groups:

- Vulnerable groups[29]
- Government/policy makers
- Economic/private sectors
- NGOs and CBOs
- Media

Communication methods will be designed to address a lack of patriotism, complacency and apathy, and feelings of inevitability, fate and disempowerment (GOSL, 2012). The Public Awareness Campaign will span the life time of the PPCR/DVRP, underpinned by the tagline: "One person, one household, one enterprise, one community, one sector, at a time" (GOSL, 2014). Key information to be imparted throughout the campaign includes:

1. Foundational knowledge to provide target audiences with the basis for action and to facilitate the ownership of DVRP/PPCR interventions and uptake of opportunities.
2. Information on DVRP/PPCR interventions being undertaken.
3. Information on opportunities through the Climate Adaptation Financing Facility (CAFF).

#### 5.6.4.2 OECS GCCA and other OECS projects

The public awareness component under the OECS *Global Climate Change Alliance (GCCA) project on Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean* included national workshops on SLM/CCA, regional forums on SLM/CCA, and engagements of the Council of Ministers of Environmental Sustainability (COMES). A documentary was produced on bioengineering on riverbanks using mango for food security and carbon sequestration. There was training in geospatial information and data in Saint Lucia in 2015.

Under the PAHO smart hospitals initiative, OECS countries received support for energy efficiency in health facilities. Training for coordinators of facilities and nurses included a requirement for staff to develop plans for their facilities.

The Eastern Caribbean Energy Labelling Project ECELP (2012-2014), a collaboration between OECS and the Bureau of Standards, included an awareness component. This was financed by the EU ACP Energy Facility, the German Federal Ministry of Economic Cooperation and Development (BMZ) and the OECS Commission. It aimed at increasing Energy Efficiency (EE) in the OECS region by introducing EE standards and labels for electrical household appliances and lighting equipment and promoting the use of energy-efficient products (REDDIV, 2017).

The Sustainable Energy Technical Assistance (SETA) funded by CDB and implemented by OECS developed energy strategies and PEO material promoting energy efficiency.

#### 5.6.4.3 Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development

The project *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* will, among other things, increase public education and awareness of environmental management areas relevant to the MEAs. The project outcomes include the following:

1. Implement tools for improved MEA and sustainable development reporting and monitoring;

[29] children, women, elderly, farmers, fishers, the poor, young males

2. Mainstream environmental management and MEA objectives and;
3. Awareness raising, education and outreach.

At the agency level, gaps in capacity, knowledge and skills result in under-utilization of data captured, in the decision making process by policy makers. The project will formalize and sustain effective mechanisms for the exchange of both general and more specialized technical information among relevant stakeholders; strengthen the capacity of targeted agencies to better generate, manage and utilize environmental management in decision making; and create a culture of information management and use as well as research.

Targeted institutions will be provided with tools and methodologies to better coordinate existing knowledge, to generate new information on the state of the environment, and to track and monitor environmental trends and changes, so as to improve environmental management. It will also establish tools for impact and vulnerability assessments, and train environmental officers in the use of assessment results to influence policy development. Coordination of environmental information will facilitate national, indicator-based reporting on conventions in a more coherent and efficient manner. Assessments can help monitor whether and how implementation of the conventions is leading to environmental change in the country, and can identify priority areas for national development planning. Agencies targeted include:

1. Ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development,
2. Water Resources Management Agency (WRMA),
3. Saint Lucia Solid Waste Management Authority (SLSWMA),
4. Ministry of Health, Welfare and Human Services (MOH),
5. Department of Forestry (DOF),
6. Water and Sewage Company (WASCO),
7. Caribbean Public Health Agency (CARPHA)
8. Sustainable Development and Environment Department (SDED),
9. Biodiversity Bio safety Units and
10. Energy Science and Technology Unit in the Ministry of Sustainable Development.
11. Statistics Department, which has a legal mandate to gather socio-economic data and to disseminate information.

Component 3 will develop expertise and understanding of environmental issues among NGOs and the general public. Stakeholders including CSOs, CBOs, NGOs and government agencies will be trained in the use of Environmental Information Systems (EIS) in different geographic areas. An online platform will be designed allowing the public to provide or validate information based on priority environmental themes and training in the use of the information platform will be undertaken. A communications strategy will be developed and public awareness programme conducted on the national environmental information system.

#### 5.6.4.4 GEF IWEco

The GEF IWEco project will build capacity and increase awareness through:

1. Trained professionals in monitoring and assessment protocols
2. Strengthened national inter-sectoral committee
3. Strengthened capacities among stakeholders in relevant areas
4. National PA/PE programme and associated media products
5. Scientific publications, books, other publications
6. Country partnership technical exchanges

#### *5.6.4.5 IICA*

IICA's work in climate change involves building resilience in agricultural value systems to natural disasters and the effects of climate change. IICA identifies areas of deficiencies and vulnerabilities, provides support services, raise awareness, and helps strengthen the business aspects of the farmers operation. In 2015 IICA launched the climate smart agriculture forum, a series of national dialogues and webinars where priority climate change related topics of concern in the region were discussed. There were presentations by experts followed by national dialogue to build the local knowledge base. All of the work of IICA is on the website which includes a resources link.

#### *5.6.4.6 Training of public officers*

The Chief Physical Planning Officer and a MOI staff member received training in the Netherlands to model risk and mapping, to develop maps for flood and landslide in the most vulnerable areas. A website was developed to be used by the region in planning design.

There has been significant capacity building through the 5Cs C-CORAL project, with regional high level and local training on mainstreaming climate change into planning. Although some may still not embrace the concepts, Ministry of Economic Planning is now applying the tool.

Department of Fisheries staff get opportunities to train in Japan. One staff member goes every year. The Wollongong University in Australia also offers a course in fisheries management. Since 2013 five persons from the Department have attended. They cover climate change issues and data collection among other things.

#### *5.6.4.7 GOSL Training List*

Every few years, agencies are requested by the Ministry of the Public Service to submit their priorities for training. The final list identifies training programmes that will receive government support. The list is now under review, and the recommendations submitted by SDED are provided in Annex 5. Areas recommended include training at Masters, Bachelors and diploma levels in modelling, climate and environmental studies, meteorology, chemicals, environmental economics and law.

#### *5.6.4.8 Climate Change Teachers Toolkit, A guide for climate change education (2011)*

The Government of Norway extended a grant to the United Nations Environment Programme (UNEP) to facilitate activities in Article 6 on Education, Training and Public Awareness of the New Delhi Work Programme. The Government of Saint Lucia entered into a memorandum of understanding with the UNEP to undertake a number of education, training and public awareness activities on climate change, including a Climate Change Teacher's Tool Kit for senior primary and secondary school teachers (De Beauville-Scott, 2011). The Tool Kit was developed in collaboration with school teachers and members of the NCCC. It presents technical information on climate change, its consequences and implications for small islands, what the world is doing, and ways in which we can help. It provides a list of other resources for more information. There are plans to update it and develop an accompanying learning tool (pers. Comm., SDED, 2017).

CIMH is now also offering a course in weather and climate for CAPE teachers.

### 5.6.5 Co-operation to promote education, training and public awareness

Several agencies benefit from cooperation to promote training, and most of these have been alluded to earlier in this report. Such arrangements include:

1. Ongoing discussions between Ministry of Agriculture and the Cuban ambassador to engage in a MOU to build capacity at the WRMA;

2. Engineers without Borders Colorado Student Chapter are proposing to work with WRMA on the maintenance of their newly installed rain gauge network. This should result in some capacity building at WRMA;
3. At the COFLAC Conference of Latin America and Caribbean Foresters in 2016, Porto Rican counterparts agreed to work with the Department of Forestry in the development of its database;
4. The Meteorological Services Department recently got help from Engineers Without Borders in a collaboration with NEMO, and a network assessment was done;
5. Ministry of Agriculture staff have had training in Morocco for technical staff in soil testing;
6. NEMO staff has received training in Early Warning Systems, Climate Change and DRR in Japan.
7. Department of Fisheries staff benefit from opportunities to train in Japan. One staff member goes every year. The Wollongong University in Australia also offers a course in fisheries management. Since 2013 five persons from the Department have attended.
8. Capacity building for technicians including one member of Fisheries staff and two others (from the Fish Marketing Corporation and a SALCC student) was provided through the ammonia refrigeration systems project. The Fisheries staff member will visit Japan in 2017 for more training.
9. There is a thrust to get technology from Japan into the agricultural sector (South-South cooperation). There are also plans for a site visit to Japan through the JCCCP. Beneficiaries are likely to be Ministry of Agriculture officials/technical officers and farmers.

### 5.6.6 Challenges, gaps, needs, options and priorities identified in climate change education, training and public awareness

The population is preoccupied with social issues – unemployment, crime and violence and poverty – with climate change relatively low on the scale of critical issues. It is important to **link current social and environmental issues and climate change** (Kairi Consultants Ltd, 2013). **Continuous and relevant information** on climate change and its effects, especially on livelihoods should be provided, effectively communicating the linkages between climate change, development and poverty (Climate Support Facility, 2014). Persons should be advised on what they can do to combat climate change. Messages should be targeted specifically to each group so that they are relevant and relatable (Accela Marketing, 2011) e.g. how farmers' livelihoods would be affected by rains, pests, heat stress, etc.; how recreational activities would be affected; what would happen if the Friday night street fair activity has to be stopped because of continued rains (Climate Support Facility, 2014). The public education programme should have a component which targets persons working in sectors that would be hard-hit by climate change. Persons must be sensitized to the realities of natural disasters, especially those living in hazard prone areas, through community awareness campaigns and evacuation plans (Accela Marketing, 2011).

Change of attitudes, perceptions and mind-sets is difficult, and requires persistent, targeted effort. There is inadequate **direct and specific engagement of civil society and the private sector**. Civil society needs to be empowered to begin the process (Climate Support Facility, 2014). The perception among all target groups needs to change to inculcate a greater sense of **collective responsibility** and a 'can do' attitude with respect to combatting climate change. A sense of ownership and self-responsibility needs to be engendered, clearly making a clarion call for all persons to take action now (Accela Marketing, 2011). There is still the notion that the government must take the main responsibility for addressing climate change. Campaign messages need to help in defining those various roles and behaviours which individuals and organisations can feasibly implement (Right Angle Imaging (2016)). Age, level of education and socio-economic status are intervening variables in the level of concern about climate change. While the entire population should be targeted, special efforts should be made to pitch the messages of climate change to women, persons with low educational levels and the elderly in the public education programme (Kairi Consultants Ltd, 2013).

There is need to **expose persons to the wide range of actions which they can implement** in addressing climate change issues. More needs to be done to **support civil society in finding out about new technologies** and how they can be integrated. This should be supported by research institutions such as such as CARDI and IICA who help to introduce new ideas to farmers. People need greater exposure to new ideas and research. Provide some measure of support for vulnerable persons, including support for retrofitting homes, and for persons with no insurance coverage to relocate and rebuild their homes in safer areas where loss of livelihood in the event of disasters brought about by climate change could be reduced (Accela Marketing, 2011).

There is broad consensus among agencies consulted that climate initiatives must be more **community focused** if there is to be sufficient uptake of recommended measures for adaptation and mitigation within the general population. A number of recent initiatives acknowledge this, including the GEF Small Grants and IICA approaches to working directly with communities and providing them with complementary business skills, and the DVRP public awareness strategy which mobilises the population to act and counters public apathy towards environmental and climate issues. More projects need to genuinely engage community from the design through implementation, to ascertain needs and to jointly agree requirements for project sustainability and success. Multiple stakeholder consultations do not occur at various stages of projects, often due to funding limitations (Climate Support Facility, 2014). There is need to factor in **community consultations** at all stages, from inception through progress to conclusion. Short focus group discussions may negate the need for funding for a venue, catering, etc. (Ibid.).

The majority of organizations (54%) had no **budget** for project plans and campaigns that focused on environmental awareness and educational outreach. Those with budget allocations did not have a proper **strategy**, nor did they have **feedback mechanisms** to evaluate the effectiveness of communication strategies (Accela Marketing, 2011). **Communication capacity building** is required across all key sectors that are to play a pivotal role in climate resilience (Right Angle Imaging, 2016). Even within most public agencies represented on the NCCC, awareness of climate change issues is limited to the climate change focal point and alternates. More needs to be done to increase staff awareness of sectoral linkages and possible relevant approaches. The draft **MOU for delivery of a National Environmental Education Programme** should be pursued. This would improve coordination of the PEO effort regarding climate change.

While traditional, alternative and social media were suggested as the ways to reach audiences, messaging should be very creative and bold to persuade people to adjust their behavioural practices. Participatory methods, interactive town hall meetings, focus group meetings, and interaction via television and radio were recommended. Agencies should dialogue with groups, churches, clubs and organisations, to influence behavioral change. In the interest of sustainability, public awareness and advocacy efforts would do well to lessen reliance on media driven messages and more in the formation of multi-sectoral coalitions where synergies can be leveraged for mutual benefit (Right Angle Imaging (2016)).

SDED gets many requests for information from researchers and students. The Department has many documents in hard copy only. Support under CCCCC CCAP will facilitate digitization of these documents so they may be more readily available to the public. A **climate change website** is needed to provide information to the public, as well as for sharing of information with agency partners. The NAP Global Network will support website development.

There is inadequate awareness and understanding of climate change by politicians. There is need for **targeted PEO efforts for the Parliament**. Targeted products will be developed under the PPCR-DVRP Project. Even if they are aware of climate concerns, most elected officials are influenced primarily by the opinion of their electorate and financial supporters. It is important therefore to ensure that the electorate and development community are well informed and do not make demands on elected officials that only perpetuate living conditions that increase the climate risks of their homes and other investments.

### 5.6.7 Entry points that are, and can be, utilised by the government and the private sector

Agency representatives gain information through participation in the NCCC and their engagement with external agencies. More should be done to infiltrate this knowledge through their organisations and beyond. Through the PEO Strategy under the PPCR-DVRP, SDED will engage each sector Ministry in bilateral discussions to assist in mainstreaming climate change in specific sectors.

Each Ministry should use every public awareness effort as an opportunity to make the linkage between their sector and climate change. The draft MOU for coordinated PEO on environmental matters would support and consolidate these efforts.

The Social Transformation Officers STOs are a resource that can be tapped into for transferring climate knowledge at a community level if they are adequately trained. There are eleven officers, assigned to specific geographical areas. It would be possible for them to obtain online climate change certification in less than 1 year (pers. Comm, MOST, 2017). Other field officers (e.g. in Health and Agriculture sectors) should be similarly trained.

The CAFF being initiated under the PPCR-DVRP will provide civil society with means to directly undertake climate change initiatives to help them in the daily lives. People are also being directed to the GEF Small Grants Programme as a means to help themselves. Empowerment of civil society through capacity building and awareness is also being supported through the PEO and other components of the PPCR-DVRP (Ibid.).

To challenge entrenched cultural attitudes, more use should be made of traditional knowledge and folk culture which respected the land and nature, and encouraging observing natural phenomena leading to wisdom about climate change (Right Angle Imaging, 2016).

The most recent experiences with storms and drought have resulted in a large number of private sector entities thinking more about impacts and planning for the continuity of their operations. This is an opportune time to engage them on introduction of measures to increase their resilience.

Ministry of Finance proposes, as part of its preparation to access GCF, to develop a Climate Resilience Plan. This will provide a basis for forecasting of skill sets required of the population to meet the future needs. A training program can then be developed in the targeted areas in collaboration with local educational institutions such as NSDC, CARE and SALCC. While it would be a more time consuming process to influence change in the CXC curriculum, CXC should be engaged to ensure that CXC graduates are better equipped to meet the requirements of future work opportunities (pers. Comm., MOF, 2017).

Governments can make the provision of free messaging about climate change and other important environmental concerns a condition for the granting of telecommunications licences. A similar public interest principle can be made to apply to radio stations and the providers of local television and cable services ((Kairi Consultants Ltd, 2013). Free airtime for government is already a feature of media licenses which should be enforced.

## 5.7 INFORMATION ON CAPACITY BUILDING ACTIVITIES, OPTIONS AND PRIORITIES

This section is arranged as follows:

1. Identification of specific challenges, gaps, needs, options and priorities for capacity building to address climate change issues
2. Participation of wide range of stakeholders in issues related to climate change
3. Activities related to co-ordination and sustainability of capacity-building activities
4. Dissemination and sharing of information on capacity-building activities
5. Opportunities for capacity building related to climate change.

### 5.7.2 Identification of specific challenges, gaps, needs, options and priorities for capacity building to address climate change issues

There is still much work to do in getting beyond awareness and understanding of climate change to a place where entities and individuals understand their roles in climate change adaptation and mitigation, and how this relates to disaster risk reduction and increased resilience. A better grasp of roles will foster increased implementation of desired measures. It is hoped that work already underway or planned will soon bridge this gap. Widespread attitudinal change is a slow and arduous process, and requires continual effort of all parties, supported with integrated and coordinated programmes that provide information, implementation support, incentives and enforcement to the public.

Substantial financial resources are available to support community climate initiatives, but most vulnerable communities do not have the capacity to access these. More needs to be done to support and build the capacity of communities to position themselves to benefit from such resources. One approach may be to establish a dedicated unit to provide much needed community and civil society support. Such a unit could work closely with the Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia.

While work with civil society has been limited, there are several examples of community projects that have not performed optimally, or, in the worst case, have failed, and new technologies and approaches have not been sustained within communities beyond the project life. There may be many reasons for this, including:

- Project designs do not adequately incorporate community knowledge or realistically acknowledge the limitations in community resources to sustain an initiative.
- Low engagement beyond community leaders.
- Lack of integration of mechanisms for sustainable financing into project design.

An analysis of reasons for past project failures should be undertaken so that lessons may be applied to new project designs to improve future performance.

Some of the initiatives aimed at building capacity relevant to climate change were described earlier, in the following sections:

- Sections 4.4 and 4.5, in relation to transfer of environmentally sustainable technologies;
- Section 5.3 in relation to climate change research and observation systems.

According to Charles (2016), many civil society organizations are not sufficiently sensitized to climate change. Representatives reported a general awareness among their membership of the climate change threat, but a low understanding of specific risks on a sectoral basis and an absence of formal programming by these organizations in response to these risks. This is also true for senior officials across all sectoral ministries (Ibid.), including the Ministry of Finance in relation to national development programming. There is need for capacity building in climate change risk assessment and response planning across all social and economic sectors, as a matter of priority (Ibid.).

Building capacity and the knowledge base at all levels (systemic, institutional and individual) of the society is a key requirement for climate change resilience building. In particular, agency capacity with regard to a science base of information for validating and monitoring climate change requires strengthening. Accurate climate detection instruments, data management, including development or expansion of computerised databases, and capacity to undertake predictive analysis are also areas to be addressed. Human capacity is currently inadequate, both in terms of numbers and skills required to guide the process of adaptation (Ibid.).

Capacity issues in specific agencies are described below. Although not all agencies are covered this gives a sense of capacity issues commonly encountered in public agencies.

#### 5.7.2.1 REDiv

The Energy, Science & Technology Division (EST) was established in 2012 under the Ministry of Sustainable Development, Energy, Science & Technology, at which time the Division was staffed by three technical officers. In 2013 the staff complement was increased by two technical officers. Since 2014 the Division has had a Head of Division who is also the Chief Public Utilities Officer, three Energy Officers and one Science and Technology Officer. Support staff is brought on to manage projects such as the Geothermal Project; the Carbon War Room /Rocky Mountain Institute Project and NETS; the ESD Caraibe project. The EST transitioned into the Renewable Energy Division (REDIV) in mid-2016, and falls within the SDED. REDiv typically working on 12 to 15 projects at any time and requires an additional officer to support collection and analysis of data, reporting (in particular, M&E of completed projects) and for technical analysis of proposals.

#### 5.7.2.2 Ministry of Agriculture

The Ministry of Agriculture has a role to provide technical support services, but is challenged by the loss of technical competence in recent times as persons retire, are seconded to other posts, or emigrate. The Ministry has no entomologist, pathologist or soil scientist on staff, and with the planned opening of the diagnostic facility, may need to recruit staff regionally.

#### 5.7.2.3 NEMO

NEMO requires in-house ICT support; an officer skilled in developing project proposals and reporting; and another in community mobilisation to train the disaster committees.

#### 5.7.2.4 WASCO

WASCO will require a GIS administrator. Staff require specific training in GIS for water utilities. WASCO has hydraulic modelling software but needs more training and more data. Better understanding of the WASCO network is required if its efficiency is to be improved and NRW reduced. A SCADA and improved IT system is needed. Additional engineers are required, as well as a very senior technical person is required to manage the technical departments.

#### 5.7.2.5 Meteorological Services Department

The Meteorological Services Department has issues with both staff numbers and staff capacity. There are vacancies in the structure that ought to be filled. More meteorologists should be trained. The Ministry of the Education should include meteorology and climatology on its priority list for education. An additional technician is required to bring the complement to three.

#### 5.7.2.6 Forestry

At the time the Forestry Department's Strategy 2015-2025 was written, the Department had been transferred from the MOA to the MSDEST. The strategy noted that this had presented both challenges and opportunities. There was a sense that the Department's influence and status had been reduced, but that alignment to the sustainable development agenda should emphasise its value in ensuring vital ecosystem services for sustainable development, provision of essential natural resources (particularly water), and adaptation and mitigation to the impacts of climate change. The Department was returned to the MOA in 2016. The structure is being revised, and it is proposed, among other things to hire an individual with a Masters in soil carbon, by early 2017, as part of establishment.

#### 5.7.2.7 Ministry of Physical Development

Ministry of Physical Development will require some capacity building to manage the National Spatial Data Infrastructure NSDI and undertake modelling. There is also a gap in planning skills, as most staff are in allied professions (architecture, engineering, geography). The Ministry of the Public Service has included planning and GIS skills on the 2017 priority list.

#### 5.7.2.8 Strengthening of Extension and Community Education Programmes

The extension and education units of various agencies should be strengthened so that activities that provide the communities they serve with technical support are strengthened and expanded, and the efforts sustained. These include agencies such as Ministries of Agriculture, Department of Fisheries, Ministry of Health (Bureau of Health Education, Department of Environmental Health and Community Nursing) to name a few.

The building sector requires strengthening if development planning is to minimise hazard risk, and infrastructure and buildings are to be more climate resilient. This requires continuously engaging and equipping groups such as engineers, architects, land surveyors, draftsmen and contractors including small builders with the appropriate tools, guidelines and other information. The Ministry of Physical Development must lead such initiatives, supported by agencies such as NEMO and Ministry of Infrastructure, and professional associations. To perform in this role, the agencies themselves require significant capacity building and re-structuring to refocus and intensify such efforts.

### 5.7.3 Participation of wide range of stakeholders in issues related to climate change

Most projects include a PEO component, but this does not include participation of a critical mass of persons in activities. A few agencies initiate pilot projects or engage individuals and groups in the field to support their work. These approaches better engender participation of stakeholders, but such practices are not widespread. Awareness of pilot projects beyond the direct beneficiaries is low, and penetration of the technologies and measures being touted is therefore also low. There is limited upscaling of pilot projects mainly due to resource constraints, so the potential benefits are not fully realized.

### 5.7.4 Dissemination and sharing of information on capacity-building activities by agencies

Most (though not all) agencies host websites where information related to their activities is posted. This may invite participation in or report on agency activities, and provide links to other agencies engaged in related work. Agencies maintain contact lists and may disseminate information directly to stakeholders by phone, email, text or WhatsApp. Information is also shared in PSAs via various media, and in community meetings. Workshops that build capacity will usually be reported on as a news item in newspapers and on radio and television.

### 5.7.5 Opportunities for capacity building related to climate change

Every successive NC requires more information, and capacity building is usually provided by the lead consultant and sector experts. Data required to inform the NC may be collected routinely, but is not necessarily applied within the various sectors in the course of their daily work. Through the NC process, this data is analysed, and the inter-sectoral approach promoted augers well for a more coordinated and holistic approach to national priorities.

There is a significant quantum of funding available in the name of climate change. In some instances, funding is available to the public sector. In others, NGOs and CSOs are required to submit proposals to access funding. The government and people of Saint Lucia must position themselves to better access such funds. Funding proposals developed must be designed to maximize potential benefits on an individual, institutional and systemic level, and to address defined national development priorities. The following is noted:

- The government is presently working assiduously to prepare to access the GCF directly.
- There may be greater opportunity to access CDM funds if the region collaborates to attract potential buyers on the carbon market.
- The SLNT has been working closely with civil society groups, and a Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia has been formed to support greater inclusiveness of civil society in the pursuit of SDGs. This has great potential to facilitate more integrated and successful approaches by civil society in relation to the climate agenda.

## 5.8 CAPACITY BUILDING ACTIVITIES AIMED AT INTEGRATING LOSS AND DAMAGE INTO MEDIUM AND LONG TERM PLANNING

This chapter addresses:

1. Understanding loss and damage
2. Identification of challenges, gaps, needs, options and priorities.

### 5.8.2 Understanding loss and damage

Addressing loss and damage to the adverse effects of climate change is a critical policy concern for small island developing countries like Saint Lucia because to date, the failure of large emitters to curb greenhouse gas emissions as quickly as necessary is highly likely to lead to impacts that even the best adaptation practices will fail to avoid. At the technical level, there may be some appreciation of this nationally, but not beyond that. A greater understanding of the risk of loss and damage to vulnerable economic sectors is required to avoid a situation of "abandon and retreat" in many coastal areas. Beyond understanding, decision makers will require the appropriate tools to be able to determine the expected magnitude and timing of impacts and develop plans for addressing them.

There is some demonstration of political commitment at both the regional and international levels to address loss and damage, but there are still significant gaps and challenges in meeting objectives, including financial, technological and human capacity needs. Saint Lucia has been very active in the implementation of work to address loss and damage in the UNFCCC process and there is the expectation that in time, this work will lead to guidance and support for national-level initiatives. In the meantime, efforts made now to raise awareness of the issue and understand the country's needs are likely to put Saint Lucia in a better position to help fashion approaches that are appropriate and to take advantage of outside support when it becomes available.

### 5.8.3 Identification of challenges, gaps, needs, options and priorities

There is a need for clear funding arrangements to be made available to assist people affected by the impacts of climate change, as well as effective risk transfer arrangements for all countries in the region. To be able to respond to climate-change related disasters and their impacts, including the protection of people displaced by the impacts of climate change, effective legal, financial and institutional response mechanisms must be in place, based on climate-change related assessments. Conducting these assessments will require a robust knowledge base on extreme and slow onset events. To build this knowledge base, the government will have to rely on the scientific community to enhance its research on and presentation of loss and damage matters, including through the preparation of peer reviewed scientific articles on, among others, ocean acidification, sea level rise and desertification, in island countries. Arrangements must be in place to ensure that the data associated with this enhanced knowledge base is made accessible to relevant governmental and non-governmental organizations in the region and updated periodically. Finally, awareness and understanding of loss and damage must be improved among the general public and the public must have a hand in identifying its own capacity needs, organised around the themes of comprehensive risk management, slow onset events and finance.

A presentation to cabinet on climate change and loss and damage is warranted. This should focus on the opportunities, as well as the challenges.

## 5.9 MEASURES TO PROMOTE INFORMATION EXCHANGE AND NETWORKING

This section provides information on steps taken to date to foster the exchange of climate change-relevant information among stakeholders and to establish and strengthen pathways and networks to facilitate such exchange. The areas specifically addressed are:

1. Activities to promote information sharing
2. Participation in, and contribution to, information networks
3. Identification of specific challenges, gaps, needs, options and priorities to facilitate information exchange and networking
4. Opportunities for promoting information exchange and networking.

### 5.9.2 Activities to promote information sharing

A number of polices and draft legislation have been developed that speak to the requirement for information exchange and networking. These include:

1. SGD
2. NEP/NEMS
3. CCAP
4. Draft Environmental Research Policy
5. Draft NEEP and NEES
6. The Environmental Management Bill and draft regulations
7. The Energy Efficiency Bill

Sound technical information is required for decision making. Section 4.3 describes the limited technology networks and noted that most agencies rely on their personal networks to collaborate and obtain information from others. While this works for those in the system, operating on the basis of who you know is not an appropriate or institutionalised approach (pers. Comm, Department of Fisheries, 2017).

The Government of Saint Lucia is implementing the project *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* under the GEF cross-cutting capacity development (CCCD) portfolio, to address capacity limitations identified in the National Capacity for Self-Assessment (NCSA) project, including the need to establish and sustain an integrated and systematic framework for information management and reporting. This was described in some detail earlier, and will strengthen environmental information systems, improve capacity to monitor and implement international conventions and better integrate environmental concerns and the value of ecosystems into the country's broader development frameworks (GOSL, date unknown).

The *Freedom of Information Bill* was developed by SDED to give the public a general right of access to official documents and to make provisions for incidental and connected purposes. The Bill binds the State and applies to all public bodies and official documents with stated exemptions. The objects of the Bill are to reinforce fundamental principles underlying the system of constitutional democracy, including governmental accountability; transparency; and public participation in national decision making.

A new *OECS website* has been launched, designed to improve information sharing. It is not fully populated yet, but documents will be digitised and uploaded, and articles will be published. OECS will consider protocols for permission for other agencies to upload documents.

### 5.9.3 Participation in, and contribution to, information networks

The NCCC is an effective mechanism for networking, although it does not meet as frequently as it should. However, it establishes relationships, and members communicate in between meetings as required. The most recent NCCC meeting was held in April 2017 and prior to that, the Committee met in April 2016.

Some examples of networking engaged in beyond Saint Lucia are provided below. This is not meant to be an exhaustive review, but gives an insight to the typical approach across the public service:

1. SDED has access to international networks such as the UNDP NC Support Programme (NCSP) and the UNDP Climate Community, and uses these facilities on an as-needed basis. SDED represents Saint Lucia as a member of the UNFCCC small island negotiating block AOSIS and collaborates as necessary. SDED sustains a relationship with CCCCC which is the main node for information exchange and networking on climate change issues and on the Caribbean region's response to managing and adapting to climate change. CCCCC has maintained a clearinghouse mechanism since 2010 with links to country websites, and this will be enhanced through CCCCC CCAP.
2. The CARILEC renewable energy platform is a source of information for REDiv officers. The Association of Utilities has participation from across the CARICOM region. The Caribbean Energy Information Systems (CEIS) shares information on developments in the energy sector. International Renewable Energy Agency IRENA is a similar international forum.
3. The Department of Forestry participates in COFLAC and Conference of Forest Officers COFO, UN Forum on Forests and CITES.
4. The Department of Environmental Health collaborates with regional agencies such as CARPHA, PAHO and WHO.
5. NEMO's regional and international collaborators are CDEMA, UNDP, USAID, UNICEF, JICA and the Korean government.
6. Department of Fisheries collaborations outside of Saint Lucia are with agencies such as CRFM, CERMES and FAO.

### 5.9.4 Identification of specific challenges, gaps, needs, options and priorities to facilitate information exchange and networking

Timely sharing of information at all levels needs to be improved. A platform is needed to share information across sectors. A publicly accessible repository of policies is needed. There should be a government portal for the publication of documents, rather than a reliance on memory, relationships and networking, to make access to information more efficient, equitable and transparent.

A greater appreciation of the knowledge that exists at a community level is required. Communities have a good grasp of how climate has affected them and their surroundings (natural features, built environment, ecologies, etc.) and old timers in particular can provide sound information on trends they have observed over time. It is important to engage communities to garner such information, involve them in planning, and factor their inputs into recommendations and decisions that will ultimately impact them.

Information intended for consumption by community and non-technical persons should be packaged in a manner that facilitates its use. Information should relate to socio-economic rather than environmental issues, and content should enable application of the information. It should be acknowledged too, that many of the adaptation measures being promoted today are variations of traditional practices that many are already familiar with (e.g. rain water harvesting).

The NEC was put on hold by the former minister until after Rio + 20, with the intention to have it succeeded by a Sustainable Development Council. The NEC was overarching, and there remains a need for such a body, perhaps chaired by the Minister of the Environment rather than the Permanent Secretary. It should meet at least twice a year and as needed. The recent establishment of the SDGNCC by Cabinet may be able to serve the intended purpose of the NEC. Other committees including the NCCC should be sub-committees of such an overarching body. A review of committees is also required to make these more efficient, and eliminate duplication. The NEC is referred to in the NEP/NEMS and in the draft Environmental Management Bill, and these should have to be revised if the SDGNCC replaces the NEC.

Access to information by the public and other state organs is also contemplated in the draft Environmental Management Act (GOSL, 2014). Sharing of information and reports between the various agencies involved in environmental research tends to be inconsistent because of the absence of formal mechanisms to facilitate ongoing collaboration (Simmons and Associates, 2008). The Freedom of Information bill that was developed by SDED should be finalized and enacted so that sharing of information is institutionalized and transparent. Public officers may be unwilling to share information as they are not clear on what the information policy is. As a result, valuable information is generated and is not appropriately shared. There should be a sound basis for not sharing, as information is generated to be applied, to support sound decision making, and to provide a foundation to build further knowledge upon.

It is important that national standards for databases be developed, to facilitate the seamless sharing of requisite information among agencies. This will require identification of data needs, responsibilities for collection, and how it is presented.

### 5.9.5 Opportunities for promoting information exchange and networking

The *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project has the potential to significantly address the shortcomings in information exchange and networking.

The establishment by Cabinet in March 2017 of the SDGNCC for the implementation and monitoring of the SDGs in Saint Lucia offers an opportunity to promote information exchange and networking.

In March 2017 Cabinet endorsed the signing of the Principle 10 Declaration on Access to Information by Saint Lucia. Principle 10 seeks to ensure that every person has access to information, can participate in the decision-making process and has access to justice in environmental matters with the aim of safeguarding the right to a healthy and sustainable environment for present and future generations. The SDED maintains a repository of documents and reports which are made available to the public upon request. These resources can be a starting point for development of an easily accessible database of policy and other documents that is so badly needed.

OECS has been discussing improvement of knowledge management internally, and this could be rolled out to Member States as a project component.

The recent establishment of a Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia provides an opportunity to better engage and involve civil society in climate related activities.

## 5.10 CHALLENGES, OPPORTUNITIES, EMERGING ISSUES, AND RECOMMENDATIONS

The State of the Environment Report (GOSL, 2015) identified a number of policy, legal, administrative and programmatic interventions which, if pursued, will help reverse negative trends where possible and move Saint Lucia to a more sustainable future. These are summarized in Table 5.5.

Charles (2016) in examining Saint Lucia's readiness for accessing GCF identified a range of challenges in relation to climate change programming, that impact all of the priority sectors. The overarching issues identified including the following:

1. Limited availability of financial resources.
2. Inadequate human resources, including inadequate availability of specialist skilled competencies.
3. Loss of institutional / sector memory with changes in human resource composition.
4. Inadequate availability and accessibility of data to inform management decisions.
5. Inadequate emphasis on research.
6. Ineffective high level co-ordination of major development sectors/issues such as development control and land management, water sector development, and strategic tourism development.
7. Inadequate infrastructure development to meet development needs.
8. Ineffective public sensitization and public education programmes to educate on key climate change issues and their nexus with national development.
9. Inadequate institutional coordination for climate change programming.
10. Lack of an integrated development planning approach to sector development.

These are not new challenges, nor will they be resolved through a single initiative. Solutions to these have to be woven into a development process that will improve sectoral and national performances over time. Several studies have been undertaken to consider how best some of these persistent issues may be addressed. Several recommendations emanating from these will now be implemented through interventions either imminent or underway. These programmes and projects will all help to institutionalise improvements in their focus areas. These include:

1. *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* which should significantly improve management of environmental and related information with beneficial implications for coordination and decision making.

2. The *Strategic Program for Climate Resilience* SPCR which seeks to institutionalize Adaptation Facilitation, Adaptation Implementation and Adaptation Financing through a wide range of projects, including building research and systematic observation capacity, raising public awareness and emphasizing the linkages between climate change and livelihoods.
3. *Global Climate Change Alliance (GCCA) project on Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean* for sustainable land management.
4. The *Iyanola*  *Natural Resource Management of the NE Coast* project which will enhance land use planning.

**Table 5.5: Sustainability First Interventions**
Extracted from State of the Environment Report (GOSL, 2015), Table 2.

| Sectors | Policy/Legal | Institutional | Projects and Programmes |
|---|---|---|---|
| Oceans, and Marine and Coastal Systems | Establish policy/ sustainable Development framework for the island's maritime jurisdiction.<br>Assess and address policy gaps, policy integration and multi-dimensional policy formulation. | Strengthen resource management agencies.<br>Institutionalize inter-agency cooperation and collaboration. | Maritime boundary delimitation.<br>Maritime mapping. |
| Forest Systems | Approve and implement draft forest policy.<br>Enact the revised Forest Act.<br>Develop and approve a comprehensive National Land Use Plan. | Provide adequate and predictable resources. | Actively implement the provisions of the 2009 Wildlife Management Plan.<br>Promote forest-based recreational activities.<br>Expand reforestation programmes.<br>Expand forest-based sustainable livelihood opportunities. |
| Freshwater Systems | Develop a policy framework for addressing climate-related impacts on the sector.<br>Institutionalize cross-sector planning.<br>Promote rainwater harvesting.<br>Develop drought management plans. | Strengthen Environmental Health Department to undertake research, data collection and information dissemination.<br>Provide framework and support mechanisms to implement the Integrated Water Resources Management Plan. | Conduct systematic research, monitoring and reporting on the health and productivity of fresh water systems.<br>Expand water processing and storage capacity.<br>Identify and assess alternative fresh water sources.<br>Undertake reforestation programmes.<br>Improve efficiencies in water abstraction, treatment and distribution. |
| Land Use and Management | Conduct a National Strategic Environmental Assessment.<br>Apply sustainable land management principles and practices to the development planning and approval processes.<br>Strengthen legislation for managing private and public forests.<br>Approve the draft Systems Plan for Protected Areas. | Strengthen capacity for research and data collection, analysis and dissemination.<br>Create or activate community-based organizations to supplement the current institutional capacity to manage lands. | Implement the provisions of the Systems Plan for Protected Areas.<br>Develop hazard and risk maps to inform land use planning.<br>Establish a national sustainable land management investment fund.<br>Expand and maintain public education and awareness programmes to promote sustainable land management.<br>Expand and sustain reforestation programmes.<br>Expand and promote urban forestry. |

**Table 5.5: Sustainability First Interventions**
Extracted from State of the Environment Report (GOSL, 2015), Table 2.

| Sectors | Policy/Legal | Institutional | Projects and Programmes |
|---|---|---|---|
| Protected Areas | Approve the Systems Plan for Protected Areas as official national policy. | Establish institutional arrangements to implement the Systems Plan for Protected Areas. | Conduct strategic environmental assessment for protected areas. |
| Waste Management | Develop an integrated, long-term solid waste management strategy.<br>Provide adequate and predictable funding to waste management entities.<br>Enact regulations to address various aspects of waste management identified in the Waste Management Act, Chapter 6.10.<br>Enact the Management of Containers Act and supporting regulations.<br>Give local legal status to the management of waste-related MEAs to which Saint Lucia is a Party. | Rationalise the roles and responsibilities of all actors involvement with waste management. | Implement waste-to energy Projects.<br>Develop and implement guidelines for managing private sector- led waste recycling.<br>Engage in sustained waste management public education and awareness programmes.<br>Develop sewage treatment facilities for Castries. |
| Chemicals Management | Revise the NEP/NEMS to include policy framework for effective chemicals management.<br>Ratify the Minamata Convention and the Rotterdam Convention, strengthening its regulatory and institutional framework for chemicals management.<br>Establish national standards for the use, storage transportation and disposal of chemicals. | Promote interagency collaboration and programming for effective chemicals management.<br>Transition the Pesticides and Toxic Chemicals Board into an Authority with greater Enforcement powers. | Undertake systematic collection, packaging,<br>storage and shipment of obsolete chemicals for destruction.<br>Establish and maintain a complete database of chemicals imported, manufactured and used in Saint Lucia.<br>Implement a sustained public education and awareness programme on chemicals hazards and responses. |
| Climate Change | Actively promote and implement the recommendations of the 2012 and revised (2015) Climate Change Adaptation Policy, including area-specific mitigation policies.<br>Establish a fiscal regime, including incentives, and standards to encourage and support the adoption of climate- friendly technologies and behaviours.<br>Actively mainstream climate thinking, policies and actions into public sector operations and planning. | Develop capacity and collaborative mechanisms to undertake climate change-relevant research and systematic observation to support decision making, as well as public education and sensitization.<br>Establish entities and capabilities, as needed, to access climate financing, support technology transfer and secure external investments in mitigation.<br>Promote horizontal cooperation, collaboration and programmes for climate change mitigation and adaptation. | Promote, at all levels of society, the willingness to take anticipatory individual and collective action to adapt to climate change and to reduce greenhouse gas emissions.<br>Execute education and capacity-building programmes, fiscal incentives and other measures to encourage the uptake of climate friendly practices.<br>Encourage and provide support to the private sector to undertake adaptation and mitigation measures to ensure long-term viability in a changing climate. |
| Ambient and Indoor Air Quality, and Noise Pollution | Finalize, adopt and implement a comprehensive national policy on air quality. | Establish and strengthen<br>Appropriate entities and regimes for, among other, testing for vehicle | Review, strengthen and enact of legislation to control air and noise pollution from industrial, commercial and other sources. |

| Table 5.5: Sustainability First Interventions<br>Extracted from State of the Environment Report (GOSL, 2015), Table 2. | | | |
|---|---|---|---|
| **Sectors** | **Policy/Legal** | **Institutional** | **Projects and Programmes** |
| | Formulate, adopt and apply a comprehensive national policy on noise pollution.<br>Establish national standards for air quality and noise. | emissions, equipment functioning, and indoor air quality. | Undertake monitoring and reporting on ambient and indoor air quality.<br>Implement physical measures to ameliorate air quality and reduce noise.<br>Plan and implement sustained public education and outreach programmes to raise awareness of and responses to air quality and noise pollution. |

5. Preparations to access GCF by the Ministry of Finance, which will impose requirements to better integrate and institutionalize climate considerations into national budgeting and programming, and steer Saint Lucia down a path towards improved integrated development planning. It is hoped that this will make more efficient use of limited financial and other resources to address national priorities including that of addressing climate change impacts.

The increasing emphasis on community level interventions is very positive, as there must be a grass roots shift in attitude and approach if a culture of adaptation and mitigation is to infiltrate the whole society.

Addressing the human resource issues is one that requires more attention. Capacity must be built at all levels, but serious consideration must be given to how persons who have benefitted can be encouraged to remain is positons where they continue to apply their skills and knowledge to contribute meaningfully to community and national development.

### 5.10.2 Recommendations

Building on and sustaining activities already in train will be important. Recommended actions are provided below.

#### *5.10.2.1 Planning and budgeting*

1. Develop a National Vison and Development Plan that integrates climate considerations, to be monitored by the Ministry of Economic Planning.
2. Develop sectoral plans on the basis of the National Vision and Development Plan.
3. Climate proof policies and infrastructural projects.
4. Introduce a Public Sector Investment Program guided by the National Development Plan.
5. Integrate climate considerations into the budgeting process e.g. by modification of project templates.
6. Value economic benefits of biodiversity and incorporate biodiversity values into national financial and economic planning and decision making.
7. Explore opportunities for regional collaboration under the CDM.
8. Establish a Central Planning & Priorities Committee chaired by the Minister of Finance, responsible for project coordination and planning and to prioritize projects for inclusion in the Public Sector Investment Program (PSIP).
9. Develop climate funding proposals that maximize potential benefits on an individual, institutional and systemic level, and address defined national development priorities.
10. Petition the GCF for a window to support technology transfer and upgrade in SIDS (this should be a SIDS effort).

11. Engage sectors and present NC sectoral recommendations.
12. Conduct mid-term reviews of achievements against NC recommendations.
13. Provide resources to sustain required research programmes.
14. Develop a national land use plan that considers climate issues.
15. Appoint a representative of the NEMO Secretariat to the DCA Board.
16. Devise approaches to encourage landowners with suitable idle lands to make these available for active agricultural use.
17. Facilitate public access to available hazard mapping.
18. Finalise adoption of the 2015 OECS Building Code, draft EIA regulations, draft planning standards and other Planning Act amendments required.

#### 5.10.2.2 Institutional arrangements and capacity building

1. Transition SDED to a Department of the Environment.
2. Establish the SDGNCC as a coordinating mechanism to effectively integrate climate change considerations into national policies and programmes. This would be in lieu of reviving the NEC. This committee is expected to give equal consideration to all three pillars of sustainable development (environment, economics, social).
3. Develop MOU between members of the SGDNCC and the DoE to define areas of cooperation.
4. Rotate the sectoral focal points for climate change/environmental sustainability among agency staff, quarterly or bi annually, with responsibility for attending climate change and NCCC meetings and disseminating information within their respective Ministries/Agencies.
5. Rationalise the various national committees involved in oversight of environmental and related matters for greater efficiency and effectiveness.
6. Synchronize work programmes of the various environmental and related agencies.
7. Build capacity in all sectors to implement climate change adaptation and mitigation measures.
8. Establish a technology research and development (R&D) Centre to monitor operating technology to identify appropriate technologies and propose modifications, including replacement with local alternatives where possible.
9. Support growth of VALERI as a centre for innovation.
10. Equip the Bureau of Standards to certify and monitor locally developed technology.
11. Clearly define the role of Budget Analysts, to be an intermediary between the Ministry of Finance and sectors, and support development of New Initiative submissions.
12. Build absorptive capacity to access financial resources.
13. Establish a dedicated unit to provide community and civil society support to access climate funds, working closely with the Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia.
14. Ensure engagement and participation of community through project design and implementation phases.
15. Analyse past project failures to incorporate lessons learnt and improve future project performance.
16. Strengthen extension officers in Ministry of Agriculture and Department of Fisheries and field officers in Department of Environmental Health.
17. Increase exposure of private sector and civil society to new and appropriate technologies, and provide supporting frameworks to encourage their participation and investments.

18. Build capacity of physical development, infrastructure and NEMO to strengthen operatives in, and regulation of the construction sector, ideally through membership organisations where they exist.

#### 5.10.2.3 Management of information

1. Establish a government-wide uniform or compatible IT platform.
2. Develop national database standards.
3. Establish a registry of technology.
4. Procure the latest satellite imagery to inform each successive national communication.
5. Upgrade MIS systems in agencies such as Department of Forestry, Meteorological Services Department and WRMA.
6. Improve security of information.

#### 5.10.2.4 Policy, legislation and regulations

1. Adopt and implement the Draft NEP/NEMS.
2. Pass the Environmental Management Bill and regulations.
3. Update the draft national policy on Environmental Research and Monitoring, to develop an Innovation Policy.
4. Finalise and enact the Freedom of Information Bill to give the public a general right of access to official documents.
5. Make provision of information for development of national policies and programmes a condition of tax and other incentives awarded to the private sector.
6. Finalise and enact patent laws.

#### 5.10.2.5 Education, training and public awareness

1. Adopt and implement the Draft National Environmental Education Policy and Draft National Environmental Education Strategy.
2. Pursue the draft MOU between agencies with a responsibility for public education to improve coordination of the PEO effort.
3. Build communication capacity across all key sectors with a pivotal role in climate resilience.
4. Sustain PEO efforts, to among other things, provide continuous and relevant information on climate change and its effects, especially on livelihoods.
5. Enforce the license requirement that requires media houses to allocate free airtime to government business, and require similar support within other media (e.g. cell phones).
6. Train Social Transformation Officers as well as other field officers in Health and Agriculture to help transfer climate knowledge at a community level.
7. Set up a climate change website to provide information to the public, as well as share information with agency partners.
8. Make the NC more available to the public.
9. Make climate initiatives more community focused to expose the population to the wide range of possible actions, and increase uptake of recommended adaptation and mitigation measures.

#### 5.10.2.6 Incentives and support

1. Provide support for vulnerable persons, such as retrofitting homes, and relocation from hazard-prone areas.
2. Provide concessional access to financing for climate resilience initiatives in vulnerable sectors.

3. Provide incentives for adoption of adaptation and mitigation measures in the private sector and civil society, and ensure the supporting frameworks are put in place to make these truly accessible.
4. Support civil society in learning about new technologies and how they can be integrated.
5. Establish a unit dedicated to providing support to civil society to take advantage of available climate financing and other opportunities.
6. Engage and support the Coalition of Civil Society Organisations for the Sustainable Development of Saint Lucia to facilitate more integrated approaches with civil society in relation to the climate agenda.
7. Build sustainable financing into community projects.
8. Engage regional head offices of insurance companies in an effort to have them incorporate climate considerations into their operational policies that would effectively encourage climate smart construction by developers.
9. Consider insurance policies for certain classes of residential development, to help finance the assistance rendered by the government for property repairs, replacement or relocation.

#### 5.10.2.7 Regional actions

1. Establish an OECS Desk or Representative to anchor OECS-led initiatives.
2. Lobby OECS to identify an officer in the Commission's Environment and Sustainable Development Programme as a Focal Point for Saint Lucia.
3. Centralise certain actions at a regional level to accelerate technology transfer.
4. Improve synchronization of regional activity with national development priorities.

## 5.11 CONCLUSIONS

Much of the climate change adaptation and mitigation effort in Saint Lucia is financed externally, and where cultural shifts do not become entrenched as a result, the benefits of such support can be short lived. The available support somehow needs to be utilized more effectively to institutionalise change, and ensure that a greater proportion of the society is impacted and influenced to act with some degree of urgency by the initiatives that are being financed. The use of the available resources can then be more focused and efficient, and the outcomes optimized and sustained.

The progress to date is significant, but much remains to be done. A number of ongoing projects should ensure that improved systems are put in place for information management that will better guide decision making at all levels. Certainly, decision making must become more integrated and holistic, and this must happen sooner rather than later. National plans developed on the basis of superior quality information should more effectively guide the technological and capacity building requirements in all sectors and at all levels of society.

The whole society must be encouraged and provided with the means to embrace the necessary measures to protect their homes, their businesses and their livelihoods. Many recommended adaptation and mitigation measures also provide opportunities to reduce cost of living and improve quality of life for ordinary people, and reduce the operational costs of businesses. The concept of sustainable development needs to be embraced if the population is going to be more responsible in how it interacts with the natural environment.

Further, losses are being experienced today, with the risks of loss and damage starkly rising as temperatures rise. With the aid of adequate and timely support, Caribbean countries like Saint Lucia will have to be equipped to respond to situations where climate change impacts overwhelm their coping capacities, especially for those who are most affected by them.

## 5.12 REFERENCES


Accela Marketing, 2011. Climate change knowledge, attitude & practice (KAP) survey report.

Accela Marketing, 2011. Report on Stakeholder Survey. Pilot Program for Climate Resilience (PPCR) in Saint Lucia.

Caribbean Catastrophe Risk Insurance Facility CCRIF, 2015. Understanding CCRIF's Hurricane, Earthquake and Excess Rainfall Policies. Technical Paper Series # 1.

CARICOM, 2009. CARICOM Liliendaal Declaration on Climate Change and Development.

CARICOM, 2009. Regional Framework for Achieving Development Resilient to Climate Change Caribbean (2009-2015).

CARICOM, 2011. Implementing the CARICOM Regional Framework for Achieving Development Resilient to Climate Change (2011-2021).

CARICOM, 2016. CCRIF completes 29 million dollar payments to Member Governments affected by Hurricane Matthew. Downloaded from http://caricom.org/media-center/communications/news-from-the-community/ccrif-completes-29-million-dollar-payments-to-member-governments-affected-b)

CCCCC, 2017. Climate Change Adaptation Program (CCAP) - 2016 – 2020.
CCCCC, 2015. Impact Assessment and National Adaptation Strategy and Action Plan to Address Climate Change in the Tourism Sector of Saint Lucia. GCCCA Intra ACP Programme.
VOLUME II
CCRIF SPC, 2016. About Us. Downloaded from http://www.ccrif.org/content/about-us

Charles, L., 2014. Climate Finance Readiness Mission to Saint Lucia: November 17-21, 2014

Chase, Dr. V., Murray, Dr. R, Francis, A., 2016. Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project. Monitoring and Evaluation Report. OECS.

Climate Support Facility, 2014. Work –Order 27: Workshop in Mainstreaming Climate Change into National Planning and Budgetary Process in Saint Lucia Mission Report.

Cox, C., 2016. IWEco Component I – Development and implementation of integrated targeted innovative, climate-change resilient solutions appropriate for Caribbean and global. PowerPoint presentation to SIDS GEF IWEco Inception Workshop. September 20-21, 2016 Kingston, Jamaica. UNEP.
De Beauville-Scott, S., 2011. Climate Change Teachers Toolkit, A guide for climate change education (2011). UNEP, GOSL.

Department of Fisheries, 2013. National Fisheries Plan.

Edmund, T., 2010. Enhanced Capacities for Disaster Risk Management In Agriculture, Fisheries And Forestry – Project Tcp/Slt/3202. Inception and Technical Reports.

GOSL, date unknown. Increasing Saint Lucia's Capacity to Monitor Implementation of Multilateral Environmental Agreements and Sustainable Development. Project Brief.

GOSL, date unknown. Explanatory Notes on Freedom of Information Bill.

GOSL, 2001.The Saint Lucia Sustainable Energy Plan.

GOSL, 2001. Compendium of Environmental Statistics 2001. Government Statistics Department and SDED.

GOSL, 2004. Coastal Zone Management in Saint Lucia: Policy, Guidelines and Selected Projects. Ministry of Agriculture, Forestry and Fisheries and Ministry of Physical Planning, Environment and Housing.

GOSL, 2004. A National Water Policy for Saint Lucia.

GOSL, 2004. Climate Change Technology Needs Assessment for Saint Lucia.

GOSL, 2008. National Action Plan And Strategic Action Plan to Combat Desertification And Drought in Saint Lucia Annex 1 National Action Plan and Strategic Action Plan –NAPSAP. Government of Saint Lucia. Ministry of Agriculture, Lands, Fisheries and Forestry. Department Of Forestry. SFA2003/SLU/BIT-1/0710/EMF/LC.

GOSL, 2010. Budget Address 2010.

GOSL, 2012. Public education and awareness strategy. Saint Lucia's Strategic Programme for Climate Resilience (SPCR), under and beyond the Pilot Programme for Climate Resilience (PPCR).

GOSL, 2012. Iyanola  Natural Resource Management of the NE Coast. GEF Project Identification Form.

GOSL, 2012. Draft MOU regarding delivery of a National Environmental Education Programme.

GOSL, 2012. Budget Address 2012.

GOSL., 2012. Water Resources Management Agency Strategic Plan: 2012 to 2017.

GOSL (unpublished). Towards the Development of a Coastal Zone Management Strategy and Action Plan for Saint Lucia. Prepared by Laverne Walker. Ministry of Physical Development and the Environment.

GOSL, 2013. Throne Speech 2013.

GOSL, 2014. Implementing a Framework for Environmental Management Feasibility Study for the Establishment of a Dedicated Environment Fund Saint Lucia. Ministry of Sustainable Development, Energy, Science and Technology Saint Lucia.

GOSL, 2014. Environmental Management Act, 2014. Implementing a Framework for Environmental Management. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2014. Sustainable Development & Environment Division (SDED) Business & Transition Plan 2014. Implementing a Framework for Environmental Management. Saint Lucia. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2014. Draft Saint Lucia Pollution Regulations 2014. Implementing a Framework for Environmental Management. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2014. National Environment Policy (NEP) and National Environmental Management Strategy (NEMS), Saint Lucia. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2014. Revised 2nd National Biodiversity Strategy and Action Plan (2nd NBSAP) for Saint Lucia Second NBSAP (2014 – 2020) for SAINT LUCIA. Department of Sustainable Development.

GOSL, 2014. Fifth National Biodiversity Report for Saint Lucia. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2014. Budget Address 2014.

GOSL, 2014. Public education and awareness strategy implementation plan (draft). Saint Lucia's Strategic Programme for Climate Resilience (SPCR), under and beyond the Pilot Programme for Climate Resilience (PPCR).

GOSL, 2015. State of the Environment, Saint Lucia 2015.

GOSL, 2015. The Saint Lucia Climate Change Adaptation Policy. Adapting one individual, one household, one community, one ENTERPRISE and one sector at a time.

GOSL, 2015. Saint Lucia Country Report on the State of Biodiversity for Food and Agriculture. Ministry of Agriculture, Food Production, Fisheries, Co-Operatives and Rural Development. FAO.

GOSL, 2015. The Electricity Supply Services Bill.

GOSL, 2016. Electricity Supply (Amendment) Act Saint Lucia No 2 of 2016.

GOSL, 2016. Agricultural Policy Framework and Strategy (2016-2021). Final Draft Report.

GOSL, 2017. Climate Change Technology Needs Assessment – Saint Lucia.

Kairi Consultants Ltd, 2013. Climate change knowledge, attitudes and practices in the OECS. Report on the KAP survey of six participating member states. Final report. Volume one: Main report.

King-Joseph, A., 2014. Review of National Disaster Management Plan and Associated Capacity Building. Final Report.

Maurice-George, N., 2017. Brief on NC Reporting Process in Saint Lucia.

Minister responsible for Physical Development, 2011. Ministry of Physical Planning and Development (Environmental Impact Assessment) Regulations.

Ministry of Agriculture, Lands, Forestry & Fisheries, 2009. Agriculture policy brief.

Ministry of Agriculture, Lands, Forestry & Fisheries, 2009. Policy Brief. National Agricultural Policy 2009 – 2015.

Ministry of Finance, Economic Affairs and Social Security (MOF), 2012. Saint Lucia: Medium Term Development Strategy 2012 – 2016. Sectoral Action Plan. Final Draft.

Ministry of Health, 2016. Policy and Strategy for Environmental Health in Saint Lucia, with a Focus on the Department of Environmental Health (2016 – 2021).

Ministry of Physical Development and the Environment, 2010. Saint Lucia National Energy Policy.

Ministry of Physical Development, Housing and Urban Renewal, 2015. Proposed Revised National Land Policy for Saint Lucia. Our land, our business, our future.

Ministry for Sustainable Development, Energy, Science and Technology, 2013. Draft Strategic Plan 2013 – 2017.

National Utilities Regulatory Commission Act Saint Lucia No 3 of 2016.

OECS, 2001 (revised 2006). St. George's Declaration (SGD) of Principles for Environmental Sustainability in the OECS.

OECS, 2006. St. George's Declaration of Principles for Environmental Sustainability in the OECS (revised).

OECS, 2017. The Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean. Update on CCA through SLM Policies.

Pierre-Nathoniel, D., 2010. GOSL, 2008. Draft National Environmental Education Policy. Report on Other Relevant Information for Saint Lucia's Second NC to the United Nations Framework Convention on Climate Change. Sustainable Development and Environment Division. Ministry of Physical Development and the Environment.

Rabinit, M., 2012. Second Audit Report, Analysis and Evaluation of the profiles to coordinate CARAIBE-HYCOS 2nd Phase.

REDiv, 2017. List of Energy Projects.

Right Angle Imaging Inc, 2016. Knowledge attitude, practices/behaviour (KAP/B) study on climate change. Saint Lucia Baseline Study 2016. UNDP.

Saint Lucia Forests and Lands Resources Department (2015) Strategy 2015–2025. Saint Lucia Forests and Lands Resources Department, Union, Saint Lucia.

SDED, date unknown. Recommendations for List of Approved Training Areas (Study leave Awards)

St. Aimee, D., 2013. Draft National Science and Technology Policy, Strategy and Action Plan. Ministry of Sustainable Development, Energy, Science and Technology.

Simmons and Associates Ltd., 2007. Increasing Saint Lucia's Capacity to Monitor Multilateral Environment Agreements (MEA) Implementation and Sustainable Development Update: 2007 National Capacity for Self-Assessment. Ministry of Sustainable Development, Energy, Science & Technology.

Simmons & Associates, 2008. Environmental Research Policy Formulation Final Report. Ministry of Economic Affairs, Economic Planning, Investment & National Development, Office of the National Authorising Officer.

Simmons & Associates, 2008. Development of a Framework for Environmental Management Final Report. Ministry of Economic Affairs, Economic Planning, Investment & National Development. Office of the National Authorising Officer.

Stiebert Consulting in association with EnviroEconomics, 2015. Saint Lucia Mitigation Assessment Final Draft. Ministry of Sustainable development, Energy, Science and technology.

Sustainable Development and Environment Division (SDED), Ministry of Sustainable Development, Energy, Science and Technology in collaboration with the National Climate Change Committee (NCCC), 2016. PPCR Annual M&E Report (January to December, 2015).

Torbert, Roy, Kaitlyn Bunker, Stephen Doig, Justin Locke, Stephen Mushegan, Siana Teelucksingh, 2016. Developing the Saint Lucia Energy Roadmap, Rocky Mountain Institute.

UNDP, 2015. Project Document: Japan-Caribbean Climate Change Partnership.

United Nations Framework Convention on Climate Change (UNFCCC), 2002: www.unfccc.int.

United Nations Framework Convention on Climate Change UNFCCC, 2003. Reporting on Climate Change. User Manual for the Guidelines on NC from non-Annex 1 Parties.

United Nations 1998. Kyoto Protocol to the Convention on Climate Change. Climate Change Secretariat and UNEP's Information Unit for Conventions.

United Nations. 2002. Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001. Addendum Part Two: Action taken by the Conference of the Parties. UNFCCC. FCCC/CP/2001/13/Add.1. 21 January 2002.

UNECLAC, 2011. An Assessment of the Economic Impact of Climate Change on the Agriculture Sector in Saint Lucia.

UNECLAC, 2011. An Assessment of the Economic Impact of Climate Change on the Health Sector in Saint Lucia.

UNECLAC, 2011. An Assessment of the Economic Impact of Climate Change on the Tourism Sector in Saint Lucia.

Vidal-Jules, G., 2011. Review of Physical Planning and Development Act and draft Regulations and Environmental Management Bill. Pilot Programme for Climate Resilience (PPCR) in Saint Lucia.

World Bank Treasury, 2011. Product Note: Catastrophic Deferred Drawdown Option. Downloaded from http://treasury.worldbank.org/bdm/pdf/Handouts_Finance/CatDDO_Product_Note.pdf

Williams-Raynor, P., 2016. SPARKS Unveiled - Supercomputer Promises Fireworks for Climate Research in the Caribbean. Published in the Jamaica Gleaner, December 1, 2016. Downloaded from http://jamaica-gleaner.com/article/news/20161201/sparks-unveiled-supercomputer-promises-fireworks-climate-research-caribbean

World Bank, 2014. “Our feet in the mud”. Qualitative Focus Group Discussions. Summary of Findings.

# CHAPTER 6. CONSTRAINTS AND GAPS AND RELATED FINANCIAL, TECHNICAL AND CAPACITY NEEDS TO THE ACHIEVEMENT OF THE OBJECTIVES OF THE UNFCCC

## 6.1 OVERVIEW

This section identifies gaps and constraints and related financial, capacity and technical needs to implement mitigation and adaptation measures in response to climate change. Although some important progress has been made since Saint Lucia's Initial and Second National Communications (published in 2004 and 2012 respectively), there is still room for further integration of climate change considerations into the country's development agenda. Although various sectoral policies have been revised to incorporate climate change considerations, and recommendations made to improve legal and institutional frameworks to more effectively address climate change issues, many of these have not been adopted. Further, in the absence of an overarching national vision and development plan, sectoral initiatives are not sufficiently coordinated for optimization of national level benefits.

## 6.2 FINANCIAL, TECHNICAL AND CAPACITY NEEDS

### 6.2.1 Adaptation Needs

Saint Lucia, like many developing countries, faces disproportionately high climate change impacts, and the country's capacity to respond appropriately to reduce vulnerability at all levels and in all sectors is constrained by limited resources exacerbated by a small and vulnerable economy.

The second national communication identified sectoral gaps and constraints, and most if not all of these remain relevant today. Persistent gaps and constraints are identified in this chapter, informed primarily by the observations and recommendations made in the V&A and mitigation assessments for Saint Lucia's Third National Communication (TNC) (GOSL, 2016), a review of available documentation, and input of stakeholders interviewed in 2017. Also provided is information on initiatives in the intervening period between the second and third national communications.

#### *6.2.1.1 Information management*

Data collection and information management across sectors to inform timely decision making is a persistent and cross cutting gap. A number of capacity building initiatives that seek to overcome constraints in this area to better support design and implementation of priority climate change initiatives are described below. There are also summarized in Box 6.1.

##### 6.2.1.1.1 Hydrological and meteorological monitoring and early warning systems

The following are some of the initiatives undertaken in this area since the SNC was published:

###### 6.2.1.1.1.1 Caribbean Institute of Meteorology and Hydrology (CIMH) transitioning to a WMO Regional Climate Centre

CIMH is a regional training centre under the World Meteorological Organisation (WMO) for meteorology, hydrology and associated sciences. It is the regional centre for climate data instrumentation and centre of excellence for satellite meteorology. With investment from USAID, the CIMH is becoming a WMO Regional Climate Centre, which will significantly improve capabilities to understand and predict climate issues in the region. This will form part of the development of the Global Framework for Climate Services (GFCS) in the Caribbean which gives a roadmap for delivery of climate services to key climate-sensitive sectors such as health, agriculture, water resources and disaster risk management.

###### 6.2.1.1.1.2 Hydro-meteorological/agrometeorological station installations

Caribbean Community Climate Change Centre (CCCCC) with support under the EU Global Climate Change Alliance (GCCA) has installed hydro-meteorological/agrometeorological stations and a network of other critical stations such as the Coral Reef Early Warning System (CREWS). The Continuous Observing Reference Stations (CORS) for observing the rate of SLR are already in place. Consideration is being given to installation of one Coral Reef Early Warning System in Saint Lucia. Additionally, a protocol for information sharing through the CCCCC Information Clearinghouse Facility will be developed (UNDP, 2015).

Hurricane Tomas in 2010 and the Christmas Eve trough in 2013 reiterated the inadequacy of the current hydrological and meteorological monitoring and the need for more effective early warning systems. GOSL (2016) noted in the Summary V&A Report, an urgent need to strengthen these to save lives and to protect livelihoods, through:

1. Hazard mapping to identify at-risk areas and the magnitude of risks from the different types of hazards that impact Saint Lucia;
2. Strengthening community resilience through hazard mapping and continued community risk profiling;
3. Upgrading and enhancing the existing network of hydro met data collection stations;
4. Dissemination of regular and easily understood hydromet information; and
5. Effective and sustainable early warning systems in hot spots in Saint Lucia.

##### 6.2.1.1.2 Mapping and modelling

The following initiatives have been undertaken in this area since the SNC:

###### 6.2.1.1.2.1 Project for the Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States (ACS)

This Mexican-funded project provided all Organisation of Eastern Caribbean States (OECS) independent member countries with high resolution satellite images (2-5m resolution) acquired between late 2014 and early 2015 (UNDP, 2015).

###### 6.2.1.1.2.2 Pilot Programme for Climate Resilience (PPCR) Caribbean regional track

The Pilot Programme for Climate Resilience (PPCR) Caribbean regional track looks at improving geospatial data and management for adaptation planning, SLR and storm surge impact analysis; consolidating and expanding the regional climate network and global platform linkages; downscaling and expanding climate projection models and high resolution maps; and applied adaptation initiatives in the health, fisheries and agriculture sectors (UNDP, 2015).

###### 6.2.1.1.2.3 DVRP-PPCR/Strategic Programme for Climate Resilience (SPCR)

Many hydromet and modeling needs will be met through the PPCR/Strategic Programme for Climate Resilience (SPCR). Initiatives under this project include:

- Sea Level Rise Modelling and Flood and Erosion Risk Mapping (US$1.5 million)
- Capacity Building for Meteorological Services (US$1.9 million)
- Design and deployment of a sea level rise monitoring networks (US$100,000)
- Collection of high resolution LiDAR data and creation of a high resolution digital topographic and bathymetric model for Saint Lucia (US$775,000)
- Management of the GeoNode (US$600,000)
- Strengthening of the country’s GIS analysis capacity (US$500,000)
- Development of Landslide Hazard Maps (US$600,000)

#### 6.2.1.1.3 Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development

The Government of Saint Lucia is implementing a 4-year project *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* to address capacity limitations identified in the National Capacity Self-Assessment (NCSA) project. The funding will be used to "strengthen environmental information systems; improve the capacity of the island to monitor and implement international Conventions; and to better integrate environmental concerns and the value of ecosystems into its broader development frameworks" (GOSL, 2016).

#### 6.2.1.1.4 Principle 10 Declaration on Access to Information

In 2017 Cabinet endorsed signing of the Principle 10 Declaration on Access to Information by Saint Lucia, which seeks to ensure that every person has access to information, can participate in the decision-making process and has access to justice in environmental matters with the aim of safeguarding the right to a healthy and sustainable environment for present and future generations.

#### 6.2.1.1.5 Draft MOU for delivery of a National Environmental Education Programme

A MOU, yet to be implemented, regarding delivery of a National Environmental Education Programme, was crafted in 2012. It was intended to formalize the environmental education responsibilities and relationships between the following agencies (note that portfolios have since been reallocated):

1. The Ministry of Public Service
2. The Ministry of Sustainable Development, Energy, Science and Technology
3. The Ministry of Education, Human Resource Development and Labour
4. The Ministry of Agriculture, Food Production, Fisheries and Rural Development
5. The Ministry of Tourism, Heritage and the Creative Industries
6. The Ministry of Health, Wellness, Human Services and Gender Relations

### BOX 6.1 RECENT DATA AND INFORMATION MANAGEMENT INITIATIVES

**Hydrological and meteorological monitoring and early warning systems**

- CIMH transitioning to a WMO Regional Climate Centre
- Hydro-meteorological/ agrometeorological station installations

**Mapping and modelling**

- Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States (ACS)
- PPCR (improving geospatial data and management; consolidating and expanding the regional climate network and global platform linkages; downscaling and expanding climate projection models and high resolution maps; and applied adaptation initiatives)
- SPCR (modelling, mapping, Met Services capacity building, monitoring, GIS capacity building)

**Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreement Implementation and Sustainable Development**

1. Tools for improved MEA and sustainable development reporting and monitoring;
2. Mainstreamed environmental management and MEA objectives;
3. Awareness raising, education and outreach.

**Agreement to sign Principle 10**

**Draft MOU for delivery of a National Environmental Education Programme** (not yet implemented)

### *6.2.1.2 Sectoral gaps and initiatives*

#### 6.2.1.2.1 Agriculture Sector

The SNC (GOSL, 2011) identified challenges to the agriculture and marine biodiversity sector. Critical capacity needs identified for effective implementation of adaption options are provided in Box 6.2. Many of the capacity gaps identified persist.

The Ministry of Agriculture relies heavily on cooperating agencies such as IICA, FAO, CARDI, GIZ and Taiwanese Technical Assistance through the International Cooperation Development Fund TICDF. The Ministry introduces new and appropriate technologies on demonstration plots and used the Farmer Field School methodology (discovery based learning method) to build farmer capacity and expose farmers to new knowledge. Extensionists provide support at the field level to ensure adoption of new technologies and appropriate practice. The Ministry of Agriculture Communications Unit regularly hosts television and radio programs.

The Ministry works with farmers in a multitude of relevant areas, e.g.:

1. Investment in drip irrigation, rainwater harvesting or storage;
2. Provision of tanks (ferro-cement, lined ponds, plastic);
3. Encouragement of the use of ground cover for improved soil moisture and reduced weeds and pests;
4. Introduction of drought tolerant varieties of vegetables;
5. Encouragement of agroforestry systems of production on river banks and forests boundaries;
6. Encouragement of flower production for sustainable land management;

#### 1.13 **Box. 6.2 Gaps in agricultural sector identified in the SNC (GOSL, 2011)**

1. Development and strengthening of institutional capacity for research and systematic observation (RSO);
2. Enhanced capacity to evaluate suitable adaptation and mitigation technologies;
3. Enhanced capacity to participate in relevant international negotiations;
4. Increased sensitivity and awareness of the need to promote and finance no-regrets options that support climate change response efforts;
5. Promotion of a mode of integrated development planning that incorporates environmental, economic and social considerations in a holistic, coordinated manner;
6. Increasing public awareness of the roles that individuals and communities can play in responding to climate change;
7. Proper documentation of lessons learnt, best practices and historical / traditional knowledge.

**Constraints identified in the marine biodiversity sector identified in the SNC**

1. Inadequate capacity for enforcement of legislation related to the protection of marine biodiversity;
2. Inadequate maintenance and need to restore the biodiversity and ecosystems that underpin the sector's resilience and ability to mitigate and adapt to climate change;
3. Inadequate policy framework that recognises the inter-dependence of climate change, biodiversity and ecosystem services, to facilitate cross sectoral interaction incorporating areas of agriculture, forestry and business, including areas of research;
4. Inadequate Coastal Infrastructure. There is a need for ecosystem-based actions which include soft coastal defences and maintenance and restoration of vegetation and green infrastructure.

7. Support with design and installation of contour and other drains to retain moisture and control runoff and soil loss; and
8. Introduction of elevated pens.

Penetration of technologies and recommended approaches is still insufficient, for e.g. in a total farmer population of approximately 1000 banana farmers and 1400 other producers, some 70 to 100 now use drip irrigation. Fewer than 50 use ground cover. The capacity of Extension Officers needs to be increased so that they are in a better position to convey information that results in behavioral change within the agricultural community (Pers. Comm., Ministry of Agriculture, 2017).

The Department of Fisheries has been promoting value added products with fishers to help maintain profitability and sustain their livelihoods. Fisheries Extension Officers and Data Collectors interact regularly with fishers. The Department convenes workshops and airs Public Service Announcements (PSAs) on radio and TV, although these are often project-related and as a result, their airing is not sustained.

## 1.2 Box 6.3 Some Recent Initiatives in Agriculture

- ***Agricultural Policy Framework and Strategy (2016-2021) Draft Final Report (Glenroy and Associates, 2016)*** Government will support development and implementation of sustainable and environmentally friendly Disaster Risk Reduction and Climate Change Adaptation Strategies that will facilitate the integration of disaster preparedness, response, recovery and rehabilitation in the development framework of the Agriculture, Forestry and Fisheries sectors

- ***Saint Lucia Country Report on the State of Biodiversity for Food and Agriculture (2015) :***Calls for institution of an effective framework for governance of biodiversity management for food and agriculture, anchored within the environmental management framework

- Cl***imate Adaptation Financing Facility (CAFF):*** Low interest loans for agriculture sector investments include drought-resistant crops, rain water harvesting, water holding facilities, drainage, soil stabilization, retrofitting of greenhouses, retrofitting of storage facilities

- ***Enhanced Capacities for Disaster Risk Management in Agriculture, Fisheries and Forestry project (2010):*** Identified good practices mitigate a number of hazards and piloted livestock and fisheries initiatives in 6 communities
- ***IICA Technical Assistance to agriculturalists:*** Building resilience in agricultural value systems to natural disasters and the effects of climate change

- ***GEF Small Grants Programme -Climate smart agriculture:*** 25 farmers in Mon Repos were engage in climate smart agricultural through the FAO field school method

- ***FAO Risk Management, Resilience Building and Territorial Development programme:*** Focuses on mitigation, prevention and preparedness of the agricultural sector for natural hazards

- ***Caritas Food for the Poor (2015):*** Installed 14 greenhouses at schools and refurbished an additional 6

- ***Banana Accompanying Measures BAM ATP (European EDF:)*** Diagnostic facility for crops and livestock under construction

- ***St Lucia Youth Agricultural Entrepreneurship Programme (YAEP):*** Entrepreneurship incubator programme involved at least 150 young entrepreneurs in agriculture

- ***Supporting Climate Resilient Investments in the Agricultural Sector (IDB and Laborie Credit Union under PPCR)****:* To strengthen the viability of agri-business operators in the south of Saint Lucia within the context of climate change, through (1) capacity building and financing of climate resilient practices (2) development and leverage of new, more sustainable and profitable market channels in tourism and retail and (3) strengthening of cooperative structures.

There is significant effort to make fisheries facilities more climate resilient, and proposals for Micoud and Laborie facilities (reconstruction or expansion) are being revised to integrate appropriate design and green technologies. A solar ice machine has been installed at Savannes. Installation of solar power for the fisheries hatchery is being considered for Taiwanese support. Recent initiatives in agriculture are listed in Box 6.3. Table 6.1 provides gaps identified in the SNC and subsequent initiatives to address these. Current status is also provided.

The V&A assessment (GOSL, 2016) promotes the following initiatives to enhance adaptive capacity and stimulate adaptive actions:

1. Carry out adaptations in the sector, industry and markets, in producer strategies and in rural development strategies, with the objective of reducing social and economic costs;
2. Implement supporting policies focusing on sensitization of the farming community to the risks associated with climate change. Include communication and information strategies regarding adaptation recommendations.

**TABLE 6.1: GAPS IN THE AGRICULTURE SECTOR**

| **SNC Gaps** | **Extent to which these have been addressed** | **TNC Gaps** |
|---|---|---|
| Capacity in RSO, evaluation of technologies | Bilateral and multi-lateral support to build capacity in the sector (public sector and civil society) has occurred to some extent, but much more work is still needed | Gap persists. Economic resources, technical knowledge and adaptive capacity in the sector to carry out adaptations in the sector, industry and markets, in producer strategies and in rural development strategies, with the objective of reducing social and economic costs |
| Integrated development planning | There is some movement in this direction, but the country still has no national development plan | Gap persists |
| Public awareness of individual and community roles | The PEO strategy under the SPCR will increase awareness and empower communities | Gap persists. Sensitization of the farming community to climate change risks and strategies regarding adaptation recommendations. |
| Documentation | Efforts to improve information management are underway and results based management is becoming more common, but there is still not a culture of documentation | Gap persists (One of the major challenges in the preparation of the Saint Lucia Country Report on the State of Biodiversity for Food and Agriculture was the paucity of documented information to substantiate anecdotal information (GOSL, 2015)) |

GOSL (2016) recommendations included:

1. Rebates encouraging the use of renewable energy production and technology in farming operations, to offset operational costs;
2. Development of more Government-managed catchment areas to assist with storage and distribution of water; and
3. Encouragement of the use of renewable energy technologies for pumping and distributing water and cooling systems (for chicken pens for instance).

Recommendations for fisheries and aquaculture sectors included:

1. Incorporating uncertainty into decision-making and management process;
2. Supporting transitions to alternative species, production and post-harvest processes;
3. Supporting the development of alternative or diversified livelihoods;
4. Enhancing natural barriers, protecting fish habitats through adaptive spatial management; and
5. Incorporating climate change into transboundary water and natural resource planning across sectors.

## BOX 6.4 Recent Forestry Projects

1. *St Lucia Forest Restoration and Rehabilitation Project* (2010) (funded by the Government of Australia) to restore forest reserves damaged by Hurricane Tomas.
2. OECS *Global Climate Change Alliance (GCCA) project on Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean* includes TA for marketing outreach and product development in support of mango biodiversity, and implementation of agro-forestry works for promoting mango biodiversity in Saint Lucia.
3. The *Strategic Program for Climate Resilience* (SPCR) aims to build country resilience to climate change impacts, and includes an integrated slopes, landslides and riverbank stabilization at various locations. The programme includes development of a climate resilient Watershed Management Framework and Plan for specific watersheds prone to flooding.
4. The *Iyanola Natural Resource Management of the NE Coast* project builds on:
   - Land use planning
   - Management and carbon benefits in deciduous seasonal and low montane rainforest zones
   - Conservation and Sustainable Management of Ecosystems
   - Sustainable Use of Biodiversity.

   **Component 4** addresses enhanced capacity for production of biodiversity, including:

   - Remove market, knowledge and capacity barriers for community level production of biodiversity friendly goods and services
   - Assess marketing potential for biodiversity friendly goods and services
   - Produce Guidelines for 3 biodiversity friendly goods and services
   - Pilot development of management plans and promotional strategies for 3 selected categories of products and services
   - Establish and implement national management system for sustainable production and sale of biodiversity friendly goods and services in inland forest and coastal communities
5. *Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco)* project aims to develop and implement integrated, targeted, innovative, climate-change resilient solutions appropriate for Caribbean and global SIDS.
6. *Reduction in Emissions from Deforestation and Forest Degradation plus Conservation (REDD+)* strategy, an addendum to the forest strategy, supported by OECS/EU GCCA.

#### 6.2.1.2.2 Forest Biodiversity Sector

The SNC (GOSL, 2011) highlighted key constraints which impact the Forest Biodiversity sector's ability to integrate climate changes concerns as follows:

1. Inadequate financial, technical and human resources to implement adaptation measures;
2. Inadequate institutional co-ordination to implement adaptation measures; and
3. Absence of an integrated development planning approach which adequately deals with land management.

The Forests and Lands Resources Department in 2015 developed its Strategy for the period 2015 to 2025 through a participatory process, to address its changing responsibilities and the demands on its resources. Recent forestry projects are listed in Box 6.4.

The V&A assessment of 2016 (GOSL, 2016) did not consider the forestry sector, but other reports speak to gaps in the sector. There is a lack of consistency in the collection and management of data in key sectors including forestry. More investment is required to study the relations between and within the various ecosystems to determine the actual value of these ecosystem services. There are no indicators and mechanisms to measure the impact of climate change and climate variability on habitat damage or loss such as forest degradation and its impact on biodiversity (GOSL, 2014).

The mitigation assessment report (GOSL, 2015), noted a very high uncertainty in historic estimates as well as limited data availability on trends in the LULUCF sector, and did not prepare projections for that sector. They noted though, that while LULUCF is not included in terms of specific projected emissions reductions, the value of Saint Lucia's forestry cover as a sink should not be underestimated, and that significant work is currently being conducted to improve forest inventory data, develop policies for forest management and protection and to identify reforestation projects. LULUCF sector contributions may be included in future updates to the NDC if sufficient data become available. GOSL (2015) indicated that in order to develop projections in the future it will be important to have a clear understanding of trends that impact biomass growth, and accumulation and removal from forestlands and croplands. They made a number of recommendations to assist in developing a baseline projection. These are provided later in this report. The Department of Forestry highlights a number of requirements to be addressed (Pers. Comm, Department of Forestry, 2017) including:

1. Re-design of sample plots to meet NDC and NC data requirements;
2. Valuing of eco-system services and development of market mechanisms to promote forest protection and conservation;
3. Building of national capacity to assess carbon sequestration rates of the various tropical species (this requires obtaining the necessary algorithms from tropical countries such as Porto Rico or Martinique);
4. Need for equipment to monitor sample plots and undertake forest inventories (e.g. GPS, data loggers, drones, dendrometers);
5. Additional staffing to meet data and research needs;
6. Maintenance of satellite imagery information, in advance of each NC, to measure changes in forest cover and type; and
7. A Forest MIS to secure, centralize and coordinate data management.

#### 6.2.1.2.3 Coastal Zone Sector

The SNC (GOSL, 2011) identified constraints which impact on the coastal sector's ability to integrate climate change concerns as follows:

1. Inadequate institutional capacity in law enforcement in relation to the protection of coastal resources;
2. Inadequate prioritization of land use;
3. Inadequate availability of data to allow cost analyses of adaptation measures; and
4. Inadequate financial resources for implementation of adaptation measures.

Adaptation projects that have been or are being undertaken in the coastal zone since the SNC are listed in Box 6.5.

The Summary V&A Report (GOSL, 2016) noted that projection lines and benchmarks for the coastline of Saint Lucia need to be updated and placed at higher elevations, to reflect the extent of the impacts of sea level rise combined with a category 5 hurricane storm surge.

A huge financial gap was identified in the Summary V&A Report as, although costs of required coastal protection for Saint Lucia were not quantified, the costs of coastal protection works required are typically enormous, ranging from 0.1 % to 10 % of GDP for most SIDS (IPCC, 2007, in GOSL, 2016). These huge costs could be prohibitive unless funding can be leveraged through, for instance, the Adaptation Fund or the Green Climate Fund. An assessment of these costs should be made.

## BOX 6.5 INITIATIVES IN COASTAL ZONE ADAPTATION

1. *Iyanola Natural Resource Management of the NE Coast*
   Rehabilitation of riparian, ravine, beach and migratory corridors of NE Coast/ Iyanola forest areas (200 ha), and establishment and implementation of a national management system for sustainable production and sale of biodiversity friendly goods and services friendly goods and services in inland forest and coastal communities.
2. *USAID/OECS Climate Variability, Change and Mitigation Project*
   Biodiversity support in coastal zone management and resilience and freshwater resources management
3. *Improving the Management of Coastal Resources and the Conservation of the Marine Biodiversity in the Caribbean Region* (GIZ)
   Address terrestrial and marine resources management by strengthening the capacity of stakeholders for integrated coastal management and the strengthening of management of marine protected areas (MPA)
4. *Caribbean Aqua-Terrestrial Solutions (CATS) Programme (GIZ)*
   Ridge-to-reef management approach through adaptation of rural economies and natural resources to climate change and management of coastal resources and conservation of marine biodiversity
5. *Coastal Protection for Climate Change Adaptation project*
   Implementation of Local Adaptation Measures (LAMs) for sustainable improvement of coastal ecosystems relevant for climate change adaptation
6. *PPCR-DVRP*
   Sea Level Rise Modelling and Flood and Erosion Risk Mapping
   Design and deployment of a sea level rise monitoring networks to provide high resolution hydrological data
   Evaluation of the health of coral reef systems and rapid monitoring methods for water quality and coral reef
7. *Building coastal and marine resilience through beach assessment, mapping, monitoring, demonstration and management in Saint Lucia (CCAP USAID)*

- To improve beach management in Saint Lucia through assessments and data collection, mapping, implementation and monitoring of innovative adaptation measures, beach management planning and capacity building, as a means to build climate resilience of vulnerable coastal areas on SIDS.

8. *CZM Policy and CZMSAP (World Bank)*

- The 2004 CZM Policy and the CZMSAP will be updated.

Adaptation options, guided by policy changes and legislation that warrant immediate short-term consideration include (Leary et al, 2008, in GOSL, 2016):

1. Formulation and implementation of land-use planning policies to address settlements and agricultural lands at risk of inundation from SLR and storm surges;
2. Fortification of sea and river defenses in vulnerable areas;
3. Further implementation of EWS against tropical storms, hurricanes and storm surges (NEMO, in GOSL, 2016);
4. Building of more shelters on high ground or inland, to shelter people in the event of inundation.

Longer-term policy changes and adaptation measures recommended to address SLR and storm surges include (GOSL, 2016):

1. Adoption of building set-backs legislation to limit major developmental work on the coast;
2. Encouragement of gradual retreat to higher grounds by making land available in the interior;
3. Detailed field surveys to identify the most vulnerable areas in settlements along the coast (such as Castries, Gros Islet, Anse La Raye, Vieux Fort, Micoud and Dennery), and determination of appropriate adaptation strategies.

GOSL (2016) noted that such adaptation strategies should be integrated with economic development policies, disaster mitigation and management plans and integrated coastal zone management plans (ICZM).

#### *6.2.1.3 Critical Infrastructure Sector*

Initiatives to address critical infrastructure gaps identified in the SNC (GOSL, 2011) and persistent gaps are provided in Table 6.2.

**TABLE 6.2: GAPS IN THE CRITICAL INFRASTRUCTURE SECTOR**

| SNC Gaps | Extent to which these have been addressed | TNC Gaps |
|---|---|---|
| Lack of involvement and collaboration of critical public and other agencies, with most climate change issues dealt with by the Sustainable Development and Environment Division (SDED) as the national focal point for the UNFCCC. | The NC process brings critical sectors together through the NCCC, and recommendations are vetted by all sectors.<br>The budgeting process is being reformed to better incorporate climate change issues. | Integrated development planning at a national level is still a gap. |
| Lack of Awareness and Education. | Several projects include a PEO component, to address this gap. Of particular note is the SPCR project. | PEO must be sustained and targeted to be effective. |
| Inadequate Information Availability and Management. | The DVRP project will address many issues in this regard. | There will still be gaps to be addressed after the DVRP project. |
| Inadequate Collaboration and Planning. | | As noted above, integrated development planning at a national level is still a gap. |
| Inadequate Capacity and Tools for implementation of Proposed Measures. | The DVRP will increase capacity in spatial data management. | Further improvements in the management of spatial data will still be required.<br>Enforcement capacity remains a critical gap. |

Hurricane Tomas in 2010 and the Christmas Eve trough in 2013 caused significant infrastructural damage across Saint Lucia, and a significant component of the PPCR-DVRP is infrastructure-focused. The works selected for implementation were based on a high risk of structural failure to the 10-year event in the case of buildings and bridges, or when annual flooding occurs in the case of flood management and urban drainage. The infrastructure selected to be either repaired or rebuilt are in critical condition and some have surpassed their lifetime, and so are more vulnerable to climate hazard conditions. It is intended that this Component engenders the use of the 'build back better' approach and foster appropriate change at the policy and operational levels.

Although the NCCC is an effort to make the national climate change response multi-sectoral, its efficacy in effecting promulgation of requisite climate information into sectoral agencies is too low. More effort at building capacity and participation across agencies is needed. The extensive public education and outreach programme planned under the PPCR-DVRP project should make a significant difference at all levels and in all sectors. The project is also significantly building capacity in several agencies with a responsibility to monitor climate, map and model hazard impacts and promote resilient development, including the Ministry of Infrastructure and the Department of Physical Planning. The *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project will also significantly improve information management across environmental agencies. Very little has been done in the area of research, and this remains a huge gap in Saint Lucia.

#### 6.2.1.4 Disaster Management Sector

The SNC (GOSL 2011) highlights a number of constraints and key issues which impact on the country's ability to integrate climate change concerns into disaster management. These are provided in Table 6.3 along with information on activities that respond to them.

The disaster management sector was not addressed directly in the most recent V&A assessment, but it did address the vulnerable groups sector, noting that among the adaptation measures that may be deployed to protect vulnerable groups from the adverse effects of climate change and sea level rise, are:

1. Public and private insurance systems to reduce, share, and spread climate change-induced risk and smooth consumption, especially among poor households;
2. Early warning systems;
3. Improved provision of relief supplies during weather-induced disasters;
4. Provision of temporary shelters during heat waves for members of vulnerable groups;
5. Restoration of proper hygienic conditions and potable water supplies; and
6. Psychosocial counselling for victims.

The OECS Commission conducted vulnerability assessments in three highly vulnerable communities: Anse La Raye village, Dennery village and Malgretoute / Vollet in Micoud. The final community vulnerability assessments included disaster risk reduction action plans developed in consultation with targeted communities and other stakeholders (Caribbean Catastrophe Risk Insurance Facility ((CCRIF), 2016).

The CCRIF is a regional catastrophe fund for Caribbean and Central American governments, designed to limit the financial impact of extreme natural events by quickly providing financial liquidity when a policy is triggered. It was created in 2007 out of the recognition that natural catastrophes impose a significant burden on the financial ability of states to function after a disaster due to an unavailability of liquidity. The facility was originally structured as an insurance instrument to provide coverage in the event of losses from tropical cyclones or earthquakes, but in 2013 CCRIF began offering coverage for excess rainfall as well.

The Livelihood Protection Policy (LPP) was developed under the Climate Risk Adaptation and Insurance in the Caribbean Project, and implemented by the Munich Climate Insurance Initiative (MCII) in collaboration with CCRIF, MicroEnsure and Munich Re. It offers insurance to individuals through various financial institutions including credit unions. It is designed to help protect the livelihoods of vulnerable low-income individuals by providing swift cash payouts following extreme weather (wind and rain) events. This support is intended to reduce poverty and vulnerability by enabling beneficiaries to recover quickly following a disaster (EC Global, 2012). Small farmers and other individuals in Saint Lucia benefited from quick insurance payouts on their LPPs in the wake of Tropical Cyclone Matthew (CARICOM, 2016).

**TABLE 6.3: GAPS IN THE DISASTER MANAGEMENT SECTOR**

| SNC Gaps | Extent to which these have been addressed | TNC Gaps |
|---|---|---|
| Inadequate agency collaboration. | The national disaster management plan was revised under the DVRP project, and recommendations made for, among other things, capacity building and inter-agency collaboration, but there has been no measurable progress against these. There has not been any adjustment to institutional arrangements to improve inter-agency collaboration in relation to disaster management, although there are collaborative efforts on a number of fronts to reduce disaster risk through, among other things, installation of EWS (e.g. in Corinth, Marchand and Anse La Raye), incorporation of climate considerations in new infrastructure design and development of hazard maps for a number of vulnerable communities. | This is still a gap. |
| Inadequate resources. | There is has not been any significant injection of additional material or financial resources to the NEMO system, except as mentioned in above. A communications officer has been assigned to NEMO. | This is still a gap. |
| Inadequate Information and Communications Technology Management. | There has been negligible progress in relation to ICT Management within NEMO. | This is still a gap. |
| Sensitization & Education. | As part of a CDB Capacity Building initiative, the DSD held a five-day Training Workshop in 2014 on undertaking Vulnerability and Capacity Assessments (VCA) pertinent to Climate Change for participants that had a leadership or participatory role in communities that are located in climate/disaster-vulnerable areas (flooding, landslides, storm surge and SLR). In 2017, training in community vulnerability and hazard mapping was undertaken in four communities, under the TNC project.<br>Despite the assignment of a Communications Officer, public sensitization by NEMO is limited by other resource constraints.<br>NEMO personnel have and are benefitting from training courses in Japan on EWS, climate change and DRR. Community-based disaster risk reduction has been facilitated, with support from the Japanese Government. This has included work in crisis communication and public awareness. | This is still a gap. |

###### 6.2.1.4.1 Financial Services Sector

The National Climate Change Policy and Action Plan (NCCPAP) (GOSL, 2002) recognized that in order "to ensure appropriate approaches to adaptation in the financial sector, the government, in collaboration with other agencies will, where feasible:

1. Implement fiscal and financial measures in order to achieve equitable distribution of the economic burden among stakeholders;
2. Ensure the adoption and implementation of building codes and other standards in order to minimize risk from climate change;
3. Sensitize stakeholders about the effects and implications of climate change;
4. Collaborate with the financial sector to develop appropriate risk management measures and regimes to address the impacts of climate change".

The SNC (GOSL, 2011) highlighted constraints and associated requirements for the financial sector consistent with the following recommendations that centered on creating an enabling environment for the FSS to integrate climate change considerations into their planning and operations:

12. **Sensitization, policy and legislative framework and enforcement** by government officials;
13. **Sector education and sensitization**;
14. More extensive **insurance coverage for the agricultural sector**;
15. **Financing for agricultural research**;
16. **Development, implementation and enforcement of climate change-sensitive building guidelines;**
17. **Risk-based pricing for insurance policies and loan approvals**;
18. **Customer education and sensitization on future climate related risks**;
19. Development and employment of **strategies by the FSS to minimize the sector's risks** and maximize opportunities;
20. **Implementation of Stress Tests** for the financial institutions by GoSL and the Eastern Caribbean Central Bank (ECCB) to determine the ability of individual financial institutions to deal with the economic crisis (and possible financial crisis) that can be brought about by climate change related events;
21. **Review of the roles, responsibilities and capacities of the evaluation and monitoring arm of the department of the Director of Finance** to determine whether it is competent to evaluate and monitor the position of financial institutions that are registered and approved; and
22. **Health coverage** offered by the FSS either for loans or insurance should consider the diseases which are likely to increase with climate change.

Insurers in Saint Lucia at that time proposed short to medium term response measures in three broad areas:

1. **Risk avoidance**: moving people and assets out of areas likely to suffer heavy climate impacts through strategic, risk-based land use policies including those on housing, and critical infrastructure;
2. **Risk reduction**: addressing vulnerabilities to weather damage effects by enacting a building code, flood and coastal defenses, infrastructure performance, technological resilience and healthcare regimes; and

3. **Risk management**: taking pro-active measures to ensure the most vulnerable people and social and economic functions are given additional protection, and providing more assured responses to events by improving contingency planning by government, business and communities.

The insurers also proposed the following policy measures:

7. Ensuring that flood and coastal defense investments keep pace with development and climate change;
8. Avoiding unnecessary damage by having a risk-based planning system and building codes with climate change considerations;
9. Evaluating the health and social costs of failing to provide adequate housing for the poor and marginalized groups in society;
10. Requiring economic regulators to take account of climate risks in reviewing utility investment plans and pricing premiums;
11. Setting climate resilient standards for public property and new property developments; and
12. Investing in scientific and technological innovation.

The gaps identified and measures taken to address these are summarized in Table 6.4.

Adaptations options to climate change in the Financial Services Sector will face several barriers (GOSL, 2016):

- economic resources;
- technical knowledge; and
- adaptive capacity in the coastal zone.

| TABLE 6.4: GAPS IN THE FINANCIAL SERVICES SECTOR | | |
|---|---|---|
| **SNC Gaps** | **Extent to which these have been addressed** | **TNC Gaps** |
| Sensitization, policy and legislative framework and enforcement by government officials. | Little if any progress in this regard. | This continues to be a gap. |
| Sector education and sensitization. | There has been some level of interface with the insurance sector, to sensitise them to climate impacts. Some use hazard maps to guide decision making. Banks appear not to discriminate once planning approval is in place. | This continues to be a gap. |
| More extensive insurance coverage for agricultural sector. | Livelihood protection policies have become available through EC Global and other lending institutions. The government is also a member of CCRIF. | There has been significant progress, but uptake by farmers is low.<br>Consideration must also be given to improving coverage for low income householders, as these are particularly vulnerable, and the government incurs significant cost in the aftermath of an event in assisting recovery within this group. |
| Financing for agricultural research. | There has been little progress in this regard. | This continues to be a gap. |
| Development, implementation and enforcement of climate change-sensitive building guidelines. | The OECS Building Code 2015 is still in draft and has not been adopted by government. Climate specific guidelines have also been drafted but are not yet adopted. | The Building Code should be finalised and adopted, along with other supporting instruments (EIA, Climate sensitive building guidelines, etc.). |

| | | |
|---|---|---|
| Risk-based pricing for insurance policies and loan approvals to discourage construction in hazard prone areas. | This does not happen. It would have to be informed by hazard mapping which is either unavailable or inadequate. | Hazard modeling and mapping must continue to develop and improve, to inform risk based pricing, in tandem with raising awareness knowledge within the sector. |
| Customer education and sensitization on future climate related risks. | The FSS does not have any products to sensitise customers except for the EC Global Livelihood Protection Policy which targets the agricultural sector and the CAFF recently on offer through the SLDB, which provides low interest loans for activities that increase climate resilience. | This continues to be a gap, but must be preceded by raised awareness and development of climate resilient strategies for the sector. |
| Development and employment of strategies to minimize the sector's risks and maximize opportunities. | There is no strategy to date. | This continues to be a gap. |
| Implementation of Stress Tests for the financial institutions by GoSL and the Eastern Caribbean Central Bank (ECCB) to determine their ability to deal with the possible economic and possible financial crises. | This has not been implemented. | This continues to be a gap. |
| Review of the evaluation and monitoring arm of the department of the Director of Finance in relation to evaluating and monitoring financial institutions. | This has not been undertaken. | This continues to be a gap. |
| Health coverage consideration of diseases likely to increase with climate change. | This has not been given consideration. | This continues to be a gap. |

###### 6.2.1.4.2 Health Sector

The SNC (GOSL, 2011) highlighted impediments which impact on the health sector's ability to integrate climate changes concerns. These and measures to address them are provided in Table 6.5.

The health sector is currently undergoing a process of reform, and is transitioning towards a separation of the main health sector functions of financing, service provision and regulation as recommended by the WHO.

The PAHO / DfID Smart Healthcare Facilities in the Caribbean Project is in the pipeline. It includes rainwater harvesting, solar power, and provides training and support for healthcare facilities to practice low cost/no cost conservation, and functional disaster preparedness.

Ministry of Health (2016) developed a *Policy and Strategy for Environmental Health in Saint Lucia, with a Focus on the Department of Environmental Health (2016 – 2021)* that acknowledges regional and international commitments such as those enshrined in the St. Georges Declaration and the UN SDGs. It identified the climate change impacts of relevance to the department, as identified by the WHO. It proposes to integrate climate change mitigation and adaptation information into relevant PEO products, and the development, financing and implementation of the National Vector Management Strategy that acknowledges, among other things, the impact of climate change. However, little has been implemented to date.

The V&A assessment of 2017 noted that strengthening of public health systems and health emergency management systems in Saint Lucia is necessary, particularly to safeguard the health of the most vulnerable population groups and respond effectively to emergencies when they arise. It emphasized that special attention should be paid to the control and eradication of vector-borne diseases, such as dengue and water-borne and respiratory diseases that may become more prominent with climate change.

**TABLE 6.5: GAPS IN THE HEALTH SECTOR**

| SNC Gaps | Extent to which these have been addressed | TNC Gaps |
|---|---|---|
| Inadequate numbers and skills of health care professionals and allied health care workers. | The EU has supported further education of a number of health care professionals in readiness for the opening of the Owen King EU National Hospital, and in support of broader health sector reform.<br>Support has also been provided by PAHO in primary health care and vector borne disease control. | This continues to be a gap.<br>Retention of trained staff is another issue to be addressed.<br>Institutional change/review is required to optimise the application of newly acquired skills of returning staff, by ensuring that they are placed in appropriate positions. |
| Inadequate surveillance systems in order to monitor disease trends. | There is ongoing surveillance within the Ministry, with structures in place to support this. Surveillance statistics are maintained and circulated within the Ministry. A National Surveillance Team with representation from various Departments within the Ministry of Health meets regularly.<br>The *Strategic Program for Climate Resilience* (SPCR) will support development of an Environmental Health Surveillance System with a focus on Climate Change.<br>The HMIS will increase efficiency of information management across the health sector. | This is no longer a significant gap, although some work remains to be done. |
| Poorly sustained national public health programmes. | There have been improvements in the primary health care system through construction and/or renovation of a number of community health facilities.<br>Neither the Owen King EU National Hospital nor the rehabilitated St. Jude's hospital has been opened, and hospital services are accommodated within antiquated or inappropriate structures. | This continues to be a gap.<br>Coordination of public health programmes is inadequate. There is low capacity to implement plans, compounded by financial resource constraints. However, use of existing resources is not optimised. |
| Weak public health responses to disease outbreaks and emergency events. | The Ministry of Health collaborates with NEMO agencies in emergency events in accordance with response plans, but is not provided with additional budget to facilitate its emergency response. Community mobilisation during emergency events is inadequate. | This continues to be a gap. |
| Inadequate capacity of National Health Services Lab to conduct rapid testing. | The Ezra Long Laboratory meets most of the personnel and equipment requirements, but lacks financial resources to obtain for consumables.<br>The Ministry receives some limited support from CARPHA. | This continues to be a gap. A national lab network should be created for improved coordination and utilisation of these services. |
| Lack of funds for awareness campaigns specifically on climate health. | The Bureau of Heath Education is active within the limits of its resource constraints. It engages in community education campaigns in the face of outbreaks of dengue, chikungunya, zika, etc. | This continues to be a gap.<br>A climate policy for health is needed. |

| | | |
|---|---|---|
| | but there is no programme specifically in relation to climate health. | |
| Poor links with other government ministries to develop national programmes that incur co-incidental health benefits. | There is collaboration with other agencies but it is *ad hoc* and not institutionalised or programmed. | This continues to be a gap. |
| Lack of quality assurance (QA) systems within the health sector. | There is a sector wide quality plan that is being rolled out, and is in the early stages of implementation. | This continues to be a gap. The EU is supporting many aspects of the rolling out of the QA plan. |
| Ineffective system for the management and analysis of data and dissemination of information. | The Saint Lucia Health Information System (SLUHIS) system being rolled out should make a significant contribution in addressing this issue. | This has been partially addressed but more work is required. A new information system (CELLMA) will complement the SLUHIS. |
| Ineffective national emergency medical system that will ensure appropriate and timely dispatch, effective stabilisation and transfer of patients and is integrated with hospital emergency rooms during a disaster. | The ambulance and EMT services are managed mainly by the Fire Service. There are significant resource issues. | This continues to be a gap. |

###### 6.2.1.4.3 Human Settlement Sector

The SNC (GOSL, 2011) highlighted many multi-sectoral issues which affect the ability of the human settlement sector to adequately deal with key issues especially in light of potential climate change impacts. The following were identified as major constraints and capacity needs which needed to be given urgent attention:

a. Inadequate availability of financial resources;
b. Inadequate availability of human resources, particularly skilled technical personnel;
c. Inadequate institutional co-ordination to facilitate the multiplicity of issues, which impact the sector; and
d. Lack of an integrated approach to development.

The Ministry of Economic Planning is proposing integrated national development planning and reform of the national budgeting process. The Physical Planning Department is slowly acquiring improved technology and skills that have the potential to improve their ability to map and model hazards to better guide decision making and forward planning. The PROUD programme assists vulnerable communities in unplanned developments, by improving infrastructure (including utility services, drainage and emergency access) in these communities. SSDF also undertakes programmes in vulnerable and low income areas to improve physical conditions.

The V&A assessment of 2017 does not address human settlement separately, but considers this in the context of coastal zone development. It proposes adaptation measures such the use of building setbacks legislation to limit buildings and other major developmental work on the coast, and making land available in the interior to encourage gradual retreat to higher grounds to decentralize economic activities and settlement on the coast.

#### 6.2.1.4.4 Tourism Sector

The SNC (GOSL, 2011) noted constraints to adaptation in this sector as:

1. **Inadequate Human Resources.** There is a need for climate change exposure or expertise in the sector to handle potential impacts;
2. **Inadequate Institutional Co-ordination.** There is a need for an effective coordinating mechanism among agencies or across ministries to ensure adequate monitoring and enforcement of tourism projects to facilitate compliance with regulations and other environmental issues;
3. **Inadequate Financial Resources.** A lack of adequate funding is an issue that affects the sector's ability to address climate change effectively;
4. **Inadequate Policy and Legal Instruments.** The absence of supportive policies, standards, regulations to effect adaptation is of major concern;
5. **Inadequate Technological Solutions** Absence of cost effective technological solutions makes adaptation unattractive;
6. **Inadequate Data and Information**. This includes sector data for example on hotel consumption patterns for energy and water and solid waste disposal practices as well as other tourism impacting information such as land use maps, GIS information and climate data relevant to the tourism sector.

Little has changed since the SNC, and there is still limited expertise within the sector, even within the Ministry of Tourism, with only those officers sitting on the NCCC being routinely exposed to climate change information. Monitoring and enforcement to facilitate compliance with regulations is lacking in all sectors including tourism, due to lack of capacity and other resources in regulatory authorities such as Ministry of Health, Ministry of Physical Development, and Department of Fisheries. When EIAs are conducted on tourism projects, the monitoring of compliance with mitigation recommendations is not undertaken. Some policy documents that propose to address deficiencies in the climate response within the tourism sector are provided in Box 6.6.

The V&A Assessment (GOSL, 2016) noted that some very few adaptation measures are being taken in the tourism sector, such as the construction of sea defenses to protect against beach losses and coastal erosion, but these may be poorly designed, and as such do not anticipate their long term adverse impacts. Other efforts include the installation of soft defenses such as the planting of mangroves. It is incumbent on the managers of the tourism industry to begin to shape policies and integrate them into Government plans to adapt to the impacts, mostly negative, of climate change. Adaptation planning should incorporate the expansion and diversification of tourism activities as for instance the further promotion of ecotourism and fiscal incentives to attract greater numbers of tourists to Saint Lucia (Ibid.).

**Box 6.6 Recent Policy initiatives in the Tourism Sector**

The *Medium Term Development Strategy (MTDS) 2012 – 2016* (MOFEASS, 2012) identifies goals and objectives with outcomes, outputs and indicators in key sectors including tourism.

The National Adaptation Strategy and Action Plan (NASAP) (2016 to 2021) (CCCCC, 2015) aims to address the anticipated adverse effects of climate change on the tourism sector.

The *Iyanola Natural Resource Management of the NE Coast* project will develop a business plan to promote new tourism and other income generating activities and enhance existing ones.

The *Agricultural Policy Framework and Strategy (2016-2021) Draft Final Report* (GOSL, 2016) advocated for market-based incentives to promote sustainable tourism, and elimination of subsidies that promote housing and tourism development in high hazard areas.

#### 6.2.1.4.5 Water Sector

The SNC (GOSL, 2011) highlighted a number of constraints in this sector which are critical to the adequate management of water resources. Progress has been made in this sector, but the deficiencies are significant, and much remains to be done to make it more resilient. See Table 6.6.

The V&A Assessment (GOSL, 2016) noted that water may become scarce in the future which could lead to conflict in affected areas. This needs to be anticipated, and appropriate mitigation and conflict resolution mechanisms put into place (Ibid.). Strategic approaches should include the following (Ibid.):

1. Protection and restoration of ecosystems;
2. Forest management plans to prevent and control soil erosion;
3. Water harvesting;
4. Protection of the water environment, prevention and control of water pollution;
5. Awareness raising to promote effective and efficient water use.

**TABLE 6.6: GAPS IN THE WATER SECTOR**

| SNC Gaps | Extent to which these have been addressed | TNC Gaps |
|---|---|---|
| Data unavailability | Work progresses to improve data availability through the Meteorological Services Office and the WRMA. | This gap is being addressed. |
| Inadequate water supply infrastructure | Some effort to increase infrastructure capacity is underway, with substantial system upgrades commencing in Vieux Fort with CDB financing, and designed for Dennery with Mexican government and CDB funding proposed. A funding deficit for Dennery has halted progress on the implementation of that system.<br>The Roseau system that services some 60% of the population is threatened by, among other things, the excessive siltation of the reservoir following Hurricane Tomas in 2010 and the Christmas Eve Trough in 2013 that severely reduces its capacity. Detailed plans have been developed for remedying the situation, and dialogue with CDB continues on this.<br>The transmission line between the John Compton Reservoir and Sarrot is badly deteriorated and this should also be addressed with some urgency.<br>The OECS RRACC project developed a WASCO GIS platform for monitoring and managing infrastructure. | This is a significant gap that required substantial resources.<br>There is a significant level of non-revenue water (approximately 42% of the water produced), a major contributor to the ongoing financial constraints faced by WASCO (GOSL, 2016) |
| Absence of implemented water & land use policy | Water and land policies are both in place. Proposed revisions to the national land policy NLP (2015) are yet to be formally adopted.<br>The National Wastewater Management Strategic Plan and Rain Water Harvesting Pilot Program are being developed under PPCR-DVRP. | The Water Sector Adaptation Strategy to Climate Change must be further developed and implemented. This will require concerted effort by all the stakeholders from both the private and public sectors, and mobilization of national, bilateral and international resources (GOSL, 2016). |

| TABLE 6.6: GAPS IN THE WATER SECTOR | | |
|---|---|---|
| **SNC Gaps** | **Extent to which these have been addressed** | **TNC Gaps** |
| Inadequate institutional and regulatory capacity | The WRMA is well established, and is increasing the availability of relevant data, to supplement that available through the Meteorological Services Office. The Water and Sewerage Commission was replaced in 2016 by the National Utilities Regulatory Commission (NURC). | Although there are various water management institutions in existence, the country lacks the complete range of integrated responses required for climate change adaptation (GOSL, 2016). |

### 6.2.2 Mitigation Needs

#### 6.2.2.1 Data requirements for GHG emissions

Stakeholders engaged noted that data requirements for greenhouse gas emissions are standard, but the consultants preparing the Greenhouse Gas Inventory and Mitigation Assessment for Saint Lucia lamented deficiencies in data to inform their work. The Saint Lucia Mitigation Assessment (GOSL, 2015) identified a number of gaps in relation to information on projections as well in resources and capacity. Table 6.7 is extracted from this report, and provides the baseline emission projection gaps that were identified, organized by Mitigation Assessment Sector. Specific recommendations were also provided. Another column was added to this table by this author to identify the agency with lead responsibility for implementing the recommendations.

**Table 6.7: Baseline Emission Projection Gaps** (GOSL, 2015)

| Mitigation Sector | Key Data Gap Identified | Recommendation for Addressing Data Gap | Lead responsibility(s) |
|---|---|---|---|
| General | Long-term GDP forecasts for Saint Lucia for major economic sectors (agriculture, manufacturing, transport, tourism) | Overall GDP growth is currently estimated from IMF long-term projections for Saint Lucia. Forecasts developed by the Government of Saint Lucia may be more reliable and match planning and policy. | Ministry of Economic Affairs |
| Energy Demand | National Energy Balances by sector and sub-sector are not regularly produced | While the Latin American Energy Organization (OLADE) recently compiled an energy balance for Saint Lucia for 2010, 2011 and 2012, the overall process would benefit if the MSDEST prepared energy balances annually using sales data from fuel distributors as well as import data. This would allow the ministry to prepare consistent and comparable energy balances annually that could also be used for planning and policy development. | REDiv |
| | No comprehensive data on energy end-use | A national study should be conducted to balance total energy use with disaggregated end-use (e.g., lighting, water heating, air conditioning) for households, hotels and commercial enterprises. The primary interest is for electricity, but other important fuels such as LPG, kerosene, wood and charcoal should be included. This study would clearly reveal how electricity and other fuels are being consumed. Information on total stock, average energy efficiency and demand (usage) would also be revealed. | REDiv |
| Electricity Generation | Long-term projections for grid transmission and distribution efficiency | Assumption is that losses remain at the same level as in the baseline, but existing plans may reveal improvements in the baseline. | LUCELEC |

| Mitigation Sector | Key Data Gap Identified | Recommendation for Addressing Data Gap | Lead responsibility(s) |
|---|---|---|---|
| | Detailed projections for supply (capacity additions, refurbishments plans, retirements, expected generation) | Supply projections were not used in the analysis, instead the baseline considers that future demand will be met by more diesel generation. Having consistency with LUCELEC projections for firm new projects would be a major asset and also account for potential retirements of existing generation). | LUCELEC |
| Transport | No comprehensive data on vehicle fuel efficiency and vehicle demand (Number of baseline vehicles by type is known). Future fuel efficiency of new vehicles is based on estimates from global datasets. | Existing registration data may provide information on average demand and fuel efficiency by vehicle type. Detailed import data could also potentially reveal fuel efficiency for new vehicles. | Ministry of Infrastructure - Transport Division<br>+<br>Customs Department |
| Agriculture | Growth in crop production and synthetic fertilizer is based on overall IMF GDP projections. Livestock projections are slower and based on historical growth. | Forecasts developed by the Ministry of Agriculture may be more reliable and match planning and policy. | Ministry of Agriculture |
| Waste | The type of wastewater treatment can dramatically impact overall baseline emissions. Total wastewater is based on population projections; however, wastewater treatment is not changed from current. | Projections of the amount of wastewater treated by type of wastewater treatment facility in the future prepared by WASCO or others (e.g., sea discharge, septic system, latrine, anaerobic treatment ponds, aerobic treatment plants) would improve the forecast. | WASCO<br>+<br>Environmental Health Department |
| | Projections of HFC emissions is based on expected demand for refrigeration and air conditioning equipment, as well as the availability of alternatives to HFCs. | Improved inventories of existing HFCs imported into Saint Lucia through products and bulk imports would assist in reducing uncertainties. | SDED<br>+<br>Customs Department |

##### 6.2.2.2 Data needs for Mitigation Assessment

The Saint Lucia Mitigation Assessment (GOSL 2015) also identified data gaps in relation to information on mitigation actions. Table 6.8 is extracted from this report, and provides these data gaps and recommendations to address these, organized by Mitigation Assessment Sector. Another column has been added to this table to identify the agency with lead responsibility for implementing the recommendations.

**Table 6.8: Data gaps and recommendations for mitigation actions** (GOSL, 2015)

| Mitigation Sector | Key Data Gap Identified | Recommendation for Addressing Data Gap | Lead responsibility(s) |
|---|---|---|---|
| Energy Demand | Uncertainty in the impact of the revised building code and enforcement measures proposed on average energy efficiency of ventilation, space cooling and lighting end-uses for new construction. | The Organization of Eastern Caribbean States should be encouraged to generate estimates of the likely energy and cost impacts of the revised building code (if strictly enforced). | OECS governments<br>+<br>OECS Commission |
| | The potential for energy efficiency standards to increase the average energy efficiency of major appliances in Saint Lucia is not clearly understood and targets are set based on estimated impacts seen elsewhere. | Saint Lucia Bureau of Standards may be able to collect data in order to estimate the energy efficiencies of major appliances through the labelling program. Average and high efficiency data could then be used to estimate the emission reduction potential of different standards. | Bureau of Standards<br>+<br>Customs Dept. |
| | Assumption that all existing street lighting can be replaced by LED by 2020. | Stakeholders should review what roll-out and penetration of LED is possible and the impact on total energy demand. | REDiv<br>+<br>LUCELEC |
| | Assumption of total electricity use in Government Buildings is based on estimate of 10% for all commercial electricity use (not including street lighting). | Estimates of total electricity use in government buildings should be prepared using a bottom-up survey of meter data. | Ministry of the Public Service<br>+<br>LUCELEC |
| Electricity Generation | Emission reduction potential varies greatly depending on the renewable technology that is selected because the target considers capacity (MW) and not % of total generation (MWh). Because of the lower capacity factors for wind and solar, an equivalent capacity of operating geothermal produces more than twice the emission reductions for the same MW rating. | Whether geothermal, biomass, waste to energy will be included in the renewable energy mix has a significant impact on estimated emission reductions achieved by the target. A more detailed assessment should be made to determine whether these technologies are likely to be part of the energy mix by 2020 and if not emission reduction potentials should be revised downward. | REDiv |
| | Utility scale renewable and baseline diesel costs were based on high and low ranges (Lazard, 2014 in GOSL, 2015). | Costs should be reviewed and adjusted to properly account for realization of renewable projects in Saint Lucia. Real costs from terms of reference and tenders should be used where possible. | REDiv |
| | A 6% target for grid distribution and transmission efficiency | LUCELEC and MSDEST should review whether this target can be achieved at a reasonable level of finance and rate of return in investment. | LUCELEC and REDiv |

| Mitigation Sector | Key Data Gap Identified | Recommendation for Addressing Data Gap | Lead responsibility(s) |
|---|---|---|---|
| | (from 8.85% in 2013) is estimated but not based on detailed cost analysis. | | |
| Transport | There is considerable uncertainty in the performance of a maintenance program in reducing greenhouse gas emissions. While there is considerable potential, barriers may prevent achieving the 3% overall emission reduction target. | A review of maintenance programs implemented in other countries may provide clearer estimates of potential and important guidance on effective design and implementation of these type of programs. | Ministry of Infrastructure |
| | The potential for vehicle fuel efficiency standards to increase the average fuel efficiency of different categories of vehicles Saint Lucia is not clearly understood and targets are set based on estimated impacts seen elsewhere. | The Ministry of Transport may be able to collect data in order to estimate the fuel efficiencies of vehicles in major categories through the labelling program. Average and high efficiency data could then be used to estimate the emission reduction potential of different standards. | Ministry of Infrastructure/ Transport Division |
| | Feasibility of increasing public transit ridership (use) by 30%. Baseline demand for passenger travel is expected to increase 36% from today by 2030 and with an additional increase in ridership of 30% this would require a remarkable growth in public transit. | Assumptions should be reviewed for public transit to ensure that they represent a reasonable scenario. | Ministry of Infrastructure/ Transport Division |
| Agriculture and LULUCF | Agroforestry emission reductions may vary substantially depending on the types of trees planted and the density. There are also issues of permanence that need to be considered. | Recent agroforestry projects and pilots that have been successful in Saint Lucia should be reviewed to determine the amount of new biomass that has grown and sequestered carbon and compared with mitigation assessment estimates. | Ministry of Agriculture/ Department of Forestry |
| | Rehabilitation of degraded forests in Saint Lucia is an activity that has been estimated to sequester 2.8 tonnes of biomass/ha annually above the baseline. | The Iyanola project should be monitored to determine what level of rehabilitation of degraded forests can be conducted and improved estimates of potential incremental biomass growth should be made based on tree types, climatic conditions and level of degradation. | Ministry of Sustainable Development + Dept. of Forestry |
| Waste | An average level of improvement in pump efficiency of 14% was estimated | The level of pump efficiency improvement overall should be reviewed by WASCO to determine if this is a feasible target with relatively attractive returns on investment. | WASCO |

| Mitigation Sector | Key Data Gap Identified | Recommendation for Addressing Data Gap | Lead responsibility(s) |
|---|---|---|---|
| | Cost feasibility of alternatives to HFCs for residential, commercial and vehicle air conditioning were estimated at EC$60 per $tCO_2e$. | MSDEST should review cost assumptions. | MSDEST |

#### 6.2.2.3 Capacity building required for mitigation assessment

Recommendations for capacity building for mitigation assessment are (GOSL, 2015):

1. Increase capacity of government agencies integral to information gathering for the different sectors, to better support future mitigation assessments and estimate emission reductions;
2. Inculcate high level **political will** and bi-partisan support to engage and direct a coordinated effort amongst the agencies involved, to move forward with implementing mitigation actions (Ibid.);
3. Assign a **strong central institution** with a clear and long-term mandate to coordinate and oversee a climate change mitigation action plan;
4. Sustain **engagement** of a broad spectrum of stakeholders for discussion and planning (Ibid.); and
5. Increase p**ublic awareness** of the potential impacts of climate change and of the actions that can be taken to reduce emissions, to increase participation and success, and to generate political pressure to take action (Ibid.).

The mitigation assessment report noted a very high uncertainty in historic estimates as well as limited data availability on trends in the LULUCF sector, and did not prepare projections for that sector. While LULUCF is not included in terms of specific projected emissions reductions, Saint Lucia's forestry cover acts as a sink whose value should not be underestimated. Significant work is currently being conducted to improve forest inventory data, develop policies for forest management and protection and to identify reforestation projects. LULUCF sector contributions may be included in future updates to the NDC if sufficient data become available (Ibid.). In order to develop projections in the future it will be important to have a clear understanding of trends that impact biomass growth, accumulation and removal from forestlands and croplands, and recommendations to assist in developing a baseline projection were made.

### 6.2.3 Inventory Data Gaps, Needs and Recommendations

A number of gaps, needs and constraints were identified by GOSL (2015) during the preparation of the Third National Communication (TNC) greenhouse gas inventory.  The specific gaps, needs and recommendations associated with activity data collection, uncertainty in emission estimates, capacity building and development of an integrated and sustainable greenhouse gas inventory system are summarized below in Table 2.21 of this TNC.  The information is organized by IPCC Sector.

#### 6.2.3.1 Uncertainty in Emission Estimates

The uncertainty analysis undertaken by GOSL (2015) suggests that efforts to reduce the overall uncertainty of Saint Lucia's greenhouse gas inventory could focus on a small number of emission sources. A total of seven source categories contributed to a combined uncertainty above 2% as a percentage of total national emissions in 2010. Table 2.22 in this TNC provides recommendations made to reduce uncertainties associated with these seven source categories, listed in the order of greatest contribution of uncertainty to the total national emissions (Ibid.).

#### 6.2.3.2 Capacity Building for information gathering

Capacity building is required at both institutional and personnel levels. Multi-sectoral representation (i.e., Energy, Industrial Processes, Solvent and Product Use, Agriculture, LULUCF and Waste) is critical since expertise is typically embedded within institutions that follow similar sectoral divisions (GOSL, 2015). Government departments such as MSDEST, Ministry of Agriculture and Department of Forestry are integral to information gathering, and their capacities should be increased to continue supporting the future development of GHG inventories, and to equip appointed government staff with the skills to complete all aspects of inventory work and minimize the requirement for outside consultants (GOSL, 2015).

#### 6.2.3.3 Sustainable Greenhouse Gas Inventory Systems

A sustainable GHG Inventory system should be a key objective for Saint Lucia, as this will:

1. Address the challenge of more frequent and demanding reporting of inventories to the UNFCCC which now includes Biennial Update Reports;
2. Inform the assessment of Nationally Appropriate Mitigation Actions (NAMAs) and global projections of progress towards targets to arrest global warming (Ibid.); and
3. Contribute to the development of a national Measuring, Reporting and Verification system

### 6.2.4 The National Communication Process

The National Communication process is coordinated by a unit within the SDED that is supported by the GEF, reporting to a NCCC comprising a broad range of stakeholders. Further information on the NCCC can be found in Section 1.11.1, and the NCCC composition is provided in Table 1.6 of this TNC. The NCCC was assigned the responsibility to oversee the NC development process by a Cabinet Conclusion in 2003. Challenges to the process relate to:

1. The inability of the NCCC to physically meet with the regularity and frequency it should due to member workloads and financial constraints. Improved collaboration and interactions between members may be facilitated through the MEA project.
2. The under-representation of certain sectors on the NCCC. Although agency representatives are co-opted as required, the membership should be reviewed to ensure that the requisite interests are appropriately represented.
3. The low participation at a sectoral level despite representation on the NCCC. There appears to be a lack of connectivity between the NCCC members (and their knowledge and experience on the NCCC) and what obtains/occurs in their Ministries as part of routine work. There is inadequate transfer of knowledge or mainstreaming/integration, resulting in low participation at a sectoral level despite representation on the NCCC. Most public officers are not sufficiently aware of the NC. More awareness building is needed if the design and implementation of NC-recommended sectoral initiatives are to be optimized. Some suggestions have been to rotate Ministry staff designated as NCCC focal points so that more officers are exposed to the workings of the NCCC.

## 6.3 THE GEF, ANNEX II PARTIES, MULTILATERAL/BILATERAL CONTRIBUTIONS

### 6.3.1 Support for preparation of National Communications

As party to the UNFCCC Saint Lucia is required, as per Article 4 and 12 of the Convention, to submit a National Communication (NC) every four years. Saint Lucia submitted its first NC to the UNFCCC in 2001, the second in 2012, and is preparing to submit its third by July 2017. The Convention, through Article 11, allows for the Global Environment Facility (GEF), as part of the Financial Mechanism of the Convention, to channel resources provided by Developed Country Parties to facilitate the preparation of NCs. These are channeled through GEF Agencies.

The allocation for the NCs falls under the Enabling Activities of the GEF. Saint Lucia was allocated US$500,000 for its Third NC. Of this amount, US$20,000 was targeted to facilitate the Project Development Component and the balance of US$480,000 to support the implementation of activities falling under the main components of the NC. A portion of the resources allocated to the GEF agency is retained to support monitoring activities throughout the duration of the NC implementation.

The various activities related to preparation of the national communication are conducted primarily through the use of local, regional and international consultants supported with GEF funding. The Sustainable Development and Environment Division SDED, as the executing agency, houses the Project Coordination Unit, which consists of a Project Coordinator and a Project Assistant on a full time basis. An accountant is also hired under the project on a part time basis. This core team is provided with backstopping support by the Climate Change Team within the Division, and additional administrative support is provided through the Division as needed. The Ministry's Accountant also provides accounting oversight of financial reports and use of funds under the NC. The NCCC and its membership provide validation of outputs provided under the NC and general guidance through their areas of expertise.

The total resources allocated are contained in Table 6.9.

**Table 6.9: Resources available for preparation of Saint Lucia's Third National Communication to the UNFCCC** (Source**:** Project Document: For implementation of activities towards Saint Lucia's Third National Communication to the UNFCCC (UNEP, 2013))

| **Cost of Project** | **US$** | **%** |
|---|---|---|
| **GEF Trust Fund** | 500,000 | 85.37 |
| **Government in-kind** | 105,620 | 14.62 |
| **Total** | 585,620 | 100 |

### 6.3.2 Support for activities related to Climate Change adaptation and mitigation

Sources and quantum of support provided for large climate change projects presently being implemented are tabulated below. A full listing of climate change-relevant projects is provided in Section 1.12 of this TNC report.

#### *6.3.2.1 Contributions from the Party*

Typically, GEF-funded Projects are provided with the capacity to implement as money is allocated for a Project Coordinator and other administrative requirements. Most GEF Projects rely on co-financing from the Party in the form of office space and administrative staff to support accounting or monitoring and evaluation.

#### *6.3.2.2 Contributions from the GEF*

Table 6.10 lists GEF-funded projects with an adaptation focus, and also identifies co-financing quantum and sources. Table 6.11 lists GEF-funded mitigation projects, and also identifies co-financing quantum and sources.

**Table 6.10: GEF-funded adaptation projects**

| **PROJECT SUMMARY DATA** | **PURPOSE** |
|---|---|
| **Name:** Third National Communication (TNC) 2012 - 2017<br>**Level:** National<br>**Agency:** GEF/UNDP<br>**GEF US$500,000**<br>**GOSL in kind: US$105,620** | To prepare Saint Lucia's Third National Communication to the UNFCCC |

| PROJECT SUMMARY DATA | PURPOSE |
|---|---|
| **NAME:** Special Programme on Adaptation to Climate Change (SPACC)<br>**DURATION:** 2007-2013<br>**LEVEL:** Sub-Regional with national components<br>**AGENCY:**GEF/WB/CCCCC<br>**Funding** (national components): EC$1,560,115. | Implementation of select adaptation measures designed to address climate change impacts on biodiversity and land degradation. |
| **Name:** Marchand Community Centre – Solar PV System<br>**Duration:** Complete by Nov 2013<br>**Level:**<br>**Agency:** GEF, CREDP, CCCCC, WB, MOST, MOPD, SDED<br>**Funding:** EC$94,801 | Add-on to Special Programme on Adaptation to Climate Change Project-SPACC |
| **Name:** Iyanola-Natural Resource Management of the North East Coast<br>**Duration:** 36 months, up to June 2014 (extended)<br>**Level:** National<br>**Agency:** GEF<br>**GEF Funding:** US$162,727 for preparation; US$ 2.4 M for implementation<br>**Co-funding:**<br>GOSL (includes bi- and multi-lateral grant (Aus Aid, EC, GIZ, PPCR) $6,114,483<br>NGOs: Durrell Wildlife Trust, HERITAS, Birdlife International, Fauna and Flora International, Saint Lucia National Trust. Cash: $50,000; In-kind: $50,000<br>CBO's: NICE, HOPE, BELFUND. Cash: $50,000; In-kind: $50,000<br>**UNEP** In-kind: $200,000<br>**Sub-total Cash:** $2,500,000 + In-kind:$6,414,483:<br>**Total** $8,914,483 | Increased management effectiveness and sustainable use of the North East Coast's natural resource base to generate multiple global environmental benefits. |
| **Name:** Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreement (MEA) Implementation and Sustainable Development<br>**Duration:** 2013-2014<br>**Level:** National<br>**Agency:** GEF<br>**Funding:** US $ 50,000 for preparation; US $ 1 M for implementation | This project will promote synergy in implementation of the Rio Conventions. |
| **Name:** Climate Change Adaptation in the Eastern Caribbean Fisheries Sector CC4FISH<br>**Duration:** 2015-2019<br>**Level:** Regional (7 Caribbean countries)<br>**Agency:** GEF<br>**Funding:** US$5,460,000<br>**Co-financing:** US$34,850,000 | The objective of this project is to increase resilience and reduce vulnerability to climate change impacts in the Eastern Caribbean Fisheries Sector, through introduction of adaptation measures in fisheries management and capacity building of fisherfolk and aquaculturists. This project aims to create better understanding and awareness of climate change vulnerability, create resilience of fisherfolk, fisherfolk organizations and aquaculturists, and improve governance by mainstreaming climate change adaptation in multilevel fisheries governance. |
| **Name:** Sustainable Transport/Green Cities (emission reduction)<br>**Duration:** was proposed to commence July 2014 under GEF 6; the PIF for this project has been approved.<br>**Level:** National<br>**Agency:** GEF<br>**Funding:** US$4,428,145. | Proposed outcomes:<br>1. Increased government, civil society, and private sector capacity for sustainable development and ecosystem management.<br>2. Restored/rehabilitated productive landscapes.<br>3. Sustainable socio-economic development pathways pursued in targeted communities. |

| PROJECT SUMMARY DATA | PURPOSE |
|---|---|
| Co-financing is US$25,800,000. | |
| **Name:** Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco)<br>**Duration:**<br>**Level:** Regional<br>**Agency:** GEF<br>**Funding:** total budget of USD 88.7 million including cash and in-kind co-financing with a total GEF cash allocation of USD 20.7 million | Component I of the IWEco project aims to develop and implement integrated, targeted, innovative, climate-change resilient solutions appropriate for Caribbean and global SIDS. |
| **Name:** Caribbean Regional Fund for Wastewater Management Project (CReW)<br>**Duration: 4 years**<br>**Level:** Regional<br>**Agency:** GEF/ IDB/ UNEP<br>Funding: The total GEF grant allocation is USD 20,000,000 but the total budget, including in-kind and loan co-financing, is USD 272,886,996 | The project will focus on piloting revolving financing mechanisms (sustainable financing), appropriate waste water management technologies and related wastewater management reforms in the Wider Caribbean Region (WCR). |
| **Name:** Implementing Integrated Land, Water & Wastewater Management in Caribbean SIDS<br>**Duration:**<br>**Level:** Regional<br>**Agency:** GEF, UNEP, UNDP<br>**Funding:** A GEF allocation of USD20.45 million is made within a total project cost USD138.45 million. | This project focuses on the implementation of an integrated approach to water, land and ecosystems services management. |
| **Name:** Sustainable Financing and Management of Eastern Caribbean Marine Ecosystems<br><br>**Duration:**<br>**Level:** Regional<br>**Agency:** GEF, WB, Nature Conservancy<br>**Funding:** US$8.75 million | To improve the management of existing and expanded marine protected area networks through the establishment of sustainable financing mechanisms. |
| **Name:** Capacity building and Mainstreaming of Sustainable Land Management Project<br>**Duration:** ended in late 2012<br>**Level:** Regional<br>**Agency:** GEF/UNDP<br>**Funding:** GEF financing for this project was USD 485,000 within a total project cost of USD1,536,200 | Building local and regional capacity to support SLM. |

### Table 6.11: Energy projects financed by GEF

| Type of Project | Project Name | Project Description |
|---|---|---|
| Energy Efficiency in Buildings | ESD Caraibe Project<br>**Agency:** UNEP<br>**Level:** Regional<br>**Funding:** GEF allocation US$522,500 | Saint Lucia is one of four member states participating in the "Energy for Sustainable Development (ESD-Caraibes) in Caribbean Buildings" project. This regional project is the first of its kind and seeks to address the adverse impact of impact of Green House Gas emissions from fossil fuels and promote the benefits of sustainable energy. Saint Lucia focus of this project is lighting retrofits. Four buildings have been identified to undergo monitoring and eventually lighting retrofits of these buildings. The four buildings are Dennery Hospital, Vieux Fort police Station, Sir Arthur Lewis |

| Type of Project | Project Name | Project Description |
|---|---|---|
| | | Community College - TR Theobalds building and the Bay Gardens Hotel. |
| Roof - Top Solar Photovoltaic (PV) Systems | Marchand Community Centre - Solar PV System - **Agency:** Special Programme on Adaptation to Climate Change (SPACC) – GEF/WB/CCCCC/ GOSL/CREDP **Funding:** US$34,895 | A 4.3kW system was installed on the Marchand Community Centre. Refer to Table 4.3 for further details. |
| Geothermal Energy | Saint Lucia Geothermal Resource Development Project **Agency:** SIDS DOCK/GEF/World Bank **Duration:** **Level:** National **Funding:** US $ 2m including US$800,000 from Government of New Zealand, and support of Clinton Climate Initiative (CCI) | Saint Lucia accessed 2 million US dollars from the GEF and the SIDS DOCK for the Saint Lucia Geothermal Resource Development Project. The project objective is to support the Government to make an informed decision regarding geothermal exploration and development in Saint Lucia by undertaking key upstream preparatory activities.<br>The surface studies/surface reconnaissance and resource assessment have been completed. The Government of New Zealand provided the technical support for the surface reconnaissance, valued in the region of US$800,000. This helped to determine suitable areas for potential geothermal exploration drilling. The aim was to better identify and understand the geothermal resource and its power generating potential.<br>In February 2015, a series of Community Engagement Consultation was held in Soufriere and Choiseul ahead of the expected surface exploration works due to commence at the end of March, 2015 by the Government of New Zealand. In July, 2015 a second run of community engagements was held in Soufriere to inform residents of the work completed, upcoming activities and implementation schedule.<br>The second component of the geothermal project relates to transaction advice and regulatory support. Over 2015/16, the Government of Saint Lucia was engaged in negotiations for geothermal development in Saint Lucia with the identified developer. The government worked closely with the World Bank and the Clinton Climate Initiative (CCI) to ensure that the country's interests were protected and the best deal obtained. CC support has included the review of the agreements and proposed tariff structure for geothermal energy. Government is continuing to engage expert advisors in a mechanism to ensure that the valuable support and advice provided is sustained as the negotiations proceed towards conclusion.<br>At the beginning of March, 2015 the Ministry held a donor's Consultation for financing mechanism for geothermal energy, given the continued need for mobilization of grant/concessional funding to address the potential risks in the next phase of geothermal development (an estimated $20-30m). The aim of the consultation was to apprise the potential donors and other stakeholders of the program and initiate a dialogue on the future development and financing of this project. The geothermal technical coordinator has been recruited under the World Bank project and the consultancy to provide the LIDAR services is being procured. In |

| Type of Project | Project Name | Project Description |
|---|---|---|
| | | December 2015 the LiDAR study was completed and the report was submitted by May, 2016. Current work programme includes:<br>-Prefeasibility Study<br>-Environmental & Social Impact Assessment<br>-Financing: Exploratory Drilling<br>And continued Negotiations: Power Purchase Agreement (PPA), Geothermal Development Agreement (GDA) & Geothermal right transfer agreement (GRTA). |

#### 6.3.2.3 Contributions from Annex II Parties and other multilateral and bilateral programmes and activities

Table 6.12 provides a list of adaptation projects that have been implemented through either bilateral programmes or a multilateral institution. Table 6.13 provides a list of mitigation projects that have been implemented through either bilateral programmes or a multilateral institution.

**Table 6.12: Adaptation projects financed by Annex II Parties and other multilateral and bilateral programmes and activities**

| PROJECT SUMMARY DATA | PURPOSE |
|---|---|
| **Name:** Pilot Programme for Climate Resilience (PPCR)<br>**Duration: 2008- ongoing**<br>**Level:** Global (selected countries)<br>**Agency:** Climate Investment Funds (CIF)/World Bank (WB)/Inter-American Development Bank (IADB)/Caribbean Development Bank (CDB)<br>**Funding:** USD 12 M in Grant and 15 M in concessional financing | To pilot and demonstrate ways in which climate risk and resilience may be integrated into core development planning and implementation. PPCR provides incentives for scaled-up action and initiates transformational change. This started off as PPCR and was eventually blended with DVRP to assist with administrative efficiency. |
| **Name:** Pilot Programme for Climate Resilience-Disaster Vulnerability Reduction Project –PPCR-DVRP<br>**Duration:** 6 years from full implementation in 2014<br>**Level:** Global<br>**Agency:** World Bank, CIF, PCU-MOF, SDED-MSDEST, MIPSAT<br>**Funding:** US $ 68 million<br>• US$ 14 million IBRD loan<br>• US $15 million IDA credit<br>• US$ 12 million, CIF, PPCR grant<br>• US$ 5 million, SCF, PPCR concessional financing | To measurably reduce vulnerability to natural hazards and climate change through<br>• Adaptation Facilitation,<br>• Adaptation Implementation,<br>• Adaptation Financing |
| **Name:** Supporting Climate Resilient Investments in the Agricultural Sector in Saint. Lucia.<br>**Duration:**<br>**Level:** National<br>**Agency:** IDB and Laborie Credit Union under PPCR Private Sector Set Aside<br>**Funding**: | |
| **Name:** EU-CCCCC Global Climate Change Alliance-GCCA<br>**Duration:** 2012-2015<br>**Level:** Regional<br>**Agency:** CCCCC, SDED-MSDEST<br>**Funding:** Up to US$726,000 | To conduct the necessary modelling and economic analyses necessary to quantify the costs and benefits of adaptation and mitigation and pursue further adaptation and mitigation options to build the resilience of the Caribbean economies (focus on modelling, economic analyses, quantification of costs & benefits of adaptation & mitigation options) |

| PROJECT SUMMARY DATA | PURPOSE |
|---|---|
| **Name:** EU-Global Climate Change Alliance-GCCA Organisation of Eastern Caribbean States (OECS)<br>**Duration:** November 2013- 2018<br>**Level:** Regional<br>**Agency:** OECS, Physical Development and SDED-MSDEST<br>**Funding:** 10.6 M Euros for 9 OECS member states | Project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) , to build Climate Change resilience through:<br>• Effective and sustainable land management frameworks and practices;<br>• Specific physical adaptation projects |
| **Name:** Japan-Caribbean Climate Change Partnership JCCCP<br>**Duration:** 2015 – 2017 (expected to be extended)<br>**Level:** Regional<br>**Agency:** UNDP<br>**Funding:**US$15,000,000 | Aim: To ensure that barriers to the implementation of climate-resilient technologies are addressed and overcome in a participatory and efficient manner.<br>Result: Concrete mitigation and adaption will be implemented on the ground, in line with the countries' long-term strategies |
| **Name:** NAP enhanced<br>**Duration:** (by end of 2017)<br>**Level:**<br>**Agency:** NAP Global Network<br>**Funding**: up to USD 103, 380 | In parallel with JCCCP- NAP initiative |
| **Name**: CCAP-Climate Change Adaptation Programme<br>**Duration:** 4 years up to 2020<br>**Level:** Regional<br>**Agency:** 5Cs and USAID<br>**Funding**: Up to 26.5 M for 10 countries in the Eastern and southern Caribbean | To reduce risks to human and natural assets resulting from climate change vulnerability |
| **Name:** Global Islands' Vulnerability Research, Adaptation, Policy and Development (GIVRAPD)<br>**Duration:** 2012-2013<br>**Level:** Global<br>**Agency:** CARIBSAVE<br>**Funding**: GBP 490,000 | To understand the multi□scale socioeconomic, governance and environmental conditions that shape vulnerability and capacity to adapt to climate change within and between small and medium□sized coastal communities. |
| **Name:** Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC)<br>**Duration:** 18 months, from Aug 2012 - 2014<br>**Level:** Sub-regional, with demonstration projects<br>**Agency:** OECS Secretariat, USAID, WASCO, SDED-MSDEST<br>**Funding:** US$288,548.10 for Saint Lucia demonstration project | The sub-regional project comprised the following components:<br>1. Improvements to institutional and operational policy and regulatory frameworks;<br>2. Demonstration activities related to freshwater and coastal management to build resilience of the agriculture and tourism sectors;<br>3. Climate change information strengthening through development of a regional marine monitoring and forecasting system supported by a permanent marine monitoring network and human capacity strengthening;<br>4. Building awareness in the public on issues related to climate change and improving national capacities for climate change adaptation<br>Saint Lucia Demonstration Project: Enhancing Management of the Water Network and Capacity in the use of GIS Related Technologies to Build Resilience and Reduce Vulnerability to Climate Change and Climate Variability. |
| **Name:** Climate Change Adaptation Planning in Latin America and Caribbean Cities<br>**Duration:** 2012-<br>**Level:** Regional<br>**Scope**: LAC Region | **Climate Change & Cities**:<br>To inform adaptation planning and policy-making at the city level. This will be done by incorporating local and international technical knowledge, tools and expertise into |

| PROJECT SUMMARY DATA | PURPOSE |
|---|---|
| **Agency:** World Bank<br>**Funding:** | existing planning structures to better respond to the adverse effects of climate change. |
| **Name:** Building Capacity in the Public Sector to Facilitate Evidenced- Based Decision Making Towards the Reduction of Climate Change and Environmental Risks<br>**Duration:** 4 -6 months, 2014<br>**Level:**<br>**Agency:** CDB, SDED-MSDEST<br>**Funding:** US$92,262 | To build capacity in the public sector to facilitate evidenced-based decision making towards the reduction of climate change and environmental risks. |
| **Name:** Review of the Economics of Climate Change Phase 2 (RECC 2)<br>**Duration:** 2010-2012<br>**Level:**<br>**Agency:** UN ECLAC/DFID<br>**Funding: Technical Assistance** | To assess the likely economic impacts of climate change on key sectors of the Caribbean economies, to stimulate governments, regional institutions and private sector actions to develop and implement policies to mitigate and adapt to climate change |
| **Name:** Ecosystem based adaptation (EBA) in the Caribbean<br>**Duration:**<br>**Level:** Regional<br>**Agency:** KfW, CCCCC<br>**Funding: Technical Assistance** | Objective: To strengthen ecosystems (particularly coral reefs, sea grass beds and mangroves) in their function to contribute to reduce climate related risks in the coastal zone of Caribbean States |
| **Name:** Economics of Climate Adaptation (ECA) in the Caribbean<br>**Duration:** 2010 - 2011<br>**Level:** Regional<br>**Agency:** Caribbean Catastrophe Risk Facility (CCRIF)/ SwissRE / Mc. Kinsey & Co<br>**Funding**: **Technical Assistance** | Developing a quantitative basis to assist decision makers in defining and developing sound adaptation strategies and business cases which can be incorporated into national development plans and claims for adaptation assistance. |
| **Name:** Enhanced Capacities for Disaster Risk Mitigation in Agriculture, Fisheries and Forestry<br>**Duration:** 2010 - 2011<br>**Level:** National<br>**Agency:** FAO<br>**Funding**: **Technical Assistance** | Improved service delivery capacities of agriculture, fishery and forestry line departments, and enhanced know how of farmers and fishermen organisations to implement natural hazard risk mitigation and preparedness measures, with particular emphasis on primary and secondary impacts of hurricanes and tropical storms |

### Table 6.13: Energy projects financed by Annex II Parties and other multilateral and bilateral programmes and activities

| Type of Project | Project Name | Project Description |
|---|---|---|
| Energy Efficiency in Buildings | Lighting Retrofit of the General Post Office- Caribbean Energy Efficiency Lighting Project<br>**Agency:** SIDSDOCK funds, administered by United Nations Development Programme | Three hundred and sixty (360) fluorescent bulbs were replaced with LED bulbs in the General Post Office in December, 2015. There has been an average reduction of at least 27% in the energy consumption of the building |
| | Lighting Retrofit of the High Court<br>**Agency:** Caribbean Energy Efficiency Lighting Project | Three hundred and sixty-two bulbs (362) were replaced with LED bulbs at the High Court in November, 2015. Unfortunately the building remained unoccupied throughout 2016. |
| | Lighting Retrofit of Infrastructure | One thousand, two hundred and nine LED bulbs have been delivered to Department of Infrastructure for the retrofit of 2nd Floor and Ground Floor in July, 2016. |

| Type of Project | Project Name | Project Description |
|---|---|---|
| | **Agency:** GOSL/Sustainable Energy/Taiwanese Government - From Concept to Action<br>**Funding:** US$49,250. | |
| | Lighting Retrofit of National Emergency Management Organisation (NEMO)<br>**Agency:** GOSL/Sustainable Energy/Taiwanese Government: From Concept to Action | In May 2015, Two hundred and seventy (270) bulbs were retrofitted with LED bulbs at the NEMO building. There has been average reduction of 15% in the energy consumption of the building due to lighting. |
| | Upgrade and Retrofit of Greaham Louisy Administrative Building (GLAB)<br>**Agency:** GOSL/Sustainable Energy: From Concept to Action<br>**Funding:** US$647,585.02. | In June 2016, the Government of Saint Lucia initiated the upgrade and retrofit of the GLAB. This includes a complete rewiring of the electrical system at GLAB to meet electrical inspection requirements of the Department of Infrastructure and the redesign and retrofit the present lighting system to ensure adequate lighting levels for each work area.<br>Project is currently ongoing and expected to be completed in June 2017. |
| Street Lighting | Street-lighting Pilot Project<br>**Agency:** GOSL<br>**Funding:** US$36,805 | May 2013, Government of Saint Lucia funded the retrofit of 48 250W HPS street lights with 120W LED street lights along the entire stretch of Jeremie Street and along the John Compton Highway up to a point close to North West. |
| | CDB project<br>**Agency:** GOSL/CDB<br>**Funding**:USD12.2M<br><br>***Policy decision pending*** | The Ministry of Finance has sort and received approval from the CDB for the full retrofit of approximately twenty one thousand streets lights. This project includes the full retrofit to LED of all the street lights. This retrofit is expected to be completed over a three year period with an expected savings of approximately 5,300MWh per year from the date of completion |
| Biogas Digesters | Biogas Digesters component, Sustainable Energy From Concept to Action<br>**Agency:** GOSL/Taiwanese Government | National Steering Committee for Biogas Digesters initiative was organized and work programme completed.<br>Five biogas digesters have been repaired at Bordelais, Laborie, Cul De Sac, Choiseul and the Sir Arthur Lewis Community College Farm.<br>CARPHA has completed the water quality analysis on the Biogas digester at Bordelais and submitted the report to the Division on May 20, 2016. The findings from this analysis have revealed that further treatment of the biogas digester effluent will be required in order to increase the water quality to an acceptable level.<br>The project is currently at the stage of finalizing the revised work plan, and seeking approval for the procurement of consultancy services, works and items for the completion of this project. |
| Solar Drying | Solar Drying component, Sustainable Energy From Concept to Action<br>**Agency**: GOSL/Taiwanese Government<br>**Funding**: US$19,000 | The Ministry designed and implemented an initiative aimed at promoting the use of solar energy in the preservation and processing of agricultural produce and products. The Ministry contracted the services of Mr. Henry Lubin to conduct two (2) training sessions in solar dryer construction and the techniques of solar drying, one in the north and one in the south respectively from November to December 2014. Over |

| Type of Project | Project Name | Project Description |
|---|---|---|
| | | 50 persons were trained as part of this initiative. In September 2015, five solar dryers were delivered to persons around the island who completed the training and qualified after an assessment was completed. |
| Roof - Top Solar Photovoltaic (PV) Systems | NEMO PV System<br>**Agency**: GOSL/Taiwanese Government<br>**Funding**: | The solar photovoltaic component of the Sustainable Energy: from Concept to Action. In February 2016, a 25KW Solar PV System was connected to grid for the NEMO building. With this system installed along with the lighting retrofit, NEMO has realized more than 50% reduction in energy consumption from the main electricity grid. |
| | National Mental Wellness Centre (NMWC)<br>**Agency:** Sustainable Energy: From Concept to Action GOSL/Taiwanese Government<br>**Funding:** US$187,174.21. | The solar photovoltaic component of the Sustainable Energy: from Concept to Action. In November 2015, a 25kW Solar PV System was connected to the grid for the NMWC. With this system installed NMWC has realized an average reduction in energy consumption from the main electricity grid of at least 5%. |
| | Government House - Solar PV System - Solar Heads of State<br>**Agency:** Solar Head of State (SHOS) initiative<br>**Funding**: | Government House received a 5.4kW Solar PV System through this project. Final electrical installations of the system is still ongoing and the system has not yet been grid-connected. |
| | Owen King EU National Hospital - Solar PV Demonstration and Upscale Project<br>**Agency:** SIDSDOCK funds administered through the World Bank<br>**Funding**:US$600,000 | This project is expected to install approximately 200kW Solar PV System at the Owen King EU National Hospital. Project manager post was advertised by the end of 2016. |
| | Green Schools NAMA Development & Green Architecture pilot<br>**Agency:** Japan-Caribbean Climate Change Partnership JCCCP/ GOSL –<br>**Funding: US$452,570** | Aim: To ensure that barriers to the implementation of climate-resilient technologies are addressed and overcome in a participatory and efficient manner.<br>Result: Concrete mitigation and adaption will be implemented on the ground, in line with the countries' long-term strategies |
| Solar Farm | 3MW Solar Farm<br>**Agency:** Carbon War Room-LUCELEC | The Government partnered with Carbon War Room and LUCELEC to develop and publish a Request for Proposals (RFP) for a 3 MW solar farm in the south of the island. Negotiations with the winning bidder were ongoing at the time of writing this report. |
| Wind Energy | 12MW Wind Farm development<br>**Agency:** Wind Tex Inc./ LUCELEC/GOSL<br><br>**Policy decision pending.** | The Department has continued to participate in discussions between a potential developer, Wind Tex Inc, and LUCELEC for the development of a 12MW Wind Farm. The Test tower has been up and over 1 year of wind data collected. Agreement to lease private lands has been completed. Government needs to facilitate access to the lands required for the Project and acquire remaining lands. Environmental Impact Assessment |

| Type of Project | Project Name | Project Description |
|---|---|---|
| | ***Policy decision pending*** | is ongoing. Community meeting was held May 18, 2016 in the community of Dennery. |
| Transport Energy Efficiency | E-mobility Workshop<br>**Agency:** Energy Programme of the Caribbean Community (CARICOM) Secretariat, through the Renewable Energy and Energy Efficiency Technical Assistance (REETA) Project<br>**Funding:** | Following a request made at the National Energy Development Partner Forum held in Saint Lucia in June 2014, the Energy Programme of the Caribbean Community (CARICOM) Secretariat, through the Renewable Energy and Energy Efficiency Technical Assistance (REETA) Project is working to develop a strategy for promoting electric mobility on the island.<br>A feasibility consultative Workshop was held 12-16 January 2015. A key output of the Workshop was the agreement of participants to pursue the development of an electric mobility strategy for Saint Lucia, which is anticipated to achieve, inter alia, 1) Improved efficiency and affordability of public transport; and 2) Targeted integration of sustainable transport as part of an eco-tourism product. |
| | Roadmap for Government Fleet Transition to Electric Vehicles<br>**Agency:** United Nations Environment Programme (UNEP)<br>**Funding:** | Following a request by the Division a study was undertaken by UNEP to develop a road map for Government Fleet transition into Electric Vehicles. The roadmap outlined a path to undertake this transition by conducting the following assessments.<br>Fleet transition plan Readiness phase 1 (Objectives and Goals+ Vehicle eligibility criteria)<br>Fleet transition plan Readiness phase 2 (Fleet assessment)<br>Fleet transition plan Readiness phase 3 (Governance assessment+ Infrastructure assessment ) |
| Regulatory reform | Regulation Reform<br>**Agency:** REDiv, Public Utilities Unit and the Eastern Caribbean Energy Regulatory Authority (ECERA)<br>**Funding:** | The Division is working closely with the Public Utilities Unit and the Eastern Caribbean Energy Regulatory Authority (ECERA) on a number of initiatives, including drafting of the new Electricity Supply Services Bill (ESSB) which is ongoing, Drafting of Energy Efficiency Bill and Revision of Grid Code. A number of public consultations were held for each of the above mentioned bills. Also the revision of the National Utilities Regulatory Commission (NURC) Bill which was NURC Act No. 3 of 2016 |
| Energy Awareness | Energy Awareness Month<br>**Agency:** REDiv<br>**Funding:** | The annual CARICOM Energy Month was held in November 2015 and 2016. This is an initiative aimed at providing information and building broad awareness for sustainable energy. These activities included school visits, Private sector energy fairs, carpooling initiatives, photo competitions, electro-mobility road show and others. |

Other supporting activities in the area of mitigation include:

1. National Energy Policy
2. National Energy Transition Strategy (NETS)
3. Small PV Net-metering
4. Existing Incentives for Renewable Energy Technologies
5. Transportation Sector Studies
6. National Energy Balance
7. Bio-Ethanol (from banana)

## 6.4 PROPOSED PROJECTS FOR FINANCING

### 6.4.1 Integrated Ecosystem Management and Restoration of Forests on the South East Coast of St Lucia (GEF 6)

The PIF for the Integrated Ecosystem Management and Restoration of Forests on the South East Coast of St Lucia under GEF 6 has been approved. GEF project financing is estimated to be US$4,428,145, and co-financing is US$25,800,000. Proposed outcomes and outputs are summarized in Table 6.14 (GOSL, 2016).

**Table 6.14: Proposed Outcomes and Outputs of the Project *Integrated Ecosystem Management and Restoration of Forests on the South East Coast of St Lucia* (GEF 6)**

| Outcome | Output |
|---|---|
| 1. Increased government, civil society, and private sector capacity for sustainable development and ecosystem management. | 1.1 A Monitoring and information system is in place to support sustainable ecosystem management and scientific capacity of stakeholders |
| | 1.2 Management effectiveness increased and two new protected areas are designated along with relevant connecting corridors, and protected species are officially recognized in legal documents (est. 4,000 hectares) |
| | 1.3 At least 1 Public-private partnership or financing mechanism promoting both economic development and ecosystem protection will be established. |
| 2. Restored/rehabilitated productive landscapes | 2.1 2500 ha have been reforested in degraded areas, agricultural areas and headwaters resulting in (682,850 tons of CO2-eq would be mitigated over 20 years, or 34,143 tons of CO2-eq per year from reforestation of 2,500 ha of degraded land) |
| | 2.2- Sea grass beds, reefs, mangroves and productive coastal systems have been protected and rehabilitated (500 ha), carbon benefits to be calculated at project inception. |
| | 2.3- Erosion controlled in areas exhibiting significant soil degradation and siltation |
| 3. Sustainable socio-economic development pathways pursued in targeted communities; | 3.1- Vulnerable communities have access to renewable energies to improve livelihoods, 9,000 tons of CO2 over 10 years based on selection of solar for pilots. |
| | 3.2- Guidelines for eco-touristic development adopted |
| | 3.3- 5,000 ha are under sustainable agro-forestry practices (177,146 tons of CO2-eq would be mitigated over 20 years, or 8,857 tons of CO2-eq per year from the operated land use change, from conventional agriculture to agroforestry;<br>and 589,875 tons of CO2-eq would be mitigated over 20 years, or 29,494 tons of CO2-eq per year from practicing agroforestry) |
| | 3.4- Additional income generated from sustainable alternative livelihoods |

### 6.4.2 Plans for Energy Projects

Planned energy projects for 2017-2018 are provided in Table 6.15 (REDiv, 2017).

**Table 6.15: New Planned Energy Projects for 2017-2018**

| Type of Project | Source of Support | Planned Activities |
|---|---|---|
| Energy Efficiency in Buildings | Sustainable Energy - From Concept to Action | Retrofits of at least three buildings. Buildings to be retrofitted are still being finalised. |
| | Green Architecture Pilot Project - Japan Caribbean Climate Change Project | Project to design buildings (residential and school) and train persons in green architecture designs with LEED certification. |
| | Japan-Caribbean Climate Change Partnership JCCCP<br>design and development of the NAMA to **increase renewable energy and energy efficiency solutions and technologies** in **schools**<br>Green Architecture Promotion Pilot (GAPP) Project | JCCCP Aim: To ensure that barriers to the implementation of climate-resilient technologies are addressed and overcome in a participatory and efficient manner.<br>JCCCP Result: Concrete mitigation and adaption will be implemented on the ground, in line with the countries' long-term strategies.<br>Project to design buildings (residential and school) and train persons in green architecture designs with LEED certification. |
| Roof-Top Solar PV Systems | Sustainable Energy - From Concept to Action | Five buildings have been assessed for rooftop Solar PV installations. These five buildings have met the criteria set out by the Division for installations.<br>Gros-Islet Secondary School - 25kW,<br>Sir Arthur Lewis Community College - TR Theobalds Building - 25KW,<br>Soufriere ICT Centre - 10kW,<br>Babonneau Police Station -7kW,<br>Public Service Training Institute - 5kW |
| Solar Powered Electric Vehicle Charging Facility | Infrastructure Solar Carport<br>Italy Government<br>Project cost US$486,675.00 | A 50kW Solar carport has been approved by the Italian Government which includes three electric vehicles, solar charging stations for electric vehicles.<br>Tender documents are being drafted for key deliverables. |
| Public Awareness | Astana Energy-Expo 2017 | An exposition that attract over 130 million visitors. The Division hopes to market the island and attract investors into the energy sector of Saint Lucia |
| | Energy Awareness Month activity | The annual CARICOM Energy Month is held during November. This is an initiative aimed at providing information and building broad awareness for sustainable energy and energy efficiency. There is sustained information dissemination of national energy development. |
| Energy Efficiency in the Transport sector | Government Fleet Transition Strategy | Fleet transition plan Readiness phase 1 (Objectives and Goals+ Vehicle eligibility criteria) Fleet transition plan Readiness |

| Type of Project | Source of Support | Planned Activities |
|---|---|---|
| | | phase 2 (Fleet assessment) Fleet transition plan Readiness phase 3 (Governance assessment+ Infrastructure assessment). |

### 6.4.3 Other recommendations for projects

Other recommendations for projects have been made through work such as:

6 V&A assessments (GOSL, 2016);
7 Mitigation assessment (GOSL, 2014);
8 Climate Finance Readiness Mission to Saint Lucia (Charles, 2014);
9 CCAP-5Cs-USAID (ten project concepts were received under this project, to be reviewed for possible implementation); and
10 The SPCR project identification process (concepts can be found for projects that have not yet been realized, in Appendix 13 of the SPCR).

These many recommendations are not repeated here. Charles (2014) noted that the range of possible initiatives identified pointed to the need for a national strategy and coordinating mechanism to maintain coherence and realize synergies. He identified a need for strengthening the institutional framework through the establishment of a Climate Planning and Response Unit to lead the national implementation process.

There is a need for the development and implementation of a targeted climate change awareness programme focused on the respective economic sectors. Such a program would introduce the personnel within that sector to the climate sensitivity of the sector and the potential impacts of climate change to the sector. This is already initiated through the current PPCR communication activities and can be further built upon.

Charles and his team (2014) proposed a Climate Finance Readiness Action Plan focused on the following areas:

1. Strategic Framework for climate change programming;
2. Integration of climate change into national development programming;
3. Formalisation of the National Designated Authority (NDA);
4. Establishment and accreditation of the National Implementing Entity (NIE);
5. Development of climate change investment projects for funding; and
6. Capacity building for climate change (Charles, 2016).

The V&A assessment (GOSL, 2016) recommended that, for adaptation measures for vulnerable groups, looking at the future (2040-2069 and 2081-2100), the Government of Saint Lucia should vigorously pursue funding from international bi-lateral and multi-lateral donor agencies (Adaptation Fund, Green Climate Fund) so as to design and implement further adaptation measures that would lessen the burden of the adverse effects of future climate change and climate-driven sea level rise, including, but not limited to:

1. Sensitization and education with respect to the potential impacts of climate change on their communities;
2. The strict adherence to the Government-recommended building codes so as to secure their households against future adverse climate events;

3. The promotion of the practice of proper hygiene, water quality, proper toilets, and an environment that minimizes the proliferation of vectors (mosquitoes, rodents) that cause diseases;
4. Agricultural diversification and modernization so as to avoid over dependence with the negative consequences as with the banana industry;
5. The development of a safety net of income in times of need with a view to protect the groups at risk;
6. Creation of employment through Government-assisted work programs and the promotion of entrepreneurial initiatives (handicrafts…) that may find a market in the tourism industry; and
7. Local government reform aimed at encouraging fuller participation and involvement of people in their communities.

### 6.4.4 Civil society engagement

Article 6, paragraph 8 of the Paris agreement encourages parties to adopt approaches that among others, "enhance public and private sector participation in the implementation of nationally determined contribution" and Article 7, paragraph 5, indicates that Parties acknowledge that "adaptation action should follow a country-driven, gender responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems".
It must be ensured that civil society will continue to be genuinely engaged in climate action.

## 6.5 INFORMATION ON IMPLEMENTATION OF ADAPTATION MEASURES

### 6.5.1 Pilot projects

A number of opportunities for implementation of adaptation measures have been or will soon be realized through pilot projects undertaken or planned through projects underway, including the following. Most of these are already described in previous sections.

a. Enhanced Capacities for Disaster Risk Management in Agriculture, Fisheries and Forestry (this sought to test demonstration activities involving farmers, fishers and other groups vulnerable to hydro-meteorological hazards; four communities were selected as pilot sites for livestock initiatives, and two for fisheries initiatives (Edmund, 2010));
b. The Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean;
c. DVRP SPCR;
d. GEF Small Grants Programme;
e. Japan-Caribbean Climate Change Partnership JCCCP; and
f. Iyanola □ Natural Resource Management of the NE Coast.

The GEF Small Grants Projects office has identified building awareness of the potential of pilot projects supported, and their replication and upscaling, as challenges.

### 6.5.2 Barriers to implementation

Barriers to implementation of adaptation measures encompass those that have been identified in relation to the transfer of ESTs in the Saint Lucian context identified as far back as the 2004 TNA report (GOSL, 2004), that still prevail today:

7. Costs of purchase and maintenance of technologies;
8. Low financial feasibility at the small scale required;
9. Limited institutional capacities to implement and sustain initiatives;

10. Costs of the supporting institutional structures (regulations, personnel, equipment)
11. Inadequate awareness of climate change impacts and of available technologies; and
12. Limited access to financial resources, especially in low income communities.

Charles (2014) found that there is no national strategic plan to guide climate change programming, and identified some of the overarching barriers and impediments to effect climate change programming as follows:

1. Limited availability of financial resources;
2. Inadequate human resources. This includes inadequate availability of specialist skilled competencies;
3. Loss of institutional / sector memory with changes in the human resource composition;
4. Inadequate availability and accessibility of data to facilitate information for management decisions;
5. Inadequate emphasis on research in all sectors;
6. Ineffective high level co-ordination of major development sectors/ issues such as development control and land management, water sector development, strategic tourism development;
7. Inadequate infrastructure development to meet the development needs of the country;
8. Ineffective public sensitization and public education programmes to educate the populace on key issues as it relates to climate change issues and its nexus with national development.
9. Inadequate institutional co-ordination for climate change programming; and
10. Lack of an integrated development planning approach to sector development (Ibid.).

Barriers to implementation of measures in the energy sector were identified by GOSL (2015) as provided in Tables 6.16 through 6.25.

**Table 6.16: Main Barriers to Implementation of measures[30] (energy efficient buildings) to reduce emissions** (GOSL, 2015).

| Barriers | Proposed Interventions and Comments |
|---|---|
| Political will to enforce building code standards | Education of decision makers on the benefits of new strengthened code will help to ensure that there is a willingness to enforce the building code standards |
| Resistance of builders to incorporate new building code requirements and recommendations | Capacity building for builders so that they understand the requirements and the overall benefits achieved. |
| Government buildings are primarily held privately and therefore more difficult to negotiate and capitalize energy efficiency actions as there are split incentives | The government will seek to issue RFPs that provide incentive to all parties; ESCOs that will deliver the program, building owners and government tenants. Savings from energy efficiency measures are expected to be sufficient to ensure compensation to all parties over the long-term. |
| Availability of local ESCOs to deliver programme | Local ESCOs operate in Saint Lucia and other ESCOs in the Caribbean have declared interest in the project. |

[30] Enact building code, support governance; Capacity training for building code; Enforcement of building code

**Table 6.17: Main Barriers to Implementation[31] of energy efficiency appliances** (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Consumer behavior and resistance to spending more upfront capital for efficient appliances | Education of decision makers on the benefits of new strengthened code will help to ensure that there is a willingness to enforce the building code standards |
| Capital costs for street lighting, particularly in maintenance budgets where replacement with incandescent occurs when failure detected | Increasing maintenance budget as proposed will help to address this issue. |
| Technology suitability / reliability for street lighting | Testing of LED options is underway and will help to identify suitable and reliable street lighting options. |
| Political will | Education of decision makers on the benefits of new appliance energy efficiency standards will help to ensure that there is a willingness to enforce the standards. Rolling out of mandatory labelling before energy efficiency standards will introduce consumers |

**Table 6.18: Main Barriers to Implementation of 35% renewable energy target[32]** (GOSL, 2015)

| **Barriers** | **Proposed Interventions and Comments** |
|---|---|
| Grid stability / infrastructure | A study to determine amount of variable renewable energy that can be added to the grid while allowing for grid stability is proposed to be carried out. |
| Securing capital Investment, address misconceptions in the banking sector leading to financing barriers (need to de-risk investment through education). | Consultations with lenders will be an important part of the process |
| Acquiring technical capacity for installations, operation and maintenance | Certification and training for installers to ensure efficient deployment is proposed. |
| Governance needs to be improved, notably better coordination between Ministries. Better education on technical issues and opportunities. | A program to coordinate ministries and address overlapping jurisdictions is proposed. |
| Some options may not reduce electricity costs, notably geothermal. | Alternative renewable mitigation options are assessed and the most cost effective and expedient options can be selected with appropriate feed-in tariffs and tax conditions for renewable technologies, equipment and installation. |
| Implementation issues associated with slow timelines related to supply chains | Successful implementation by 2020 will rely on ample time available for the tendering process. |

[31] Complete labeling program, improve governance; Public Awareness Campaign; Street Lighting Project; Prioritize and enact new efficiency standards

[32] Create necessary regulatory environment to enable large scale renewable integration; Capacity Building; Connect 21 MW of renewable power

**Table 6.19: Main Barriers to Implementation Improvements to Grid Distribution and Transmission Efficiency**[33] (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Securing required capital investment | Government could provide tax rebates or other financial incentives to encourage LUCELEC to make necessary investments as proposed. |
| Political will to implement change | New Utilities Regulatory Commission will have authority and influence to determine appropriate targets for system losses |

**Table 6.20: Main Barriers to Implementation Transport (efficient vehicles)**[34] (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| High incremental capital costs for new efficient vehicles | Some proposed measures to encourage fuel efficiency (i.e., tax shifting, financial rebates) would address higher capital costs |
| Consumer preferences for existing inefficient vehicles | Vehicle labelling program and public awareness campaigns would raise awareness among consumers of benefits |
| Physical infrastructure for electric vehicles | The intervention does not rely on electric vehicles to achieve fuel efficiency targets. Infrastructure investment would only make sense if significant penetration was expected and may be financed by vehicle producers. |
| Political will, reflecting cultural barriers. | Supporting governance and demonstrating benefits of programs to policy makers and the public will help to reduce this barrier. |
| Governance challenges, classifying cars by fuel type. | The proposed intervention provides for governance support and capacity building. |

**Table 6.21: Main Barriers to Implementation Transport (Improve and Expand Public Transit)**[35] (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| High capital costs for public transit infrastructure (vehicles, stations, stops, priority lanes) | Some proposed measures to encourage fuel efficiency (i.e., tax shifting, financial rebates) would address higher capital costs |
| Consumer preferences for personal vehicles | Promotion of public transit and benefits and adoption of new services that provide comfort and convenience will encourage adopters |
| Resistance to change from existing mini-bus drivers that may impact revenues, costs. | The cohesive strategy developed should consider potential impacts of plan on existing mini-bus drivers and should seek to limit negative impacts on this group. |
| Low standards of service given range of private owner/operators (reliability etc.). | The cohesive strategy developed should account for this barrier and provide the necessary support or training to ensure a high level of service |

[33] Negotiate new targets with LUCELEC for system losses; Provide appropriate incentives for capital investment in grid efficiency;

[34] Taxation/subsidies to encourage efficient vehicles; Improve and Expand Public Transit; Mandatory efficiency standards; Improve traffic management; Vehicle Maintenance Programs; Road Charges; Bio-ethanol; Ferry Transport Passenger; Ferry Transport Freight

[35] Develop regional and national plans for public transit system (cohesive transit strategy); Implement appropriate measures to increase efficiency of public transit; Promote public transit

Barriers to implementation of measures in Agriculture, Land-Use, Land-Use Change and Forestry Mitigation Actions[36] are tabulated in Table 5.12 below.

**Table 6.22: Main Barriers to Implementation of Sustainable Agroforestry**[37] (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Reluctance of farmers to change practices and adopt new systems (risk aversion) | Capacity building is proposed to enhance the skills and knowledge of farmers related to agroforestry and also to demonstrate the productivity and profitability of agroforestry before it is implemented. |
| Agroforestry practices can require additional labour that is expensive | The proposed agroforestry program should identify labour requirements and costs |
| Access to market infrastructure can inhibit farmers from exploiting benefits of fruits, nuts and timber generated by trees | The government should undertake studies to determine what market infrastructure is available or required. |
| Initial capital investment in trees and delay before income is available | For a number of years farmers may not have substantial yields and returns. The proposed agroforestry program should include low-cost loans or grants to ensure viability of farms during this transition. |

**Table 6.23: Main Barriers to Implementation Forestry Management and Reforestation**[38](GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Impact on current users (charcoal producers, timber producers, farmers) | Current users that remove wood from the forest reserve and other protected forests for charcoal production, timber production or firewood may be doing so illegally; however, they because this is a long standing practice restricting them from doing so will have negative impacts on their livelihoods. The proposed intervention should seek ways to provide income in other ways to these users. |
| Programme costs for ongoing management and protection are substantial, lack of capacity to monitor | Increasing the level of enforcement as proposed will require long-term funding. Climate financing may be one way to secure these funds. |
| Private land ownership | The proposal will require that agreements between regulators and private land-owners to ensure protection. |
| Weak governance structures, overlapping jurisdictions | The ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development must provide an overall governing structure for all local governments that are impacted under the plan. |

[36] Sustainable Agroforestry; Reforestation; Watershed and Flood Management; Biogas Digesters; National Land Use Policy; Carbon Storage in Soil; Solar Dryers

[37] Capacity building for farmers, extension services; Implementation of agroforestry projects, improve governance

[38] Reinforce IYANOLA Project; Development and implementation of national forest strategy based on regional plans; Enforcement and Public Awareness of zoning and forestry regulations

Barriers to implementation of measures in waste[39] are tabulated in Table 5.14 below.

**Table 6.24: Main Barriers to Implementation Water Distribution / Network Efficiency**[40](GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Capital investment for replacement and repair of existing infrastructure | WASCO has been operating at a deficit for many years, and does not have available capital or financing to address efficiency and water system losses. It is likely that funding will need to come from climate finance or other sources for this mitigation action to be fully implemented. |

**Table 6.25: Main Barriers to Implementation HFC Phase-Out**[41] (GOSL, 2015)

| Barriers | Proposed Interventions and Comments |
|---|---|
| Availability of alternatives | A clear identification of alternatives available to consumers needs to be conducted. |
| Cost effectiveness and performance of alternatives | A study of cost impacts on consumers needs to be conducted |
| Difficulty in regulating HFCs contained in imported air-conditioning and refrigeration products | Better tracking of HFCs through customs by providing improved training and better licensing of agents that handle HFC refrigerants is proposed. |
| Stakeholder acceptance | The proposed public awareness campaign and training for technicians can help to address stakeholder acceptance. |

## 6.6 TECHNOLOGY TRANSFER

There has been progress in meeting the needs identified in the previous technology needs assessment (of 2004), but there is still much work to be done. Support in the transfer of technologies and associated capacity building has been provided through the projects listed below. These have all been described in detail earlier in this report (see Section 1.12).

1. Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project
2. The Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean
3. Strategic Program for Climate Resilience (SPCR)
4. Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development
5. Japan-Caribbean Climate Change Partnership JCCCP
6. Hydro-meteorological/agrometeorological station installations
7. CIMH transitioning to a WMO Regional Climate Centre
8. Pilot Programme for Climate Resilience (PPCR) Caribbean regional track
9. Coastal Protection for Climate Change Adaptation project

[39] Water distribution / Network Efficiency; HFCs phase-out; Waste to Energy; Effective Systems for Liquid Waste Treatment; Waste Management (3Rs)
[40] Implement pump replacement and maintenance and repair of valves, appurtenances and pipes
[41] Improved Management and Repair Program, improved governance; HFC phase-out, governance

10. Caribbean Regional Fund for Wastewater Management Project (CReW)
11. Project for the Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States (ACS)

In the energy sector, some technology transfer has occurred in the following areas:

1. Caribbean Energy Efficiency Lighting Project - Energy Efficiency in Buildings
2. Street Lighting
3. Biogas Digesters
4. Solar Drying
5. Roof - Top Solar Photovoltaic (PV) Systems
6. Geothermal Energy
7. Solar Farm
8. Transport Energy Efficiency

### 6.6.1 Ongoing needs for technology transfer

Priority sectors to be targeted for low emissions and low vulnerability development to achieve maximum development goals and benefits for mitigation and adaptation were identified through stakeholder consultation (GOSL, 2017), and these are reproduced in Table 6.16.

**Table 6.26: Non-Exhaustive Treatment of Climate Change Impacts on Development Priorities** (Source: Climate Change Technology Needs Assessment - Saint Lucia (GOSL, 2017) Table 1 – A)

| Development Priority | Climate Change Direct Impacts | Climate Change Indirect Impact | Suggested Technology and Development Response |
|---|---|---|---|
| ***Agriculture Development*** | Emergence of exotic pest; changing $CO_2$ levels in the atmosphere changes productivity of some plants;<br>Changes in rainfall patterns affecting plant yields;<br>Loss of crops due to flood or drought. | Decline in human and animal health due to food shortage;<br>Higher cost of living due to food imports;<br>Loss of jobs. | Irrigation systems supported by rainwater harvesting;<br>Early warning systems for floods and droughts along with engineering structures to manage runoff;<br>Heat and Drought tolerant plants and animals;<br>Improve Pest and disease resistance plants and animals;<br>Forest management and monitoring;<br>Crop Research;<br>Agro Forestry;<br>Soil and water management;<br>Wind breaks and hedges. |
| ***Coastal Zone Management/ Development*** | Loss of coral reefs and coastal wetlands;<br>Changes in fisheries such as changes in migration patterns;<br>Fish species disappear;<br>Loss of coastal lands beaches and infrastructure;<br>Salt water intrusion into fresh water systems. | Decline in tourism;<br>Loss of livelihood activities affecting socio-economic wellbeing. | Wave attenuation devices and coastal engineering structures;<br>Reef and land development monitoring equipment;<br>Coastal system/ coral reef restoration /wetlands restoration. |
| ***Economic Stability*** | Frequent storms with damage exceeding national GDP; | Unemployment and economic downturn. | Risk transfer system such as catastrophic insurance;<br>Implementation of building codes. |

| Development Priority | Climate Change Direct Impacts | Climate Change Indirect Impact | Suggested Technology and Development Response |
|---|---|---|---|
| | Increasing debt to GDP ratio as government borrows to respond to climate change as well as undertake recovery efforts after storms. | | EIA requirement addressing climate change. |
| ***Energy*** | Increased temperatures demand increased cooling with high energy consumption. | Increased awareness of the need to and benefits of moving away from fossil fuels which will require that the various sectors invest in new technology. | Capacity building in Solar, Wind and Geothermal Energy;<br>Move to renewable and indigenous energy sources;<br>Use of Energy Efficient tools and Equipment;<br>Improved data collection and analysis |
| ***Forest Management*** | Forest fires during periods of drought;<br>Landslides from excess rain destroy nature sites;<br>Loss of biodiversity – plants and animal species. | Changes in cultural practices associated with specific biodiversity;<br>Decline in tourism. | Need for more robust management systems training;<br>Gene bank to protect endangered species;<br>Forest rehabilitation management and monitoring. |
| ***Fresh Water Resource*** | Change in precipitation patterns affect surface water;<br>Overuse of wells resulting in saline intrusion;<br>Increase evaporation rates;<br>Floods contaminating water sources. | Decline in health standards;<br>High cost of constructing and maintaining of water treatment plants and sewage systems. | Water conservation;<br>Improved water treatment systems and elevated storage systems;<br>Domestic rainwater harvesting systems;<br>Line loss reduction;<br>Pollution prevention and control;<br>Restoration of River Bank and Wetlands. |
| ***Health*** | Increase temperatures affecting vulnerable sectors of the population;<br>Droughts and floods affecting food security;<br>Pollution of surface water due to flooding. | Increase health care cost;<br>Increase air pollution from chemicals used in vector control;<br>Potential increase in disease vectors. | Integrated pest management;<br>Technology to improve indoor air quality –humidifiers etc.;<br>Strengthening Environmental heath capacity, promotion, and surveillance;<br>Medical Intervention;<br>Strengthening Development Controls. |
| ***Infrastructure Development*** | Need for energy efficient buildings with natural cooling;<br>High cost of resistant building material;<br>Damage to roads and bridges. | Higher cost of homes;<br>Increase pressure on foreign exchange;<br>Interruption to transport. | Greater emphasis on land use planning to guide location of facilities;<br>Manufacture of synthetic building material. |
| ***Information & Communication Technology (ICT)*** | Loss of transmission towers;<br>Hardware deterioration. | High maintenance cost. | Need for remote communication systems. |
| ***Environmental Quality*** | Damage to natural resource;<br>Loss of homes and amenities as a result of flooding;<br>Loss of biodiversity. | Loss of visitors/tourist after storms or damage to amenity sites or natural resources;<br>Land slippage in key residential areas. | Land use planning using GIS technology;<br>Stream gauges for water monitoring;<br>Improved Waste Management;<br>Vector Eradication; |

| Development Priority | Climate Change Direct Impacts | Climate Change Indirect Impact | Suggested Technology and Development Response |
|---|---|---|---|
| | | | Enhance data collection, surveillance and monitoring. |
| ***Manufacture*** | Shortage of locally available plant based raw materials impacted by higher levels of $CO_2$ in the air. | Modification of tools and methodology with decreased production in some areas. | Scale down machines; energy efficient machines;<br>Renewable Energy;<br>Emissions monitoring and reduction. |
| ***Tourism Development*** | Warmer climates further north reduce visitor arrivals;<br>Damage from tropical weather systems discourages visitors;<br>Infrastructure located near the coast highly susceptible to storm damage. | Need to invest more in site maintenance and modification to attract and maintain clients. | Improved UV monitoring devices;<br>Energy efficient cooling systems;<br>Protection of tourism Infrastructure;<br>Diversification of tourism product;<br>Impact monitoring equipment;<br>Environmental Engineering Tools and techniques.<br>Development Planning. |
| ***Disaster Management*** | Damage to infrastructure and threats to human life. | Increased storms and other environmental related disaster requires more resources and capacity to respond in a short time frame. | Building codes and the use of weather resistant building material;<br>Early Warning Systems (EWS). |

Development priorities and suggested technological responses are identified in the TNA 2017. See section 5.4.1 in this TNC for conclusions from the TNA of 2017. The 2017 TNA identified the need for an effective Information Technology (IT) system as critical to, among other things, improve stakeholder coordination. This gap should be significantly addressed through the *Increase Saint Lucia's capacity to Monitor Multilateral Environmental Agreements Implementation and Sustainable Development* project presently being implemented, as this project will formalize and sustain effective mechanisms for the exchange of both general and more specialized technical information among relevant stakeholders, and improve inter-agency collaboration and access by public and private sector interests to data for use in their development planning and decision-making.

## 6.7 CAPACITY-BUILDING NEEDS OTHER THAN THOSE IDENTIFIED

More effort is required to get the populace to understand and embrace and implement adaptation and mitigation measures. This requires an understanding of how climate change can affect every individual, and what is within the power of that individual to address. It requires the transferring of requisite information and providing people with the means to implement the desired measures. This may include the offering of incentives, reducing costs of desirable technologies, and providing more tangible support to the vulnerable within the society.

Many public officers interface with the public from day to day, and there is an opportunity to make these persons an army of climate change transformers. Climate change information is not as widespread through the public sector as it should be, despite the many efforts that have been made to date. There is need to further build knowledge within the entire public sector, and in particular, among those public officers who interface with the public routinely, to increase sensitivity of these groups to climate change, and to pass on information to their members, in a manner that will encourage application and effect change;

such as:

1. Extension Officers in agriculture and fisheries
2. Fisheries Data Collectors
3. Social Transformation Officers
4. Planning Officers and Building Officers
5. Environmental Health Officers
6. Community Nurses and Community Health Aides
7. Police Officers
8. Teachers
9. District Disaster Committees

Civil society and membership organizations should also be targeted, such as:

1. the Employers Federation
2. Saint Lucia National Trust
3. Saint Lucia Hotel and Tourism Association
4. Trade Unions

## 6.8 REFERENCES


CCCCC, 2015. Impact Assessment and National Adaptation Strategy and Action Plan to Address Climate Change in the Tourism Sector of Saint Lucia. GCCCA Intra ACP Programme.

CCRIF, 2016. CCRIF SPC Annual Report 2015-2016.

CEP/UNEP, 2014. Integrating Water, Land and Ecosystem Management in Caribbean Small Island Developing States - GEF IWEco. Downloaded from http://cep.unep.org/gef-iweco-1/gef-iweco

CEP/UNEP, 2014. GEF Projects. Downloaded from http://www.cep.unep.org/gef-projects

Charles, L., 2014. Climate Finance Readiness Mission to Saint Lucia: November 17-21, 2014

Chase, Dr. V., Murray, Dr. R, Francis, A., 2016. Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Project. Monitoring and Evaluation Report. OECS.

Cox, C., 2016. IWEco Component I – Development and implementation of integrated targeted innovative, climate-change resilient solutions appropriate for Caribbean and global. PowerPoint presentation to SIDS GEF IWEco Inception Workshop. September 20-21, 2016 Kingston, Jamaica. UNEP.

Edmund, T., 2010. Enhanced Capacities for Disaster Risk Management In Agriculture, Fisheries And Forestry – Project Tcp/Slt/3202. Inception and Technical Reports.

Murray, R, 2013. Capacity Building and Mainstreaming of Sustainable Land Management in Saint Lucia. Terminal Evaluation.

GOSL, 2016. Agricultural Policy Framework and Strategy (2016-2021). Final Draft Report.

GOSL, date unknown. Increasing Saint Lucia's Capacity to Monitor Implementation of Multilateral Environmental Agreements and Sustainable Development. Project Brief.

GOSL 2002, National Climate Change Policy and Adaptation Plan (NCCPAP)

GOSL, 2004. Climate Change Technology Needs Assessment for Saint Lucia.

GOSL, 2011. Second National Communication on Climate Change for Saint Lucia.

GOSL, 2012. Public education and awareness strategy. Saint Lucia's Strategic Programme for Climate Resilience (SPCR), under and beyond the Pilot Programme for Climate Resilience (PPCR).

GOSL, 2012. Iyanola  Natural Resource Management of the NE Coast. GEF Project Identification Form.

GOSL, 2012. Draft MOU regarding delivery of a National Environmental Education Programme.

GOSL, 2014. Public education and awareness strategy implementation plan (draft). Saint Lucia's Strategic Programme for Climate Resilience (SPCR), under and beyond the Pilot Programme for Climate Resilience (PPCR).

GOSL, 2014. Fifth National Biodiversity Report for Saint Lucia. Ministry of Sustainable Development, Energy, Science and Technology.

GOSL, 2015. Saint Lucia Country Report on the State of Biodiversity for Food and Agriculture. Ministry of Agriculture, Food Production, Fisheries, Co-Operatives and Rural Development. FAO.

GOSL, 2015. Intended Nationally Determined Contribution under the United Nations Framework Convention on Climate Change (UNFCCC).Communicated to the UNFCCC on November 17, 2015.

GOSL, 2015. Saint Lucia Mitigation Assessment Final Draft. Ministry of Sustainable development, Energy, Science and technology.

GOSL, 2015. Saint Lucia National Greenhouse Gas Inventory Report. Ministry of Sustainable development, Energy, Science and technology.

GOSL, 2016. V&A Assessment for Saint Lucia's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).

GOSL, 2016. Consultancy Services for preparation of the V&A Assessment for Saint Lucia's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC). Summary V&A Report.

GOSL, 2016. GEFTF Project Information. Integrated Ecosystem Management and Restoration of Forests on the South East Coast of St Lucia.

International Waters Learning Exchange and Resource Network, 2017. Implementing Integrated Land Water and Wastewater Management in Caribbean SIDS. Downloaded from http://iwlearn.net/iw-projects/4932

Maurice-George, N., 2017. Brief on National Communications Reporting Process in Saint Lucia.

Ministry of Agriculture, Lands, Forestry & Fisheries, 2009. Agriculture policy brief.

Ministry of Agriculture, Lands, Forestry & Fisheries, 2009. Policy Brief. National Agricultural Policy 2009 – 2015.

Ministry of Health, 2016. Draft Health Sector Policy and Strategy.

Ministry of Finance, Economic Affairs and Social Security (MOFEASS), 2012. Saint Lucia: Medium Term Development Strategy 2012 – 2016. Sectoral Action Plan. Final Draft.

Ministry for Sustainable Development, Energy, Science and Technology, 2013. Draft Strategic Plan 2013 – 2017.

OECS, 2017. The Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean. Update on CCA through SLM Policies.

REDiv, 2017. List of Energy Projects.

Saint Lucia Forests and Lands Resources Department (2015) Strategy 2015–2025. Saint Lucia Forests and Lands Resources Department, Union, Saint Lucia.

SDED PowerPoint Presentations:

1. Current Climate Change Initiatives. Inception Workshop for Third National Communication. Friday 28th November 2013.
2. Climate change Initiatives in Saint Lucia. Sustainable Development and Environment Division Ministry of Sustainable Development, Energy, Science and Technology. June 2014
3. Meeting of National Climate Change Committee (NCCC). Complementary Climate Change Initiatives. Sustainable Development & Environment Division, Ministry of Sustainable Development, Energy, Science & Technology. May 19, 2015.
4. Climate Change Initiatives Past & Present. Relevant Climate Changes Initiatives Undertaken or Planned to Date. Sustainable Development & Environment Division. Ministry of Sustainable Development, Energy, Science & Technology. March 2013.

5. Meeting of National Climate Change Committee (NCCC). Complementary Climate Change Initiatives. Sustainable Development & Environment Division, Ministry of Sustainable Development, Energy, Science & Technology. March, 2016.
6. Mainstreaming Climate Change into National development Planning, High level briefing for Permanent Secretaries/Policy Makers. Contemporary Issues: The National Context. Sustainable Development & Environment Division, Ministry of Sustainable Development, Energy, Science & Technology. April 08, 2015.

Sustainable Development and Environment Division (SDED), Ministry of Sustainable Development, Energy, Science and Technology in collaboration with the National Climate Change Committee (NCCC), 2016. PPCR Annual M&E Report (January to December, 2015).

Torbert, Roy, Kaitlyn Bunker, Stephen Doig, Justin Locke, Stephen Mushegan, Siana Teelucksingh, 2016. Developing the Saint Lucia Energy Roadmap, Rocky Mountain Institute.

UNDP, 2015. Project Document: Japan-Caribbean Climate Change Partnership.

UNEP, 2013. Project Document: For implementation of activities towards Saint Lucia’s Third National Communication to the UNFCCC.

United Nations Framework Convention on Climate Change (UNFCCC), 2002: www.unfccc.int.

United Nations Framework Convention on Climate Change (UNFCCC), 2003. Reporting on Climate Change. User Manual for the Guidelines on National Communications from non-Annex 1 Parties.

United Nations 1998. Kyoto Protocol to the Convention on Climate Change. Climate Change Secretariat and UNEP’s Information Unit for Conventions.

## ANNEX 1: KEY CLIMATE CHANGE-RELEVANT POLICY INSTRUMENTS

| INSTRUMENT | SCOPE | PURPOSE | STATUS | SPECIFIC REFERENCE TO CLIMATE CHANGE |
|---|---|---|---|---|
| Legal and Institutional Review of Environmental Management | National | Strengthening legal and institutional framework for environmental management | Adopted in 2002. Proposal to draft climate change legislation initiated under the PPCR project | Chapter 2 addresses climate change and ozone depletion. |
| Mauritius Strategy of Implementation | Global | Sustainable Development of SIDS | Mauritius Strategy | Paragraphs 16 - 20 |
| St. George's Declaration of Environmental Principles for the OECS. | Sub-regional (Organization of Eastern Caribbean States) | To guide environmental management in the OECS States | Adopted 2001. Revised 2006. | Principles 8 and 16 |
| CARICOM Energy Policy | Regional | Provision of sustainable and secure supplies of energy, accessible to all CARICOM citizens | Approved in 2012 | No specific reference |
| Climate Change and the Caribbean: A regional Framework for Achieving Development Resilient to Climate Change 2009-2015 | Regional | To establish direction for the continued building of resilience to the impacts of Global Climate Change (GCC) on the part of the CARICOM countries. | Adopted in 2009 | The document includes four Strategic Elements and nineteen related goals to address resilience to GCC |
| National Environmental Policy & National Environmental Management Strategy (NEP/NEMS) | National | To ensure that development is environmentally sustainable. | Approved 2005; Revised 2014 | Included under Main Policy Interventions |
| National Climate Change Policy and Adaptation Plan | National | To foster and guide a national process of addressing effects of climate change | Approved 2002 | Numerous references for interventions to address climate change both holistically and at the sectoral level |
| National Land Policy | National | To guide the use, management, development and administration of land resources in Saint Lucia | Approved 2007 | Under Priority Policy Directions |

| INSTRUMENT | SCOPE | PURPOSE | STATUS | SPECIFIC REFERENCE TO CLIMATE CHANGE |
|---|---|---|---|---|
| | | | | |
| A systems Plan for Protected Areas in Saint Lucia | National | To create a framework for the designation, protection and effective management of a comprehensive network of protected areas across Saint Lucia. | Completed 2009. Not approved | Recognises climate change as a direct threat to the protection and effective management of protected areas |
| National Energy Policy | National | The National Energy Policy sets the framework to meet national energy supplies at least cost, to encourage private sector participation in the energy sector, to promote the exploitation of new and renewable sources of energy and for the regulation of the energy sector | Approved 2010 | Refers to the need to control greenhouse gas emissions and to take advantage of the CDM |
| Sustainable Energy Plan | National | The SEP sets out a strategy for the growth of the energy sector and reducing reliance on imported energy | Approved 2001. | A strategy for the maintenance and growth of the energy sector in Saint Lucia |
| The Ten Island Challenge | Regional | To accelerate the transition of Caribbean island economies from a heavy dependence on fossil fuels to renewable resources | Launched by the carbon War Room in 2012 | Directly addresses climate change mitigation |
| National Biodiversity Strategy and Action Plan (NBSAP) | National | To ensure that conservation and sustainable practices for use of biological diversity are effectively integrated into national development | Approved in 2000, revised 2006 | Revised NBSAP makes reference to climate change as a cross-cutting issue and to the importance of addressing this to slow or halt loss of species and genetic diversity. |
| Coastal Zone Management Policy | National | To maintain the integrity and productivity of the coastal zone and resources therein | Approved 2004 | Reaffirms the policy directives outlined in the NCCPAP, regarding the coastal and marine resources of Saint Lucia. |
| A National Water Policy of Saint Lucia | National | To “sustain economic growth, human development and environmental sustainability by promoting and facilitating the use of freshwater | Approved 2004 | In the context of natural disaster management, and the ability of resource managers to respond to climate change |

| INSTRUMENT | SCOPE | PURPOSE | STATUS | SPECIFIC REFERENCE TO CLIMATE CHANGE |
|---|---|---|---|---|
| | | resources in an efficient, sustainable and equitable manner | | |
| National Forestry Policy | National | To conserve and manage the forest resources of Saint Lucia for protection of water, wildlife and soil resources and to sustain the contribution of forests to national socio-economic development and rural livelihoods. | Revised draft prepared 2008 | |
| Framework for Integrated Environmental Management in Saint Lucia | National | To elaborate a strategic approach for more effective environmental management in Saint Lucia. | Produced in 2005 | Several references |
| Environmental Management Act | National | purpose of the Act is to provide for the allocation of administrative responsibilities for environment management, the undertaking and coordination of environmental management and related activities | Draft prepared in 2008. Currently under review | References to pollution and energy efficiency |
| Montreal Protocol Act and Regulations | National | To monitor and control trade on ozone depleting substances and related technologies | Enacted in 2000 | No. The phase out of Ozone Depleting Substances achieve reduction in greenhouse gas emissions. |
| OECS Development Charter | Regional | A commitment to the long term sustainable development of the OECS Member States | Approved in 2004 | Through reference to the St. Georges Declaration of Principles |
| National Capacity Needs Assessment for Global Environmental Management | National | To identify opportunities and priority needs to strengthen objectives of the Rio Conventions | Completed in 2007 | Addresses the three Rio Agreements, one of which is the UNFCCC |
| National Action Plan (UNCCD) | National | National Action Plan for the implementation of the UNCCD | Completed in 2007 | Yes |
| National Vision Plan | National | To leverage the cultural and heritage of Saint Lucia to create an authentic tourism experience whilst preserving | Completed and adopted as a National Plan in 2008 | No specific reference |

| INSTRUMENT | SCOPE | PURPOSE | STATUS | SPECIFIC REFERENCE TO CLIMATE CHANGE |
|---|---|---|---|---|
| | | the richness and varied local capital of the island for the benefit of all. | | |
| Net-Metering | National | LUCELEC has recently entered into agreements with a private individual and a government agency, respectively, to allow for the interconnection of a limited number of PV systems on an experimental basis | A number of installations have been connected. | In keeping with the National Energy Policy approved in 2010. |
| National Agricultural Policy (Policy Brief) | National | To promote economic development, generate employment and enhance the viability of rural communities**.** | Adopted in 2009 | Refers to effects of global climate change on agricultural production cycles and related gestation characteristics |
| State of the Environment Report | National | To provide objective environmental information to support decision-making for sustainable development in Saint Lucia through the provision of credible environmental information and data. | Completed in 2006 | |
| National Environmental Education Policy | National | To guide the development and administration of national environmental education in Saint Lucia towards sound environmental management sustainable development | Draft to be finalized for submission to Cabinet | Relevant as climate change has become the subject of a number of many environmental education and awareness campaigns. |
| Tourism Policy | National | To establish sustainable tourism as a strategic economic development priority | Draft (2003) | None |
| Engineering Guidelines for Incorporating Climate Change into the Determination of Wind Forces on Buildings and Other Structured | National | Appendix to National Hurricane Plan: | Approved 2010 | Specifically developed to support climate change adaptation |
| National Emergency Management Plan | National | To outline preparedness, prevention, mitigation and response activities to an emergency situation associated with | Revised version approved 2009 | Yes. Climate change is referenced and the subject of analysis in the purpose of |

| INSTRUMENT | SCOPE | PURPOSE | STATUS | SPECIFIC REFERENCE TO CLIMATE CHANGE |
|---|---|---|---|---|
| | | natural and man-made disasters or technological incidents on the island | | the Plan and the engineering guidelines and response plans |
| Sustainable Energy Strategy | National | To provide a framework and options to achieve the goals of the Sustainable Energy Plan. | Approved 2010 | References and relevant to climate change mitigation |
| Saint Lucia Medium Term Development Strategy (2012-16) | National | The goals of the Plan are:<br>• An economy characterized by increased productivity levels and enhanced work ethic; and<br>• A more integrated economy, with sustainable links between the productive sectors. | Approved 2012 | One of the major imperatives of the Plan is retrofitting of existing infrastructure to meet the more demanding requirements created by global climate change and from the estimated risks that attend resilience in a vulnerable and ecologically brittle island state. |
| Saint Lucia Climate Change Adaptation Policy | National | To define strategic directions and processes, and an appropriate enabling policy environment and for adapting to the impacts of climate change | Approved in 2015 | Yes |
| Draft Geothermal Bill | National | This Bill sets out a legal and regulatory framework aimed at facilitating successful geothermal resources development in Saint Lucia. | Draft available for review | No, but the Bill is developed to support Saint Lucia's climate change mitigation policy and commitment. |
| Electricity Supply Services Bill | National | To create a national Utilities regulatory Commission and to promote competition in electricity generation from renewable sources. | Draft Bill awaiting finalization and enactment | The bill supports climate change mitigation be promoting the generation of electricity from renewable energy sources. |
| Addis Ababa Action Agenda | Global | A global framework for financing development post 2015 | Adopted in July 2015 at the Third International Conference on Financing for Development | To the extent that its areas of focus ( Protecting Ecosystems; Biodiversity conservation; Disaster-resilient development; Threats to coastal and low-lying areas; Inclusive and Sustainable industrialization; Sustainable livelihoods and protection of oceans and marine ecosystems are climate sensitive. |
| The 2030 Agenda for Sustainable Development | Global | Sustainable development | Adopted by the UNGA | Under Goal 13 |

## ANNEX 2: MAJOR CLIMATE CHANGE PROJECTS SINCE THE SECOND NATIONAL COMMUNICATIONS

| PROJECT SUMMARY DATA | PURPOSE | KEY OUTPUTS/ADDITIONAL PROGRESS TO DATE |
|---|---|---|
| **Name:** Caribbean Planning for Adaptation to Climate Change (CPACC)<br>**Duration:** 1997 – 2001<br>**Level:** Regional<br>**Agency:** GEF/ World Bank/ OAS | To build capacity in the Caribbean region for the adaptation to climate change impacts, particularly sea level rise through the completion of vulnerability assessments, adaptation planning, and capacity building activities | **Establishment of a sea level and climate monitoring system** – A total of 18 monitoring systems, along with the related data management and information networks, were installed in 12 countries.<br>**Improved access and availability of data** – An integrated database for the monitoring of climate change effects was established through the Inventory for Coastal Resources and the institutionalization of coral reef monitoring.<br>**Increased appreciation of climate change issues at the policy-making level** – CPACC enabled more unification among regional parties and better articulation of regional positions for negotiations under the United Nations Framework Convention on Climate Change (UNFCCCC) and the Kyoto Protocol.<br>**Meeting country needs for expanded vulnerability assessment** – Pilot vulnerability studies<br>**Establishment of coral reef monitoring protocols –Articulation of national climate change adaptation policies and implementation plans**<br>**Creation of a network for regional harmonization** |
| **Name:** Initial National Communication (INC)<br>**Duration:** 1998 – 2001<br>**Level:** National<br>**Agency:** GEF/UNDP | To prepare Saint Lucia's Initial National Communication to the UNFCCC | • Greenhouse Gas Inventory, Mitigation Strategy, V&A Assessment, Other Relevant Information, Training completed.<br>• INC submitted to the CoP in 2001. |
| **Name:** Adapting to Climate Change in the Caribbean (ACCC)<br>**Duration:** 2001 – 2004<br>**Level:** Regional<br>**Agency:** CIDA | To mainstream adaptation to climate change in the Caribbean by supporting the development of a permanent capacity in the Caribbean to assist countries develop adaptation plans that will reduce vulnerability and increase risk reduction, building on the achievements of the CPACC programme | • Development and distribution of risk management guidelines for climate change adaptation decision making; Political endorsement (by CARICOM) of the business plan; and establishment of the basis of financial self-sustainability for the Caribbean Community Climate Change Centre (CCCCC);<br>• Development of a guide to assist environmental impact assessment (EIA) practitioners in CARICOM countries to integrate climate change in the EIA process;<br>• A draft regional public education and outreach strategy;<br>• Development and handover to MACC (see below) of the organization's website;<br>• Successful launch of a Master's Programme in climate change (the first set of graduates, in 2003, included eight students);<br>• Statistically downscaled climate scenarios development for Jamaica, Trinidad and Tobago, and Barbados;<br>• Staff training and development at the Caribbean Institute for Meteorology and Hydrology in climate trend analysis in order to strengthen climate change capacity; |

| PROJECT SUMMARY DATA | PURPOSE | KEY OUTPUTS/ADDITIONAL PROGRESS TO DATE |
|---|---|---|
| | | • Dialogue established with the South Pacific Regional Environment Programme and the Pacific Islands Climate Change Assistance Programme for collaboration on issues related to climate change; and<br>• Implementation of pilot projects on adaptation studies in the water health and agricultural sectors. |
| **Name:** Enabling Activity (Additional Financing for Capacity Building in Priority Areas)<br>**Duration:** 2001 - 2004<br>**Level:** National<br>**Agency:** GEF/UNDP | To build National Capacity additional to INC and prior to SNC | • Climate Change Technology Needs Assessment<br>• Sector Workshops (and accompanying Reports) on Agriculture and Health<br>• Acquisition of Additional automated Meteorological Station and additional sensors for other stations<br>• Training in maintenance of automated stations<br>• Preliminary Assessment of Data needs for Climate Change |
| **Name:** Mainstreaming Adaptation to Climate Change (MACC)<br>**Duration:** 2004 - 2008<br>**Level:** Regional<br>**Agency:** GEF / WB | To build further capacity in the small island and low-lying coastal states of the Caribbean, thereby increasing their resilience to climate change risks, through the identification and implementation of feasible adaptation option | Five components, namely:<br>• Build capacity to assess vulnerability and risks associated with climate change<br>• Build capacity to reduce vulnerability to climate change (adaptation)<br>• Build capacity to effectively access and utilize resources to reduce vulnerability to climate change<br>• Public education and outreach<br>• Project Management |
| **Name:** Vulnerability & Capacity Assessment (VCA)<br>**Duration:** 2005/2007<br>**Level:** National (but also undertaken by MACC in other countries)<br>**Agency:** UNDP/NOAA | To provide a practical approach to vulnerability and capacity assessment cognizant of recent advances in the field and building on past interventions in the Caribbean region. The VCA methodology, developed by NOAA on behalf of the MACC, allows for developing an integrated, interactive and dynamic approach for Vulnerability and Capacity Assessments of climatic risks in the Caribbean. | Focus area: Vieux-Fort;<br>Thematic area: Water- especially in relation to agriculture and tourism<br>Activities:<br>▪ Community Sensitization<br>▪ KAP Study- Vieux-Fort Area<br>▪ Project Report |
| **Name:** Second National Communication (SNC)<br>2006 - 2010 | To prepare Saint Lucia's Second National Communication to the UNFCCC | Comprehensive Reports on:<br>▪ National Circumstances<br>▪ GHG Inventory |

| PROJECT SUMMARY DATA | PURPOSE | KEY OUTPUTS/ADDITIONAL PROGRESS TO DATE |
|---|---|---|
| **Level:** National<br>**Agency:** GEF/UNDP | | ▪ V & A Assessment: Several Key Sectors and Systems<br>▪ Mitigation Assessment<br>▪ Gaps & Constraints<br>▪ Other Relevant Information<br>Capacity-Building in use of scenarios, V&A Assessments, GHG Inventories<br>Second National Communication |
| **NAME:** Special Programme on Adaptation to Climate Change (SPACC)<br><br>**DURATION:** 2007-2011<br><br>**LEVEL:** Sub-Regional with national components<br><br>**AGENCY:**GEF/WB/CCCCC | Implementation of select adaptation measures designed to address climate change impacts on biodiversity and land degradation. | 1. National sub-components/pilots:<br>a) Sustainability of Water Resources and Supply of the Vieux-Fort Region and<br>b) Strengthened Critical Coastal Infrastructure in the Castries Area.<br>2. Strengthened Critical Coastal Infrastructure in the Castries Area-to demonstrate the design and implementation of appropriate interventions to reinforce critical infrastructure against stronger hurricanes (ne Public Sector Building)<br>3. Sustainability of Water Resources and Supply of the Vieux-Fort (one pilot hybrid rainwater harvesting, irrigation and sewage recycling facility at a private hotel) |
| **Name:** Investment & Financial Flows (I&FF)<br>**Duration:** 2008 - 2010<br>**Level:** Global (selected countries)<br>**Agency:** UNDP | To assess investment and financial flows to address climate change for up to three key sectors | Upon completion:<br>▪ Private and Public Sector individuals trained in assessing investment and financial flows for the water and coastal zone sectors;<br>▪ Assessments undertaken for three sectors to 2030.<br>Project withdrawn because of administrative hurdles. |
| **Name:** Pilot Programme for Climate Resilience – Disaster Vulnerability Reduction Project (PPCR-DVRP)<br>**Duration:** 2008 - **Ongoing**<br>**Level:** Global (selected countries)<br>**Agency:** Climate Investment Funds (CIF)/World Bank (WB)/Inter-American Development Bank (IADB)/Caribbean Development Bank (CDB) | To pilot and demonstrate ways in which climate risk and resilience may be integrated into core development planning and implementation. PPCR provides incentives for scaled-up action and initiates transformational change | • Funding for technical assistance to enable developing countries to build upon existing national work to integrate climate resilience into national and sectoral development plans.<br>• Funding public and private sector investments identified in national or sectoral development plans or strategies addressing climate resilience. |

| PROJECT SUMMARY DATA | PURPOSE | KEY OUTPUTS/ADDITIONAL PROGRESS TO DATE |
|---|---|---|
| **Name:** Review of the Economics of Climate Change (RECC)<br>**Duration:** 2008<br>**Level:** Regional<br>**Agency:** UNECLAC/ DFID | To assess the likely economic impacts of climate change on key sectors of the Caribbean economies, to stimulate governments, regional institutions and private sector actions to develop and implement policies to mitigate and adapt to climate change | Phase 1: Establishes the scope and feasibility of carrying out a study on the costs and benefits of taking action on climate change adaptation and the cost effectiveness of mitigation in the Caribbean compared to a "business as usual" scenario.<br><br>Phase 2: Provide country-by-country assessments of the impacts of climate change on Caribbean countries<br><br>Phase 3: Broaden Phase 2 assessments by incorporating multiplier effects caused by regional interdependence with a view to feeding results into an analysis of the costs and benefits of climate change mitigation and policy recommendations for countries and regional bodies |
| **Name:** Economics of Climate Adaptation (ECA) in the Caribbean<br>**Duration:** 2010<br>**Level:** Regional<br>**Agency:** Caribbean Catastrophe Risk Facility (CCRIF)/ SwissRE / Mc. Kinsey & Co | Developing a quantitative basis to assist decision makers in defining and developing sound adaptation strategies and business cases which can be incorporated into national development plans and claims for adaptation assistance | Final outputs of the ECA exercise include a baseline that will "provide transparency about current and future expected losses from climate risks under three climate change scenarios; and assessment of adaptation measures – identification of feasible and applicable measures to adapt to the expected risks based on quantitative analysis of total cost and expected benefits of risk mitigation and transfer measures"<br>Saint Lucia is one of the pilot countries studied. |
| **Name:** Enhanced Capacities for Disaster Risk Mitigation in Agriculture, Fisheries and Forestry<br>**Duration:** 2010 - 2011<br>**Level:** National<br>**Agency:** FAO | Improved service delivery capacities of agriculture, fishery and forestry line departments, and enhanced know how of farmers and fishermen organisations to implement natural hazard risk mitigation and preparedness measures, with particular emphasis on primary and secondary impacts of hurricanes and tropical storms | • Improved capacities of the Forestry, Fisheries and Agriculture Department staff.<br>• Improved capacities for vulnerability mapping and damage assessment.<br>• Development of a communication public awareness programme, making use of the local dialect "Kweyol" and local media including the Government Information Service and the Agricultural Communications Unit, targeted to farmers and civil society.<br>• Community based risk mitigation approaches promoted and measures identified, and tested demonstration activities involving farmers and fishers as well as representatives of other groups vulnerable to hydro-meteorological hazards. A list of Improved Practices concerning soil and water conservation, pest management, hurricane-resistant storage facilities and animal housing is available on http://www.fao.org/climatechange/73799/en/ |

## ANNEX 3: INDICATORS FOR CLIMATE CHANGE

(Extracted from Saint Lucia's 2015 State of the Environment Report

1 Changes in global greenhouse gas (GHG) emissions.

2 Long-term changes in global greenhouse concentrations.

3 Long-term changes in global average temperature.

4 Long-term changes in sea level (sea level rise (SLR).

5 Average temperature over time.

6 Average precipitation over time.

7 Sea level over time.

8 Number of development projects incorporating climate change considerations.

9 Number of households and businesses implementing climate change-friendly measures.

10 Number of hospitals, hurricane shelters and other critical buildings strengthened to withstand more intense hurricanes.

11 Lives lost in extreme weather events.

12 Recovery cost from effects of extreme weather events.

13 Loss of income from extreme weather events.

14 Formulation and adoption of a national policy on mitigation.

15 Number, value and funding source for mitigation and adaptation projects implemented by public and private sectors and civil society.

16 Annual greenhouse gas emissions avoided from mitigation measures.

17 Avoided conventional energy generation through the use of renewable energy projects.

18 Total and per capita national greenhouse gas emissions.

19 Number or percentage of certified clean-energy or hybrid vehicles.

20 Number and capacity of photovoltaic systems installed.

21 Number or percentage of national, sectoral or agency policies that include climate change considerations.

22 Percentage of population knowledgeable of key climate change concepts.

23 Number of persons or companies taking advantage of government climate change incentives.

24 Number of persons trained in climate-change related fields.

25 Designated entities for respective climate change mechanisms (e.g. for GCF) established and operational.

26 Number of Climate Change Adaptation (CCA) and Mitigation policies formulated, adopted and implemented.

27 Number of agencies formally mainstreaming climate change considerations into operations.

28 Financing accessed from dedicated climate change funds.

## ANNEX 4: SDED RECOMMENDATIONS FOR LIST OF APPROVED TRAINING AREAS (STUDY LEAVE AWARDS)

Saint Lucia is party to a number of Multilateral Environmental Agreements is expected to honour our obligations through the development, implementation and monitoring of various initiatives which will contribute to successful environmental management and governance. Adequate technical capacity is key to effectively:

- Managing the impacts of climate change;
- Promoting holistic coastal zone management;
- Promoting the proper use and management of chemicals;
- Mobilizing resources towards the effective implementation of environmental management;
- Improving the institutional, legal, policy and management structures for environmental management in Saint Lucia; and
- Managing Saint Lucia' rich biodiversity

Therefore, the following areas are recommended for consideration and inclusion on the list of approved training areas for 2017/18 and beyond:

### Masters level:

- Applied Mathematical Sciences with Climate Change Impacts Modelling
- Modelling Climate Change Policies
- Climate Studies & Meteorology
- Environmental Monitoring, Modelling and Reconstruction
- Biological Conservation

### Masters or Bachelors level:

- Climate Change studies with focus on-
    - Comprehensive Risk Management
    - Non-economic losses in the context of climate change
    - Mitigation
    - Migration, Displacement and human mobility
    - Slow onset events
    - Renewable Energy
- Coastal Zone/Marine Studies
- Monitoring and Evaluation
- Genetic Engineering
- Chemicals or Hazardous waste Management
- Environmental Law
- Environmental Economics
- Biological Conservation

### Diploma/Certificate Level

- Coastal Zone Management
- Financial Management and Monitoring and Evaluation

# ANNEX 5: STANDARD REPORTING TABLES (2000, 2005 AND 2010)

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |
| **Title of Inventory** | Third National Communication Greenhouse Gas Inventory for Saint Lucia |
| **Contact Name** | Seton Stiebert |
| **Title** | Principal |
| **Organisation** | Stiebert Consulting |
| **Address** | Ministry of Sustainable Development, Energy, Science and Technology (MSDEST) |
| | Norman Francis Building, Balata, Castries |
| | Saint Lucia |
| **Phone** | (613) 294-5955 |
| **Fax** | |
| **E-Mail** | seton@stiebertconsulting.com |
| **Is uncertainty addressed?** | yes |
| **Related documents filed with UNFCCC** | |

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

## TABLE 1 SECTORAL REPORT FOR ENERGY
## (Sheet 1 of 3)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ |
| **Total Energy** | **489.430** | **0.118** | **0.0049** | **2.700** | **17.365** | **3.408** | **0.189** |
| **A Fuel Combustion Activities** (Sectoral Approach) | **489.430** | **0.118** | **0.0049** | **2.700** | **17.365** | **3.199** | **0.189** |
| **1 Energy Industries** | **251.305** | **0.0127** | **0.0021** | **0.687** | **0.070** | **0.018** | **0.080** |
| a Public Electricity and Heat Production | | | | | | | |
| b Petroleum Refining | | | | | | | |
| c Manufacture of Solid Fuels and Other Energy Industries | | | | | | | |
| **2 Manufacturing Industries and Construction** | **6.903** | **0.00017** | **0.000049** | **0.0163** | **0.0010** | **0.00041** | **0.0019** |
| a Iron and Steel | | | | | | | |
| b Non-Ferrous Metals | | | | | | | |
| c Chemicals | | | | | | | |
| d Pulp, Paper and Print | | | | | | | |
| e Food Processing, Beverages and Tobacco | | | | | | | |
| f Other (please specify) | | | | | | | |

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

## TABLE 1 SECTORAL REPORT FOR ENERGY
## (Sheet 2 of 3)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ |
| **3 Transport** | **200.7614** | **0.0430** | **0.0017** | **1.9301** | **16.2873** | **3.0655** | **0.0643** |
| a Civil Aviation | 0.0313 | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | |
| b Road Transportation | 197.1285 | 0.0428 | 0.00168 | 1.8562 | 16.2380 | 3.0556 | |
| c Railways | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 | 0.0000 | |
| d Navigation | 3.6016 | 0.00025 | 0.000030 | 0.0740 | 0.0493 | 0.0099 | |
| e Other (please specify) | 0.0000 | | | | | | |
| Pipeline Transport | 0.0000 | | | | | | |
| **4 Other Sectors** | **30.4608** | **0.0626** | **0.00104** | **0.0665** | **1.0067** | **0.1155** | **0.0429** |
| a Commercial/Institutional | 4.6452 | 0.00074 | 0.000044 | 0.0074 | 0.0015 | 0.0004 | |
| b Residential | 20.2081 | 0.0611 | 0.00095 | 0.0515 | 1.0037 | 0.1148 | 0.0412 |
| c Agriculture/Forestry/Fishing | 5.6075 | 0.00076 | 0.00005 | 0.0076 | 0.0015 | 0.0004 | 0.0018 |
| **5 Other (please specify)** | **0.0000** | **0.0000** | **0.00000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **B Fugitive Emissions from Fuels** | **0.0000** | **0.0000** | **0.00000** | **0.0000** | **0.0000** | **0.2088** | **0.0000** |
| **1 Solid Fuels** | **0.0000** | **0.0000** | **0.00000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| a Coal Mining | | 0.0000 | | | | | |
| b Solid Fuel Transformation | | | | | | | |
| c Other (please specify) | | | | | | | |
| **2 Oil and Natural Gas** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.2088** | **0.0000** |
| a Oil | | 0.0000 | | 0.0000 | 0.0000 | 0.2088 | 0.0000 |
| b Natural Gas | | 0.0000 | | | | | |
| c Venting and Flaring | | 0.0000 | | | | | |

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

**TABLE 1 SECTORAL REPORT FOR ENERGY**
**(Sheet 3 of 3)**

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | |
|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ |
| **Memo Items** (1) | | | | | | | |
| **International Bunkers** | **107.9985** | **0.00098** | **0.00092** | **0.5168** | **0.1967** | **0.0837** | **0.0000** |
| Aviation | 104.4120 | 0.00074 | 0.00089 | 0.4435 | 0.1478 | 0.0739 | 0.0000 |
| Marine | 3.5865 | 0.00024 | 0.00003 | 0.0734 | 0.0489 | 0.0098 | 0.0000 |
| **$CO_2$ Emissions from Biomass** | **23.0348** | | | | | | |

(1) Please do not include in energy totals.

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

## TABLE 2 SECTORAL REPORT FOR INDUSTRIAL PROCESSES
## (Sheet 1 of 2)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | P | A | P | A | P | A |
| **Total Industrial Processes** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **1,016.1984** | **0.0000** | **0.0226** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **A Mineral Products** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **1,015.9898** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 Cement Production | 0.0000 | | | | | | 0.0000 | | | | | | |
| 2 Lime Production | 0.0000 | | | | | | | | | | | | |
| 3 Limestone and Dolomite Use | 0.0000 | | | | | | | | | | | | |
| 4 Soda Ash Production and Use | 0.0000 | | | | | | | | | | | | |
| 5 Asphalt Roofing | | | | | 0.0000 | 0.0000 | | | | | | | |
| 6 Road Paving with Asphalt | | | | | | 1,015.9898 | | | | | | | |
| 7 Other (please specify) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Glass Production | | | | | | 0.0000 | | | | | | | |
| Concrete Pumice Stone | | | | | | | 0.0000 | | | | | | |
| **B Chemical Industry** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 Ammonia Production | 0.0000 | | | | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Nitric Acid Production | | | 0.0000 | 0.0000 | | | | | | | | | |
| 3 Adipic Acid Production | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | |
| 4 Carbide Production | 0.0000 | 0.0000 | | | | | | | | | | | |
| 5 Other (please specify) | | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| **C Metal Production** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 Iron and Steel Production | 0.0000 | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Ferroalloys Production | 0.0000 | | | | | | | | | | | | |
| 3 Aluminium Production | 0.0000 | | | 0.0000 | 0.0000 | | 0.0000 | | | | 0.0000 | | |
| 4 $SF_6$ Used in Aluminium and Magnesium Foundries | | | | | | | | | | | | | 0.0000 |
| 5 Other (please specify) | 0 | | | | | | | | | | | | |

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach. This only applies in sectors where methods exist for both tiers.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 2 SECTORAL REPORT FOR INDUSTRIAL PROCESSES
## (Sheet 2 of 2)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | P | A | P | A | P | A |
| **D Other Production** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.2086** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 Pulp and Paper | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Food and Drink | | | | | | 0.2086 | | | | | | | |
| **E Production of Halocarbons and Sulphur Hexafluoride** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 By-product Emissions | | | | | | | | | 0.0000 | | 0.0000 | | |
| 2 Fugitive Emissions | | | | | | | | | 0.0000 | | 0.0000 | | |
| 3 Other (please specify) | | | | | | | | | | | | | |
| **F Consumption of Halocarbons and Sulphur Hexafluoride** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0226** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1 Refrigeration and Air Conditioning Equipment | | | | | | | | | 0.0000 | | 0.0000 | | |
| 2 Foam Blowing | | | | | | | | | 0.0000 | | 0.0000 | | |
| 3 Fire Extinguishers | | | | | | | | | 0.0000 | | 0.0000 | | 0.0000 |
| 4 Aerosols | | | | | | | | | 0.0000 | | 0.0000 | | |
| 5 Solvents | | | | | | | | | 0.0000 | | 0.0000 | | |
| 6 Other (please specify) | | | | | | | | | 0.0000 | | 0.0000 | | 0.0000 |
| **G Other (please specify)** | | | | | | | | | | | | | |

P = Potential emissions based on Tier 1 Approach. A= Actual emissions based on Tier 2 Approach. This only applies in sectors where methods exist for both tiers.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
## (Sheet 1 of 1)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | |
|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $N_2O$ | NMVOC |
| **Total Solvent and Other Product Use** | **0.0000** | **0.0068** | **0.3440** |
| **A Paint Application** | | | 0.223 |
| **B Degreasing and Dry Cleaning** | | | |
| **C Chemical Products, Manufacture and Processing** | | 0.0068 | |
| **D Other (household use)** | | | 0.121 |

Please account for the quantity of carbon released in the form of NMVOC in both the NMVOC and the $CO_2$ columns.

Note: The Revised 1996 IPCC Guidelines do not provide methodologies for the calculation of emissions of $N_2O$ from solvent and other product use. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

| Country | Saint Lucia |
| --- | --- |
| Inventory Year | 2010 |

## TABLE 4 SECTORAL REPORT FOR AGRICULTURE
## (Sheet 1 of 2)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | |
| --- | --- | --- | --- | --- | --- |
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC |
| **Total Agriculture** | **0.5075** | **0.0815** | **0.0000** | **0.0000** | **0.0000** |
| **A Enteric Fermentation** | **0.3268** | | | | |
| 1 Cattle | 0.2574 | | | | |
| 2 Buffalo | 0.0000 | | | | |
| 3 Sheep | 0.0239 | | | | |
| 4 Goats | 0.0328 | | | | |
| 5 Camels and Llamas | 0.0000 | | | | |
| 6 Horses | 0.0000 | | | | |
| 7 Mules and Asses | 0.0000 | | | | |
| 8 Swine | 0.0127 | | | | |
| 9 Poultry | 0.0000 | | | | |
| 10 Other (please specify) | | | | | |
| **B Manure Management** | **0.1807** | **0.0130** | | | |
| 1 Cattle | 0.0049 | | | | |
| 2 Buffalo | 0.0000 | | | | |
| 3 Sheep | 0.0010 | | | | |
| 4 Goats | 0.0014 | | | | |
| 5 Camels and Llamas | 0.0000 | | | | |
| 6 Horses | 0.0000 | | | | |
| 7 Mules and Asses | 0.0000 | | | | |
| 8 Swine | 0.1651 | | | | |
| 9 Poultry | 0.0083 | | | | |

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 4 SECTORAL REPORT FOR AGRICULTURE
## (Sheet 2 of 2)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | |
|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC |
| **B Manure Management (cont...)** | | | | | |
| 10 Anaerobic | | 0.0000 | | | |
| 11 Liquid Systems | | 0.0002 | | | |
| 12 Solid Storage and Dry Lot | | 0.0128 | | | |
| 13 Other (please specify) | | 0.0000 | | | |
| **C Rice Cultivation** | **0.0000** | | | | |
| 1 Irrigated | 0.0000 | | | | |
| 2 Rainfed | 0.0000 | | | | |
| 3 Deep Water | 0.0000 | | | | |
| 4 Other (please specify) | | | | | |
| **D Agricultural Soils** | | **0.0686** | | | |
| **E Prescribed Burning of Savannas** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | |
| **F Field Burning of Agricultural Residues** (1) | **0.0000** | **0.0000** | **0.0000** | **0.0000** | |
| 1 Cereals | | | | | |
| 2 Pulse | | | | | |
| 3 Tuber and Root | | | | | |
| 4 Sugar Cane | | | | | |
| 5 Other (please specify) | | | | | |
| **G Other (please specify)** | | | | | |

Note: The Revised IPCC 1996 Guidelines do not provide methodologies for the calculation of $CH_4$ emissions, and $CH_4$ and $N_2O$ removals from agricultural soils, or $CO_2$ emissions from savanna burning or agricultural residues burning. If you have reported such data, you should provide additional information (activity data and emissions factors) used to make these estimates

(1) Sub-items of F should be linked to Worksheet 4-4 sheets 1 and 2.

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

## TABLE 5 SECTORAL REPORT FOR LAND-USE CHANGE AND FORESTRY
## (Sheet 1 of 1)

| **SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)** | | | | | | |
|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO |
| **Total Land-Use Change and Forestry** | (1) **0.0000** | (1) **-122.8683** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **A Changes in Forest and Other Woody Biomass Stocks** | (1) **0.0000** | (1) **-136.4525** | | | | |
| 1 Tropical Forests | | | | | | |
| 2 Temperate Forests | | | | | | |
| 3 Boreal Forests | | | | | | |
| 4 Grasslands/Tundra | | | | | | |
| 5 Other (please specify) | | | | | | |
| **B Forest and Grassland Conversion** | **7.9127** | | | | | |
| 1 Tropical Forests | 7.9127 | | | | | |
| 2 Temperate Forests | 0.0000 | | | | | |
| 3 Boreal Forests | 0.0000 | | | | | |
| 4 Grasslands/Tundra | 0.0000 | | | | | |
| 5 Other (please specify) | 0.0000 | | | | | |
| **C Abandonment of Managed Lands** | | **0.0000** | | | | |
| 1 Tropical Forests | | 0.0000 | | | | |
| 2 Temperate Forests | | 0.0000 | | | | |
| 3 Boreal Forests | | 0.0000 | | | | |
| 4 Grasslands/Tundra | | 0.0000 | | | | |
| 5 Other (please specify) | | 0.0000 | | | | |
| **D CO2 Emissions and Removals from Soil** | (1) **0.0049** | (1) **0.0000** | | | | |
| **E Other (Conversion of cropland to other land)** | **5.67** | | | | | |

(1) The formula does not provide a total estimate of both $CO_2$ emissions and $CO_2$ removals. It estimates "net" emissions of $CO_2$ and places a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Please note that for the purposes of reporting, the signs for removals are always (-) and for emissions (+

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

**TABLE 5B (OPTIONAL) SECTORAL REPORT FOR LAND USE, LAND-USE CHANGE AND FORESTRY**
**(Using the categories of the IPCC Good Practice Guidance on Land Use, Land-Use Change and Forestry)**
**(Sheet 1 of 1)**

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | |
|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO |
| **Total Land Use, Land-Use Change and Forestry** | **-13.5842** | **136.4525** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **A. Forest Land** | **0.0000** | **98.0018** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Forest Land Remaining Forest Land | | 54.3946 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Forest Land | | 43.6072 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **B. Cropland** | **-0.0049** | **37.7870** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Cropland Remaining Cropland | -0.0049 | 37.7870 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Cropland | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **C. Grassland** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Grassland Remaining Grassland | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Grassland | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **D. Wetlands** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Wetlands Remaing Wetlands | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Wetlands | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **E. Settlements** | **0.0000** | **0.6636** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Settlements Remaining Settlements | | 0.6636 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Settlements | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **F. Other Land** | **-13.5793** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| 1. Other Land Remaining Other Land | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2. Land Converted to Other Land | -13.5793 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **G. Other (Please specify)** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| Harvested Woord Products | | | | | | |
| | | | | | | |
| **Information items** | | | | | | |
| Forest Land converted to Other Land-Use Categories | | | | | | |
| Grassland converted to Other Land-Use Categories | | | | | | |

Non-$CO_2$ Emissions in this Summary Table are directly linked to the Summary Table in Module5B (LULUCF). $CO_2$ emissions and $CO_2$ removals, however, need to be entered manually here.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 6 SECTORAL REPORT FOR WASTE
## (Sheet 1 of 1)

| SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | |
|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ (1) | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC |
| **Total Waste** | **0.0000** | **3.5539** | **0.0122** | | | |
| **A Solid Waste Disposal on Land** | **0.0000** | **3.2579** | **0.0000** | | | |
| 1 Managed Waste Disposal on Land | | | | | | |
| 2 Unmanaged Waste Disposal Sites | | | | | | |
| 3 Other (please specify) | | | | | | |
| **B Wastewater Handling** | **0.0000** | **0.2960** | **0.0122** | | | |
| 1 Industrial Wastewater | | 0.0050 | | | | |
| 2 Domestic and Commercial Wastewater | | 0.2910 | 0.0122 | | | |
| 3 Other (please specify) | | | | | | |
| **C Waste Incineration** | | | | | | |
| **D Other (please specify)** | | | | | | |

(1) Note that $CO_2$ from waste disposal and incineration should only be included if it stems from non-biological or inorganic waste sources.

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2010 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 1 of 3)**

| **SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **Total National Emissions and Removals** | **489.4300** | **-122.8683** | **4.1799** | **0.1054** | **2.7003** | **17.3648** | **1,019.9506** | **0.1893** | **0.02257** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **1 Energy** | **489.4300** | **0.0000** | **0.1185** | **0.0049** | **2.7003** | **17.3648** | **3.4083** | **0.1893** | | | | | | |
| A Fuel Combustion (Sectoral Approach) | 489.4300 | | 0.1185 | 0.0049 | 2.7003 | 17.3648 | 3.1995 | 0.1893 | | | | | | |
| 1 Energy Industries | 251.3047 | | 0.0127 | 0.0021 | 0.6873 | 0.0698 | 0.0181 | 0.0802 | | | | | | |
| 2 Manufacturing Industries and Construction | 6.9031 | | 0.0002 | 0.0000 | 0.0163 | 0.0010 | 0.0004 | 0.0019 | | | | | | |
| 3 Transport | 200.7614 | | 0.0430 | 0.0017 | 1.9301 | 16.2873 | 3.0655 | 0.0643 | | | | | | |
| 4 Other Sectors | 30.4608 | | 0.0626 | 0.0010 | 0.0665 | 1.0067 | 0.1155 | 0.0429 | | | | | | |
| 5 Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| B Fugitive Emissions from Fuels | 0.0000 | | 0.0000 | | 0.0000 | 0.0000 | 0.2088 | 0.0000 | | | | | | |
| 1 Solid Fuels | | | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Oil and Natural Gas | | | 0.0000 | | 0.0000 | 0.0000 | 0.2088 | 0.0000 | | | | | | |
| **2 Industrial Processes** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **1,016.1984** | **0.0000** | **0.0226** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| A Mineral Products | 0.0000 | | | | | 0.0000 | 1,015.9898 | 0.0000 | | | | | | |
| B Chemical Industry | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| C Metal Production | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| D Other Production | 0.0000 | | | | 0.0000 | 0.0000 | 0.2086 | 0.0000 | | | | | | |
| E Production of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| F Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0226 | 0.0226 | 0.0226 | 0.0226 | 0.0226 | 0.0226 |
| G Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | 0.0000 | | 0.0000 |

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES
**(Sheet 2 of 3)**

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **3 Solvent and Other Product Use** | **0.0000** | | | **0.0068** | | | **0.3440** | | | | | | | |
| **4 Agriculture** | | | **0.5075** | **0.0815** | **0.0000** | **0.0000** | | | | | | | | |
| A Enteric Fermentation | | | 0.3268 | | | | | | | | | | | |
| B Manure Management | | | 0.1807 | 0.0130 | | | | | | | | | | |
| C Rice Cultivation | | | 0.0000 | | | | | | | | | | | |
| D Agricultural Soils | | | | 0.0686 | | | | | | | | | | |
| E Prescribed Burning of Savannas | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| F Field Burning of Agricultural Residues | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| G Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **5 Land-Use Change & Forestry [(2)]** | **(1) 0.0000** | **(1) -122.8683** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | | | |
| A Changes in Forest and Other Woody Biomass Stocks | (1) 0.0000 | (1) -136.4525 | | | | | | | | | | | | |
| B Forest and Grassland Conversion | 7.9127 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| C Abandonment of Managed Lands | | 0.0000 | | | | | | | | | | | | |
| D $CO_2$ Emissions and Removals from Soil | (1) 0.0049 | (1) 0.0000 | | | | | | | | | | | | |
| E Other (please specify) | 5.6666 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| **6 Waste** | | | **3.5539** | **0.0122** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | |
| A Solid Waste Disposal on Land | | | 3.2579 | | | | | | | | | | | |
| B Wastewater Handling | | | 0.2960 | 0.0122 | | | | | | | | | | |
| C Waste Incineration | | | | | | | | | | | | | | |
| D Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **7 Other (please specify)** | | | | | | | | | | | | | | |

(1) The formula does not provide a total estimate of both $CO_2$ emissions and $CO_2$ removals. It estimates "net" emissions of $CO_2$ and places a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+)

(2) Note that if you have used the IPCC Good Practice Guidance on Land Use, Land-Use Change and Forestry, you will have to use a mapping back procedure before entering emission/removals here

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 3 of 3)**

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **Memo Items** | | | | | | | | | | | | | | |
| **International Bunkers** | **107.9985** | | **0.0010** | **0.0009** | **0.5168** | **0.1967** | **0.0837** | **0.0000** | | | | | | |
| Aviation | 104.4120 | | 0.0007 | 0.0009 | 0.4435 | 0.1478 | 0.0739 | 0.0000 | | | | | | |
| Marine | 3.5865 | | 0.0002 | 0.0000 | 0.0734 | 0.0489 | 0.0098 | 0.0000 | | | | | | |
| **$CO_2$ Emissions from Biomass** | **23.0348** | | | | | | | | | | | | | |

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 7B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 1 of 1)

| SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | | P | A | P | A | P | A |
| **Total National Emissions and Removals** | | **489.4300** | **-122.8683** | **4.1799** | **0.1054** | **2.7003** | **17.3648** | **1,019.9506** | **0.1893** | **0.0226** | **0** | **0** | **0** | **0** | **0** |
| **1 Energy** | Reference Approach (1) | **490.3427** | | | | | | | | | | | | | |
| | Sectoral Approach (1) | **489.4300** | | **0.1185** | **0.0049** | **2.7003** | **17.3648** | **3.4083** | **0.1893** | | | | | | |
| A Fuel Combustion | | 489.4300 | | 0.1185 | 0.0049 | 2.7003 | 17.3648 | 3.1995 | | | | | | | |
| B Fugitive Emissions from Fuels | | 0.0000 | | 0.0000 | | 0.0000 | 0.0000 | 0.2088 | 0.0000 | | | | | | |
| **2 Industrial Processes** | | **0.0000** | | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **1,016.1984** | **0.0000** | **0.0226** | **0** | **0** | **0** | **0** | **0** |
| **3 Solvent and Other Product Use** | | **0.0000** | | | **0.0068** | | | **0.3440** | | | | | | | |
| **4 Agriculture** | | | | **0.5075** | **0.0815** | **0.0000** | **0.0000** | | | | | | | | |
| **5 Land-Use Change & Forestry** | | (2) **0.0000** | (2) **-122.8683** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | | | |
| **6 Waste** | | | | **3.5539** | **0.0122** | | | | | | | | | | |
| **7 Other (please specify)** | | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | |
| **Memo Items:** | | | | | | | | | | | | | | | |
| **International Bunkers** | | **107.9985** | | **0.0010** | **0.0009** | **0.5168** | **0.1967** | **0.0837** | **0.0000** | | | | | | |
| Aviation | | 104.4120 | | 0.0007 | 0.0009 | 0.4435 | 0.1478 | 0.0739 | 0.0000 | | | | | | |
| Marine | | 3.5865 | | 0.0002 | 0.0000 | 0.0734 | 0.0489 | 0.0098 | 0.0000 | | | | | | |
| **$CO_2$ Emissions from Biomass** | | **23.0348** | | | | | | | | | | | | | |

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

(1) For verification purposes, countries are asked to report the results of their calculations using the Reference Approach and explain any differences with the Sectoral Approach. Do not include the res of both the Reference Approach and the Sectoral Approach in national total

(2) The formula does not provide a total estimate of both $CO_2$ emissions and $CO_2$ removals. It estimates "net" emissions of $CO_2$ and places a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 8A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 1 of 3)

| OVERVIEW TABLE | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | $CH_4$ | | $N_2O$ | | $NO_x$ | | CO | | NMVOC | | $SO_2$ | | HFCs | | PFCs | | $SF_6$ | | Documen-tation | Disaggrega-tion | Footnotes |
| | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | | | |
| **Total National Emissions and Removals** | | | | | | | | | | | | | | | | | | | | | | | |
| **1 Energy** | | | | | | | | | | | | | | | | | | | | | | | |
| A Fuel Combustion Activities | | | | | | | | | | | | | | | | | | | | | | | |
| Reference Approach | ALL | H | | | | | | | | | | | | | | | | | | | | | |
| Sectoral Approach | ALL | H | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NO | - | NO | - | NO | - | M | 2 | 1 |
| 1 Energy Industries | ALL | H | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NO | - | NO | - | NO | - | M | 2 | 1 |
| 2 Manufacturing Industries and Construction | ALL | H | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NO | - | NO | - | NO | - | M | 2 | 1 |
| 3 Transport | ALL | H | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NO | - | NO | - | NO | - | M | 3 | 1 |
| 4 Other Sectors | ALL | H | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NO | - | NO | - | NO | - | M | 3 | 1 |
| 5 Other (please specify) | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | NO | - | NO | - | NO | - | M | - | - |
| B Fugitive Emissions from Fuels | NA | - | NA | - | NA | - | NA | - | NA | - | PART | M | NA | - | NO | - | NO | - | NO | - | M | 2 | 1 |
| 1 Solid Fuels | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| 2 Oil and Natural Gas | NA | - | NA | - | NA | - | NA | - | NA | - | PART | M | NA | - | NO | - | NO | - | NO | - | M | 2 | 1 |
| **2 Industrial Processes** | | | | | | | | | | | | | | | | | | | | | | | |
| A Mineral Products | NO | - | NO | - | NO | - | NO | - | NO | - | ALL | M | NO | - | NO | - | NO | - | NO | - | M | 2 | 1 |
| B Chemical Industry | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | NA |
| C Metal Production | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | NA |
| D Other Production | NO | - | NO | - | NO | - | NO | - | NO | - | ALL | M | NA | - | NO | - | NO | - | NO | - | M | 2 | 1 |
| E Production of Halocarbons and Sulphur Hexafluoride | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NA | - | NO | - | NO | - | NO | - | - | - | NA |

| Notation Key for Overview Table | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Estimates** | | **Quality** | | **Documentation** | | **Diaggregation** | |
| *code* | *Meaning* | *code* | *Meaning* | *code* | *Meaning* | *code* | *Meaning* |
| **PART** | Partly Estimated | **H** | High Confidence in Estimation | **H** | High (all background information included) | **1** | Total emissions estimated |
| **ALL** | Full estimate of all possible sourc | **M** | Medium Confidence in Estimatio | **M** | Medium (some background information included | **2** | Sectoral split |
| **NE** | Not estimated | **L** | Low Confidence in Estimation | **L** | Low (only emission estimates included) | **3** | Subsectoral split |
| **IE** | Estimated but included elsewhere | | | | | | |
| **NO** | Not occurring | | | | | | |
| **NA** | Not applicable | | | | | | |

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 8A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 2 of 3)

| OVERVIEW TABLE | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | $CH_4$ | | $N_2O$ | | $NO_x$ | | CO | | NMVOC | | $SO_2$ | | HFCs | | PFCs | | $SF_6$ | | Documen-tation | Disaggre-gation | Footnotes |
| | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | | | |
| **Industrial Processes (cont...)** | | | | | | | | | | | | | | | | | | | | | | | |
| F Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | | | | | | | | | | | | | | | | |
| Potential (1) | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | PART | L | NO | - | NO | - | M | 3 | 1 |
| Actual (2) | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NE | - | NO | - | NO | - | - | - | - |
| G Other (please specify) | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| **3 Solvent and Other Product Use** | NO | - | NO | - | PART | M | NO | - | NO | - | PART | L | NO | - | NO | - | NO | - | NO | - | M | 2 | 1 |
| **4 Agriculture** | | | | | | | | | | | | | | | | | | | | | | | |
| A Enteric Fermentation | NO | - | ALL | M | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | M | 3 | 1 |
| B Manure Management | NO | - | ALL | M | ALL | M | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | M | 3 | 1 |
| C Rice Cultivation | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| D Agricultural Soils | NO | - | NO | - | ALL | M | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | M | 1 | 1 |
| E Prescribed Burning of Savannas | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| F Field Burning of Agricultural Residues | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| G Other (please specify) | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| **5 Land-Use Change & Forestry** | | | | | | | | | | | | | | | | | | | | | | | |
| A Changes in Forest and Other Woody Biomass Stocks | ALL | L | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | L | 2 | 1 |
| B Forest and Grassland Conversion | ALL | L | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | L | 2 | 1 |

(1) Potential emissions based on Tier 1 Approach.

(2) Actual emissions based on Tier 2 Approach.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

## TABLE 8A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 3 of 3)

| OVERVIEW TABLE | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | $CH_4$ | | $N_2O$ | | $NO_x$ | | CO | | NMVOC | | $SO_2$ | | HFCs | | PFCs | | $SF_6$ | | Documen-tation | Disaggre-gation | Footnotes |
| | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | Estimate | Quality | | | |
| **5 Land-Use Change & Forestry (cont....)** | | | | | | | | | | | | | | | | | | | | | | | |
| C Abandonment of Managed Lands | ALL | L | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | L | 2 | 1 |
| D $CO_2$ Emissions and Removals from Soil | ALL | L | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | L | 2 | 1 |
| E Other (please specify) | ALL | L | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | L | 2 | 1 |
| **6 Waste** | | | | | | | | | | | | | | | | | | | | | | | |
| A Solid Waste Disposal on Land | NA | - | ALL | H | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | H | 3 | 1 |
| B Wastewater Handling | NA | - | ALL | M | ALL | L | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | NA | - | M | 3 | 1 |
| C Waste Incineration | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| D Other (please specify) | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| **7 Other (please specify)** | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | NO | - | - | - | - |
| **Memo Items:** | | | | | | | | | | | | | | | | | | | | | | | |
| **International Bunkers** | | | | | | | | | | | | | | | | | | | | | | | |
| Aviation | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | ALL | M | NA | - | NA | - | NA | - | NA | - | M | 3 | 2 |
| Marine | ALL | L | ALL | L | ALL | L | ALL | L | ALL | L | ALL | L | NA | - | NA | - | NA | - | NA | - | M | 1 | 1 |
| **$CO_2$ Emissions from Biomass** | ALL | L | | | | | | | | | | | | | | | | | | | M | 2 | 1 |

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

**National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors**

| Greenhouse gas source and sink categories | $CO_2$ emissions (Gg) | $CO_2$ removals (Gg) | $CH_4$ (Gg) | $N_2O$ (Gg) | $NO_x$ (Gg) | CO (Gg) | NMVOCs (Gg) | $SO_x$ (Gg) |
|---|---|---|---|---|---|---|---|---|
| **Total national emissions and removals** | **489.430** | **-122.868** | **4.180** | **0.105** | **2.700** | **17.365** | **1,019.951** | **0.189** |
| **1. Energy** | **489.430** | **0.000** | **0.118** | **0.005** | **2.700** | **17.365** | **3.408** | **0.189** |
| A. Fuel combustion (sectoral approach) | 489.430 | | 0.118 | 0.005 | 2.700 | 17.365 | 3.199 | 0.189 |
| 1. Energy Industries | 251.305 | | 0.013 | 0.002 | 0.687 | 0.070 | 0.018 | 0.080 |
| 2. Manufacturing industries and construction | 6.903 | | 0.000 | 0.000 | 0.016 | 0.001 | 0.000 | 0.002 |
| 3. Transport | 200.761 | | 0.043 | 0.002 | 1.930 | 16.287 | 3.065 | 0.064 |
| 4. Other sectors | 30.461 | | 0.063 | 0.001 | 0.067 | 1.007 | 0.116 | 0.043 |
| 5. Other (please specify) | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| B. Fugitive emissions from fuels | 0.000 | | 0.000 | | 0.000 | 0.000 | 0.209 | 0.000 |
| 1. Solid fuels | | | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 |
| 2. Oil and natural gas | | | 0.000 | | 0.000 | 0.000 | 0.209 | 0.000 |
| **2. Industrial processes** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **1,016.198** | **0.000** |
| A. Mineral products | 0.000 | | | | 0.000 | 0.000 | 1,015.990 | 0.000 |
| B. Chemical industry | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| C. Metal production | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| D. Other production | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.209 | 0.000 |
| E. Production of halocarbons and sulphur hexafluoride | | | | | | | | |
| F. Consumption of halocarbons and sulphur hexafluoride | | | | | | | | |
| G. Other (please specify) | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **3. Solvent and other product use** | **0.000** | | | **0.007** | | | **0.344** | |
| **4. Agriculture** | | | **0.507** | **0.082** | **0.000** | **0.000** | **0.000** | **0.000** |
| A. Enteric fermentation | | | 0.327 | | | | | |
| B. Manure management | | | 0.181 | 0.013 | | | 0.000 | |
| C. Rice cultivation | | | 0.000 | | | | 0.000 | |
| D. Agricultural soils | | | | 0.069 | | | 0.000 | |
| E. Prescribed burning of savannahs | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| F. Field burning of agricultural residues | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| G. Other (please specify) | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| **5. Land-use change and forestry** [1] | **0.000** | **-122.868** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** |
| A. Changes in forest and other woody biomass stocks | 0.000 | -136.452 | | | | | | |
| B. Forest and grassland conversion | 7.913 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | |
| C. Abandonment of managed lands | | 0.000 | | | | | | |
| D. $CO_2$ emissions and removals from | 0.005 | 0.000 | | | | | | |
| E. Other (please specify) | 5.667 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | |
| **6. Waste** | | | **3.554** | **0.012** | **0.000** | **0.000** | **0.000** | **0.000** |
| A. Solid waste disposal on land | | | 3.258 | | 0.000 | | 0.000 | |
| B. Waste-water handling | | | 0.296 | 0.012 | 0.000 | 0.000 | 0.000 | |
| C. Waste incineration | | | | | 0.000 | 0.000 | 0.000 | 0.000 |
| D. Other (please specify) | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **7. Other (please specify)** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** |
| **Memo items** | | | | | | | | |
| **International bunkers** | **107.999** | | **0.001** | **0.001** | **0.517** | **0.197** | **0.084** | **0.000** |
| Aviation | 104.412 | | 0.001 | 0.001 | 0.443 | 0.148 | 0.074 | 0.000 |
| Marine | 3.587 | | 0.000 | 0.000 | 0.073 | 0.049 | 0.010 | 0.000 |
| **$CO_2$ emissions from biomass** | **23.035** | | | | | | | |

[1] If you have completed the LUCF section of Table 7As, these data will appear here automatically. If, however, you have used the IPCC Good Practice Guidance and Categories therein, apply the mapping back procedure for this sector and insert the corresponding numbers here manually.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

**National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and $SF_6$**

| Greenhouse gas source and sink categories | HFCs[a,b] (Gg) | | | | | PFCs[a,b] (Gg) | | | $SF_6$[a] (Gg) |
|---|---|---|---|---|---|---|---|---|---|
| | HFC-23 | HFC-134 | HFC410a | HFC-404a | Insert HFC | $CF_4$ | $C_2F_6$ | Insert PFC | |
| **Total national emissions and removals** | **0** | **0.01639** | **0.002835** | **0.003285** | | **0** | **0** | | **0** |
| **1. Energy** | | | | | | | | | |
| A. Fuel combustion (sectoral | | | | | | | | | |
| 1. Energy Industries | | | | | | | | | |
| 2. Manufacturing industries and construction | | | | | | | | | |
| 3. Transport | | | | | | | | | |
| 4. Other sectors | | | | | | | | | |
| 5. Other (please specify) | | | | | | | | | |
| B. Fugitive emissions from fuels | | | | | | | | | |
| 1. Solid fuels | | | | | | | | | |
| 2. Oil and natural gas | | | | | | | | | |
| **2. Industrial processes** | **0** | **0.01639** | **0.002835** | **0.003285** | | **0** | **0** | | **0** |
| A. Mineral products | | | | | | | | | |
| B. Chemical industry | | | | | | | | | |
| C. Metal production | | | | | | | | | |
| D. Other production | | | | | | | | | |
| E. Production of halocarbons and sulphur hexafluoride | | | | | | | | | |
| F. Consumption of halocarbons and sulphur hexafluoride | | 0.01639 | 0.002835 | 0.003285 | | | | | |
| G. Other (please specify) | | | | | | | | | |
| **3. Solvent and other product use** | | | | | | | | | |
| **4. Agriculture** | | | | | | | | | |
| A. Enteric fermentation | | | | | | | | | |
| B. Manure management | | | | | | | | | |
| C. Rice cultivation | | | | | | | | | |
| D. Agricultural soils | | | | | | | | | |
| E. Prescribed burning of savannahs | | | | | | | | | |
| F. Field burning of agricultural | | | | | | | | | |
| G. Other (please specify) | | | | | | | | | |
| **5. Land-use change and forestry** | | | | | | | | | |
| A. Changes in forest and other woody | | | | | | | | | |
| B. Forest and grassland conversion | | | | | | | | | |
| C. Abandonment of managed lands | | | | | | | | | |
| D. $CO_2$ emissions and removals from | | | | | | | | | |
| E. Other (please specify) | | | | | | | | | |
| **6. Waste** | | | | | | | | | |
| A. Solid waste disposal on land | | | | | | | | | |
| B. Waste-water handling | | | | | | | | | |
| C. Waste incineration | | | | | | | | | |
| D. Other (please specify) | | | | | | | | | |
| **7. Other (please specify)** | | | | | | | | | |
| **Memo items** | | | | | | | | | |
| International bunkers | | | | | | | | | |
| Aviation | | | | | | | | | |
| Marine | | | | | | | | | |
| **$CO_2$ emissions from biomass** | | | | | | | | | |

[a] Parties may wish to express HFC, PFC and $SF_6$ emissions as either potential or actual. Potential emissions should be estimated using the tier 1 approach of the IPCC Guidelines. Actual emissions should be estimated using the tier 2 approach of the IPCC Guidelines.

[b] Parties reporting HFCs and PFCs should provide emission estimates on a gas-by-gas basis, that is, disaggregated estimates by chemical expressed in units of mass (Gg), as indicated in the table (e.g. HFC-23), where information is available. This should be done by inserting a column for each HFC and PFC gas for which emissions do occur in the country; the gases in the column headings are given as examples only. Other gases to be reported in this table include HFC-32, HFC-41, HFC-43-10, HFC-125, HFC-134a, HFC-152a, HFC-43-10mee, HFC-143a, HFC-227ea, HFC-236fa, HFC-245ca, $C_3F_8$, $C_4F_{10}$, c-$C_4F_8$, $C_5F_{12}$, $C_6F_{14}$, and any other GHG with high global warming potential not covered in this list.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2010 |

| IPCC Source Category | Sector | Source Categories to be Assessed in Key Source Category Analysis [1] | Applicable Greenhouse Gas | Estimate (current year, non-LULUCF) (Gg CO2eq) | Estimate (current year, LULUCF) [3] (Gg CO2eq) | Removals (current year, all sectors) (GgCO2eq) | Emissions estimate (non-LULUCF) base year (Gg CO2eq) | Emissions/ Removals LULUCF base year (Gg CO2eq) | Emissions/ Removals all sectors base year (Gg CO2eq) | Total absolute estimate incl. LULUCF (current year) (Gg CO2eq) | Level Assessment excl. LULUCF (%) | Cumulative level excl. LULUCF (%) | Level Assessment incl. LULUCF (%) | Cumulative level incl LULUCF (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sum** | **Sum** | **Sum** | | **646.9** | **-122.9** | **524.0** | **0.0** | **0.0** | **0.0** | **796.9** | | | | |
| 1.A.1 | Energy | CO2 Emissions from Stationary Combustion (Liquid-A) | CO2 | 251.3 | | 251.3 | | | 0.0 | 251.3 | 38.8% | 38.8% | 31.5% | 31.5% |
| 1.A.3 | Energy | CO2 Mobile Combustion: Road Vehicles | CO2 | 197.1 | | 197.1 | | | 0.0 | 197.1 | 30.5% | 69.3% | 24.7% | 56.3% |
| 6.A | Waste | CH4 Emissions from Solid Waste Disposal Sites | CH4 | 68.4 | | 68.4 | | | 0.0 | 68.4 | 10.6% | 79.9% | 8.6% | 64.9% |
| 5.A | LULUCF | 1. Forest Land Remaining Forest Land | CO2 | | -54.4 | -54.4 | | | 0.0 | 54.4 | n/a | 79.9% | 6.8% | 71.7% |
| 5.A | LULUCF | 2. Land Converted to Forest Land | CO2 | | -43.6 | -43.6 | | | 0.0 | 43.6 | n/a | 79.9% | 5.5% | 77.2% |
| 5.A | LULUCF | 1. Cropland Remaining Cropland | CO2 | | -37.8 | -37.8 | | | 0.0 | 37.8 | n/a | 79.9% | 4.7% | 81.9% |
| 2.F | Industrial P | HFC Emissions from Substitutes for Ozone Depleting Substances (ODS Substitutes) | HFCs | 37.0 | | 37.0 | | | 0.0 | 37.0 | 5.7% | 85.6% | 4.6% | 86.5% |
| 4.D | Agriculture | N2O (Direct and Indirect) Emissions from Agriculutural Soils | N2O | 21.3 | | 21.3 | | | 0.0 | 21.3 | 3.3% | 88.9% | 2.7% | 89.2% |
| 1.A.4 | Energy | Other Sectors: Residential CO2 | CO2 | 20.2 | | 20.2 | | | 0.0 | 20.2 | 3.1% | 92.0% | 2.5% | 91.7% |
| 5.E | LULUCF | 2. Land Converted to Other Land | CO2 | | 13.6 | 13.6 | | | 0.0 | 13.6 | n/a | 92.0% | 1.7% | 93.4% |
| 1.A.2 | Energy | CO2 Emissions from Manufacturing Industries and Construction | CO2 | 6.9 | | 6.9 | | | 0.0 | 6.9 | 1.1% | 93.1% | 0.9% | 94.3% |
| 4.A | Agriculture | CH4 Emissions from Enteric Fermentation in Domestic Livestock | CH4 | 6.9 | | 6.9 | | | 0.0 | 6.9 | 1.1% | 94.2% | 0.9% | 95.2% |
| 6.B | Waste | CH4 Emissions from Wastewater Handling | CH4 | 6.2 | | 6.2 | | | 0.0 | 6.2 | 1.0% | 95.1% | 0.8% | 96.0% |
| 1.A.4 | Energy | Other Sectors: Agriculture/Forestry/Fishing CO2 | CO2 | 5.6 | | 5.6 | | | 0.0 | 5.6 | 0.9% | 96.0% | 0.7% | 96.7% |
| 1.A.4 | Energy | Other Sectors: Commercial CO2 | CO2 | 4.6 | | 4.6 | | | 0.0 | 4.6 | 0.7% | 96.7% | 0.6% | 97.2% |
| 4.B | Agriculture | N2O Emissions from Manure Management | N2O | 4.0 | | 4.0 | | | 0.0 | 4.0 | 0.6% | 97.3% | 0.5% | 97.7% |
| 4.B | Agriculture | CH4 Emissions from Manure Management | CH4 | 3.8 | | 3.8 | | | 0.0 | 3.8 | 0.6% | 97.9% | 0.5% | 98.2% |
| 6.B | Waste | N2O Emissions from Wastewater Handling | N2O | 3.8 | | 3.8 | | | 0.0 | 3.8 | 0.6% | 98.5% | 0.5% | 98.7% |
| 1.A.3 | Energy | CO2 Mobile Combustion Water Borne Navigation | CO2 | 3.6 | | 3.6 | | | 0.0 | 3.6 | 0.6% | 99.1% | 0.5% | 99.1% |
| 3 | Solvent an | N2O Emissions | N2O | 2.09 | | 2.1 | | | 0.0 | 2.1 | 0.3% | 99.4% | 0.3% | 99.4% |
| 1.A.4 | Energy | Other Sectors: Residential CH4 | CH4 | 1.3 | | 1.3 | | | 0.0 | 1.3 | 0.2% | 99.6% | 0.2% | 99.6% |
| 1.A.3 | Energy | CH4 Mobile Combustion: Road Vehicles | CH4 | 0.9 | | 0.9 | | | 0.0 | 0.9 | 0.1% | 99.7% | 0.1% | 99.7% |
| 5.A | LULUCF | 1. Settlements Remaining Settlements | CO2 | | -0.7 | -0.7 | | | 0.0 | 0.7 | n/a | 99.7% | 0.1% | 99.8% |
| 1.A.1 | Energy | N2O (Non-CO2) Emissions from Stationary Combustion | N2O | 0.7 | | 0.7 | | | 0.0 | 0.7 | 0.1% | 99.8% | 0.1% | 99.8% |
| 1.A.3 | Energy | N2O Mobile Combustion: Road Vehicles | N2O | 0.5 | | 0.5 | | | 0.0 | 0.5 | 0.1% | 99.9% | 0.1% | 99.9% |
| 1.A.4 | Energy | Other Sectors: Residential N2O | N2O | 0.3 | | 0.3 | | | 0.0 | 0.3 | 0.0% | 99.9% | 0.0% | 100.0% |
| 1.A.1 | Energy | CH4 (Non-CO2) Emissions from Stationary Combustion | CH4 | 0.3 | | 0.3 | | | 0.0 | 0.3 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.3 | Energy | CO2 Mobile Combustion: Aircraft | CO2 | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.4 | Energy | Other Sectors: Agriculture/Forestry/Fishing CH4 | CH4 | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.4 | Energy | Other Sectors: Commercial CH4 | CH4 | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.2 | Energy | N2O Emissions from Manufacturing Industries and Construction | N2O | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.4 | Energy | Other Sectors: Agriculture/Forestry/Fishing N2O | N2O | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.4 | Energy | Other Sectors: Commercial N2O | N2O | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.3 | Energy | N2O Mobile Combustion Water Borne Navigation | N2O | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 1.A.3 | Energy | CH4 Mobile Combustion Water Borne Navigation | CH4 | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |
| 5.D | LULUCF | 1. Cropland Remaining Cropland | CO2 | | 0.0 | 0.0 | | | 0.0 | 0.0 | n/a | 100.0% | 0.0% | 100.0% |
| 1.A.2 | Energy | CH4 Emissions from Manufacturing Industries and Construction | CH4 | 0.0 | | 0.0 | | | 0.0 | 0.0 | 0.0% | 100.0% | 0.0% | 100.0% |

Perform Level Assessment

Perform Trend Assessment

Specify Base Year

[1] A Key Catgeory Analysis including the Land Use, Land-Use Change and Forestry is only performed if the Categories of the IPCC (2003) are being used. If the 1996 IPCC Land-Use categories are being used, they first need to be mapped onto the more recent categories before they can be entered here.

[2] Follow the Guidance in Section 5.4.2 of IPCC (2003) on the aggregation level at which the analysis should be performed. Take into account Tables 3.1.1 and 3.1.3 in Chapter 3 of IPCC (2003).

[3] In this column net emissions/removal estimates from the LULUCF sector should be entered

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2005 |
| **Title of Inventory** | Third National Communication Greenhouse Gas Inventory for Saint Lucia |
| **Contact Name** | Seton Stiebert |
| **Title** | Principal |
| **Organisation** | Stiebert Consulting |
| **Address** | Ministry of Economic Affairs, Economic Planning, National Development and the Public Service |
| | Price Waterhouse Coopers Building |
| | St. Lucia |
| **Phone** | (613) 294-5955 |
| **Fax** | |
| **E-Mail** | seton@stiebertconsulting.com |
| **Is uncertainty addressed?** | yes |
| **Related documents filed with UNFCCC** | |

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2005 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 1 of 3)**

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **Total National Emissions and Removals** | **395.2796** | **-86.7919** | **4.0340** | **0.0918** | **2.0973** | **16.1936** | **8.3257** | **0.1661** | **0.0225** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **1 Energy** | **395.2796** | **0.0000** | **0.1239** | **0.0043** | **2.0973** | **16.1936** | **3.1768** | **0.1661** | | | | | | |
| A Fuel Combustion (Sectoral Approach) | 395.2796 | | 0.1239 | 0.0043 | 2.0973 | 16.1936 | 2.9573 | 0.1661 | | | | | | |
| 1 Energy Industries | 202.2563 | | 0.0111 | 0.0017 | 0.5539 | 0.0634 | 0.0149 | 0.0646 | | | | | | |
| 2 Manufacturing Industries and Construction | 3.0544 | | 0.0001 | 0.0000 | 0.0084 | 0.0006 | 0.0002 | 0.0010 | | | | | | |
| 3 Transport | 158.7325 | | 0.0384 | 0.0014 | 1.4625 | 14.9262 | 2.8043 | 0.0508 | | | | | | |
| 4 Other Sectors | 31.2364 | | 0.0742 | 0.0012 | 0.0724 | 1.2034 | 0.1379 | 0.0498 | | | | | | |
| 5 Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| B Fugitive Emissions from Fuels | 0.0000 | | 0.0000 | | 0.0000 | 0.0000 | 0.2195 | 0.0000 | | | | | | |
| 1 Solid Fuels | | | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Oil and Natural Gas | | | 0.0000 | | 0.0000 | 0.0000 | 0.2195 | 0.0000 | | | | | | |
| **2 Industrial Processes** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **4.6924** | **0.0000** | **0.0225** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| A Mineral Products | 0.0000 | | | | | 0.0000 | 4.5571 | 0.0000 | | | | | | |
| B Chemical Industry | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| C Metal Production | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| D Other Production | 0.0000 | | | | 0.0000 | 0.0000 | 0.1352 | 0.0000 | | | | | | |
| E Production of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| F Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0225 | 0.0225 | 0.0225 | 0.0225 | 0.0225 | 0.0225 |
| G Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | 0.0000 | | 0.0000 |

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2005 |

## TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 2 of 3)

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **3 Solvent and Other Product Use** | **0.0000** | | | **0.0020** | | | **0.4565** | | | | | | | |
| **4 Agriculture** | | | **0.5190** | **0.0750** | **0.0000** | **0.0000** | | | | | | | | |
| A Enteric Fermentation | | | 0.3639 | | | | | | | | | | | |
| B Manure Management | | | 0.1550 | 0.0109 | | | | | | | | | | |
| C Rice Cultivation | | | 0.0000 | | | | | | | | | | | |
| D Agricultural Soils | | | | 0.0641 | | | | | | | | | | |
| E Prescribed Burning of Savannas | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| F Field Burning of Agricultural Residues | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| G Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **5 Land-Use Change & Forestry (2)** | **(1) 0.0000** | **(1) -86.7919** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | | | |
| A Changes in Forest and Other Woody Biomass Stocks | (1) 0.0000 | (1) -100.3761 | | | | | | | | | | | | |
| B Forest and Grassland Conversion | 7.9127 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| C Abandonment of Managed Lands | | 0.0000 | | | | | | | | | | | | |
| D $CO_2$ Emissions and Removals from Soil | (1) 0.0049 | (1) 0.0000 | | | | | | | | | | | | |
| E Other (please specify) | 5.6666 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| **6 Waste** | | | **3.3912** | **0.0104** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | |
| A Solid Waste Disposal on Land | | | 3.1300 | | | | | | | | | | | |
| B Wastewater Handling | | | 0.2612 | 0.0104 | | | | | | | | | | |
| C Waste Incineration | | | | | | | | | | | | | | |
| D Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **7 Other (please specify)** | | | | | | | | | | | | | | |

(1) The formula does not provide a total estimate of both $CO_2$ emissions and $CO_2$ removals. It estimates "net" emissions of $CO_2$ and places a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+

(2) Note that if you have used the IPCC Good Practice Guidance on Land Use, Land-Use Change and Forestry, you will have to use a mapping back procedure before entering emission/removals here

| **Country** | Saint Lucia |
|---|---|
| **Inventory Year** | 2005 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 3 of 3)**

| **SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GREENHOUSE GAS SOURCE AND SINK CATEGORIES** | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **Memo Items** | | | | | | | | | | | | | | |
| **International Bunkers** | **93.8427** | | **0.0008** | **0.0008** | **0.4267** | **0.1540** | **0.0699** | **0.0000** | | | | | | |
| Aviation | 92.1106 | | 0.0007 | 0.0008 | 0.3913 | 0.1304 | 0.0652 | 0.0000 | | | | | | |
| Marine | 1.7320 | | 0.0001 | 0.0000 | 0.0354 | 0.0236 | 0.0047 | 0.0000 | | | | | | |
| **$CO_2$ Emissions from Biomass** | **27.5688** | | | | | | | | | | | | | |

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2000 |
| **Title of Inventory** | Third National Communication Greenhouse Gas Inventory for Saint Lucia |
| **Contact Name** | Seton Stiebert |
| **Title** | Principal |
| **Organisation** | Stiebert Consulting |
| **Address** | Ministry of Economic Affairs, Economic Planning, National Development and the Public Service |
| | Price Waterhouse Coopers Building |
| | St. Lucia |
| **Phone** | (613) 294-5955 |
| **Fax** | |
| **E-Mail** | seton@stiebertconsulting.com |
| **Is uncertainty addressed?** | yes |
| **Related documents filed with UNFCCC** | |

| | |
|---|---|
| **Country** | Saint Lucia |
| **Inventory Year** | 2000 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 1 of 3)**

**SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)**

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | A | P | A | P | A |
| **Total National Emissions and Removals** | **340.1902** | **-86.7919** | **3.8207** | **0.1039** | **1.8448** | **14.7042** | **4.7862** | **0.1590** | **0.02522** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| **1 Energy** | **340.1902** | **0.0000** | **0.1305** | **0.0040** | **1.8448** | **14.7042** | **2.7001** | **0.1590** | | | | | | |
| A Fuel Combustion (Sectoral Approach) | 340.1902 | | 0.1305 | 0.0040 | 1.8448 | 14.7042 | 2.6586 | 0.1590 | | | | | | |
| 1 Energy Industries | 175.7222 | | 0.0106 | 0.0015 | 0.4819 | 0.0621 | 0.0133 | 0.0561 | | | | | | |
| 2 Manufacturing Industries and Construction | 5.1522 | | 0.0002 | 0.0000 | 0.0152 | 0.0010 | 0.0004 | 0.0015 | | | | | | |
| 3 Transport | 134.6191 | | 0.0338 | 0.0012 | 1.2557 | 13.1907 | 2.4773 | 0.0434 | | | | | | |
| 4 Other Sectors | 24.6966 | | 0.0860 | 0.0013 | 0.0919 | 1.4505 | 0.1677 | 0.0581 | | | | | | |
| 5 Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| B Fugitive Emissions from Fuels | 0.0000 | | 0.0000 | | 0.0000 | 0.0000 | 0.0415 | 0.0000 | | | | | | |
| 1 Solid Fuels | | | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| 2 Oil and Natural Gas | | | 0.0000 | | 0.0000 | 0.0000 | 0.0415 | 0.0000 | | | | | | |
| **2 Industrial Processes** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **1.7597** | **0.0000** | **0.0252** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| A Mineral Products | 0.0000 | | | | | 0.0000 | 1.4497 | 0.0000 | | | | | | |
| B Chemical Industry | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | |
| C Metal Production | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| D Other Production | 0.0000 | | | | 0.0000 | 0.0000 | 0.3100 | 0.0000 | | | | | | |
| E Production of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| F Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | | 0.0252 | 0.0252 | 0.0252 | 0.0252 | 0.0252 | 0.0252 |
| G Other (please specify) | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | 0.0000 | | 0.0000 |

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2000 |

## TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES
## (Sheet 2 of 3)

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **3 Solvent and Other Product Use** | **0.0000** | | | **0.0014** | | | **0.3264** | | | | | | | |
| **4 Agriculture** | | | **0.5490** | **0.0891** | **0.0000** | **0.0000** | | | | | | | | |
| A Enteric Fermentation | | | 0.4210 | | | | | | | | | | | |
| B Manure Management | | | 0.1280 | 0.0129 | | | | | | | | | | |
| C Rice Cultivation | | | 0.0000 | | | | | | | | | | | |
| D Agricultural Soils | | | | 0.0762 | | | | | | | | | | |
| E Prescribed Burning of Savannas | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| F Field Burning of Agricultural Residues | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| G Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **5 Land-Use Change & Forestry [(2)]** | **(1) 0.0000** | **(1) -86.7919** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | | | |
| A Changes in Forest and Other Woody Biomass Stocks | (1) 0.0000 | (1) -100.3761 | | | | | | | | | | | | |
| B Forest and Grassland Conversion | 7.9127 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| C Abandonment of Managed Lands | | 0.0000 | | | | | | | | | | | | |
| D $CO_2$ Emissions and Removals from Soil | (1) 0.0049 | (1) 0.0000 | | | | | | | | | | | | |
| E Other (please specify) | 5.6666 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | | | | | | | |
| **6 Waste** | | | **3.1411** | **0.0094** | **0.0000** | **0.0000** | **0.0000** | **0.0000** | | | | | | |
| A Solid Waste Disposal on Land | | | 2.9093 | | | | | | | | | | | |
| B Wastewater Handling | | | 0.2318 | 0.0094 | | | | | | | | | | |
| C Waste Incineration | | | | | | | | | | | | | | |
| D Other (please specify) | | | 0.0000 | 0.0000 | | | | | | | | | | |
| **7 Other (please specify)** | | | | | | | | | | | | | | |

(1) The formula does not provide a total estimate of both $CO_2$ emissions and $CO_2$ removals. It estimates "net" emissions of $CO_2$ and places a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+

(2) Note that if you have used the IPCC Good Practice Guidance on Land Use, Land-Use Change and Forestry, you will have to use a mapping back procedure before entering emission/removals here

| Country | Saint Lucia |
|---|---|
| Inventory Year | 2000 |

**TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES**
**(Sheet 3 of 3)**

| SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ Emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ | HFCs | | PFCs | | $SF_6$ | |
| | | | | | | | | | P | A | P | A | P | A |
| **Memo Items** | | | | | | | | | | | | | | |
| **International Bunkers** | **101.2899** | | **0.0022** | **0.0009** | **0.8119** | **0.4315** | **0.1192** | **0.0000** | | | | | | |
| Aviation | 77.7030 | | 0.0005 | 0.0007 | 0.3294 | 0.1098 | 0.0549 | 0.0000 | | | | | | |
| Marine | 23.5868 | | 0.0016 | 0.0002 | 0.4825 | 0.3217 | 0.0643 | 0.0000 | | | | | | |
| **$CO_2$ Emissions from Biomass** | **32.7792** | | | | | | | | | | | | | |