GREENHOUSE GAS MITIGATION ASSESSMENT FOR DOMINICA

Final Report

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GLOSSARY

Bbl	Barrel
Boe	barrel oil equivalent
CDM	Clean Development Mechanism
CEIS	Caribbean Energy Information System
CER	Certified emission reductions
CFB	Circulating fluidised bed
CFL	Compact fluorescent light
CH_4	Methane
CNG	Compressed natural gas
CO_2	Carbon dioxide
CO_2 e	CO_2 equivalents
COP	Conference of Parties
CSO	Central Statistics Office
DNA	Designated national authority
DOMLEC	Dominica Electricity Services Ltd.
DOWASCO	Dominica Water and Sewage Company Ltd.
DSEC	Dominica Sustainable Energy Corporation
DSM	Demand side management
EFW	Energy from Waste
E10	Gasoline ethanol mixture with 10% ethanol
EPI	Environmental Performance Index
FOEB	Fuel oil equivalent barrel
GDP	Gross domestic product
GEF	Global Environment Facility
Gg	Gigagram (10^9 g or 1000 tonne or 1 kilotonne)
GHG	Greenhouse gas
GJ	Gigajoule
GWP	Global warming potential
HCFC	Hydrochlorofluorocarbon
HDDV	Heavy duty diesel vehicle (>3856 kg)
HDGV	Heavy duty gasoline vehicle (>3856 kg)
HDI	Human Development Index
HFC	hydrofluorocarbon
HFO	Heavy fuel oil
HH	Households
ICT	Information and Communications Technology
LDDT	Light duty diesel truck (2722 - 3856 kg)
LDDV	Light duty diesel vehicle (0 - <1701 kg)
LDGT	Light duty gasoline truck (1701 – 2722 kg)
LDGV	Light duty gasoline vehicle (0-1701 kg)
LDV	Light duty vehicle
LEAP	Long-Range Energy Alternatives Planning System
LPG	Liquefied petroleum gas
MC	Motorcycle
Mg	Megagram (10^6 g or 1 tonne)
MSW	Municipal solid waste

MW	Megawatt
MWh	Megawatt hour
PV	Photovoltaic
SLC	Survey of living conditions
T&D	Transmission and distribution
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VER	Verifiable emissions reductions
VKMT	Vehicle kilometres travelled
VMT	Vehicle miles travelled

EXECUTIVE SUMMARY

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC), whose stated objective is to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the earth's climate system, includes obligations by signatories to periodically submit National Communications that include a greenhouse gas (GHG) mitigation assessment, a national GHG emissions inventory, a report on climate change adaptation and a vulnerability assessment.

Objective and Scope

This report provides the greenhouse gas mitigation assessment for the Commonwealth of Dominica. The assessment covers the period 2000 to 2030 and uses historical data for the period 2000 (the base year) to 2008 in order to calibrate where feasible, the bases for the projections for 2009 to 2030.

Background Information

Dominica is located in the Windward Islands in the eastern Caribbean between Martinique and Guadeloupe and has an area of 75,100 hectares and a population of 71,518 in 2008. Its economy is dependent on agriculture (18% of GDP at current factor cost in 2005) which faces challenges from diminishing export markets for bananas and grapefruit but there is increased emphasis on fishing, ecotourism and financial services. Dominica has no known petroleum energy resources but has extensive geothermal energy potential in addition to hydroelectric, solar, wind and biomass resources. It makes use of some of its hydroelectric energy resource.

Dominica's energy supply is heavily dependent on fossil fuel imports of diesel fuel used mainly for electricity generation and gasoline for transportation. Demand for electricity in 2009 was mainly from the domestic (45.3%) and commercial (40.2%) sectors. Gasoline accounted for 72% of the fuel used for transportation and the remainder was provided by diesel (27.9%) and LPG (0.1%). The industrial sector is small (up to 8.1% of GDP at factor cost in 2005) and is limited to packaging of soaps, detergents, dental cream and floor polish.

Dominica has a number of policies and initiatives that serve the energy sector. These include:

- Climate Change Adaptation Policy
- Sustainable Energy Plan and National Energy Policy
- Energy Development Programme for Dominica
- Dominica Tourism Master Plan 2005 – 2015 and the Sustainable Tourism Policy and Marketing Strategy (2005-2009)

The key institutions in the energy sector are the Ministry of Public Works, Energy & Ports, the Independent Regulatory Commission (IRC) and the privately owned Dominica Electrical Power Company (DOMLEC). The key information sources for the assessment included DOMLEC annual reports, Central Statistical Office (CSO) and publications that used CSO data and an Interim World Bank Report on Caribbean Regional Electricity Generation, Interconnection and Fuels Supply Strategy.

Opportunities for mitigation of GHG emissions from energy supply will focus on the introduction of electricity generation from geothermal resources and also from the use of wind, hydro and solar

(photovoltaic and solar water heating) resources. The use of more efficient electricity end use devices (lighting, air conditioning, domestic appliances) and transportation (increased diesel fuelled vehicles, hybrid and LPG fuelled vehicles) as well as increased awareness about energy efficiency and improved public transit also provide opportunities for reducing GHG emissions from energy demand.

The mitigation analysis used the Long-Range Energy Alternatives Planning System (LEAP) model[i] and examined the demand, transformation, resources and non-energy sector emissions and effects. The base year used in this analysis is 2000 - the same year used for compilation of the national GHG emission inventory and is the year preferred by UNFCCC for reporting Second National Communications. The input data for the LEAP model are grouped into five categories called modules, namely:

Key Assumptions	Macroeconomic, demographic and other time-series variables used in the other categories
Demand	Overall energy consumption of households, industry, government, road transport and various DOMLEC electricity customer rate classes
Transformation	Electricity distribution and generation, charcoal production
Resources	Indigenous energy resources (hydro, wind, solar, geothermal, biomass, municipal solid waste)
Non-Energy Sector effects	Landfill emissions

The subcategories in the model are shown in Table 1.

Three scenarios are developed to project emissions – a Reference Scenario and two other scenarios (Scenario 2 and Scenario 3) characterised primarily by increasingly aggressive mitigation measures. The Reference Scenario only includes activities and projects that are currently under way and does not include any additional GHG mitigation. The other scenarios describe various possible and plausible energy use and development strategies and activities that are required to satisfy the demand for energy based on population growth and national development goals. Various mitigation options (technologies and measures that can affect GHG emissions) are included in these scenarios. Notable among these is the future utilisation of Dominica's geothermal resource potential, continued use of hydroelectric energy and possible utilisation of wind and solar energy. Details of the mitigation measures are provided in Tables 2 and 3.

Table 1 Subcategories in the Five Modules in the LEAP Model Input Data

Key Assumptions	**Demand**	**Transformation**	**Resources**	**Non-Energy Sector Effects**
Population Household Size Population growth rate	Transportation (Seven classes of vehicles plus off road vehicles) Commercial Hotel Domestic (Cooking, Lighting, Refrigeration Television, Washing machine, All other) Industrial Street lighting	Transmission & Distribution Transmission Loss reduction Electricity Generation (Hydro, Thermal, Geothermal, Wind, Municipal solid waste, Photovoltaic (distributed))	Primary Wind Geothermal Solar Municipal Waste Biomass	Landfill emissions

Table 1-2 Scenarios for the Demand and Non-Energy Sector Effects

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Key Parameters			
Population	Growth at 0.4% from 2009	Same as Reference	Same as Reference
GDP Growth rate	Real GDP growth of 3% after 2010.	Same as Reference	Same as Reference
Demand			
Households (HH)	Assume to be the same as the number of residential electricity customers	Assume to be the same as the number of residential electricity customers	Assume to be the same as the number of residential electricity customers
Domestic (Residential Customers)	Growth at 2.8% from 2009, 1.8% from 2015, 0.8% from 2020, 0% from 2025 Note: Percentages of households (HH) with cooking, lighting, refrigerators, TVs and washing machines from the Country Poverty Assessment based on the 2002 Survey of Living Conditions (SLC) and SLC data for 2009.	Same as Reference	Same as Reference
Cooking	LPG from 79% of HH in 2002; 86.7% in 2009 to 91% in 2015; Charcoal: from 5% of HH in 2002, 2.6% in 2009 to 1% in 2015 Firewood: from 13% in 2002, 9.4% in 2009 to 3% in 2015	Same as reference	Same as reference
Refrigerators	No energy efficient refrigerators. Note – recent imports used to determine growth in number of refrigerators. Penetration from 74% in 2002, 71.3% in 2009 to 98% in 2015 Energy efficiency – no change after 2009	Penetration same as reference [% of HH with more energy efficient refrigerators increases from 0% in 2012 to 30% in 2020, and 40% in 2030.]	Penetration same as reference [% of HH with more energy efficient refrigerators increases from 0% in 2012 to 40% in 2020, and 60% in 2030.]

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Lighting	CFLs in use (distributed to all residences during 2007 so assume penetration of 50% in 2007 and 90% as of 2008). No LED	Introduction of LED lighting after 2015 (10% of HH by 2020).]	Introduction of LED lighting after 2012 to 45% of HH by 2030 at the expense of CFL which decrease from 90% of HH in 2012 to 45% of HH by 2030 and incandescent which decrease from 10% of HH in 2012 to 5% by 2030.]
Washing machines	Penetration from 42% in 2002, 53.4% in 2009. Assume 2009 penetration rate remains the same Energy efficiency – no change after 2009	Penetration to 80% of HH by 2015 [50% of new fridges are more energy efficient (i.e., 13% of HH)]	Penetration to 90% of HH by 2015 [50% of new fridges are more energy efficient (i.e., 18% of HH)]]
TV, stereo, radio	Penetration from 69% in 2002, 74% in 2009, and remaining the same onward. Energy efficiency – no change after 2009	Penetration to 90% of HH by 2015 [More energy efficient TVs: 5% in 2009 increasing to 80% by 2030]	Penetration to 95% of HH by 2015 [More energy efficient TVs: 5% in 2009 increasing to 90% by 2030]
All other	Includes items such as air conditioners (whose penetration rates are unknown), electric water heaters, microwave ovens, clothes iron and other small appliances. Assume current penetration rates remain the same Energy efficiency – no change after 2009	[Assume 10% reduction in energy efficiency by 2030]	[Assume 20% reduction in energy efficiency by 2030]
Commercial	Electrical energy and LPG fuel used (Note: poor data for LPG use) Growth rate (customers) 3% to 2015; 1% to 2030 No change in energy intensity	Growth rate same as reference Reduction in electricity and LPG use: 10% by 2015; 15% by 2030 due to efficient HVAC and additional solar water heating	Growth rate same as reference Reduction in electricity and LPG use: 15% by 2015; 25% by 2030 due to efficient HVAC and additional solar water heating]

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Industry	Electrical energy and diesel fuel used Growth rate (customers) 3% to 2015; 1% to 2030 No change in energy intensity	Growth rate same as reference 10% Reduction in overall energy by 2015 and 15% by 2030 due to energy conservation measures (education)	Growth rate same as reference 15% Reduction in overall energy by 2015 and 25% by 2030 due to energy conservation measures (education)
Hotel	Electrical energy and LPG fuel used (Note: poor data for LPG use) Growth rate (customers) 5% to 2015; 2% to 2030 No change in energy intensity	Growth rate same as reference 10% Reduction in overall energy use by 2015 and 15% by 2030 due to energy conservation measures (education) Flat after.	Growth rate same as reference 15% Reduction in overall energy use by 2015 and 25% by 2030 due to energy conservation measures (education) Flat after.
Street lighting	Growth rate (customers) 5% to 2015; 2% to 2030	Growth rate same as reference Efficient street lighting from 0% in 2015 to 10% in 2030 [Efficient street lighting is 4x more efficient than existing]	Growth rate same as reference Efficient street lighting from 0% in 2015 to 20% in 2030 [Efficient street lighting is 4x more efficient than existing]
DOMLEC Own use	No change	5% reduction in use by 2015 and 10% by 2030	10% reduction in use by 2015 and 15% by 2030
Transportation			
Fleet (vehicle stocks) divided into 7 vehicle classes (LDGV, LDDV, LDGT, LDDT, HDGV, HDDV, MC) plus off road based on vehicle licensing data for 2000 to 2007. No data to allow estimates of a marine category. Registered vehicles assumed to be 10% greater than licensed vehicles. The assignments of vehicle stocks to vehicle classes based on vehicle inspections data and sales based on import data are subject to considerable uncertainty since vehicle inspections data do not segregate vehicles by fuel type and weight class. No data available for annual vehicle miles (VMT) or kilometres (VKT) travelled. The estimated VMT are believed to be conservative (high) but were selected (along with fuel economy) to match fuel consumption. Fuel economy values were based on published city fuel economy values (as opposed to the composite of highway and city fuel economies). Note – no CNG but LPG instead for LDVs. No mitigation for MC.			
Growth in fleet	1% to 2012, 0.5% to 2020, 0.1% to 2035	Improved mass transit Import restrictions and tax incentives to promote more fuel efficient vehicles and hybrids	Improved mass transit Import restrictions and tax incentives to promote more fuel efficient vehicles and hybrids
Fuels	Only gasoline and diesel. E10, biodiesel and low sulphur diesel and gasoline not considered		

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Vehicle Class VKT {VMT}			
LDGV 9656 km {6000 mi}	All gasoline	*S2* LPG: 15% of LDGV by 2020 *S2* Hybrid: 20% of Hybrid vehicles by 2020	*S3* LPG: 30% of fleet by 2030 *S3 Hyb*: Hybrid: 15% by 2020; 25% by 2030
LDDV 9656 km {6000 mi}	All diesel	*S2*; LPG: 15% of LDDV by 2020 *S2* Hybrid: 15% of Hybrid vehicles by 2020	*S3*; LPG: 15% by 2020; 25% of fleet by 2030 *S3 Hyb*; 15% by 2020; 25% by 2030
LDGT 10863 km {6750 mi} 9656 km LPG & hybrid {6000 mi LPG}	All gasoline	*S2*; LPG: 15% of LDGT by 2020 *S2* Hybrid: 15% of by 2020	*S3*; LPG: 15% by 2020; 25% of fleet by 2030 *S3 Hyb*: Hybrid: 15% by 2020; 25% of fleet by 2030
LDDT 10863 km {6750 mi}	All diesel	LPG: 15% of LDDT by 2020 *S2* Hyb: 10% of Hybrid vehicles by 2020	LPG: 30% of fleet by 2030 *S3 Hyb*: 20% of fleet Hybrid by 2030
HDGV 10863 km gasoline {6750 mi} 9656 km hybrid {6000 mi} hybrid	All gasoline	*S2* & *S2* Hyb; LPG: 15% of HDGV by 2020	*S3*& *S3 Hyb*; LPG: 15% by 2020; 35% of fleet by 2030
HDDV 10863 km {6750 mi}	All diesel	*S2* & *S2* Hyb; LPG: 15% of HDDV by 2020	*S3* & *S3 Hyb*; LPG: 15% by 2020, 30% by 2030
MC 8047 km {5000 mi}	All gasoline	No change	No change

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Off Road (includes tractors, rollers, forklifts etc.) 6437 km {4000 mi}	Assumed 40% gasoline; 20% LPG; 40% diesel	No change	No change
Non-Energy Sector Effects			
Landfill Emissions	MSW to landfills based on population growth projections	Diversion of ~40% of MSW to landfills after 2015	Diversion of ~80%? MSW to landfills after 2015

E10 – Gasoline with 10% ethanol. Energy intensity is the annual energy use per appliance or per unit activity

Table 1-3 Scenarios for Transformation and Energy Resources

Transformation Category	**Reference (REF)**	**Scenario 2 (*S2*)**	**Scenario 3 (*S3, S3 HYB*)**
Transmission & Distribution			
Electricity Distribution	Losses reduced from 12% in 2008 to 8% in 2015	Same as Reference	Same as Reference
Electricity Generation			
Additional thermal plants HFO Diesel	7.5 MW in 2011	7.5 MW in 2011	7.5 MW in 2011
Distributed photovoltaic	None	1.5 MW by 2015	2 MW by 2015; 5 MW by 2030
Wind	None	5 MW in 2015	5 MW in 2015, 10 MW total in 2025
MSW Waste to Energy	None	0.75 MW in 2015	0.75 total MW in 2020
Geothermal	None	10 MW by 2015; 10 MW in 2017	20 MW by 2015; additional 100 MW in 2020
Hydro			
Retirements & Export		Retire Fond Cole 2015	Retire Fond Cole 2015 Retire Portsmouth 2020 Export 565 GWh starting in 2020

Summary of Results

The results of the analysis will focus on presenting the **energy demand** broken down by demand transformation categories and branches within the categories where appropriate and the **environmental loadings** (GHG emissions) and. The loadings are provided either:

a) where they occur in the various branches (demand, transformation and non-energy sector effects), or;

b) by allocating the emissions in the transformation categories back to the demand branches.

Alternative b) gives the final energy demand (or final environmental loadings) by allocating emissions used by various appliances and/or categories in proportion of the average mix of supply side (electricity generating) processes and the associated emissions. The presentation of the **environmental loadings** for all three scenario projections includes the current account period (2000 to 2008) so that comparisons can be made between the GHG emissions inventory and/or energy consumption over this period.

The differences in the final energy demand are highlighted in Figure 1 which shows the **differences** relative to the Reference scenario.

The overall non-biogenic CO_2 emissions for the various scenarios are shown in Figure 2. Also included in the figure are the CO_2 emissions obtained in the emission inventory. The inventory emissions are 7 to 11% lower than those calculated in the Reference scenario (current accounts) between 2000 and 2005. The agreement is reasonable given the challenges in estimating emissions from diesel fuel in the transportation, industrial and commercial sectors.

Figure 1 Final Energy Demand for Dominica, All Scenarios, Relative to the Reference Scenario

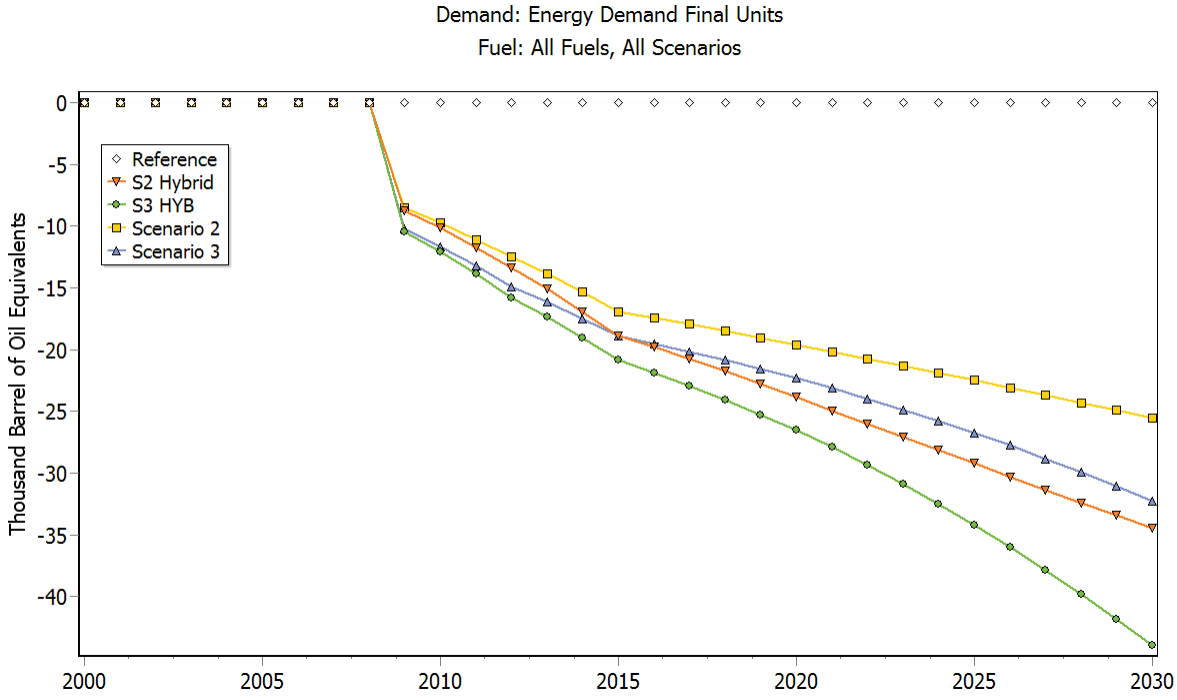
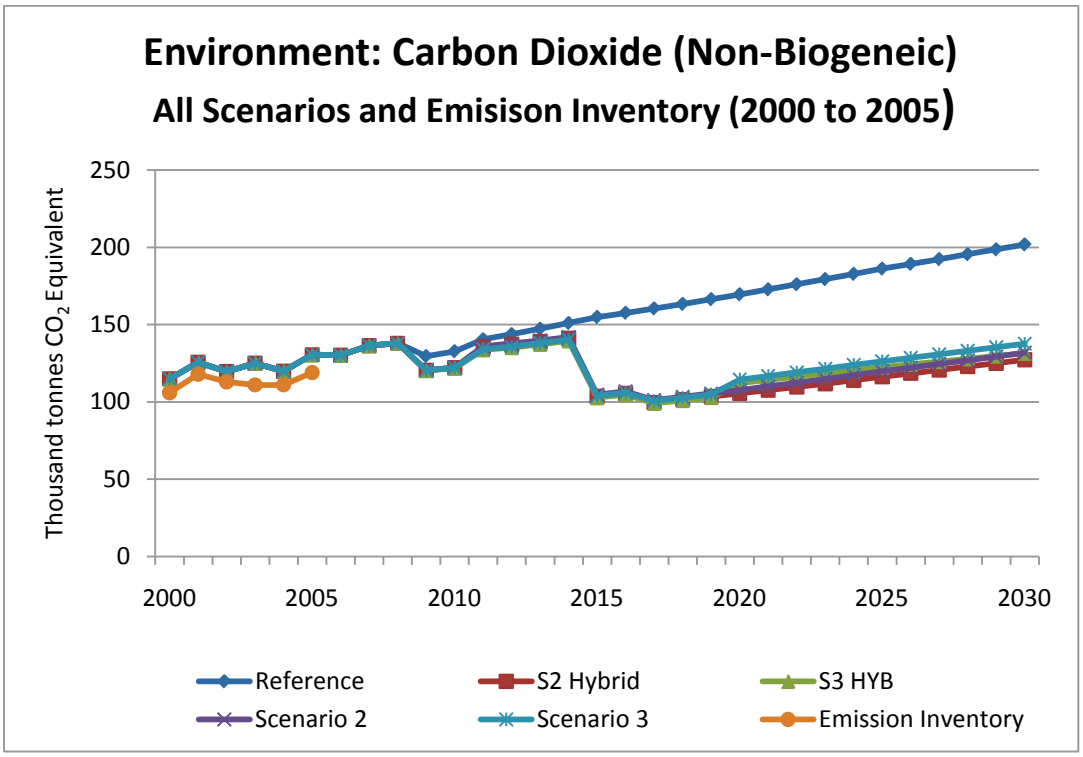


Figure 2 Non-Biogenic Carbon Dioxide Emissions for Dominica: All Scenarios



Transportation Branch

The available vehicle registration data (for 2000 to 2008) were categorised into seven (7) vehicle classes by making estimates of the fuel type and weight class for the available data. These data are subject to much uncertainty since vehicle weight class and fuel type data were lacking. The on road fleet (licensed vehicles) was assumed to be 10% greater[1] than the vehicle registrations (the vehicles inspected each year). Mitigation measures for transportation entailed the introduction of LPG in *S2* and *S3* and hybrid vehicles in *S2 Hyb* and *S3 Hyb.* The impacts of these mitigation measures on non-biogenic CO_2 emissions for the transportation branch are shown in Figure 3 (showing emission reductions relative to the reference scenario).

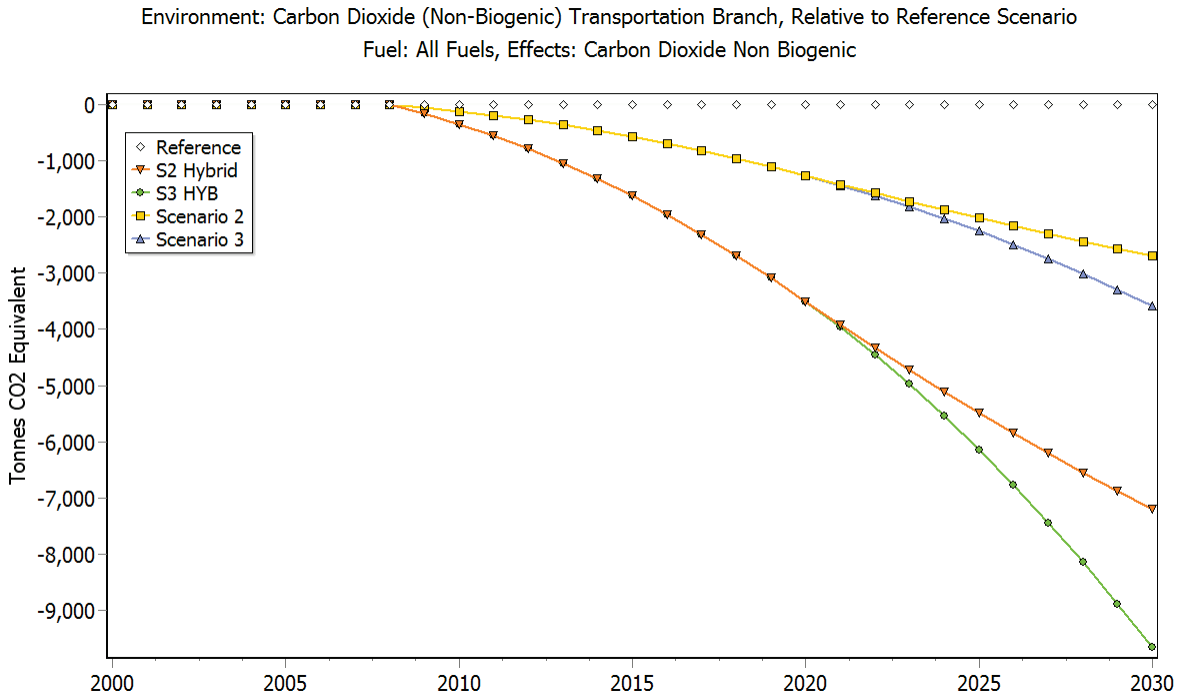
The percentage reductions in **transportation** emissions relative to 2008 are shown in Table 1. It is clear that the use of hybrids will provide the greatest reductions in emissions and that the reductions increase as the amount of hybrids in the fleet increases.

Table 1 Percentage Reductions in Transportation Emissions Relative to 2008

Scenario	Percentage Reductions from 2008	
	2020	2030
S2	2.5	5.2
S2 Hyb	6.8	18.7
S3	2.5	7.0
S3 HYB	6.8	18.7

[1] Data for 2002 to 2004 reported that licensed vehicles were 3.3 to 5.5% higher than those registered.

Figure 3 Non-Biogenic Carbon Dioxide Emissions for Dominica: Transportation Branch, All Scenarios Relative to the Reference Scenario



Domestic Emissions

The mitigation measures proposed for the domestic sector are based on adoption of more energy efficient appliances (TVs, refrigerators) and adoption of LED lighting after 2020. Since distribution of compact fluorescent lighting (CFL) bulbs in Dominica took place during 2007 there is limited scope for additional energy savings from CFL bulbs. No mitigation measures are proposed for cooking.

The mitigation measures could be achieved by adoption of import policies that require energy efficient appliances (e.g., by adopting Energy Star standards).

The CO_2 emissions from the domestic branch subcategories are illustrated in Figure 4 where the impact of geothermal electricity generation (after 2014) is evident. Between 2009 and 2014 the impact of mitigation measures is negligible since they are counteracted by the increases in the number of customers. The relative contributions from the various sub-branches in the domestic branch to CO_2 emissions are illustrated in Figure 5 (for the reference scenario) and Figure 6 for *S3*. These show that cooking accounts for most of the emissions. For scenario *S3*, once geothermal energy is used to generate electricity the allocated emissions for non-cooking activities are all but eliminated.

Figure 4 Environmental Loadings for Residential Demand Category: All Scenarios, Non Biogenic CO_2 Allocated to Demands

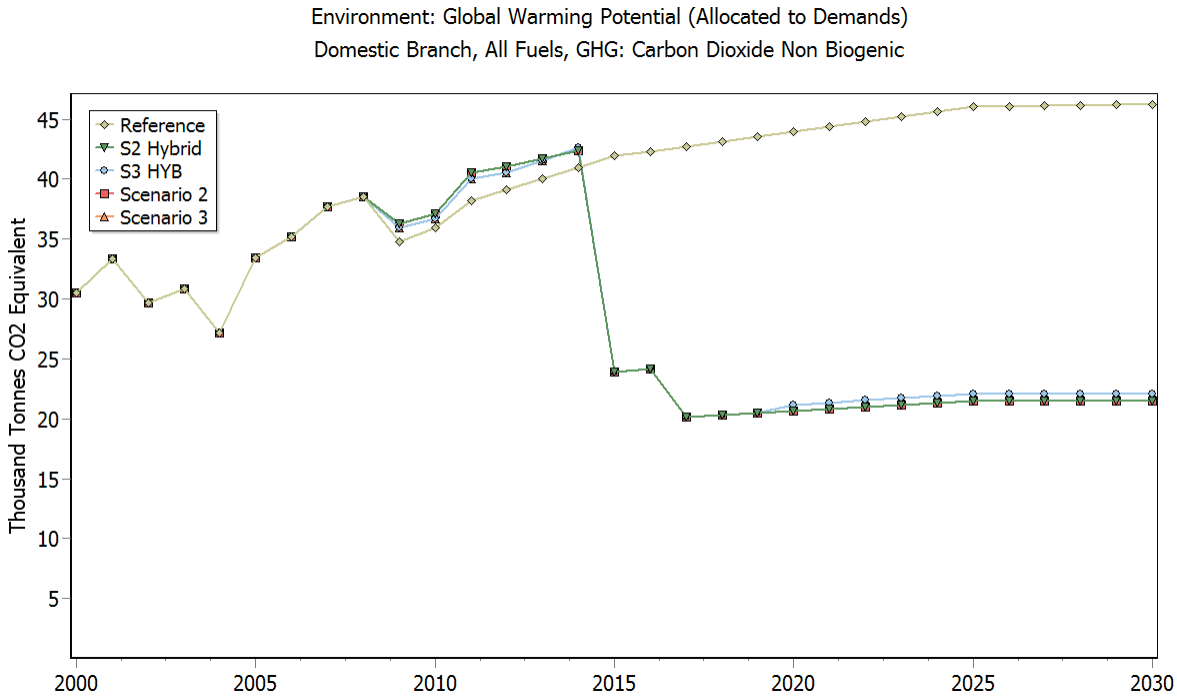


Figure 5 Environmental Loadings for Residential Demand Category Sub Branches: Reference Scenario, Non Biogenic CO_2 Allocated to Demands

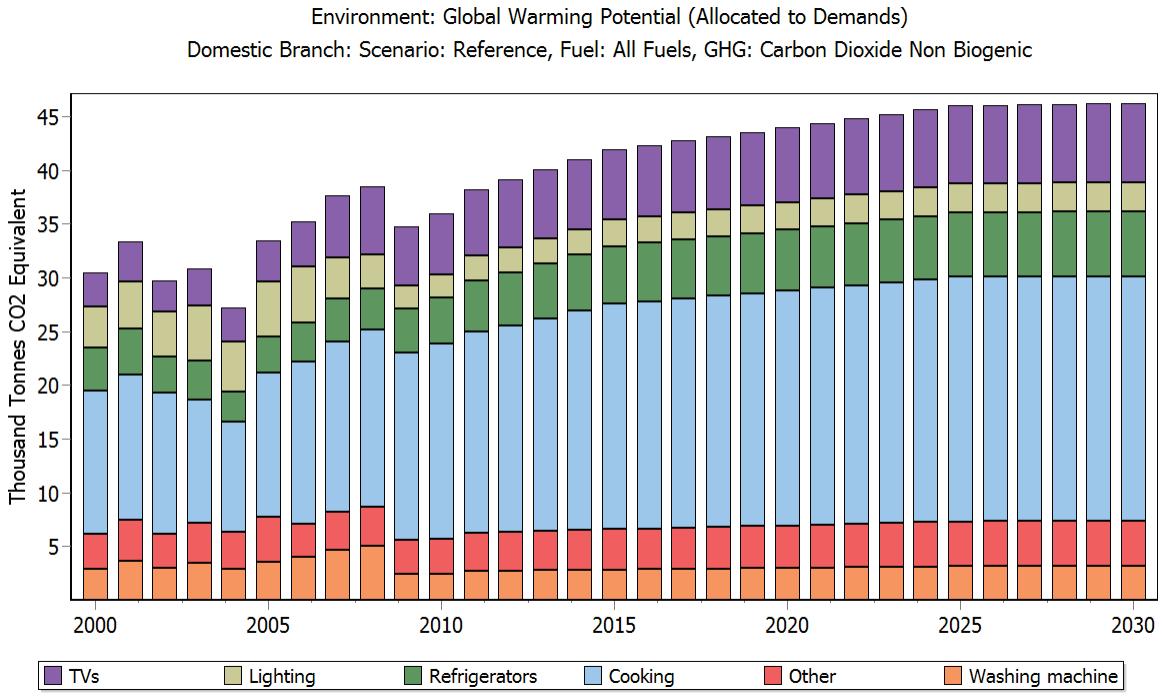
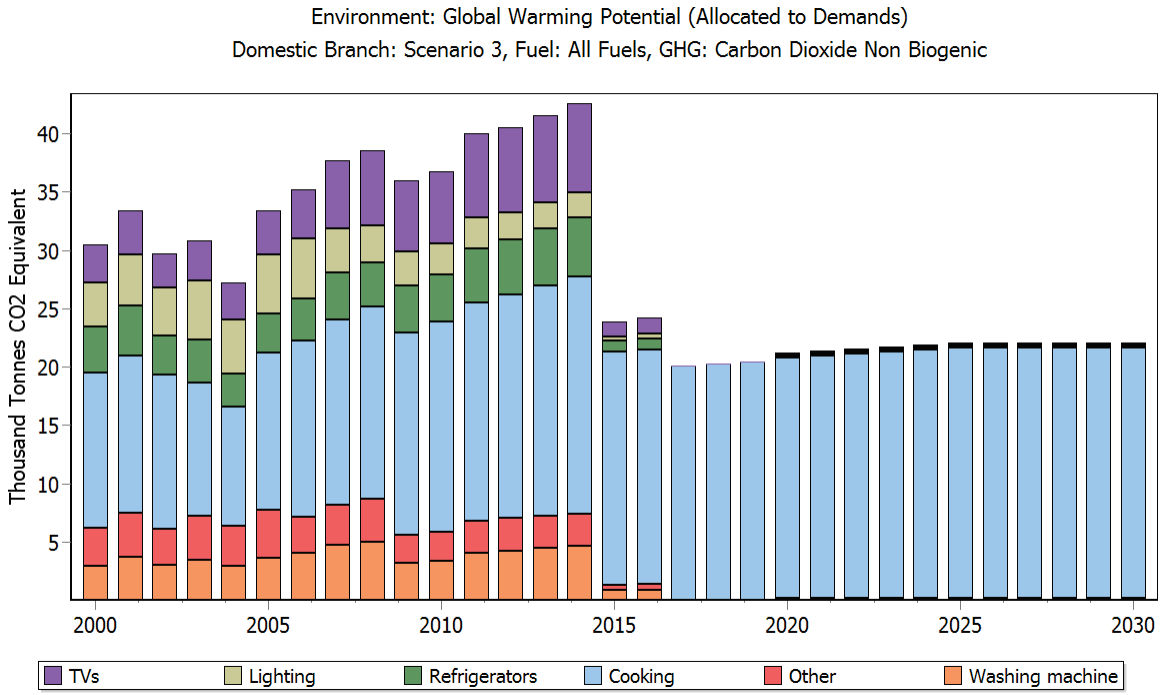


Figure 6 Environmental Loadings for Residential Demand Category Sub Branches: Scenario *S3*, Non Biogenic CO_2 Allocated to Demands



Commercial, Hotel and Industrial Sectors and DOMLEC Own Use

The mitigation measures proposed for these branches are based on general public education for energy conservation and introduction of additional solar water heating and more efficient air conditioning. Information on the numbers, sizes and types of refrigerant used would have allowed proposal of more specific mitigation measures.

Transformation

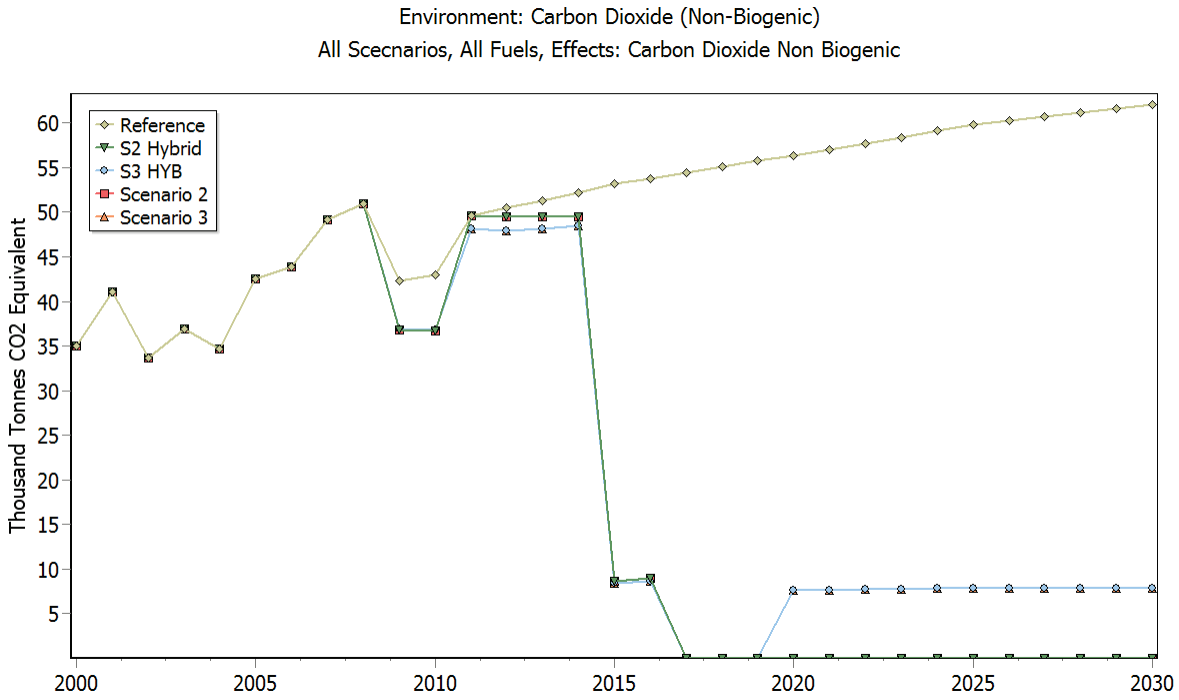
The transformation categories consist of transmission (of electricity), electricity generation and charcoal production activities.

Although the emissions directly associated with these activities are allocated to demand categories it is instructive to indicate the emissions directly associated with these activities. It should be noted that the analysis here made no effort to produce a least cost generation mix and hence the added generation capacity resulted in higher than normal reserve margins.

DOMLEC's proposed transmission reduction target (losses reduced from 12% in 2008 to 8% in 2015) was assumed in all scenarios but transmission losses for export were not taken into consideration.

Emissions from electricity generation arise mainly from diesel fuelled generators and in some scenarios form landfill gas combustion. The emissions for all scenarios are shown in Figure 7.

Figure 7 Environmental Loadings for Electricity Generation Branch, All Scenarios, Non Biogenic CO_2



MITIGATION ACTIVITIES FOR IMPLEMENTATION

Implementation of GHG mitigation will require various institutions with suitable policies and legislation to guide and govern them. Gaps in the current institutions and associated policies and legislation are identified together with specific recommendations for implementing mitigation activities.

The main energy sector institutions are the Ministry of Public Works, Energy and Ports, the Independent Regulatory Commission (IRC) and the Dominica Electric Power Company (DOMLEC).

The ministry has broad responsibility for the electricity sector and includes the Energy Unit that coordinates activities related to the development and expansion of electricity production and distribution. IRC was established in 2006 (under the Electricity Supply Act) and acts independently of Government or of any person, corporation or authority, except that the Commission shall have due regard to the public interest and overall Government policy as embodied in the legislation. The IRC routinely publishes its policies and decisions as well as the bases and supporting information for the decisions.

DOMLEC is a privately owned company and along with other entities is now subject to licences issued by IRC for the generation, transmission and distribution of electricity.

A key related institution is the Central Statistics Office (CSO) in the Ministry of Finance since it compiles and provides information on most data needed in the mitigation analysis. Additional detailed data can be obtained from relevant institutions such as IRC, DOMLEC. These latter two institutions provide regular and timely web-published data that satisfy the vast majority of data needed for electricity generation and transmission and some demand related data and information.

Implementation of Mitigation Measures

The mitigation measures need to address both the demand and supply of energy. The transportation (54%), domestic (18.5%) and industrial (13.6%) sectors which together account for 86% of the energy demand in 2008 will provide most of the opportunities for mitigation.

Demand related mitigation measures include the introduction of LPG and hybrid vehicles and increasing the use of diesel fuelled vehicles and more efficient domestic electric appliances. In addition public education and other measures to increase awareness about energy conservation will reduce energy use in all sectors.

Mitigation measures in the energy supply are centred on the development and introduction of geothermal energy as well as other alternate and renewable energy supplies (wind, distributed photovoltaic, hydro and energy from municipal solid waste).

Successful implementation of the mitigation measures will *inter alia* depend on:

- Introduction of policies to encourage alternative fuelled (LPG) and/or hybrid vehicles.
- Development of policies and programmes designed to influence market behaviour towards adopting more efficient use in energy across all sectors
- The provision of tax and other incentives/disincentives for the development and use of innovative technologies that improve/worsen efficiency
- Development of a policy and institutions that will enable carbon emissions trading
- Strengthening the institutional capacities in the energy and environment sectors
- Promotion of strategic partnerships between the public and private sectors to finance and develop small and large scale renewable energy projects and implementation of more efficient energy end use technologies

Gaps

A number of institutional, policy and information related gaps that could inhibit implementation of mitigation measures were identified.

Institutional and Policy Related Gaps

Dominica's National Energy Policy and Sustainable Development Plan are currently being formulated together with the drafting of Alternative Energy Legislation and Regulations. These initiatives provide a sound basis for the future development of energy related activities.

However, no specific mention was made of carbon trading or CDM in the Sustainable Development Plan or the National Energy Policy therefore the issue is identified as a gap. Carbon trading would allow geothermal and other renewable projects to take advantage of the CDM and similar schemes by registering projects with the CDM Executive Board. In order to be considered for registration, a project must first be approved by the Designated National Authority (DNA) but currently Dominica does not have a DNA nor any institutions or legislation that would promote the development of carbon trading eligible projects, review and approve carbon trading projects and generally provide governance for carbon trading. A carbon trading policy should be developed to be followed by the establishment of suitable institutions and legislation.

Information Gaps

There are a number of information gaps that are barriers to reliable determination of the mitigation potential and monitoring the progress of mitigation measures. Dominica's reliance on imported fossil fuels for transportation and most of its electricity generation has made it vulnerable to shocks to the economy (e.g., higher electricity, gasoline and diesel fuels costs) caused by higher fossil fuel prices. Gaps in the transportation and domestic energy demand sectors have severely limited the reliability of mitigation measures in these sectors. These are the very demand sectors that not only have high GHG emissions but also afford best opportunities for mitigation. There are also some information gaps in the electricity and fuel demand for the hotel, industrial and commercial sectors. In general there is adequate information for energy transformation (i.e., electricity generation).

The specific information gaps are as follows.

- Lack of fuel end use by sector
  - Gasoline
    - service station sales
    - agriculture/forestry/fishing sales
  - Diesel
    - service station sales
    - sales to the industrial, commercial and hotel sectors
  - LPG
    - Sales to domestic customers
    - Sales to commercial customers
    - Sales to hotels
- Need for more detailed motor vehicle fleet information
  - Recording of vehicle manufacturer, model year, make, vehicle weights (laden/unladen), type of fuel during vehicle registration in a database
- Survey data for annual vehicle kilometres travelled (or records of odometer readings during motor vehicle inspections) should be considered
- Installed capacities
  - Solar water heaters (domestic, commercial, hotel)
  - Photovoltaic systems and other renewable electricity generation systems (currently being implemented by IRC's self generators' registration requirements)
  - Data on the domestic, commercial air conditioning systems (the types and amounts of refrigerants in air conditioning systems)
- More frequent updates of Survey of Living Conditions (SLC) data

SLC surveys were conducted in 2002 and 2009. These surveys provide invaluable information on the total number of households and the percentages of households that use various types of fuel for cooking and lighting and the percentages of households that own various types of durable (electrical) goods and appliances (e.g., refrigerators, washing machines, air conditioning units, dish washers, TVs). More frequent surveys would allow for better tracking of the response to various mitigation related policies and mitigation measures.

Recommendations

The following recommendations are proposed to address information and policy gaps and build capacity in order to facilitate the implementation of mitigation measures.

- Complete the Sustainable Development Plan and National Energy Policy

- Revise the bases for tax/customs duties so that they are based on vehicle weight class and fuel type (not cc rating)
- Implement import and other policies to promote the introduction of alternate fuelled vehicles (LPG and/or hybrids)
- Develop and implement the regulatory framework to allow carbon trading to take place. This should include legislation establishing the DNR and associated entities and specification of the trading modalities for local and international entities (e.g., licensing, certification or regulation of such entities, owning certified emission reductions (CERs) and Verifiable Emissions Reductions (VERs) etc.)
- Build capacity to support carbon trading
- Enhance the import classifications of motor vehicles and electrical appliances and equipment to clearly distinguish between various categories of vehicles (based on fuel and vehicle weight) and appliances (based on technology and ranges of energy use). Examples are as follows:
    - Motor vehicles – to distinguish fuel used (i.e., diesel, gasoline, CNG, hybrid, electricity only etc.) and weight class
    - Refrigerators (range in SEER value, refrigerant (HC, HFC or HCFC)
    - TVs (based on technology and/or energy intensity)
    - Energy Star rated equipment/appliances
- Implement data collection and reporting systems to capture and report on gasoline, diesel and LPG fuel sales by sector
- Include more detailed information for the motor vehicle fleet and develop a suitable database and reporting system for the motor vehicle fleet

1. INTRODUCTION

1.1 BACKGROUND

The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty whose stated objective is to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the earth's climate system.

The treaty, which came into force on March 21, 1994, includes obligations by signatories to periodically submit National Communications that include a greenhouse gas (GHG) mitigation assessment, a national GHG emissions inventory, a report on climate change adaptation and a vulnerability assessment.

The (Revised) Terms of Reference for the contract for the Lead International Consultant (the Contractee) are as follows:

TERMS OF REFERENCE

GHG Inventory

1. *Provide assistance with Implementation Arrangements and Project Initiation by:*
2. *Participate in workshop at which draft inventory report is presented to stakeholders*
3. *Review draft final inventory report*

Mitigation Assessment

4. *Review previous mitigation options and relevant existing policies and institutional arrangements*
5. *Assist in the development of scenarios (time period, number and nature of scenarios)*
6. *Participate in workshop to develop mitigation scenarios*
7. *Assist in the implementation (training) in the use of the LEAP model*
8. *Review draft report on mitigation for the SNC*
9. *Participate in workshop to present mitigation report/findings*

This report provides the greenhouse gas mitigation assessment for Dominica. The deliverables for the Contractee were as follows:

a. submission of the first draft GHG report (delivered for review December 3, 2009)
b. acceptance of the final GHG inventory document (delivered for review March 13, 2010)
c. development of mitigation scenarios (delivered for review July 20, 2010)
d. delivery of training workshop (January 12, 2007)
e. acceptance of the final mitigation assessment document (delivered for review October 22, 2010)

The mitigation assessment is a national-level analysis of the impacts of various technologies and practices that affect greenhouse gas emissions. The assessment provides policy makers with an evaluation of those technologies and practices that can a) affect GHG emissions, b) identify policies and programs that could enhance the adoption of GHG mitigation measures and c) contribute to national development objectives.

This mitigation assessment should be followed by more detailed evaluation of specific policies, programs, or projects designed to encourage implementation of selected technologies and practices.

1.2 OBJECTIVES AND SCOPE

The mitigation assessment study was initiated in March 2009, with the financial assistance of the Global Environment Facility (GEF), through the United Nations Development Program (UNDP). The implementing agency in the Government of Dominica is the Environment Division.

The scope of this assessment covers projections of GHGs for the period 2009 to 2030 and uses historical data for the period 2000 (the base year) to 2008 in order to calibrate where feasible, the bases for the projections. Three scenarios are developed to project emissions – a Reference Scenario and two other scenarios (Scenario 2 and Scenario 3) characterised primarily by increasingly aggressive mitigation measures. The Reference Scenario only includes activities and projects that are currently under way and does not include any additional GHG mitigation.

The other scenarios describe various possible and plausible energy use and development strategies and activities that are required to satisfy the demand for energy based on population growth and national development goals. Various mitigation options (technologies and measures that can affect GHG emissions) are included in these scenarios.

1.3 REPORT STRUCTURE

The report is presented in four sections.

Section 2 of the report presents the overall approach which comprises:

- General background information;
- GHG emissions and mitigation opportunities;
- energy sector resource profile;
- key national policies and initiatives;
- the methodology for the mitigation assessment including the scenarios; and
- constraints and data gaps in carrying out the assessment.

The results of the projections for each scenario are presented in Section 3.

Mitigation options, policy implications, capacity building needs and recommendations are presented in Section 4.

2. APPROACH

2.1 BACKGROUND INFORMATION

Geography

Dominica is an island among the Windward Islands in the eastern Caribbean Sea situated approximately 42 km to the south of Guadeloupe and 40 km to the north of Martinique. It is located between 15° 12' and 15° 39' N Latitude and 61° 14' and 61° 29' W Longitude. It is 48 km long and 24 km wide at its widest point with an area of 75,100 hectares (ha).

Dominica is a volcanic island characterised by very rugged and steep terrain extending above 1500 metres (m) in elevation over much of the country. The cone of Morne Diablotin (1730 m) dominates the topography of the northern half of the island whilst a chain of mountains, including Morne Trois Piton (1424 m), Morne Micotrin, Morne Anglais, and Morne Plat Pays extend through the south of the island. The peaks of all these mountains are less than 7 km from the sea. Flat land is limited to coastal areas in the northeast, in river valleys and in certain areas in the centre of the island. Sixty-nine percent (69%) of the island is forested ranging from dry scrub woodland on the coast to lush, tropical forest in the interior.

Climate

The climate is humid tropical-maritime, with a mean annual temperature of 27° C, varying between a maximum of 33° C along the coast and 27° C in the mountains during the day, and a minimum of 18° C and to 12° C respectively, during the night. Average annual precipitation varies from over 7620 mm (300 inches) in the lush forested interior to an average of about 1270 mm (50 inches) along the central portion of the west coast, which tends to be the driest section of the island. The drier season is from February - May and a wetter season from June –January (see Figure 2-1 for rainfall and temperature data for the capital, Roseau and Table 2-1 for precipitation data for Marigot and Canefield).

Dominica is situated in the tropical Atlantic hurricane belt and has been impacted by fifteen (15) tropical weather systems, eleven (11) of which were hurricanes since 1979. The frequent hurricanes have adversely impacted the development of Dominica's social and economic infrastructure.

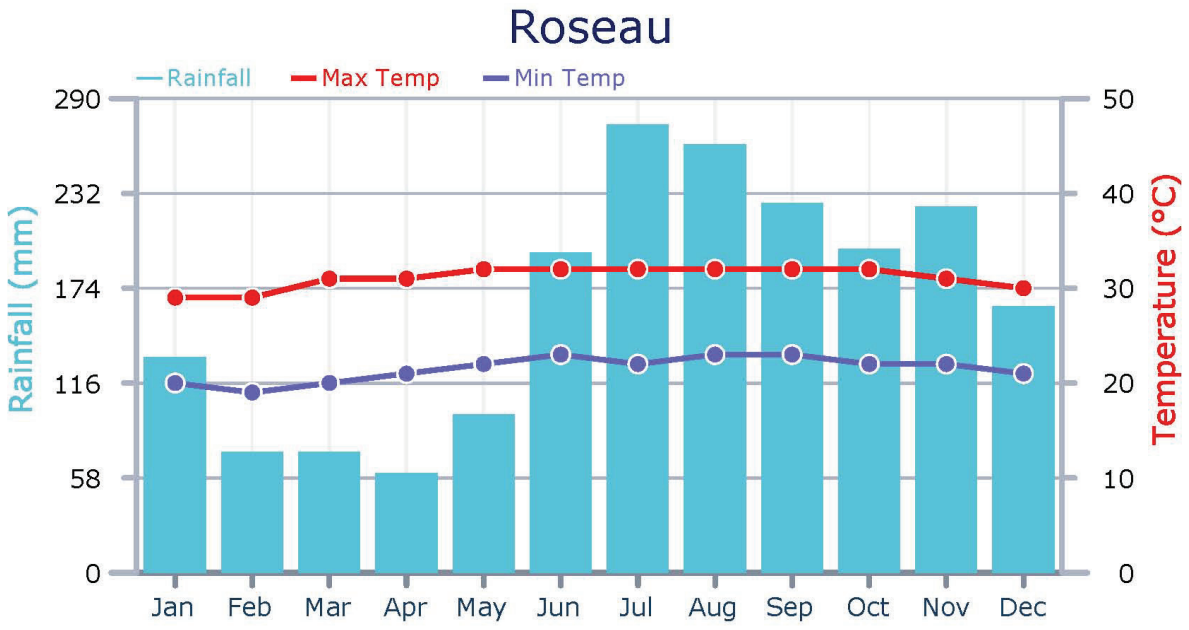
Economy

Dominica's economy is heavily dependent on agriculture which accounts for ~18% of the gross domestic product (GDP) at current factor cost between 2002 and 2006 (see Table 2-2). Agricultural production has been dominated by bananas and grapefruit for export while other crops are for local consumption. Hurricane Dean in 2007 inflicted damage (primarily to the agriculture sector) estimated at 20% of GDP and economic growth declined to ~1.5% in 2007 from 3% prior. External public debt is high (95% of GDP in 2007) but is projected to be reduced over the next few years (see Table 2-3). There are challenges faced in market access for bananas and there is now increased focus on fishing, ecotourism and financial services.

Dominica's industrial sector is small (up to 8.1% of GDP at factor cost in 2005) and is limited to packaging of soaps, detergents, dental cream and floor polish.

A baseline International Monetary Fund (IMF) growth scenario anticipates GDP growth in the medium term to increase to 3% in 2010 and thereafter (to 2013 (see Table 2-3). The IMF staff report concluded that "further diversification of the economy, including the development of the tourist industry, would be key to enhancing growth prospects. Plans for developing the tourist

Figure 2-1 Rainfall and Temperature for Roseau



Source: http://www.wordtravels.com/Cities/Dominica/Roseau/Climate

Table 2-1 Average Monthly Rainfall (mm)

Station	2001	2002	2003
Marigot	2356	2378	2586
Canefield	1523	1476	1615

Source: Dominica statistics at a glance 2005 http://www.dominica.gov.dm/cms/?q=node/8

Table 2-2 Dominica: Gross Domestic Product at Current Factor Cost

	2000	2001	2002	2003	2004	2005
	(In millions of Eastern Caribbean dollars)					
GDP at current factor cost	621.6	602.8	575.2	581.1	611.4	641.3
Agriculture	112.5	106.4	102.1	106.2	114.5	115.2
Crops	90.1	83.7	79.1	82.8	90.6	90.6
Livestock	8.3	8.4	8.4	8.5	8.6	9.0
Forestry	3.6	3.7	3.7	3.7	3.7	3.7
Fishing	10.6	10.7	10.9	11.2	11.5	11.8
Manufacturing	5.2	5.2	3.9	4.6	5.2	5.8
Mining and quarrying	54.4	45.1	44.5	46.5	50.8	51.9
Electricity and water	33.9	31.3	36.9	36.9	39.3	41.3
Construction	52.2	52.4	39.2	46	50.7	56.1
Wholesale and retail trade	72.6	73.4	69.7	73.2	77.4	82.6
Hotels and restaurants	17	16	15.5	15.1	17.7	18.8
Transport	57.7	53	45.3	48.8	54.9	56.6
Road transport	29.8	27.7	22.6	26	29.4	30
Sea transport	23.1	20.7	18.7	18.5	20.6	21.2
Air transport	4.9	4.5	4.0	4.4	5.0	5.4
Communications	47.8	44.3	39.6	26.1	27.0	28.4
Banks and insurance	70.1	70.1	64.8	65.6	69.1	76.2
Real estate and housing	20.9	21.3	21.8	22.3	22.7	23.7
Government services	121.7	128.4	133	127.8	123.7	126.3
Other services	9.5	9.9	10.4	10.4	10.9	11.8
Less imputed service charge	54	54.1	51.5	48.3	52.4	53.5
	(In percent of GDP at current factor cost)					
GDP at current factor cost	100	100	100	100	100	100
Agriculture	18.1	17.7	17.7	18.3	18.7	18
Crops	14.5	13.9	13.7	14.3	14.8	14.1
Livestock	1.3	1.4	1.5	1.5	1.4	1.4
Forestry	0.6	0.6	0.6	0.6	0.6	0.6
Fishing	1.7	1.8	1.9	1.9	1.9	1.8
Manufacturing	0.8	0.9	0.7	0.8	0.9	0.9
Mining and quarrying	8.8	7.5	7.7	8	8.3	8.1
Electricity and water	5.5	5.2	6.4	6.3	6.4	6.4
Construction	8.4	8.7	6.8	7.9	8.3	8.8
Wholesale and retail trade	11.7	12.2	12.1	12.6	12.7	12.9
Hotels and restaurants	2.7	2.7	2.7	2.6	2.9	2.9
Transport	9.3	8.8	7.9	8.4	9	8.8
Communications	4.8	4.6	6.9	4.5	4.4	4.4
Banks and insurance	3.7	3.4	11.3	11.3	11.3	11.9
Real estate and housing	0.8	0.7	3.8	3.8	3.7	3.7
Government services	7.7	7.3	23.1	22	20.2	19.7
Other services	11.3	11.6	1.8	1.8	1.8	1.8
Less imputed service charge	3.4	3.5	9	8.3	8.6	8.3

Source: Dominica: Statistical Appendix; IMF Country Report 07/324; July 2, 2007

Table 2-3 Key Macroeconomic Indicators under Baseline Scenario (In percent of GDP, unless otherwise noted)

	2007	2008	2009	2010	2011	2012	2013
Real GDP growth (percent)	1.5	2.6	2.8	3	3	3	3
Inflation (percent, end period)	5.7	6.7	2.8	1.5	1.5	1.5	1.5
Central government overall balance	1.1	0.6	1	1.3	1.5	1.7	1.8
Central government primary balance	3	2.4	3	3	3	3.1	3
Public sector debt	94.3	84.8	78.3	72.9	67.6	62.5	57.5
External current account balance	-23.6	-28.4	-25.5	-23.6	-22	-20.4	-18.8
Public sector external debt	65	57.8	52.4	47.7	42.6	38	33.9

Source: IMF Country Report No. 08/310. Dominica: 2008 Article IV Consultation—Staff Report; Staff Supplement; Staff Statement, and Public Information Notice on the Executive Board Discussion, page 6.

sector, including improving air access and roads to tourist attractions, are well advanced and should be financed with a view to maintaining the sustainability of public debt".

Social Development

Selected social development indicators are given in Table 2-4. As measured by the Human Development Index[2] (HDI), Dominica is considered to be a high level human development country, with an HDI score of 0.814, ranking 73rd out of 182 countries in 2007. The HDI combines measures of life expectancy, literacy, school enrolment and per capita GDP into a single index to measure relative human development among nations. This index value reflects the fact that Dominica is characterized by moderate economic development as evidenced by GDP growth rates (1.4% between 1990 and 2007), an 88% adult literacy rate and relatively strong social indicators including high life expectancy (76.9). In 2007, Dominica's GDP purchasing power parity (PPP) per capita was US$7,893 (73rd among 182 nations and territories of the world). There was no 2010 Environmental Performance Index (EPI) ranking for Dominica[3].

Resources

Dominica has no known petroleum energy resources but makes use of some of its hydroelectric energy resource. It has extensive geothermal energy potential in addition to solar, wind and biomass resources. Dominica's geothermal, hydro and solar photovoltaic (PV) resources have been estimated at 100 MW, 8 MW and 45 MW respectively[4]. There have been proposals for wind and biogas generation and there is some solar power for household water-heating. The wind potential along Dominica's East coast was conservatively estimated in the range of 20-30 MW[5]. A pilot 1 kW wind turbine was erected in August 2002 at Delices by Dominica Sustainable Energy Corporation (DSEC)[4].

2.2 GHG EMISSIONS AND MITIGATION OPPORTUNITIES

The potential opportunities for reductions in Dominica's GHG emissions in part can be determined by examination of the GHG emission inventory. The GHG emissions for 2000 to 2005 (see Tables 2-5 and 2-6) show that CO_2 dominated the emissions (383 Gg). Most CO_2 emissions (~97%) were from the energy sector. The relative contributions to CO_2 emissions in 2005 are shown in Figure 2-2. Emissions of methane (CH_4) were 1.6 Gg or 33.6 Gg CO_2 equivalents (CO_2e) when the global warming potential for CH_4 is taken into account. CH_4 emissions are from agriculture (50%), the waste sector (43%) and the remainder from forestry and energy sectors. In view of the dominance of CO_2 emissions from the energy sector mitigation opportunities will be examined only for the energy sector but it will be also equally important to maintain the sinks (forestry) in Dominica.

2.3 ENERGY SECTOR RESOURCE PROFILE

Dominica has no known primary petroleum or coal reserves and imports all of its petroleum requirements. Use of solar energy is negligible (water heaters). There is limited use of wood and charcoal for domestic use (cooking).

Dominica Electricity Services Ltd. (DOMLEC) is currently the sole licensed provider of electricity. DOMLEC operates three hydro-electric power stations namely: Laudat (1.3 MW), Trafalgar (4.46 MW) and Padu (1.88 MW)[6]; and two medium speed diesel power stations at Fond Cole and Sugar Loaf. Diesel oil is used to produce electricity. Currently, the installed nameplate hydroelectric capacity is 7.66 MW[4] and 15.9 MW diesel[7]. Firm capacity, after allowing for dry season derating of the hydro, is 14.8 MW. The transmission and distribution (T&D) network, comprising 368 kilometres (km) of 11 kV and 922 km of low voltage overhead lines, serves about 98% of the island's population[8].

Table 2-4 Select Socio-Economic Indicators

INDICATORS	2002	2006	2007	2009##
Population ('000) [a]	70.382	71.008	71.258	72.011
Population Growth Rate (%)	-0.8	0.4	0.4	0.4
Human Development Index [b]			0.814	
Emigration rate (%) [b]			38.3%	
Remittances (Million US $) [b]			26.0	
Overseas Development Assistance/capita (US $) [b]			288	
GDP per capita [b]			US $7,893	
Adult Literacy (% of ages 15 and older) [b]			88%	
Combined gross enrolment ratio [b]			78.5%	
Life Expectancy at Birth (years) [c]	77.3		75.77	
% Population below Poverty Line [d]	39%			
No access to safe water [d]	9%			
Access to public electricity [d]	88%			
Type of fuel for cooking by % of households: [d]				
Charcoal	5			2.55
Wood	13			9.42
LPG	79			86.7
Other	4			1.36

Sources:

2009 Survey of Living Conditions, Central Statistical Office. Estimated values are highlighted in yellow.

a Selected economic indicators statistics from http://www.dominica.gov.dm/cms/index.php?q=node/1013 accessed October 13, 2010.
b Human Development Report 2009 Available at
http://hdrstats.undp.org/en/countries/country_fact_sheets/cty_fs_DMA.html
c Life expectancy 2010: http://www.populationdata.net/index2.php?option=pays&pid=56&nom=dominique
d Dominica Country Poverty Assessment. Caribbean Development Bank, Government of the Commonwealth of Dominica Country Poverty Assessment Final Report Volume 1 of 2: Main Report: Halcrow Group Limited in association with Decision Economics (Canada), Willms and Shier (Canada), DPU, University College London (UK) and The National Assessment Team of Dominica, June 2003.

Gross domestic product at factor cost is the value at factor cost of the product, before deduction of provisions for the consumption of fixed capital, attributable to factor services rendered to resident producers of the given country.

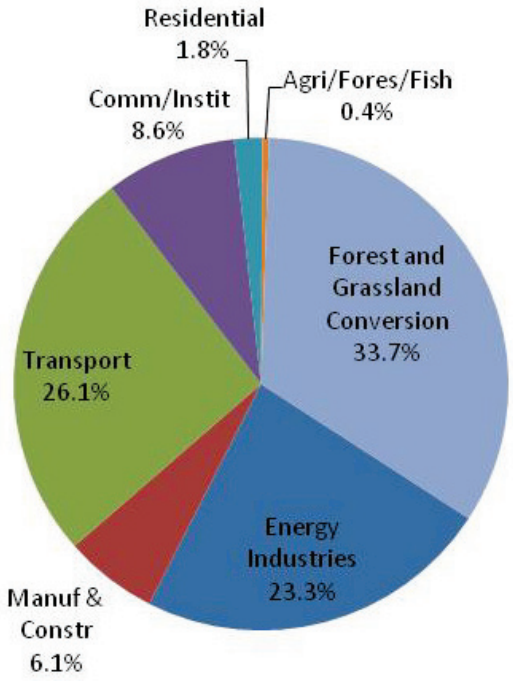
Table 2-5 Dominica's GHG Emissions and Removals (Gg) 2000 to 2005

	CO_2	CO_2	CH_4	N_2O	HFCs
	Emissions	Removals			
2000	106	-138	1.57	0.118	0.0046
2001	118	-137	1.57	0.108	0.0050
2002	113	-133	1.56	0.101	0.0017
2003	111	-131	1.55	0.107	0.0019
2004	111	-130	1.56	0.076	0.0027
2005	119	-128	1.56	0.097	0.0030

Table 2-6 Dominica's GHG Emissions (Gg) 2000 to 2005

	1994[#]	2000	2001	2002	2003	2004	2005
1 Energy	72.6	106	118	113	111	111	119
A Fuel Combustion (Sectoral Approach)	0.0	106	118	113	111	111	119
1 Energy Industries	20.2	34.9	40.3	33.1	36.1	34.1	41.8
2 Manufacturing Industries & construction	4.10	9.10	10.1	10.5	13.2	11.6	11.0
3 Transport	37.4	47.1	53.7	55.4	46.8	42.9	46.8
4 Other Sectors	10.8	14.7	13.8	14.3	15.0	22.3	19.5
a Commercial/Institutional	7.33	10.0	9.43	9.91	10.7	18.4	15.4
b Residential	3.41	4.07	3.67	3.59	3.42	3.08	3.29
c Agriculture/Forestry/Fishing	0.100	0.631	0.721	0.766	0.856	0.811	0.766
5 Land-Use Change & Forestry [(2)]							
A Changes in Forest & Other Woody Biomass Stocks (Removals)	-355	-198	-198	-193	-192	-190	-188
B Forest and Grassland Conversion	26.5	60.4	60.4	60.4	60.4	60.4	60.4
C Abandonment of Managed Lands	-43.7	0	0	0	0	0	0
D CO_2 Emissions and Removals from soil	0.37	0	0	0	0	0	0

Figure 2-2 Dominica's GHG Emissions: 2005



Other petroleum fuels imported are liquefied petroleum gas (LPG) used for domestic cooking and in commercial establishments, gasoline for transportation and diesel for transportation and industrial use.

The Electricity Supply Act of 2006 established the Independent Regulatory Commission (IRC) to deal with regulatory matters for the generation, transmission, distribution and supply of electricity services. IRC became operational in June 2008 and has been active in moving to establish systems, procedures, licences, tariffs, and standards for the electricity sector.

The CO_2 emissions between 2000 and 2005 from the energy sector (see Table 2-6) show that emissions from transportation ranges from 38.6 to 44.4% while that from electricity generation ranges from 29.3% to 35.1%. Between them transportation and electricity generation account for just over 69% to 80% of the CO_2 emissions.

2.4 KEY NATIONAL POLICIES AND INITIATIVES

The key national policies that are relevant to mitigation are those associated with the sectors that affect GHG emissions or are potentially affected by climate change. These sectors are energy (electricity production and associated demand categories namely, transportation) and waste management. The growing importance and emphasis on the tourism sector warrants separate consideration although many aspects of the tourism sector are associated with the demand for electricity and fuel consumption.

As is the case with other small island states, Dominica contributes negligibly to global GHG emissions but is disproportionately affected by climate change impacts. The climate change adaptation policy is therefore important to set the national planning and development context for adaptation to climate change.

The key policies, programs and plans are:

- Climate Change Adaptation Policy
- Sustainable Energy Plan and National Energy Policy
- Energy Development Programme for Dominica
- Dominica Tourism Master Plan 2005 – 2015 and the Sustainable Tourism Policy and Marketing Strategy (2005-2009)

Climate Change Adaptation Policy

Dominica's National Climate Change Adaptation Policy was adopted by cabinet in 2002. The policy encourages all agencies in Dominica to integrate adaptation to climate change in the development of their policies, plans and projects by incorporating appropriate adaptive responses and to ensure that all levels of society are adequately informed about climate change issues and their implications. Responsibility for implementing the policy rests with the Environmental Coordinating Unit (ECU) in the Ministry of Agriculture and Fisheries.

Sustainable Energy Plan and National Energy Policy

The Sustainable Energy Plan together with the National Energy Policy[9] will:

- Lay out a strategy by which the energy production and use in Dominica may be transformed, becoming more economically and environmentally sustainable, while enhancing the electricity generation mix.

- Ensure the existence of adequate energy supplies at affordable rates to sustain economic development, while meeting current and projected power demand.
- Provide for stable, reliable, and affordable electricity supplies for all customers.
- Reduce the cost of electricity for consumers.
- Enhance the security of energy supply and use for all sectors of the economy.
- Allow reasonable incomes for businesses engaged in the local energy sector, while attracting international investment where appropriate –tourism; manufacturing; agro-processing...
- Create new job opportunities for Dominicans.
- Promote energy efficiency and conservation at all levels of the economy in order to achieve optimum economic use of renewable and non-renewable sources of energy.
- Protect the local and global environment by maximizing the use of renewable-energy and energy-efficiency alternatives where viable. This is especially relevant in Dominica as much of the renewable energy generation may take place in nature preserves or rain forest areas. It is essential that this be done in a manner that does not threaten biodiversity, forestation levels, and other environmental aspects.
- Promote the generation of income through energy exports produced from renewable energy sources (esp. geothermal resources).
- Contribute to improving the Balance of Payments accounts for Dominica.

The National Energy Policy will articulate government's position with regards to the governance of the energy sector, and shall provide guidance on areas such as:

- Regulation;
- Legal Aspects;
- Pricing and taxation;
- Safety and Industry Standards;
- Power expansion planning/development;
- Public-Private Partnerships/Engagements;
- Trading and Export;
- Capacity Building

The National Energy Policy will look at:

- Self Generation;
- Independent Power Production;
- Net Metering;
- Development of indigenous sources of renewable energy –geothermal; hydro; solar; wind; biomass...
- Service standards;
- Tariffs;
- Energy Efficiency;
- Environmental Aspects;
- Universal access to electricity

Dominica Tourism Master Plan 2005 – 2015 and the Sustainable Tourism Policy and Marketing Strategy (2005-2009)

The objectives of the Tourism Master Plan are to:

- provide a comprehensive planning framework for the development of the tourism sector so that it can play a key role in the diversification of the Dominica economy;
- elaborate a vision of the future direction and content of the sector, which can help to focus and guide the actions of the various stakeholders towards a shared goal;
- identify priority areas for tourism development, related tourism facilities and supporting infrastructure; and
- specify the major programmes, roles and responsibilities of key players, institutional arrangements and resource requirements for achieving the vision.

Achieving the Master Plan target will position the tourism sector as a driver of the economy such that.

- tourism to represent between 8% and 12% of GDP by 2015
- foreign exchange earnings of EC$400M by 2015
- government receipts from tourism between EC$50 and EC$60M annually by 2015
- up to 3,000 new job opportunities (hotels, restaurants, guides, transportation services, attractions) created by 2015

In addition, the Dominica economy will receive further stimulus from the new investments in facilities and infrastructure. Over the period of the plan these new investments will amount to about EC$2,665M, representing an injection of about EC$300M annually to the building and construction sector and the commercial sector with downstream benefits to the agriculture and services sectors.

A five year tourism action plan presented in 2010 focuses heavily on increasing cruise ship visitors to the island by maintaining a 3.5% growth rate and increasing revenue left behind by cruise and stay over visitors.

2.5 METHODOLOGY FOR THE MITIGATION ASSESSMENT

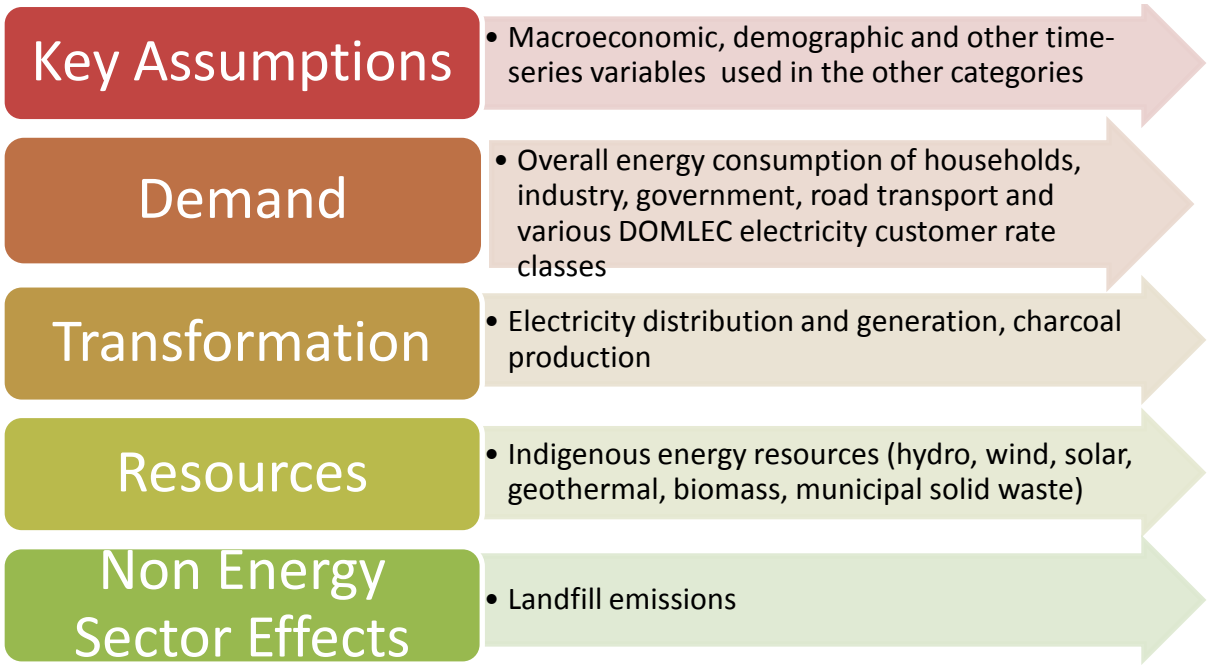
A mitigation assessment seeks to provide a national level analysis of the various practices and technologies that have the potential to affect GHG emissions over time. The assessment will include the development of long term scenarios that quantify how future GHG emissions can be reduced relative to one or more baseline scenarios.

The mitigation analysis used the Long-Range Energy Alternatives Planning System (LEAP) model[10] and examined the demand, transformation, resources and non-energy sector emissions and effects. LEAP is a scenario-based energy-environment modelling tool based on comprehensive accounting of how energy is consumed, converted and produced in a given region or economy under a range of alternative assumptions. Scenarios are self-consistent story lines of how a future energy system might evolve over time in a particular socio-economic setting and under a particular set of policy options defined for example by specific projects and measures. Scenarios in LEAP can be compared to assess their energy requirements, environmental impacts and social costs and benefits.

The base year used in this analysis is 2000 - the same year used for compilation of the national GHG emission inventory and is the year preferred by UNFCCC for reporting Second National Communications. The first projection year for all scenarios was 2009 and the last 2030. Historical data between 2000 and 2008 were used in the so called Current Account (LEAP model terminology).

Projections for the years 2009 to 2035 were made for three groups of scenarios: the Reference Scenario and two others called Scenario 2 and Scenario 3. The input data for the LEAP model are grouped into five categories called modules (see Figure 2-3).

Figure 2-3 Modules in the LEAP Model



The subcategories or branches in each of these modules were determined by the level of detailed data that were available. The subcategories in the model are shown in Table 2-7. The information sources for the data used in the five categories are described below.

2.5.1 Information Sources

Since the emission sources in Dominica are limited to the energy sector, the information required for the mitigation assessment consists of electricity generation and the associated demands for electricity and other petroleum fuels. Industrial activity in Dominica is limited and energy use is primarily in the form of electricity and diesel fuel use. The demand for energy was therefore broken down into the categories for which data are available (electricity demand for household, government, industrial, commercial customers) and fuels used in transportation. GHG emissions associated with agriculture and forestry sectors are small and the potential for mitigation in these sectors is limited and were therefore excluded from the analysis.

The key information sources included the Central Statistical Office (CSO) in the Ministry of Finance and Dominica Electricity Services Ltd. (DOMLEC) and an interim World Bank report on Caribbean Regional Electricity Generation, Interconnection, and Fuels Supply Strategy.

2.5.2 Modules used in the Analysis

2.5.2.1 Key Assumptions Module

This module contains macroeconomic (GDP and GDP growth rate) and demographic (population, population growth rate, household size) data. Historical and projected gross domestic product (GDP) data were obtained or derived from data published by the Central Statistics Office (CSO) and the International Monetary Fund (IMF) staff reports (see footnotes in Tables 2-2 and 2-3).

2.5.2.2 Demand Module

The demand module requires activity and energy intensity data such that the product of the two gives the energy consumption. The demand module was broken down into various "branches" namely, domestic households, commercial, hotel, industry, street lighting and transport. These branches were selected because fuel and electricity use and other activity data are available for them and/or subcategories within them. The methodologies applied for the various demand branches are described below. Additional details for future activity and energy intensity information are provided in the following section on scenarios.

Domestic Households

The 2001 census[11] and the *Dominica: Country Poverty Assessment*[12] provided detailed household (residential) data for the numbers of households that have or use various types of household amenities or appliances. These amenities or appliances are used as the sub-branches indicated in Table 2-7. Appliances with small penetration (low percentages of households that have them) and either low annual energy use or little prospect for increased penetration were grouped into the sub-branch "All other".

Country-specific energy intensity data for residential (household) appliances (i.e., average annual electricity consumption for various appliances) used in Dominica are not available and so U.S. or Canadian energy intensity data were used since nearly all appliances used are imported from North America.

Future energy intensity data used in scenarios *S2* and *S3* were based on existing and proposed voluntary energy standards for the appliances used in the U.S. and/or Canadian Energy Star programs but with later implementation (by 2 years) or penetration for Dominica. Import data for various appliances and the typical and maximum lifetimes of appliances together with policy initiatives were taken into consideration in estimating the penetration of energy efficient appliances in scenarios *S2* and *S3*.

Commercial, Hotel, Industrial, and Street lighting

The only reliable energy consumption data available for these sub branches is the electricity consumption. The amount of diesel fuel used by the industrial sector is not tracked and had to be estimated (see below).

Transportation

Limited fleet composition and gasoline consumption data were also available. The fleet data did not include the breakdown between gasoline and diesel fuelled vehicles. Allocations of vehicles to fuel type were made based on gasoline and diesel consumption for road transportation.

2.5.2.3 Transformation Module

The transformation module includes electricity generation and charcoal production. In 2002 charcoal was used for cooking in 5% of households and wood was used in 13% of households[13]. Charcoal production was estimated from these data.

2.5.2.4 Resources Module

The indigenous energy resources available in Dominica are charcoal, solar energy, wind and municipal waste but currently there is very limited use of these resources.

Table 2-7 Subcategories in the Five Modules in the LEAP Model Input Data

Key Assumptions	Demand	Transformation	Resources	Non-Energy Sector Effects
Population Household Size Population growth rate	Transportation Seven classes of vehicles plus off road vehicles Commercial Hotel Domestic Cooking Lighting Refrigeration Television Washing machine All other Industrial Street lighting	Transmission & Distribution Transmission Loss reduction Electricity Generation Hydro Thermal Geothermal Wind EFW (municipal solid waste) Photovoltaic (distributed)	Primary Wind Geothermal Solar Municipal Waste Biomass	Landfill emissions

Charcoal and fuel wood were used for cooking by 5% and 13% of households respectively in 2002[12]. There is also very limited commercial use of wood in bakeries. Data on fuel wood use and charcoal production are not compiled and estimates are subject to large uncertainties. Use of wood and charcoal is expected to decline further. Mitigation scenarios include use of solar, wind and municipal solid waste. Expanded use of solar water heating for example in hotels would reduce the need for energy derived from fossil fuel combustion.

2.5.2.5 Non-Energy Sector Effects

The methane generated from landfill emissions is the only significant non-CO_2 GHG emission. Simple projections of these emissions were made based on population growth.

2.6 SCENARIOS

Three groups of scenarios were defined: *Reference*, *S2* and *S3*. The main features of the scenarios are as follows.

- The *Reference* scenario does not have any mitigation measures.
- The *S2* and *S3* scenarios include progressively aggressive mitigation measures for electricity consumption. The mitigation measures for the reduction in electricity demand include more efficient appliances, additional penetration of compact fluorescent (CFL) bulbs for lighting, solar water heating for hotels and residences and more efficient air conditioning (hotels).
- Mitigation measures for transportation in the *S2* and *S3* scenarios are based on whether there are no hybrid vehicles but a mix of gasoline/diesel together with LPG (*S2*) in which there are hybrid vehicles (*S2 Hyb*). *S3* is subdivided into *S3 and S3 HYB*.
- All scenarios assume the construction of a 7.5 MW medium speed diesel plant in 2011.
- The *S2* and *S2 HYB* scenarios assume the following electricity generation mix:
    - 2 MW distributed photovoltaic (PV) systems between 2012 and 2030
    - 5 MW wind in 2015
    - 20 MW of geothermal in 2015
    - 1.5 MW Energy from municipal waste in 2015
- The *S3* scenarios assume:
    - 5 MW distributed PV between 2012 and 2030
    - 5 MW wind in 2015 and an additional 5 MW in 2020
    - 15 MW geothermal plant by 2015 and a total of 120 MW by 2020 with Interisland connections to Martinique and Guadeloupe and 100 MW exported in 2020
    - 1.5 MW Energy from municipal waste in 2015; additional 1.5 MW in 2020
- The ongoing transmission loss reduction program is assumed for all scenarios (losses reduced from 12.1% in 2008 to 10% in 2015)

Tables 2-8 and 2-9 summarise the assumptions in developing the mitigation scenarios for the demand and transformations modules.

Table 2-8 Scenarios for the Demand and Non-Energy Sector Effects

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Key Parameters			
Population	Growth at 0.4% from 2009	Same as Reference	Same as Reference
GDP Growth rate	Real GDP growth of 3% after 2010.	Same as Reference	Same as Reference
Demand			
Households (HH)	Assume to be the same as the number of residential electricity customers	Assume to be the same as the number of residential electricity customers	Assume to be the same as the number of residential electricity customers
Domestic (Residential Customers)	Growth at 2.8% from 2009, 1.8% from 2015, 0.8% from 2020, 0% from 2025 Note: Percentages of households (HH) with cooking, lighting, refrigerators, TVs and washing machines from the Country Poverty Assessment based on the 2002 Survey of Living Conditions (SLC) and SLC data for 2009.	Same as Reference	Same as Reference
Cooking	LPG from 79% of HH in 2002; 86.7% in 2009 to 91% in 2015; Charcoal: from 5% of HH in 2002, 2.6% in 2009 to 1% in 2015 Firewood: from 13% in 2002, 9.4% in 2009 to 3% in 2015	Same as reference	Same as reference
Refrigerators	No energy efficient refrigerators. Note – recent imports used to determine growth in number of refrigerators. Penetration from 74% in 2002, 71.3% in 2009 to 98% in 2015 Energy efficiency – no change after 2009	Penetration same as reference [% of HH with more energy efficient refrigerators increases from 0% in 2012 to 30% in 2020, and 40% in 2030.]	Penetration same as reference [% of HH with more energy efficient refrigerators increases from 0% in 2012 to 40% in 2020, and 60% in 2030.]

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Lighting	CFLs in use (distributed to all residences during 2007 so assume penetration of 50% in 2007 and 90% as of 2008). No LED	Introduction of LED lighting after 2015 (10% of HH by 2020).]	Introduction of LED lighting after 2012 to 45% of HH by 2030 at the expense of CFL which decrease from 90% of HH in 2012 to 45% of HH by 2030 and incandescent which decrease from 10% of HH in 2012 to 5% by 2030.]
Washing machines	Penetration from 42% in 2002, 53.4% in 2009. Assume 2009 penetration rate remains the same Energy efficiency – no change after 2009	Penetration to 80% of HH by 2015 [50% of new fridges are more energy efficient (i.e., 13% of HH)]	Penetration to 90% of HH by 2015 [50% of new fridges are more energy efficient (i.e., 18% of HH)]]
TV, stereo, radio	Penetration from 69% in 2002, 74% in 2009, and remaining the same onward. Energy efficiency – no change after 2009	Penetration to 90% of HH by 2015 [More energy efficient TVs: 5% in 2009 increasing to 80% by 2030]	Penetration to 95% of HH by 2015 [More energy efficient TVs: 5% in 2009 increasing to 90% by 2030]
All other	Includes items such as air conditioners (whose penetration rates are unknown), electric water heaters, microwave ovens, clothes iron and other small appliances. Assume current penetration rates remain the same Energy efficiency – no change after 2009	[Assume 10% reduction in energy efficiency by 2030]	[Assume 20% reduction in energy efficiency by 2030]
Commercial	Electrical energy and LPG fuel used (Note: poor data for LPG use) Growth rate (customers) 3% to 2015; 1% to 2030 No change in energy intensity	Growth rate same as reference Reduction in electricity and LPG use: 10% by 2015; 15% by 2030 due to efficient HVAC and additional solar water heating	Growth rate same as reference Reduction in electricity and LPG use: 15% by 2015; 25% by 2030 due to efficient HVAC and additional solar water heating]

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Industry	Electrical energy and diesel fuel used Growth rate (customers) 3% to 2015; 1% to 2030 No change in energy intensity	Growth rate same as reference 10% Reduction in overall energy by 2015 and 15% by 2030 due to energy conservation measures (education)	Growth rate same as reference 15% Reduction in overall energy by 2015 and 25% by 2030 due to energy conservation measures (education)
Hotel	Electrical energy and LPG fuel used (Note: poor data for LPG use) Growth rate (customers) 5% to 2015; 2% to 2030 No change in energy intensity	Growth rate same as reference 10% Reduction in overall energy use by 2015 and 15% by 2030 due to energy conservation measures (education) Flat after.	Growth rate same as reference 15% Reduction in overall energy use by 2015 and 25% by 2030 due to energy conservation measures (education) Flat after.
Street lighting	Growth rate (customers) 5% to 2015; 2% to 2030	Growth rate same as reference Efficient street lighting from 0% in 2015 to 10% in 2030 [Efficient street lighting is 4x more efficient than existing]	Growth rate same as reference Efficient street lighting from 0% in 2015 to 20% in 2030 [Efficient street lighting is 4x more efficient than existing]
DOMLEC Own use	No change	5% reduction in use by 2015 and 10% by 2030	10% reduction in use by 2015 and 15% by 2030
Transportation			
Fleet (vehicle stocks) divided into 7 vehicle classes (LDGV, LDDV, LDGT, LDDT, HDGV, HDDV, MC) plus off road based on vehicle licensing data for 2000 to 2007. No data to allow estimates of a marine category. Registered vehicles assumed to be 10% greater than licensed vehicles. The assignments of vehicle stocks to vehicle classes based on vehicle inspections data and sales based on import data are subject to considerable uncertainty since vehicle inspections data do not segregate vehicles by fuel type and weight class. No data available for annual vehicle miles (VMT) or kilometres (VKT) travelled. The estimated VMT are believed to be conservative (high) but were selected (along with fuel economy) to match fuel consumption. Fuel economy values were based on published city fuel economy values (as opposed to the composite of highway and city fuel economies). Note – no CNG but LPG instead for LDVs. No mitigation for MC.			
Growth in fleet	1% to 2012, 0.5% to 2020, 0.1% to 2035	Improved mass transit Import restrictions and tax incentives to promote more fuel efficient vehicles and hybrids	Improved mass transit Import restrictions and tax incentives to promote more fuel efficient vehicles and hybrids
Fuels	Only gasoline and diesel. E10, biodiesel and low sulphur diesel and gasoline not considered		

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Vehicle Class VKT {VMT}			
LDGV 9656 km {6000 mi}	All gasoline	*S2* LPG: 15% of LDGV by 2020 *S2* Hybrid: 20% of Hybrid vehicles by 2020	*S3* LPG: 30% of fleet by 2030 *S3 Hyb*: Hybrid: 15% by 2020; 25% by 2030
LDDV 9656 km {6000 mi}	All diesel	*S2*; LPG: 15% of LDDV by 2020 *S2 Hybrid*: 15% of Hybrid vehicles by 2020	*S3*; LPG: 15% by 2020; 25% of fleet by 2030 *S3 Hyb*; 15% by 2020; 25% by 2030
LDGT 10863 km {6750 mi} 9656 km LPG & hybrid {6000 mi LPG}	All gasoline	*S2*; LPG: 15% of LDGT by 2020 *S2* Hybrid: 15% of by 2020	*S3*; LPG: 15% by 2020; 25% of fleet by 2030 *S3 Hyb*: Hybrid: 15% by 2020; 25% of fleet by 2030
LDDT 10863 km {6750 mi}	All diesel	LPG: 15% of LDDT by 2020 *S2* Hyb: 10% of Hybrid vehicles by 2020	LPG: 30% of fleet by 2030 *S3 Hyb*: 20% of fleet Hybrid by 2030
HDGV 10863 km gasoline {6750 mi} 9656 km hybrid {6000 mi} hybrid	All gasoline	*S2* & *S2 Hyb*; LPG: 15% of HDGV by 2020	*S3*& *S3 Hyb*; LPG: 15% by 2020; 35% of fleet by 2030
HDDV 10863 km {6750 mi}	All diesel	*S2* & *S2 Hyb*; LPG: 15% of HDDV by 2020	*S3* & *S3 Hyb*; LPG: 15% by 2020, 30% by 2030
MC 8047 km {5000 mi}	All gasoline	No change	No change

Category	Reference (REF)	Scenario 2 (*S2, S2 Hyb*)	Scenario 3 (*S3, S3 Hyb*)
Off Road (includes tractors, rollers, forklifts etc.) 6437 km {4000 mi}	Assumed 40% gasoline; 20% LPG; 40% diesel	No change	No change
Non-Energy Sector Effects			
Landfill Emissions	MSW to landfills based on population growth projections	Diversion of ~40% of MSW to landfills after 2015	Diversion of ~80%? MSW to landfills after 2015

E10 – Gasoline with 10% ethanol.
Energy intensity is the annual energy use per appliance or per unit activity

Table 2-9 Scenarios for Transformation and Energy Resources

Transformation Category	**Reference (REF)**	**Scenario 2 (*S2*)**	**Scenario 3 (*S3, S3 HYB*)**
Transmission & Distribution			
Electricity Distribution	Losses reduced from 12% in 2008 to 8% in 2015	Same as Reference	Same as Reference
Electricity Generation			
Additional thermal plants HFO Diesel	7.5 MW in 2011	7.5 MW in 2011	7.5 MW in 2011
Distributed photovoltaic	None	1.5 MW by 2015	2 MW by 2015; 5 MW by 2030
Wind	None	5 MW in 2015	5 MW in 2015, 10 MW total in 2025
MSW Waste to Energy	None	0.75 MW in 2015	0.75 total MW in 2020
Geothermal	None	10 MW by 2015; 10 MW in 2017	20 MW by 2015; additional 100 MW in 2020
Hydro			
Retirements & Export		Retire Fond Cole 2015	Retire Fond Cole 2015 Retire Portsmouth 2020 Export 565 GWh starting in 2020

2.7 DATA GAPS

The energy use and hence GHG emissions are greatest for the transport and electricity generation sectors. Excellent data are available for the amount of fuel used for electricity generation but data (amount of each type of fuel used) for the transportation (especially) and other sectors are limited. The analysis is constrained by the following:

- Current data collection does not include a sectoral breakdown by the type of fuel used (i.e., into domestic, commercial, industry, hotel, agriculture/forestry/fishing by each type of fuel). These breakdowns are needed especially for diesel and LPG use. Current estimates were derived from data obtained from the Caribbean Energy Information System (CEIS) which could not be verified independently.
- The numbers of vehicles in the on-road fleet by vehicle weight class and fuel type are not known reliably. Estimates were made based on import data (which include a breakdown of vehicles by fuel) between 2000 and 2008 but these data are subject to considerable uncertainty.
- Cost data for mitigation options and for some processes were not always available and hence costs were not modelled.
- Projections related to HFC emissions are not included

3. RESULTS

3.1 SCOPE OF RESULTS PRESENTED

The results of the analysis will focus on presenting the **environmental loadings** (GHG emissions) and the **energy demand** broken down by demand and transformation categories and branches within the categories where appropriate.

LEAP allows presentation of the emissions either a) where they occur in the various branches (demand, transformation and non-energy sector effects) or b) by allocating the emissions in the transformation categories back to the demand branches. Alternative b) gives the final energy demand (or final environmental loadings) by allocating emissions used by various appliances and/or categories in proportion of the average mix of supply side (electricity generating) processes and the associated emissions. The presentation of the **environmental loadings** for all three scenario projections includes the current account period (2000 to 2008) so that comparisons can be made between the GHG emissions inventory and/or energy consumption over this period.

3.1.1 Constraints

The analysis is constrained by the following:

- Cost data for mitigation options and for some processes were not always available and hence costs were not modelled.
- Projections related to HFC emissions are not included
- There were data gaps (previously noted) that required estimation of selected parameters.
- There direct interaction with stakeholders was limited by a single workshop held in Dominica at the outset of the project. Circulation among stakeholders for comment on the draft GHG inventory and mitigation assessment reports and of the proposed scenarios for the mitigation assessment resulted in negligible response. The compilation of the inventory and development of the mitigation analysis would have benefited from at least three other workshops with direct contact with stakeholders as follows:
    - to present the results of the GHG inventory
    - to present the proposed scenarios
    - to present the draft Final report

3.2 ENERGY BALANCE

The energy balance for Dominica in 2008 is illustrated in Figures 3-1. The energy balance shows a summary of energy consumption, conversion and production. The bars to the left of the chart show the consumption broken down into final demand, export and secondary consumption components (expressed as barrels of oil equivalents (boe) for individual fuels) while those to the right show the energy supplies broken down into indigenous production, imports and secondary production components.

The energy balance diagrams in 2020 for the Reference scenario, Scenario 2 (*S2*) and Scenario 3 (*S3*) are shown in Figures 3-2, 3-3 and 3-4 respectively. Note that the reference scenario does not include any geothermal electricity generation and is reliant on diesel and hydro while *S2* includes 20 MW of geothermal and *S2* has 120 MW geothermal with 188 boe (~304 GWh) exported.

Figure 3-1 Energy Balance for Dominica, Reference Scenario, 2008

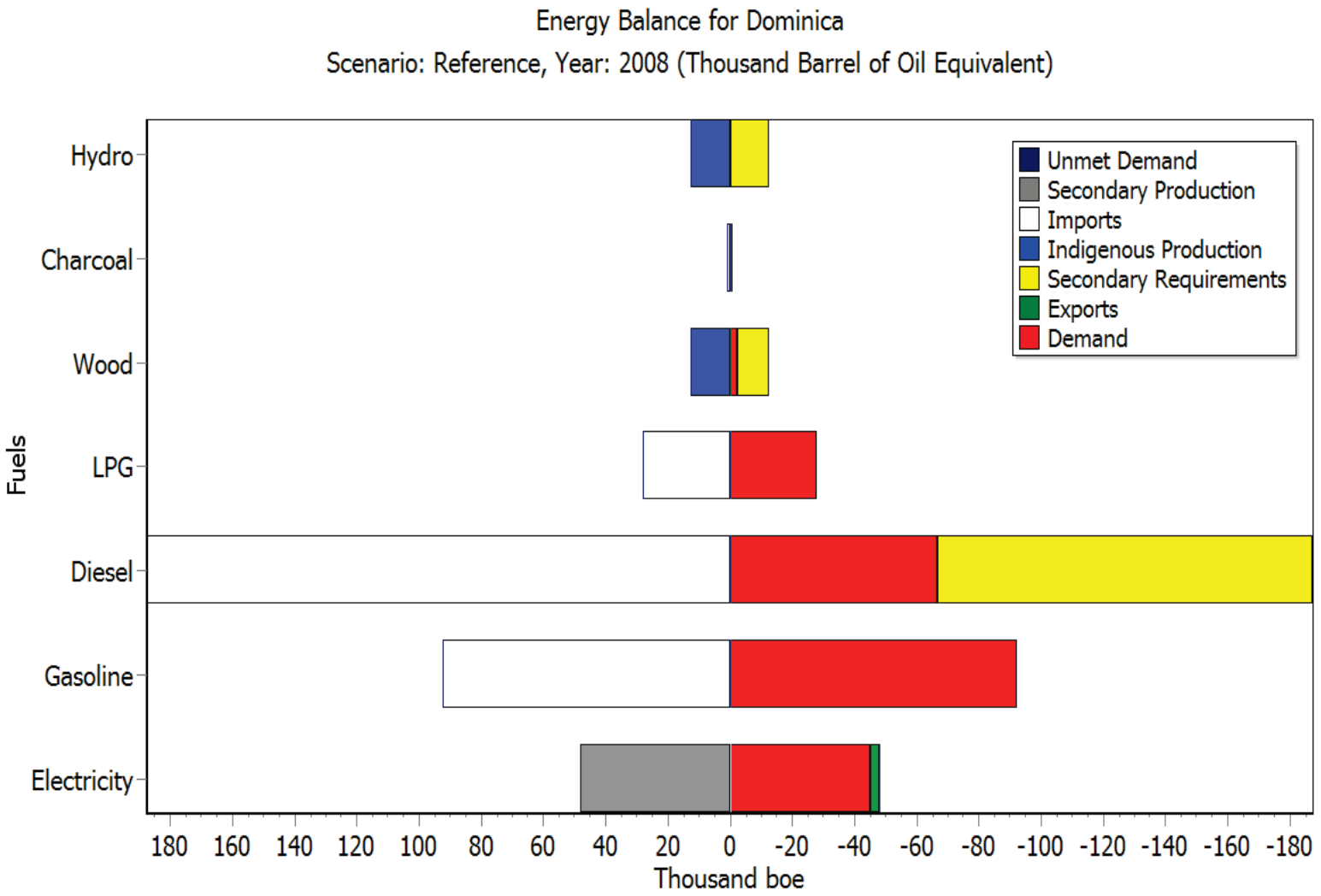


Figure 3-2 Energy Balance for Dominica, Reference Scenario, 2020

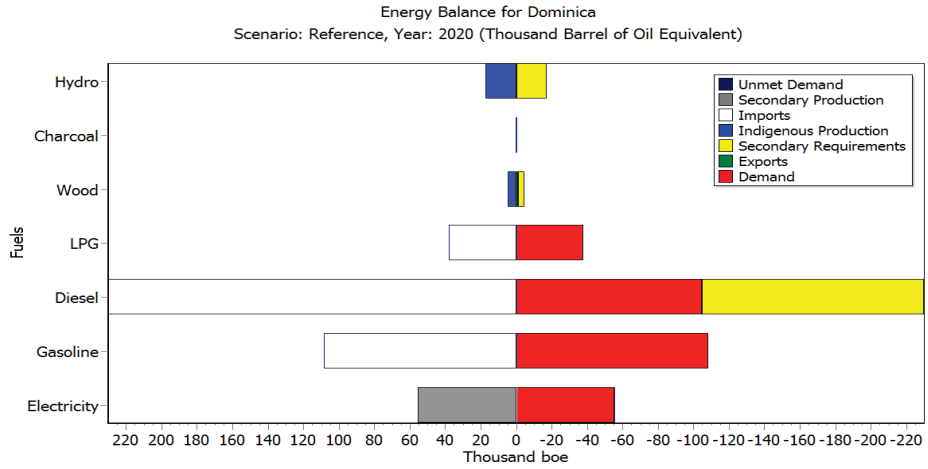


Figure 3-3 Energy Balance for Dominica, Scenario 2, 2020

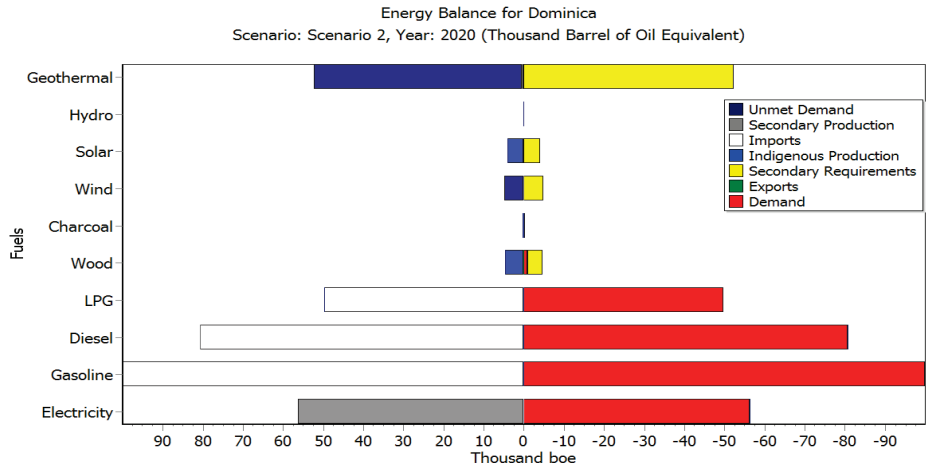
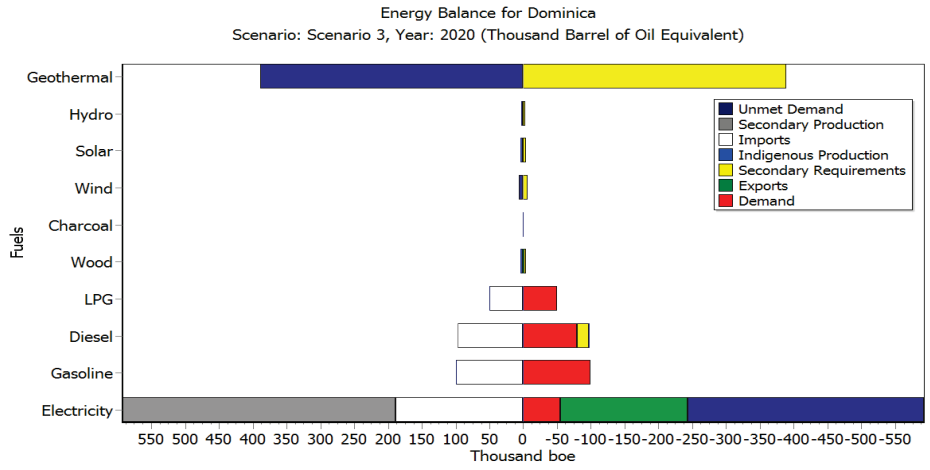


Figure 3-4 Energy Balance for Dominica, Scenario 3, 2020



3.3 OVERVIEW OF PROJECTIONS

3.3.1 Overview of Final Energy Demand Projections

The energy demand projects can be shown as either primary or final units. The primary energy demand indicates the primary energy sources (e.g., hydro, wood, charcoal) that are required. Energy demand in final units show the type of energy actually used to satisfy the demand.

The final energy demand for all scenarios is shown in Figure 3-5. The Reference scenario has the highest demand – again because there are no mitigation measures – compared to the *S2* or *S3* scenarios. The differences in the final energy demand are highlighted in Figure 3-6 which shows the **differences** relative to the Reference scenario.

The peak electricity generation capacity for the various scenarios are shown in Figure 3-7

3.3.2 Overview of Environmental Loadings

The environmental loadings are expressed as the mass of greenhouse gas (GHG) emissions either as individual GHGs or as the global warming potentials (GWPs) for one or more GHGs expressed in CO2 equivalents (CO2e). The results presented here will be for non-biogenic CO_2 only since biogenic CO_2 removals or emissions (e.g., from forests or burning of biomass) are not included in the mitigation assessment. The non-CO_2 GHGs (nitrous oxide and methane) are very small relative to CO_2 and are included only in the case of methane since one mitigation option entails the use of landfill gases for power generation.

The overall non-biogenic CO_2 emissions for the various scenarios are shown in Figure 3-8. Also included in Figure 3-8 are the CO_2 emissions obtained in the emission inventory. The inventory emissions are 7 to 11% lower than those calculated in the Reference scenario (current accounts) between 2000 and 2005. The agreement is reasonable given the challenges in estimating emissions from diesel fuel in the transportation, industrial and commercial sectors.

The projections for the Reference scenario are higher than the others since no mitigation measures are included in the Reference scenario. The emissions for scenarios *S2 Hyb* and *S3 Hyb* (involving hybrid motor vehicles) are lower than the corresponding *S2* and *S3* scenario (because emissions from hybrid vehicles are lower than those using regular fuels (gasoline or LPG)).

The introduction of geothermal electricity in scenarios *S2* and *S3* account for their lower emissions in the *S2* and *S3* scenarios. It should be noted that since geothermal energy has no CO_2 emissions the introduction of additional geothermal emissions in *S3* have no additional impact on CO_2 emissions. The general increase in emissions from ~2020 is due to increased growth in emissions from various subsectors.

Figure 3-5 Final Energy Demand for Dominica, All Scenarios

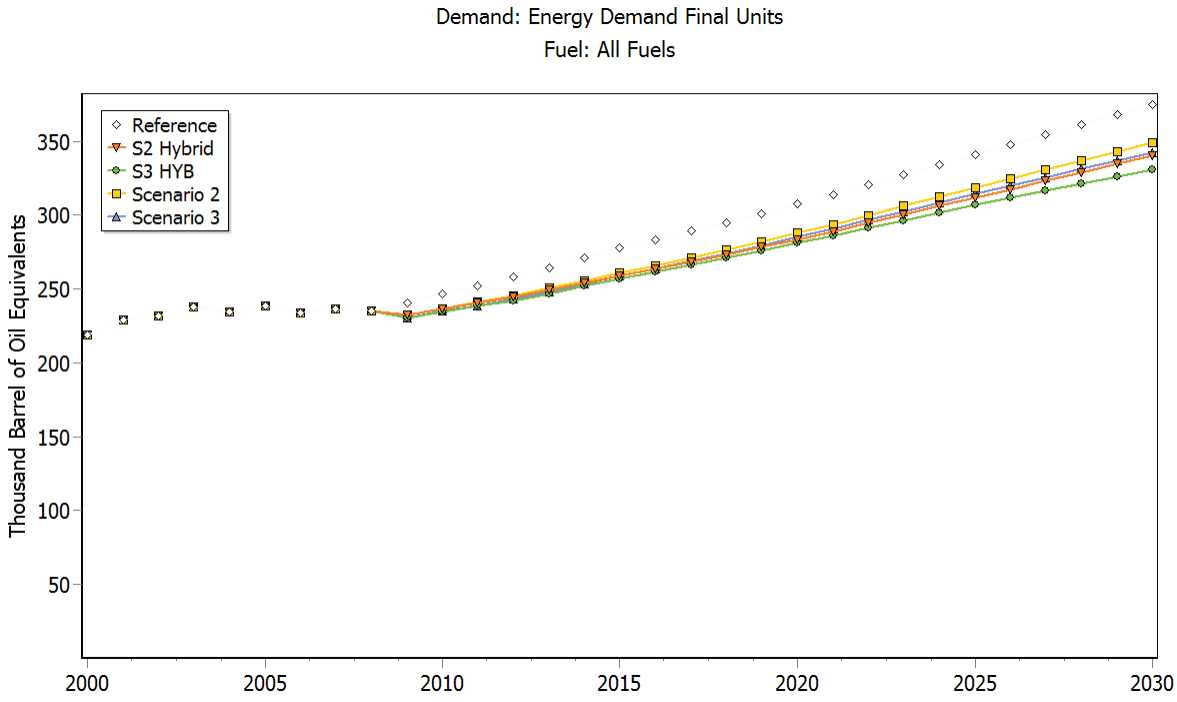


Figure 3-6 Final Energy Demand for Dominica, All Scenarios, Relative to the Reference Scenario

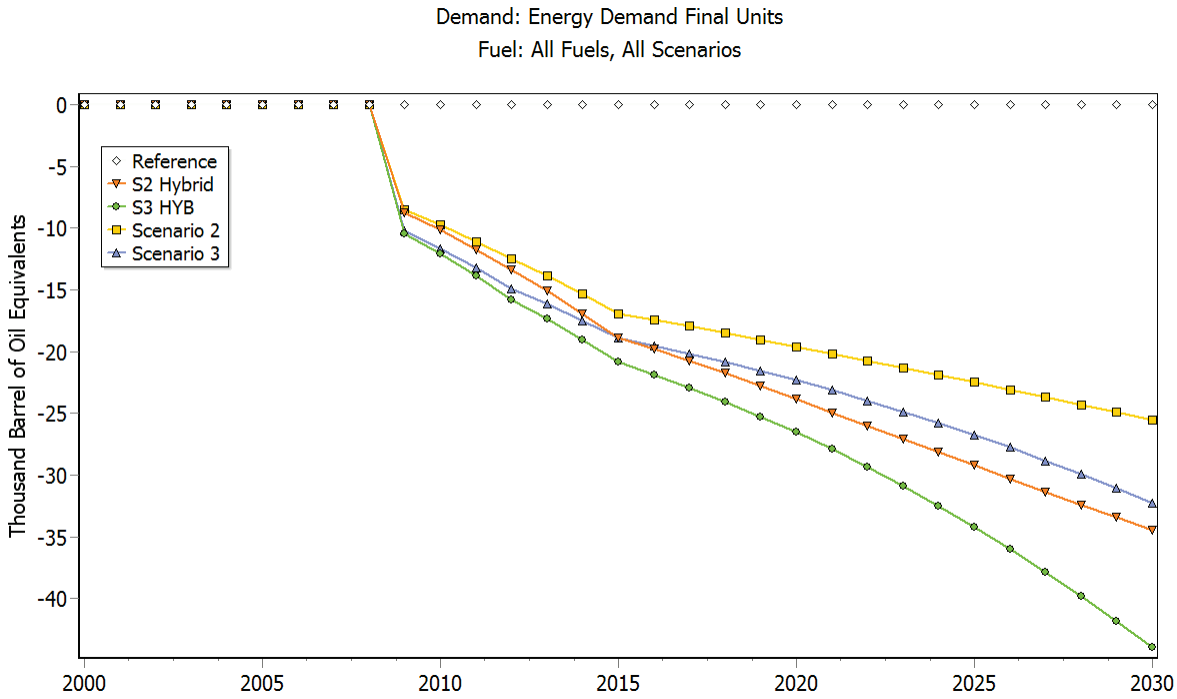


Figure 3-7 Electricity Generating Capacities: All Scenarios

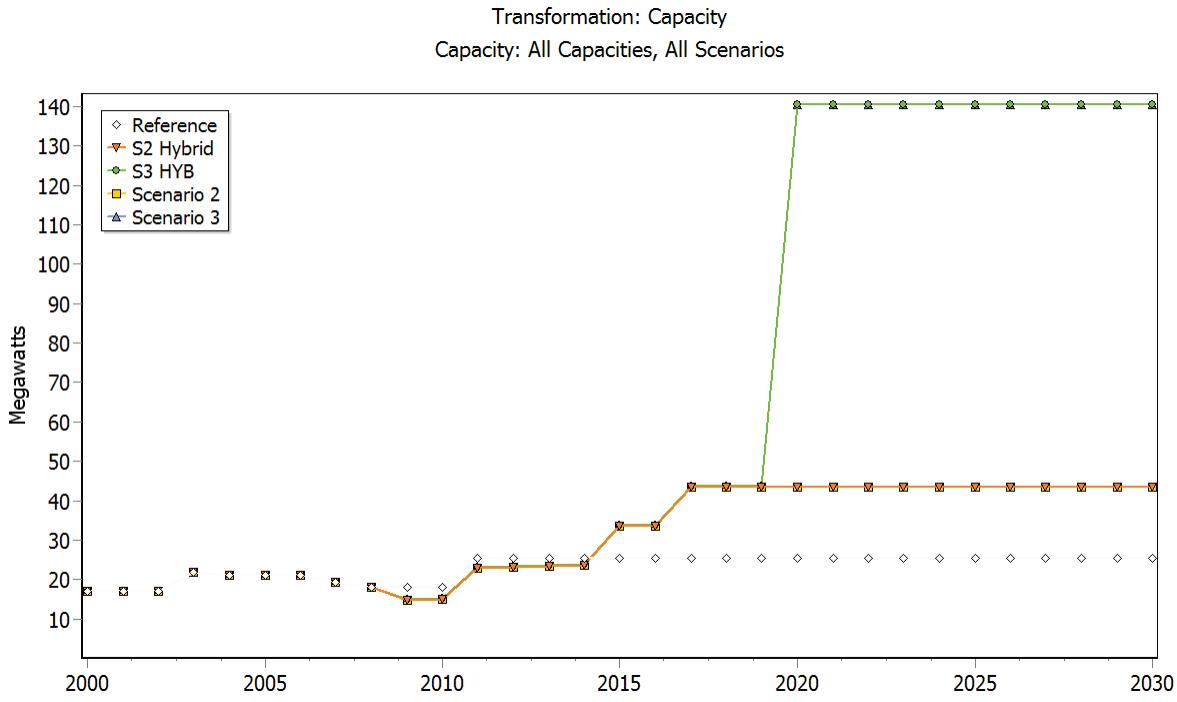
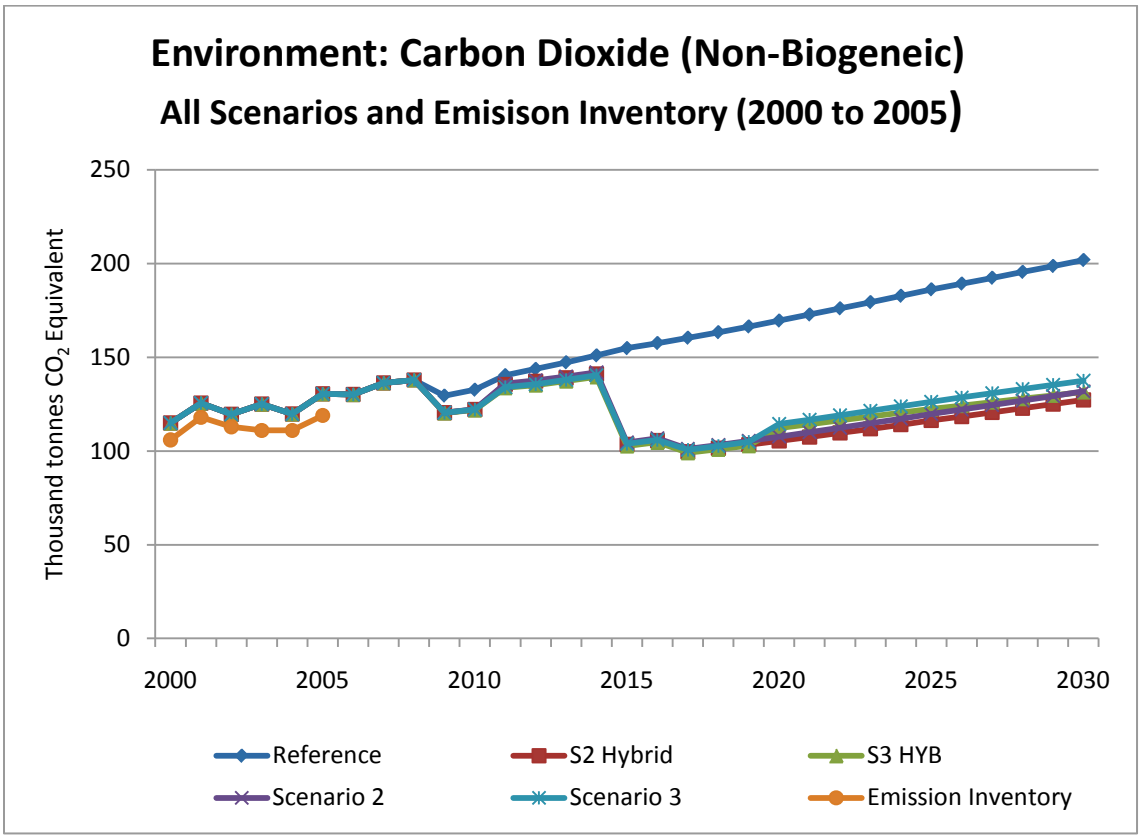


Figure 3-8 Non-Biogenic Carbon Dioxide Emissions for Dominica: All Scenarios



3.3.3 Detailed Analysis of Selected Environmental Loadings

The emissions in the demand branches (transportation, domestic, commercial, lighting, hotel, industrial, street lighting and DOMLEC own use) are considered in the following sections. The branches in the demand category reflect the breakdown of electricity customers. Reporting of electricity sales to street lighting customers was discontinued in 2005 and because of this they are not discussed further.

3.3.4 Transportation Branch

The data available for the on and off road fleet comprised the number of vehicle registrations by various types that unfortunately did not indicate the type of fuel used (gasoline or diesel) and had limited information related to the weight of vehicles. [Estimates of vehicle emissions are based on the type of fuel, the associated fuel economy for vehicles based on various weight classes and annual vehicle mileage.] Also lacking was the amount of diesel fuel used by the on-road fleet (i.e., fuel sold to service stations). Although the total gasoline sales were available, some of the gasoline is likely used for marine activities.

The available vehicle registration data (for 2000 to 2008) were categorised into seven (7) vehicle classes by making estimates of the fuel type and weight class for the available data. These data which are subject to much uncertainty are shown in Table 3-1. The on road fleet (licensed vehicles) was assumed to be 10% greater[b] than the vehicle registrations (the vehicles inspected each year).

Table 3-1 Assignment of Vehicle Registrations to Vehicle Weight Classes

Vehicle Class#	2000	2001	2002	2003	2004	2005	2006	2007	2008
LDGV	7974	8846	9413	9956	10638	11435	12064	12725	13093
LDDV	654.5	693	727	754	776.5	806	842.5	879	902.5
LDGT	654.5	693	727	754	776.5	806	842.5	879	902.5
LDDT	1310	1419	1514	1609	1752	1950	2081	2236	2345
HDGV	212	227.2	241.2	253.2	271.6	300.4	326.8	357.2	370.4
HDDV	482	524.8	557.8	585.8	630.4	682.6	745.2	815.8	854.6
MC	435	526	655	774	850	925	1009	1107	1181
Misc & Off Road	65	73	78	86	92	100	107	121	133
Total	11787	13002	13913	14772	15787	17005	18018	19120	19782

Vehicle Classes

LDGV	Light duty gasoline vehicles	LDDV	Light Duty diesel vehicles LDDT
LDGT	Light duty gasoline trucks	LDDT	Light duty diesel trucks
HDDV	Heavy duty diesel vehicles	HDGV	Heavy duty gasoline vehicles
MC	Motor cycles	Misc & Off Road	Tractors, rollers, forklifts etc.

Mitigation measures for transportation entailed the introduction of LPG in *S2* and *S3* and hybrid vehicles in *S2 Hyb* and *S3 Hyb.* The *S2* scenario has 15% of the fleet (except motor cycles and the Off Road & Miscellaneous category) using LPG by 2020 while for the *S3* scenarios the percentage with LPG is increased to 25% by 2030. The *S2 Hyb* and *S3 Hyb* scenarios are similar except that the corresponding hybrid-fuelled vehicles are used instead of LPG. The impacts of these mitigation measures on non-biogenic CO_2 emissions for the transportation branch are shown in Figures 3-9 (showing the absolute emissions) and 3-10 (showing emission reductions relative to the reference scenario).

[b] Data for 2002 to 2004 reported that licensed vehicles were 3.3 to 5.5% higher than those registered.

Figure 3-9 Non-Biogenic Carbon Dioxide Emissions for Dominica: Transportation Branch, All Scenarios

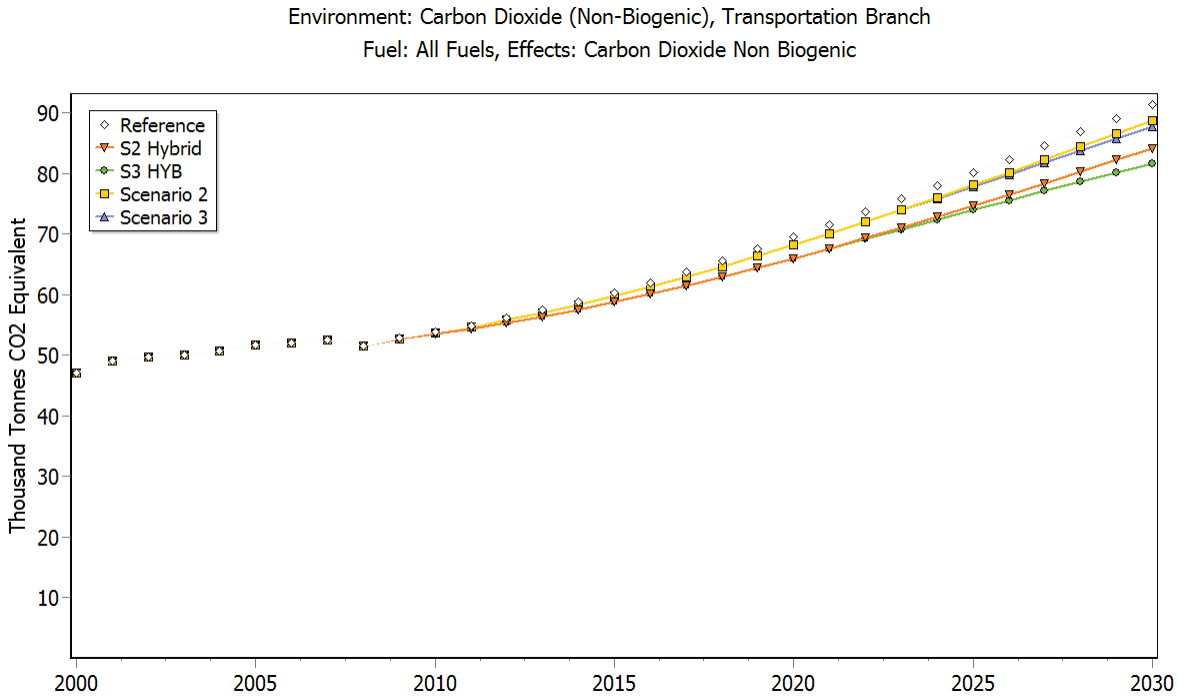
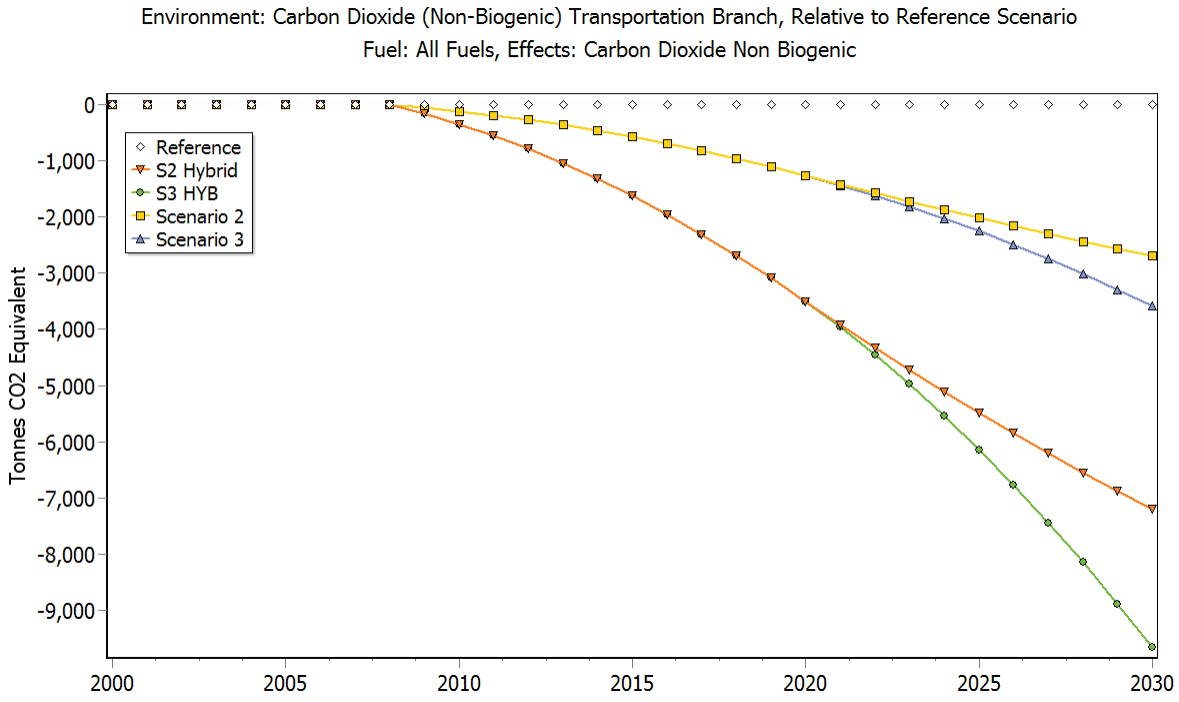


Figure 3-10 Non-Biogenic Carbon Dioxide Emissions for Dominica: Transportation Branch, All Scenarios Relative to the Reference Scenario



The percentage reductions in **transportation** emissions relative to 2008 are shown in Table 3-2. It is clear that the use of hybrids will provide the greatest reductions in emissions and that the reductions increase as the amount of hybrids in the fleet increases.

Table 3-2 Percentage Reductions in Transportation Emissions Relative to 2008

Scenario	Percentage Reductions from 2008	
	2020	2030
S2	2.5	5.2
S2 Hyb	6.8	18.7
S3	2.5	7.0
S3 HYB	6.8	18.7

3.3.5 Domestic Emissions

CO_2 emissions from the domestic branch are driven by increases in the number of residential customers which is taken as a proxy for the number of households. The increase in domestic customers was assumed to follow the rate of population increase (0.4%). Increased demand for electricity is also driven by increases in the percentages of households acquiring appliances such as televisions (TVs), refrigerators, washing machines etc. The mitigation measures proposed for the domestic sector are based on adoption of more energy efficient appliances (TVs, refrigerators) and adoption of LED lighting after 2020. These could be achieved by adoption of import policies that require energy efficient appliances (e.g., by adopting Energy Star standards). No mitigation measures are proposed for cooking but the percentages of households using wood and charcoal were assumed to decrease from the values in 2009. Use of charcoal and wood for cooking was assumed in all scenarios to decrease from 2.55% of households in 2009 to 1% by 2015 (charcoal) and from 9.42% in 2009 to 3% by 2015 (wood).

Since distribution of compact fluorescent bulbs in Dominica took place during 2007 it was assumed the effective saturation (percentage of houses with CFL bulbs) of CFL bulbs was 50% in 2007 and 90% thereafter. As a result there is limited scope for additional energy savings from CFL bulbs. LED lighting was assumed to take place after 2015 (by which time the costs may be more competitive) and reach 10% saturation by 2020 in the *S2* scenario and 45% by 2030 in the *S3* scenario.

The CO_2 emissions from the domestic branch subcategories that use electricity are estimated by allocating the CO_2 that would be used to generate the electricity. These are illustrated in Figure 3-11 where the impact of geothermal electricity generation (after 2014) is evident. Between 2009 and 2014 the impact of mitigation measures is negligible since they are counteracted by the increases in the number of customers.

The relative contributions from the various sub-branches in the domestic branch to CO_2 emissions are illustrated in Figures 3-12 (for the reference scenario) and 3-13 for *S3*. These show that cooking accounts for most of the emissions. For scenario *S3*, once geothermal energy is used to generate electricity the allocated emissions for non-cooking activities are all but eliminated.

Figure 3-11 Environmental Loadings for Residential Demand Category: All Scenarios, Non Biogenic CO_2 Allocated to Demands

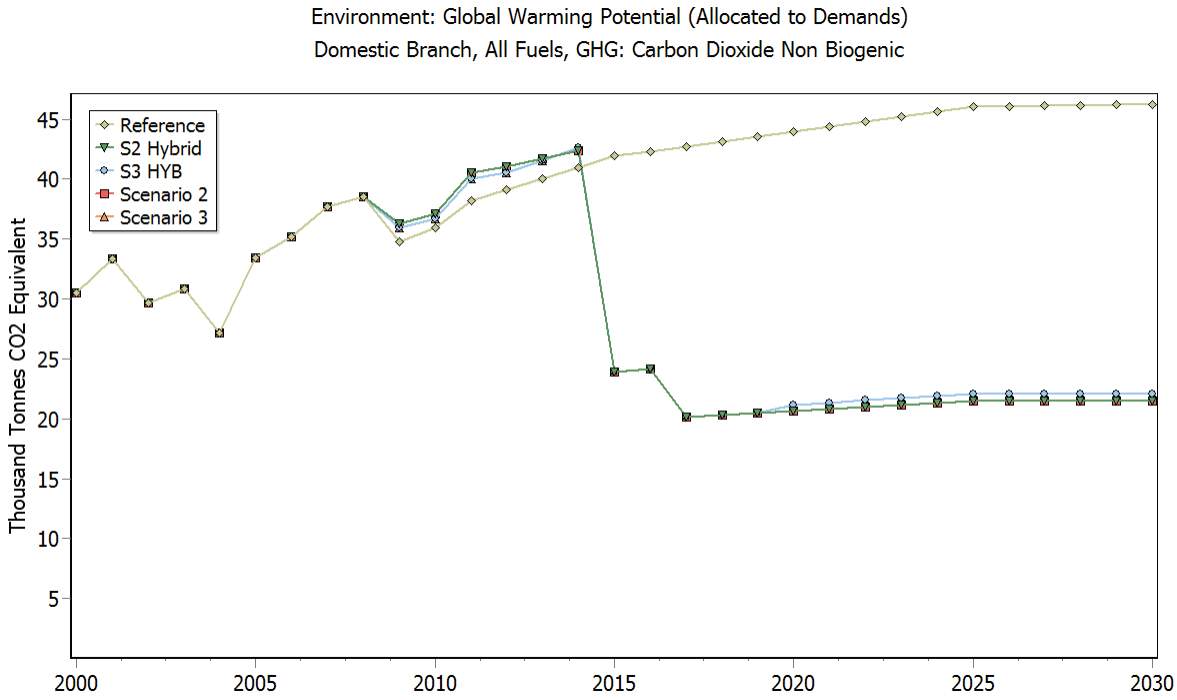


Figure 3-12 Environmental Loadings for Residential Demand Category Sub Branches: Reference Scenario, Non Biogenic CO_2 Allocated to Demands

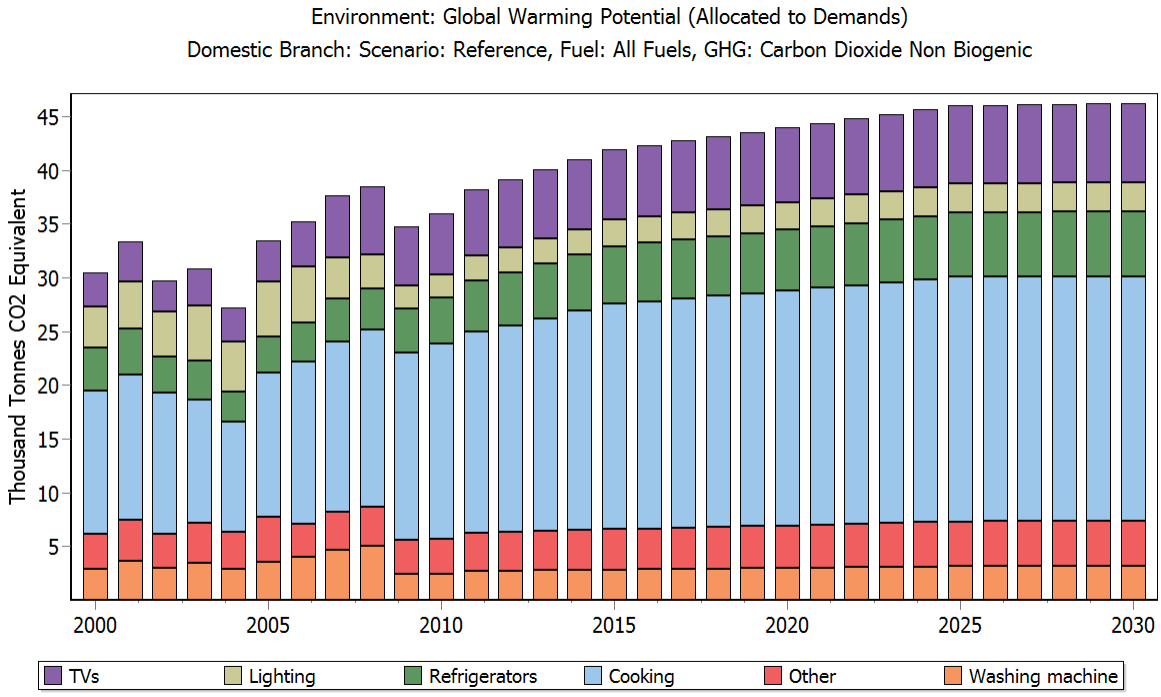
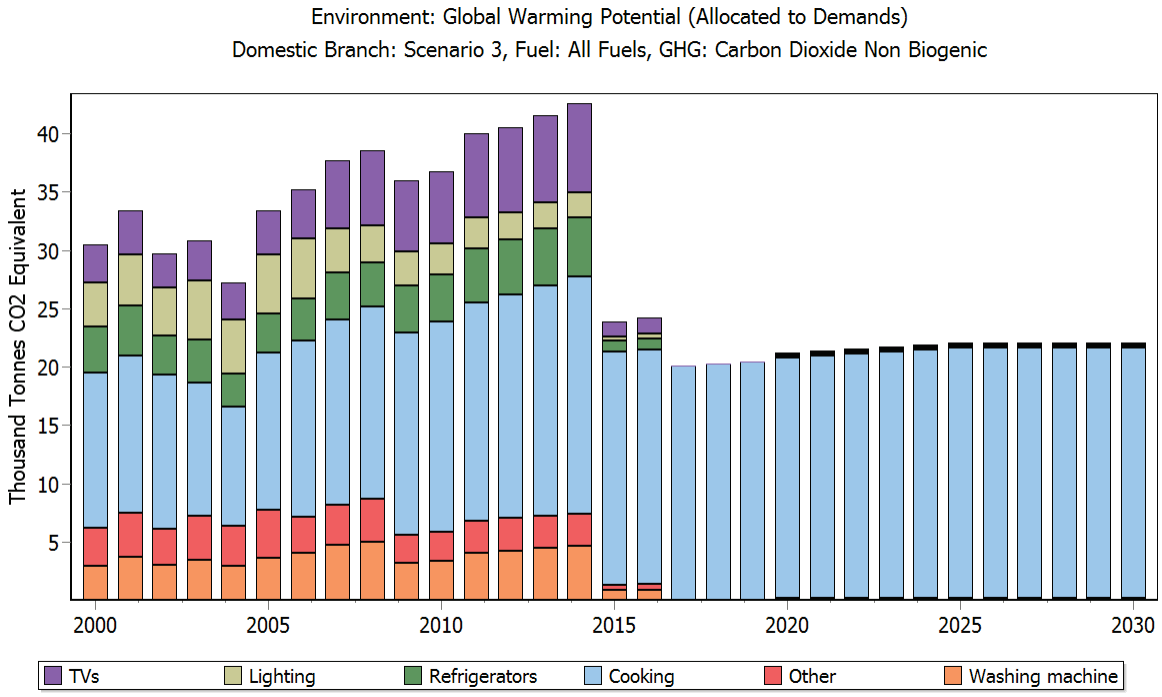


Figure 3-13 Environmental Loadings for Residential Demand Category Sub Branches: Scenario *S3*, Non Biogenic CO_2 Allocated to Demands



3.3.6 Commercial, Hotel and Industrial

The customers in these branches use primarily electricity as well as smaller amounts LPG (Commercial and Hotel) or diesel (Industrial). The growth in the numbers of Commercial and Industrial customers was assumed to be 3% to 2015 and 1% to 2030 and for hotels 5% to 2015 and 2% to 2030.

The mitigation measures proposed for these branches are based on general public education for energy conservation and introduction of additional solar water heating and more efficient air conditioning. Information on the numbers, sizes and types of refrigerant used would have allowed proposal of more specific mitigation measures.

The projected non-biogenic emissions from these branches are shown in Figures 3-14 to 3-16 for respectively Commercial, Hotel and Industrial customers. Since the amounts of energy derived from fuels (LPG or diesel) increase from commercial to industrial customers the impact of allocated emissions is least for the industrial branch.

3.3.7 DOMLEC Own Use

The projected non-biogenic emissions from DOMLEC Own Use branch is shown in Figure 3-17. Since electricity is the only energy source used the impact of geothermal electricity generation for scenarios *S2* and *S3* are marked. It was assumed that the energy conservation (mitigation) measures would result in a 5% reduction in electricity use by 2015 and 10% by 2030.

3.4 TRANSFORMATION

The transformation categories consist of transmission (of electricity) and transformation (electricity generation and charcoal production) activities.

Although the emissions directly associated with these activities are allocated to demand categories it is instructive to indicate the emissions directly associated with these activities. The LEAP model produces electricity outputs to match the demand based (among other things) on the load shape, the availability of generating units and the order of dispatch etc.

It should be noted that the analysis here made no effort to produce a least cost generation mix and hence the added generation capacity resulted in higher than normal reserve margins.

Transmission

DOMLEC's proposed transmission reduction target (losses reduced from 12% in 2008 to 8% in 2015) was assumed in all scenarios but transmission losses for export were not taken into consideration.

Electricity Generation

Capacity additions for the three scenarios Reference, *S2* & *S2 Hyb* and *S3* & *S3 Hyb* are respectively shown in Figure 3-18 to 3-20. Retirements are shown in Figure 3-21 (all scenarios).

Emissions from electricity generation arise mainly from diesel fuelled generators and in some scenarios form landfill gas combustion. The emissions for all scenarios are shown in Figure 3-22.

Figure 3-14 Environmental Loadings for Commercial Demand Branch, All Scenarios, Non Biogenic CO_2 Allocated to Demands

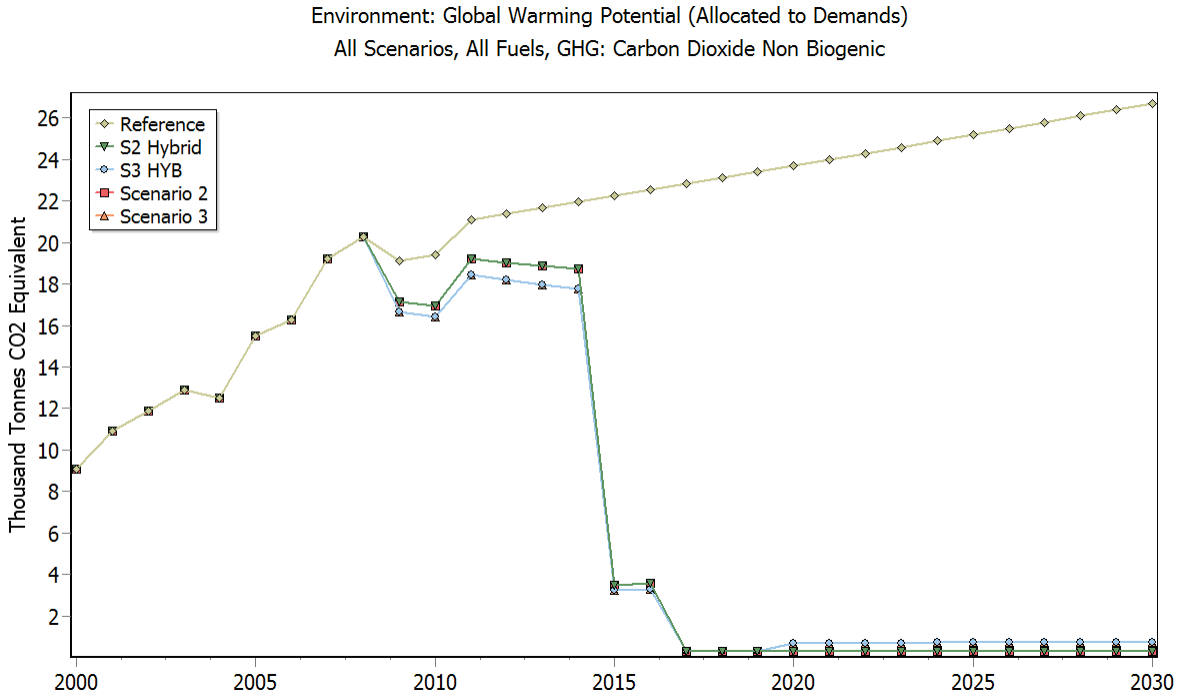


Figure 3-15 Environmental Loadings for Hotel Demand Branch, All Scenarios, Non Biogenic CO_2 Allocated to Demands

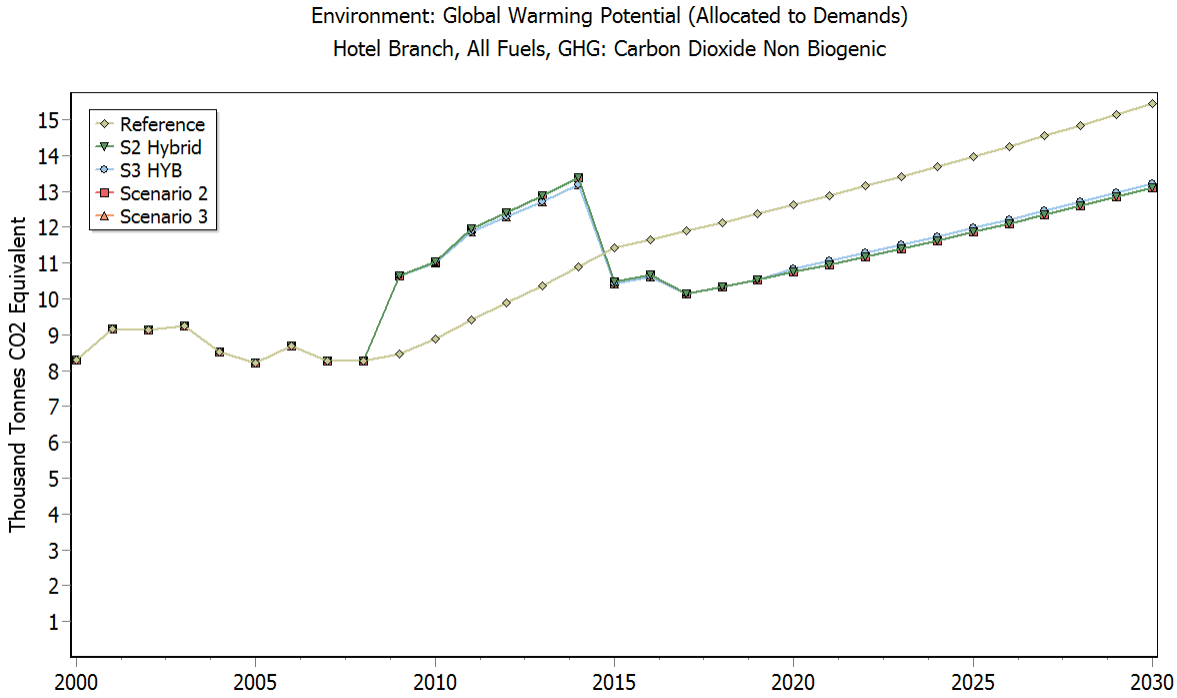


Figure 3-16 Environmental Loadings for Industrial Demand Branch, All Scenarios, Non Biogenic CO_2 Allocated to Demands

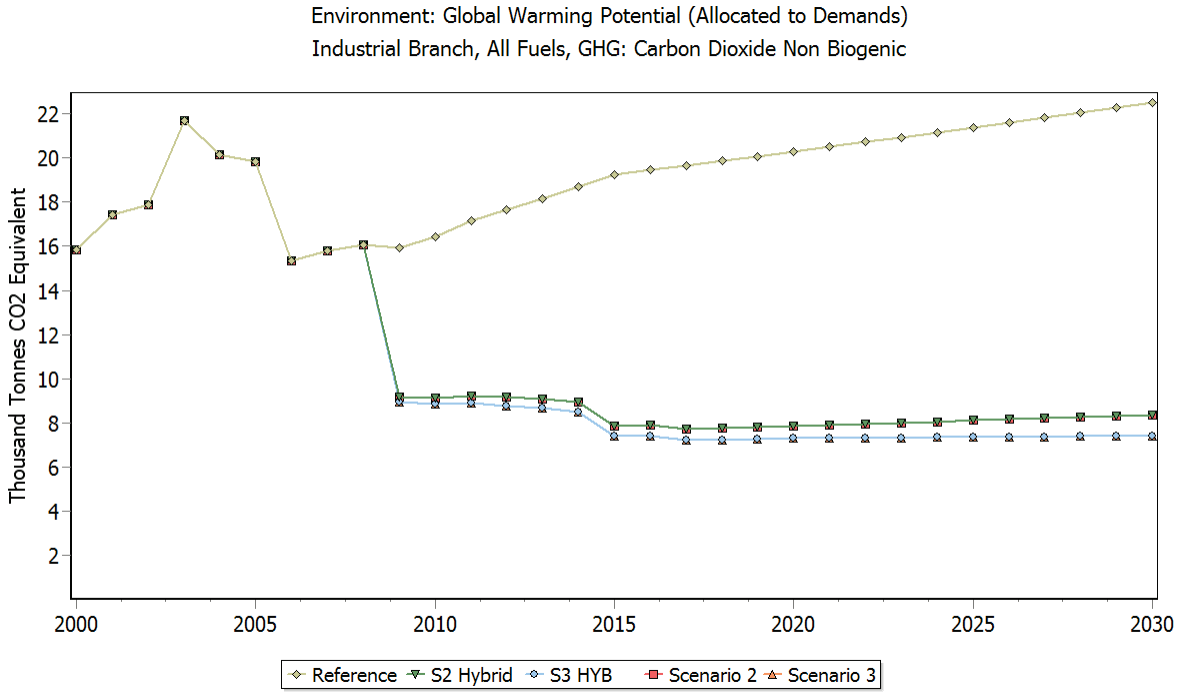


Figure 3-17 Environmental Loadings for DOMLEC Own Use Demand Branch, All Scenarios, Non Biogenic CO_2 Allocated to Demands

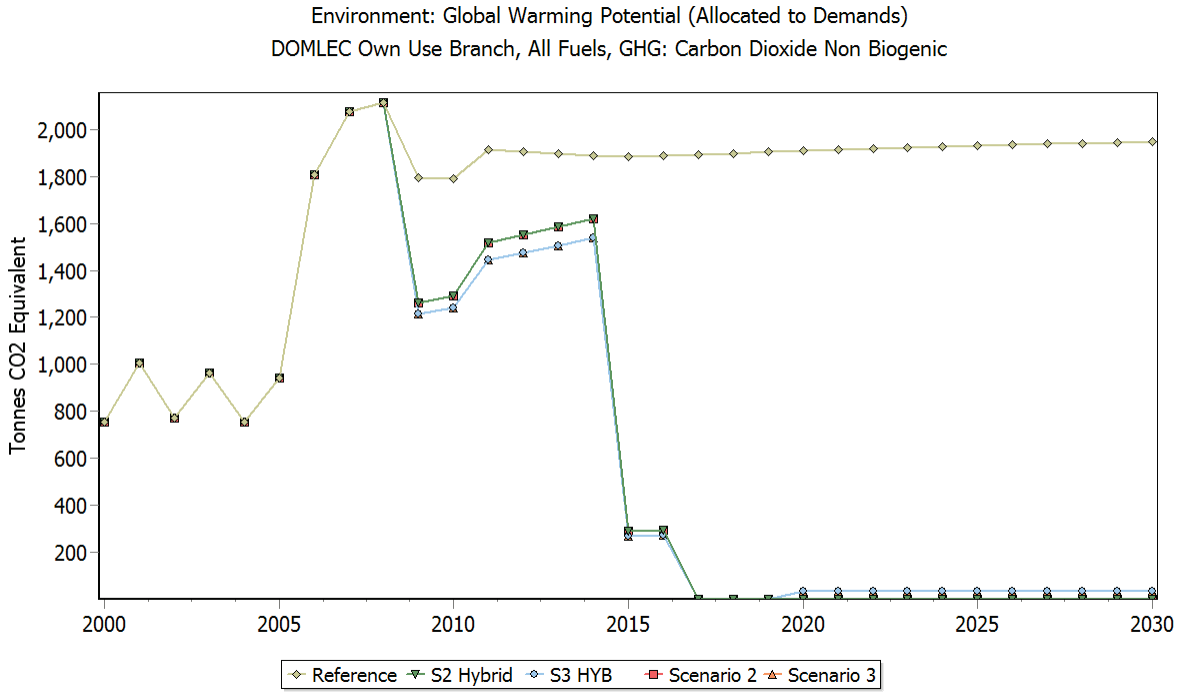


Figure 3-18 Transformation: Electricity Generation Capacity Added: Reference Scenario

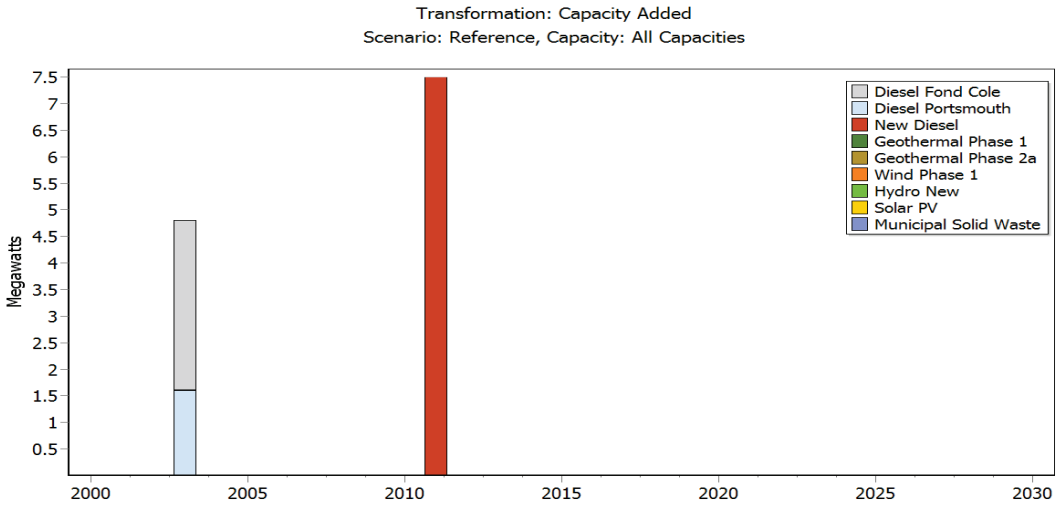


Figure 3-19 Transformation: Electricity Generation Capacity Added: Scenarios *S2* and *S2 Hyb*

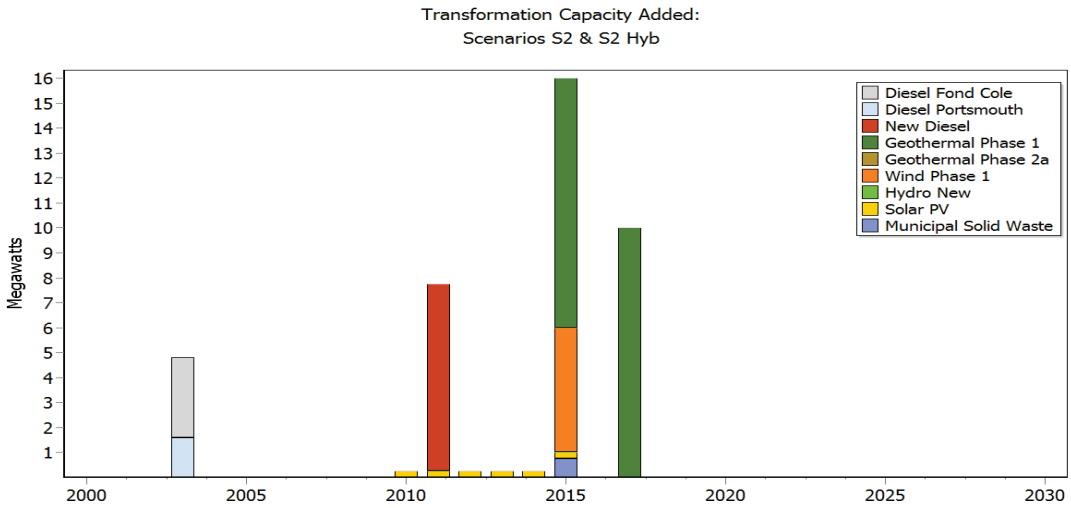


Figure 3-20 Transformation: Electricity Generation Capacity Added: Scenarios *S3* and *S3 Hyb*

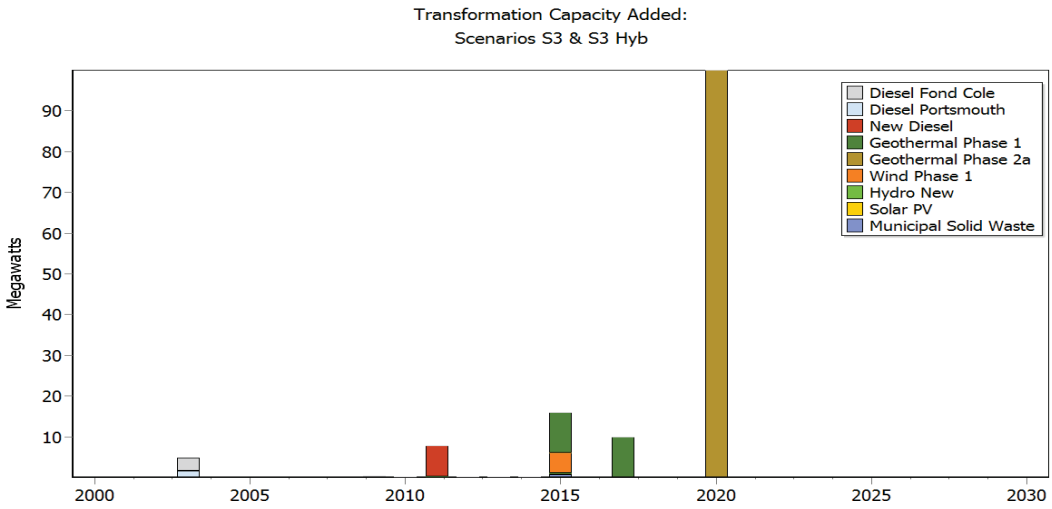


Figure 3-21 Transformation: Power Plant Retirements: All Scenarios

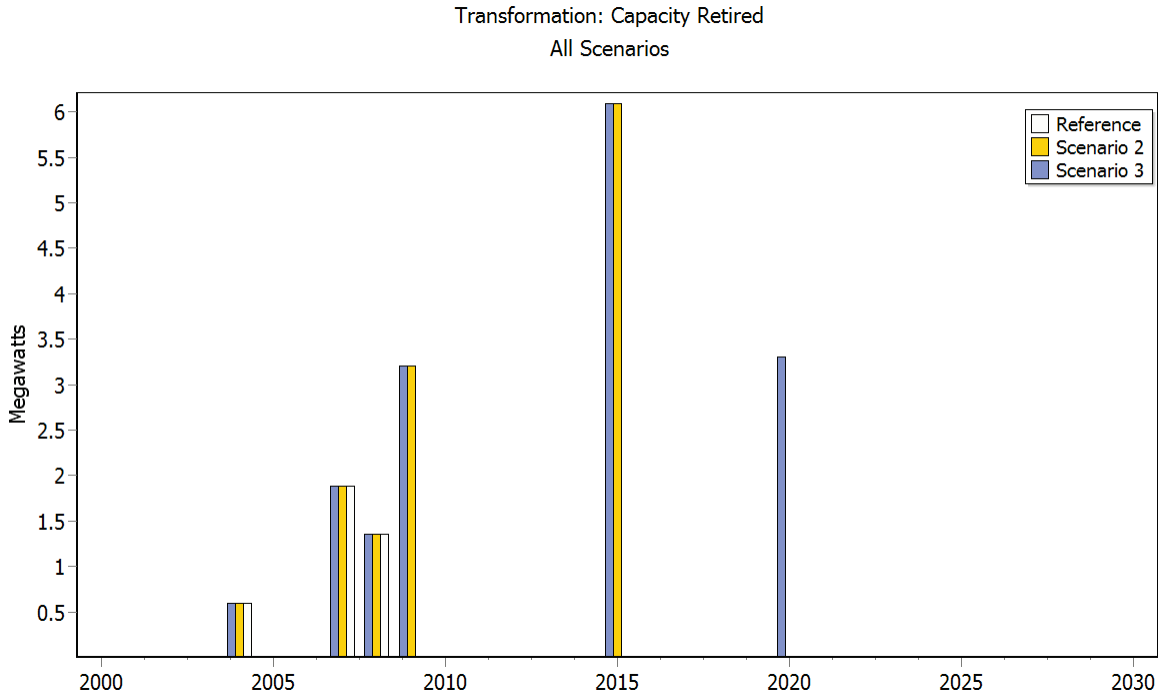
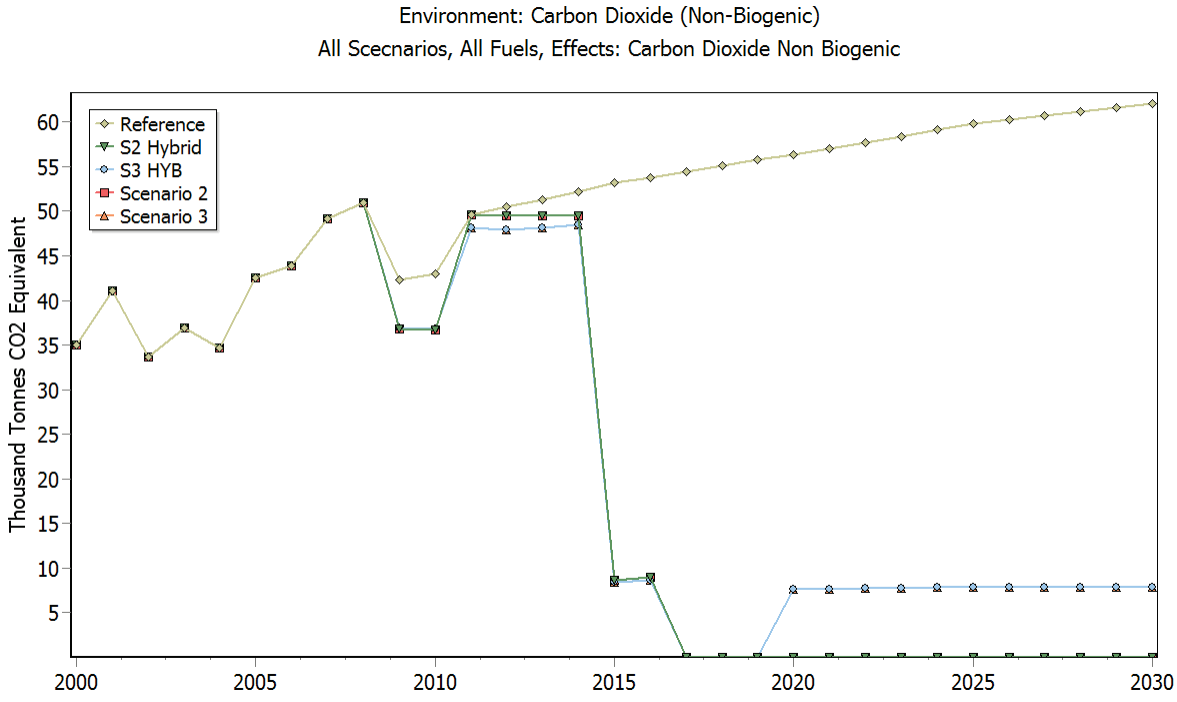


Figure 3-22 Environmental Loadings for Electricity Generation Branch, All Scenarios, Non Biogenic CO_2



4. MITIGATION ACTIVITIES FOR IMPLEMENTATION

This section:

- describes the responsibilities and plans and/or goals for the main energy sector institutions that could be involved in the implementation of mitigation activities;
- indicates the main requirements for implementing mitigation measures;
- identifies some of the gaps, and
- provides specific recommendations for implementing some of the mitigation measures.

4.1 ENERGY SECTOR AND RELATED INSTITUTIONS

Ministry of Public Works, Energy & Ports

This ministry's portfolio includes responsibility for monitoring and coordinating activities in the air and sea ports, the maritime, electricity, and water sectors and in the operations of the Postal Services. The State-owned Dominica Water and Sewage Company Ltd. (DOWASCO) and the Dominica Air and Sea Ports Authority report directly to the Minister for Public Utilities, Energy and Ports. This ministry's e mandate is governed by various legal instruments including the Electricity Supply Act No. 10 of 2006.

The Energy Unit within the ministry coordinates activities related to the development and expansion of electricity production and distribution, including the development of renewable energy sources such as geothermal, solar, photovoltaic, wind energy and hydro energy, and the supply and provision of public lighting. The short term goal is to generate at least 25% of all electricity from renewable sources by 2010, while encouraging and promoting energy efficiency and energy security.

The Ministry's plans include support to restore and possibly expand the generation capacity of the Padu hydro electricity generation station from 1.8 to 3 MW. The Ministry also encourages other investments for the expansion of hydro electric capacity and photovoltaic (solar) electric systems for domestic, commercial and institutional use.

Dominica is undertaking a project with support from the Government of France and the European Union that will seek to eventually establish a 100 MW geothermal facility most (80%) of which would be exported to the French Departments of Guadeloupe and Martinique via submarine cables. This project will determine and characterize Dominica's geothermal resource and set the stage for investments in geothermal energy generation plants or commercialization of the resource.

Independent Regulatory Commission (IRC)

The IRC which was established by the Electricity Supply Act No. 10 of 2006, is designed to encourage the expansion of electricity supply to Dominica where this is economic and cost effective and in the public interest and to generally encourage the operation and development of a safe, efficient and economical electricity sector in Dominica. The IRC is to ensure the security and efficiency of the supply of electricity, and facilitate the promotion of sustainable and fair competition in the sector, while protecting the interest of all classes of consumers of electricity in Dominica.

The stated functions of the IRC[14] are as follows:

- Encouraging wider availability of electricity supply throughout Dominica.
- Ensuring that all reasonable demands for electricity are met
- Promoting efficiency in the generation, transmission, distribution, supply and use of electricity
- Establishing technical standards applicable to providing electricity service or equipment installed on customers' premises
- Protecting the interests of consumers
- Facilitating competition in the electricity sector
- Enabling the financial viability of efficient licensees
- Issuing, monitoring and amending licences and collecting licence and other fees
- Establishing and monitoring standards by which the efficiency of the service provision can be evaluated
- Inspecting and testing electrical plant and equipment owned by licensees as well as consumers
- Protecting the health and safety of all persons affected by the operations of the sector
- Protecting the natural environment
- Advising the Minister on all issues relevant to the electricity sector
- Promoting wider regional cooperation in the regulation and operation of the electricity sector

The Act requires the IRC to be independent in the performance of its functions and duties, and not be subject to the direction and control of the Government or of any person, corporation or authority, except that the Commission shall have due regard to the public interest and overall Government policy as embodied in the legislation.

Dominica Electric Power Company DOMLEC

DOMLEC is a privately owned company (WRB Enterprises and Dominica Social Security) that had been solely responsible for the generation, transmission, distribution and sale to customers. The Electricity Supply Act (2006) requires the IRC to determine the conditions under which entities are licensed to generate, transmit and distribute electricity and hence DOMLEC no longer has exclusive responsibility for the generation of electricity.

DOMLEC operates three hydro-electric power stations (Laudat, Trafalgar and Padu) and two diesel power stations (Fond Cole and Sugar Loaf). All generation sources are linked via 11 kV inter-connectors and, in some instances, via 11 kV distribution feeders. The secondary distribution voltage is 230/400V. The transmission and distribution (T&D) network, comprising 368 km of 11 kV and 922 km of low voltage overhead lines, serves about 98% of the island's population.[15]

A key related institution is the Central Statistics Office (CSO) in the Ministry of Finance since it compiles and provides information on most data needed in the mitigation analysis. Additional detailed data can be obtained from relevant institutions such as IRC, DOMLEC. These latter two institutions provide regular and timely web-published data that satisfy the vast majority of data needed for the electricity generation and transmission and some demand related data and information.

4.2 IMPLEMENTATION OF MITIGATION MEASURES

The mitigation measures considered in this analysis address both the demand and supply of energy. The transportation (54%), domestic (18.5%) and industrial (13.6%) sectors which together account for 86% of the energy demand in 2008 will provide most of the opportunities for mitigation. Demand related mitigation measures include the introduction of LPG and hybrid vehicles and increasing the use of diesel fuelled vehicles and more efficient domestic electric appliances. In addition public education and other measures to increase awareness about energy conservation will reduce energy use in all sectors.

Mitigation measures in the energy supply are centred on the development and introduction of geothermal energy as well as other alternate and renewable energy supplies (wind, distributed photovoltaic, hydro and energy from municipal solid waste).

Successful implementation of the mitigation measures will *inter alia* depend on:

- Introduction of policies to encourage alternative fuelled (LPG) and/or hybrid vehicles.
- Development of policies and programmes designed to influence market behaviour towards adopting more efficient use in energy across all sectors
- The provision of tax and other incentives/disincentives for the development and use of innovative technologies that improve/worsen efficiency
- Development of a policy and institutions that will enable carbon emissions trading
- Strengthening the institutional capacities in the energy and environment sectors
- Promotion of strategic partnerships between the public and private sectors to finance and develop small and large scale renewable energy projects and implementation of more efficient energy end use technologies

4.3 GAPS

The implementation of GHG mitigation measures will be facilitated by filling the following institutional & policy and information related gaps.

Institutional and Policy Related Gaps

Dominica's National Energy Policy and Sustainable Development Plan are currently being formulated with technical assistance from CARICOM, in association with the Organisation of American States (OAS) and the German Technical Assistance (GTZ). Alternative Energy Legislation and Regulations are also being drafted with assistance from the World Bank funded Growth and Social Protection Technical Assistance Project (GSPTA). The legislation is intended to provide the legal and regulatory framework for the development of alternative energy technology, including hydropower, solar, wind, geothermal energy and other forms of renewable energy in Dominica.

The goals of the Sustainable Energy Plan and the initiatives included in the National Energy Policy (previously presented in Section 2.4) provide a comprehensive framework to address the current and future needs of Dominica's energy sector development. They will also provide a sound basis for implementing the GHG mitigation measures.

Dominica's Sustainable Development Plan relies heavily on projects to develop geothermal energy and other renewable energy resources (e.g., wind, PV) and alternate energy sources. These projects provide the basis for the proposed GHG mitigation measures and as such could take advantage of

the UNFCCC's Kyoto Protocol. The Kyoto Protocol introduced the Clean Development Mechanism (CDM) as a trading regime such that developed (Annex 1) countries with commitments to meet GHG emission targets can implement project activities to reduce GHG emissions in developing (non-Annex 1) countries while also contributing to sustainable development. Such projects would earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2 which can be traded and sold and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The commitment period for industrialised countries under the Kyoto Protocol ends in 2012 but negotiations are ongoing that will hopefully establish a second commitment period and associated emission targets together with a successor mechanism to the CDM that will allow carbon trading after the current commitment period ends in 2012. Countries or private entities in developed countries also take part in a voluntary carbon trading market by implementing projects in developing countries and seek verifiable emissions reductions (VERs) that are outside of the Kyoto compliance regime. These VERs are also purchased in the expectation that they can be used to comply with future obligations under the successor to the Kyoto protocol.

Since no specific mention was made of carbon trading or CDM in the Sustainable Development Plan or the National Energy Policy the issue is identified as a gap. Carbon trading would allow geothermal and other renewable projects to take advantage of the CDM and similar schemes by registering projects with the CDM Executive Board. In order to be considered for registration, a project must first be approved by the Designated National Authority (DNA) but currently Dominica does not have a DNA nor any institutions or legislation that would promote the development of carbon trading eligible projects, review and approve carbon trading projects and generally provide governance for carbon trading. A carbon trading policy should be developed to be followed by the establishment of suitable institutions and legislation.

Information Gaps

There are a number of information gaps that are barriers to reliable determination of the mitigation potential and monitoring the progress of mitigation measures. Dominica's reliance on imported fossil fuels for transportation and most of its electricity generation has made it vulnerable to shocks to the economy (e.g., higher electricity, gasoline and diesel fuels costs) caused by higher fossil fuel prices. Gaps in the transportation and domestic energy demand sectors have severely limited the reliability of mitigation measures in these sectors. These are the very demand sectors that not only have high GHG emissions but also afford best opportunities for mitigation. There are also some information gaps in the electricity and fuel demand for the hotel, industrial and commercial sectors. In general there is adequate information for energy transformation (i.e., electricity generation).

The specific information gaps are as follows.

- Lack of fuel end use by sector
  - Gasoline
    - service station sales
    - agriculture/forestry/fishing sales
  - Diesel
    - service station sales
    - sales to the industrial, commercial and hotel sectors
  - LPG
    - Sales to domestic customers
    - Sales to commercial customers
    - Sales to hotels

Need for more detailed motor vehicle fleet information

Recording of vehicle manufacturer, model year, make, vehicle weights (laden/unladen), type of fuel during vehicle registration in a database

Survey data for annual vehicle kilometres travelled (or records of odometer readings during motor vehicle inspections)

Installed capacities

Solar water heaters (domestic, commercial, hotel)

Photovoltaic systems and other renewable electricity generation systems (currently being implemented by IRC's self generators' registration requirements)

Data on the domestic, commercial air conditioning systems (the types and amounts of refrigerants in air conditioning systems)

More frequent updates of Survey of Living Conditions (SLC) data

SLC surveys were conducted in 2002 and 2009. These surveys provide invaluable information on the total number of households and the percentages of households that use various types of fuel for cooking and lighting and the percentages of households that own various types of durable (electrical) goods and appliances (e.g., refrigerators, washing machines, air conditioning units, dish washers, TVs). More frequent surveys would allow for better tracking of the response to various mitigation related policies and mitigation measures.

4.4 Enabling Environment For Mitigation Measures

It is expected that the National Energy Policy and the Sustainable Development Plan will comprehensively address the framework within which GHG mitigation will take place. The mitigation measures proposed in this report include transformation as well as demand related measures.

The mitigation measures for energy supply are centred around establishing large geothermal electricity generation capacity with smaller capacities from wind, hydro, photovoltaic and municipal solid waste generation. The enabling environment for these initiatives is being addressed in the National Energy Policy and the Sustainable Development Plan. It is noted however that to date no specific mention has been made of carbon trading and the potential to derive benefits from implementing the planned renewable energy projects. The enabling environment for carbon trading therefore needs to be addressed through the establishment of a DNA and appropriate supporting institutions and, if necessary, legislation.

The proposed mitigation measures related to demand aim to:

a) reduce the emissions from transportation by changing the vehicle fleet to include alternate fuelled vehicles and hybrids which will be more fuel efficient. Specific policies will need to be developed to promote and encourage the use of such vehicles; and
b) reduce electricity use in the domestic sector specifically by adopting more energy efficient appliances and in other sectors more generally through more efficient air conditioning, increased use of solar water heating and public education.

It is noted that transportation is recognised as a sector of concern[12] and additional measures such as public education and public transport and traffic flow related measures (although not estimated in this report) will provide additional transportation sector emissions reductions. Specific policies will be needed to promote the use of alternate fuelled vehicles.

The proposed GHG mitigation measures for the reduction in electricity demand are based on adoption of more energy efficient household appliances and commercial/industrial equipment (air conditioning) and use of solar water heating to replace electric or gas-fired water heating. Specific policies will be needed to promote and track the importation of such appliances and equipment. These should include adapting/adopting or developing energy efficiency standards for consumer and industrial electrical equipment (e.g. by adopting the Energy Star program) and base import duties for such equipment in part on energy efficiency standards.

4.5 RECOMMENDATIONS

The following recommendations are proposed to address information and policy gaps and build capacity in order to facilitate the implementation of mitigation measures.

- Complete the Sustainable Development Plan and National Energy Policy
- Revise the bases for tax/customs duties so that they are based on vehicle weight class and fuel type (not cc rating)
- Implement import and other policies to promote the introduction of alternate fuelled vehicles (LPG and/or hybrids)
- Develop and implement the regulatory framework to allow carbon trading to take place. This should include legislation establishing the DNR and associated entities and specification of the trading modalities for local and international entities (e.g., licensing, certification or regulation of such entities, owning certified emission reductions (CERs) and Verifiable Emissions Reductions (VERs) etc.)
- Build capacity to support carbon trading
- Enhance the import classifications of motor vehicles and electrical appliances and equipment to clearly distinguish between various categories of vehicles (based on fuel and vehicle weight) and appliances (based on technology and ranges of energy use). Examples are as follows:
    - Motor vehicles – to distinguish fuel used (i.e., diesel, gasoline, CNG, hybrid, electricity only etc.) and weight class
    - Refrigerators (range in SEER value, refrigerant (HC, HFC or HCFC)
    - TVs (based on technology and/or energy intensity)
    - Energy Star rated equipment/appliances
- Implement data collection and reporting systems to capture and report on gasoline, diesel and LPG fuel sales by sector
- Include more detailed information for the motor vehicle fleet and develop a suitable database and reporting system for the motor vehicle fleet
- There direct interaction with stakeholders was limited by a single workshop held in Dominica at the outset of the project. Circulation among stakeholders for comment of the draft GHG inventory and mitigation assessment reports and of the proposed scenarios for the mitigation assessment resulted in negligible response. The compilation of the future GHG inventories and development of the mitigation analyses would benefit additional direct interaction with stakeholders. It is therefore recommended that at least four workshops with direct contact with stakeholders be held as follows:

- to engage stakeholders in the processes r
- present the results of the GHG inventory
- to present the proposed scenarios
- to present the draft Final report

5. REFERENCES

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[13] Caribbean Development Bank, Government of the Commonwealth of Dominica, Country Poverty Assessment, Final Report, Volume 2 of 2: Appendices: Table 34.

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