

Challenges and Opportunities for the Energy Sector in the Eastern Caribbean

Grenada Energy Dossier

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Abstract

This Energy Dossier is part of a series of publications produced by the Energy Division of the Infrastructure and Environment Department of the Inter-American Development Bank. It is designed to increase the knowledge base about the composition and organization of the energy sector of Latin American and Caribbean countries. Each dossier describes the energy matrix of the country under analysis and then dives deeply into the institutional organization and regulatory framework of the energy sector in that country. This series is an important contribution to the understanding of the energy sector of the Eastern Caribbean countries, as many projects providing comparable information have been carried out in this part of the hemisphere.

Keywords: Energy; electricity; energy matrix; Caribbean; Eastern Caribbean

JEL Codes: Q40, Q43, Q48

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Index

Guide to acronyms	4
Country Overview	5
The Energy Matrix	6
Institutional Organization of the Energy Sector	20
Historical Development of the Energy Sector	33
Methodology	34
References	35

Acronyms

Boe/day	Barrels of oil equivalent per day
CR&W	Combustible renewables and waste
ECERA	Eastern Caribbean Energy Regulatory Authority
ESA	Electricity Supply Act of 1994
ESB	Electricity Supply Bill of 2015
GDP	Gross domestic product
GPP	Grenada Private Power Limited
GRENLEC	Grenada Electricity Services Limited
GREN SOL	Grenada Solar Power Limited
GWh	Gigawatt hour
IPP	Independent power producer
Kboe/day	Thousand barrels of petroleum equivalent per day
LPG	Liquefied petroleum gas
LPH	Light and Power Holdings of Barbados
MW	Megawatt
NEP	National Energy Policy
PUC	Public Utilities Commission
PV	Photovoltaic
RESVP	Renewable energy special purpose vehicle

Country Overview: Grenada

The island state of Grenada is located at the southern end of the Grenadines in the Eastern Caribbean. The state's territory encompasses the three major islands, Grenada, Carriacou, and Petite Martinique, as well as a number of smaller islands. Together the islands cover 344 square kilometers, with a population of 105,897 (World Bank, 2014a). More than 90 percent of the population lives on Grenada, and about one-third reside in the national capital of St. George's.

Map 1 Grenada



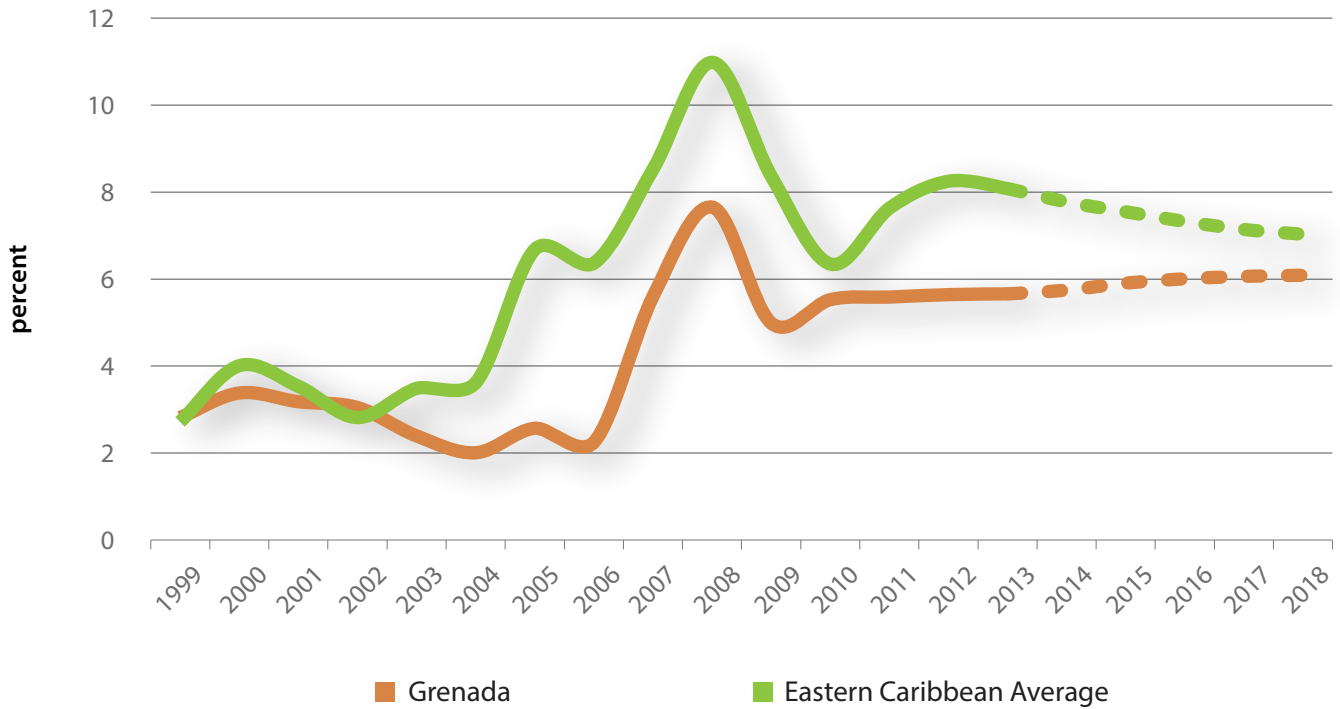
Source: Author's elaboration.

Grenada has a high level of development, with a score of 0.744, ranking 79th out of 187 countries on the 2013 Human Development Index (UNDP, 2014). In 2013, it recorded a national gross domestic product (GDP) of US\$822m, and its per capita GDP stood at US\$7,784 (IMF, 2015).

Like the economies of most of the Caribbean island states, Grenada's economy is disproportionately service oriented. The national economy is dominated by the service sector, primarily government services, education, banking and insurance, tourism, and communications, which contributes 78 percent to the GDP. Industry and agriculture contribute 16 percent and 6 percent, respectively (IRENA, 2012a). The tourism sector directly contributes to 7.3 percent of GDP, but taking multiplier effects into account, the sector's contribution is estimated to be around 24 percent (OAS, 2010).

Like many island states, Grenada is highly reliant on imported fossil fuels to meet its energy needs. However, due to relatively efficient generation in the electricity sector and less dominance of the transport sector as the largest consumer of energy compared to other Eastern Caribbean countries, its oil import costs have historically remained below the Eastern Caribbean average. Still, Grenada currently spends about 6 percent of its GDP on the import of oil products, below the Eastern Caribbean average of 8.2 percent (IMF, 2013).

Figure 1 Oil Import Costs as Share of GDP



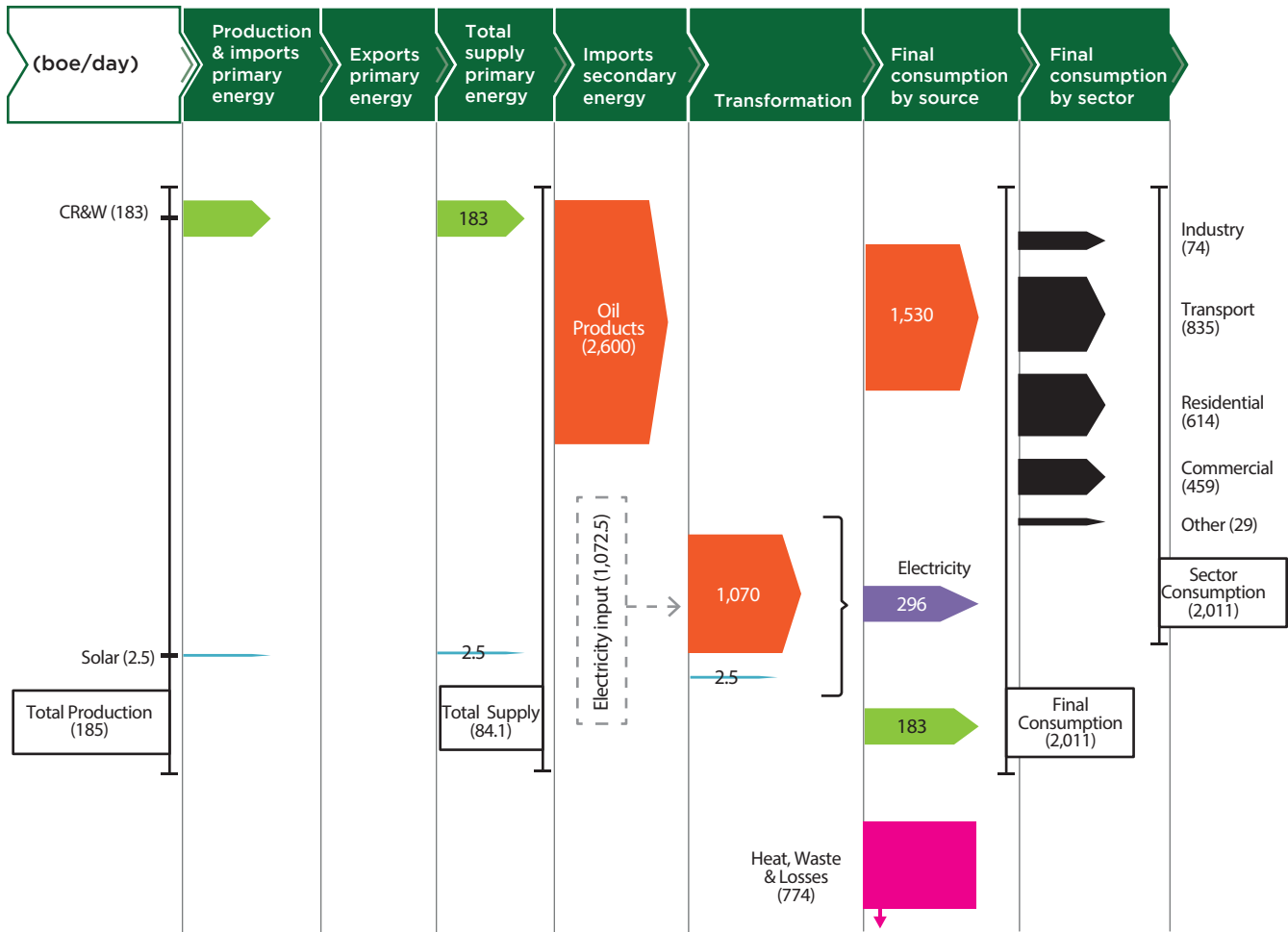
Source: IMF (2013).

The Energy Matrix of Grenada

Grenada's production of primary energy was limited to 182.5 barrels of oil equivalent per day (boe/day) of combustible renewable and waste (CR&W) and 2.5boe/day of solar energy. The vast majority of energy, around 93 percent, was imported in the form of oil products. The island nation imported a total of 2600 boe/day. About 41 percent of oil products (1070 boe/day) are used to generate electricity. Losses during generation, distribution, and transmission total 774 boe/day, leaving 296 boe/day for final consumption. In total, final consumption of Grenada stands at 2011 boe/day, of which 1530 boe/day are oil products, 296 boe/day are consumed in the form of electricity and 182.5 boe/day are CR&W.

Consumption by sector is as follows: the transportation sector consumes 41 percent of energy with 835 boe/day, followed by the residential sector with 614 boe/day with 30.5 percent; the commercial sector with 23 percent and 459 boe/day; the industrial sector with 74 boe/day and 3.5 percent; and other consumption, including street lighting and government, with 29 boe/day and 1.5 percent.

Figure 2 Grenada, 2013



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Authors: Malte Humpert.

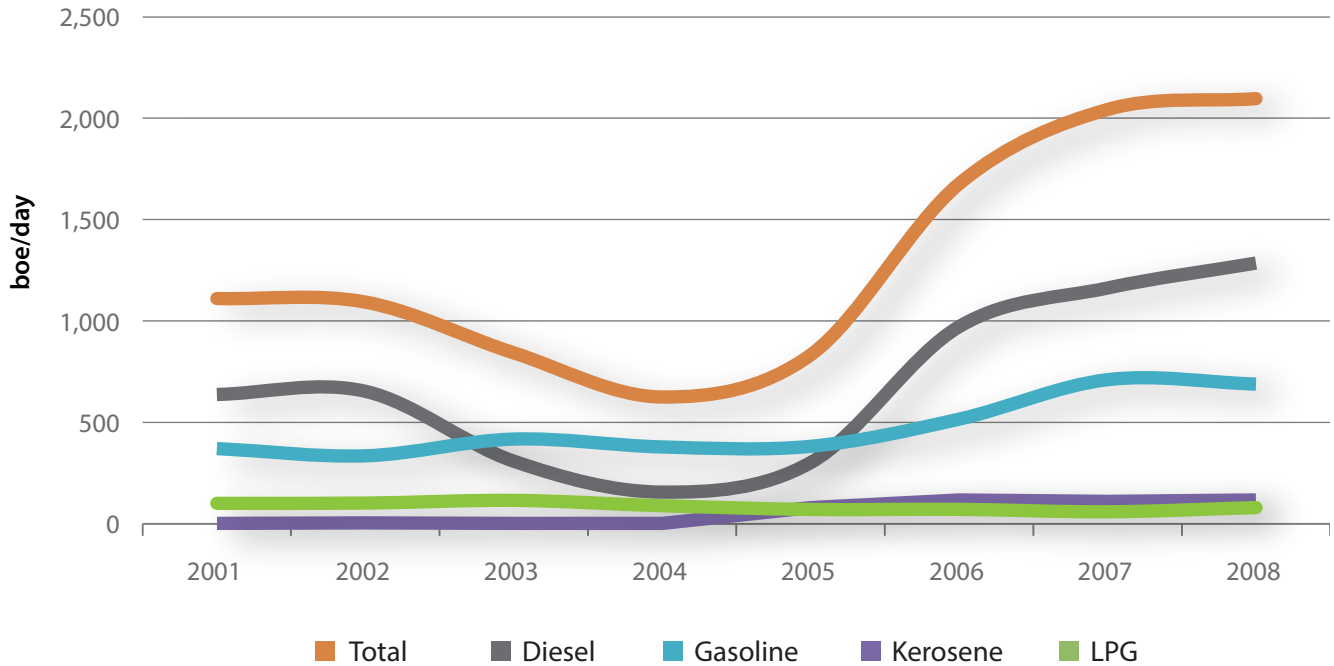
Source: Own calculations based on EIA, Grenada Government, GRENLEC, IRENA.

Total Energy Supply

The total energy supply (TES) in Grenada was 2785 boe/day in 2013. Imported oil products accounted for 2,600 boe/day and made up 93 percent of TES, with the remaining 7 percent coming from CR&W with 182.5 boe/day and solar energy with 2.5 boe/day, accounting for just 0.01 percent (EIA, 2012; GRENLEC, 2013a; IRENA, 2012c).

While Grenada has no proven fossil fuel resources, it possesses substantial renewable energy potential. Its geothermal prospects are excellent, and its location in the tropics ensures widespread availability of wind and solar resources as well as municipal waste-to-energy.

Figure 3 Total Oil Product Supply in Boe/day, 2001-08



Source: Government of Grenada (2011).

Grenada's imports of hydrocarbon resources have increased rapidly over the past 10 to 15 years. Excluding wood-fuel and other biomass sources, TES grew from 1110 boe/day in 2001 to 2096 boe/day by 2008. Diesel fuel accounts for more than half of total supply with 1285 boe/day, followed by gasoline with 688 boe/day, kerosene with 117 boe/day, and liquefied petroleum gas with 79 boe/day.

The sharp decline and subsequent rebound in 2004 and 2005 can be explained in part by the impacts of Hurricanes Ivan and Emily on the electricity sector, which reduced demand for diesel fuels due to damages to the infrastructure. About 80 percent of diesel imports are used in the electricity sector, with the rest consumed by the transport sector (Government of Grenada, 2011).

Domestic Production

Grenada is highly dependent on imported oil products. Its domestic production is limited to CR&W, representing 7 percent of TES, and is used primarily for heating and cooking. Grenada does not have known fossil fuel resources. Around 93 percent of its energy resources are imported in the form of oil products, including gasoline, jet kerosene, gas, diesel, heavy fuel oil, and liquefied petroleum gas.

Figure 4 Share of Total Energy Supply, 2010



Source: EIA (2012); GRENLEC (2013a); IRENA (2012c).

In addition to CR&W, Grenada uses solar water heating in the residential sector as well as the hotel industry. While the penetration is not as high as in Barbados, it is estimated to be around 80kW per 1,000 inhabitants. This figure is high compared to those of its immediate neighbors in the Eastern Caribbean (Samuel, 2013).

Commercial Balance of Primary Energy

Grenada did not import or export any primary energy in 2013.

Domestic Primary Energy Supply

The primary energy supply of Grenada was 185 boe/day in 2013.

Electricity

Installed capacity

Grenada Electricity Services Limited (GRENLEC), a privately-publicly owned, vertically integrated utility company, holds a monopoly on the generation, transmission, distribution, and sale of electricity. It provides electricity to the islands of Grenada, Petite Martinique, and Carriacou. Between the three islands and including private interconnected photovoltaic (PV) systems, Grenada had an installed capacity of 53.3 MW in 2014. On the island of Grenada, GRENLEC operates 13 generating units ranging in

size from 1.2MW to 8MW. Total capacity on the island stands at 48.59MW, and the island recorded a peak demand of 30.2MW in 2013.

GRENLEC operates diesel power plants at Queen's Park on the main island of Grenada with an installed capacity of 45.9 MW. The facility was last expanded in 2002, when GRENLEC added two 5.5MW units. An additional 2.8MW is available on standby basis at St. George's University.

In addition, it has diesel-powered capacity of 3.17 MW on Carriacou and 0.483 MW on Petite Martinique (GRENLEC, 2013a). Grenada has around 1MW of installed renewable energy capacity, with around 0.7MW from privately owned small-scale solar PV, around 0.2MW of PV capacity owned by GRENLEC, and 0.1MW of wind power owned by Paradise Bay Resort.

Grenada also makes limited use of solar water heaters. Between 2000 and 2008, around 4,500 solar water heater units were imported into the country, and estimated penetration as a share of electricity consumers stands at 10 percent. The Grenada Public Service Co-Op Credit Union offers a tailored loan program to provide financing for solar water heaters (Castalia, 2015).

Additional renewable energy projects, such as a 2MW wind farm on Carriacou originally expected for 2012, a 2MW solar PV plant on Grenada, and a 10-20MW geothermal plant initially envisioned for 2016, have not yet materialized as they have faced repeated delays (Castalia Consulting, 2012; Government of Grenada, 2011; OAS, 2010). In September 2014, the government signed a Geothermal Support Partnership Agreement with the government of New Zealand. As of May 2015, geological and geochemical surveys had been completed and assessed at twelve locations. The Carriacou Wind/Diesel Project was launched in September 2012 and receives partial funding in the amount of 2.5 million Euro from the European Union, with counterpart funding of 2 million by GRENLEC. The facility will cut Carriacou's oil dependence for electricity generation by 60 percent. Proposal tenders were received until November 2014 and construction is slated to take place in 2015 with a projected opening in 2016. The status of the project is currently unknown (GRENLEC, 2015a). In addition, GRENLEC's board authorized the construction of a 2.2MW PV solar plant on Grenada, similar to the facility constructed on Petite Martinique in 2013 (GRENLEC, 2015c).

Electricity prices in Grenada, as in many other small islands states in the Caribbean, rank among the highest in the world. As of March 2015, they stood at around EC\$1.00/kWh, even without considering additional environmental levies and value-added taxes (Government of Grenada, 2011; GRENLEC, 2012; GRENLEC, 2015b).

Table 1 Inventory of GRENLEC Power Stations, 2014

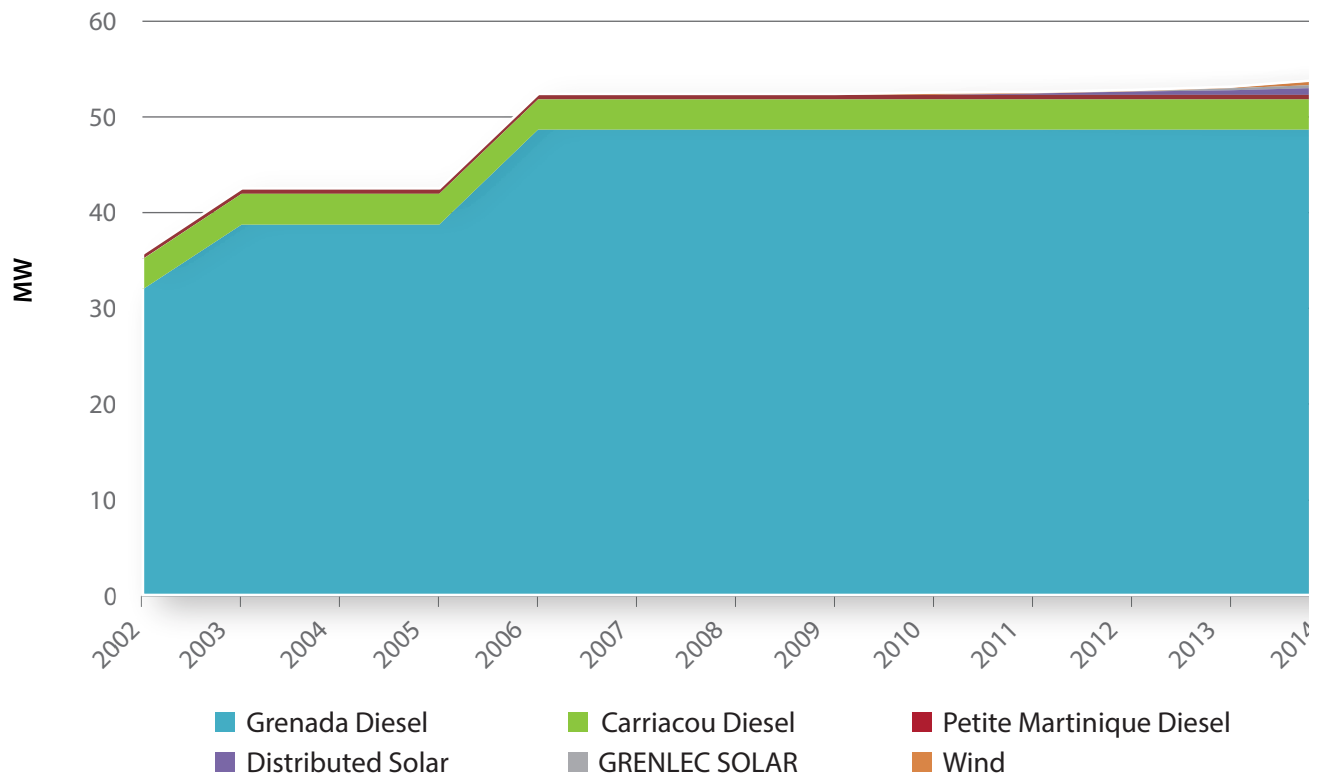
Power stations	Type	Capacity in WM	Year built
Grenada, Queen's Park	Diesel	45.89	No data available
Carriacou	Diesel	3.17	No data available
Petite Martinique	Diesel	0.483	No data available
Petite Martinique	Solar PV	0.031	Oct 2013
Grenada, Grand Anse	Solar PV	0.148	Sep 2013
Grenada, St. George's University	Diesel	2.8 (standby)	No data available
Private generation and distribution	Solar PV	0.717	2005-2014
Paradise Bay Resort	Wind	0.080	2010

Source: Castalia Consulting, (2012); Government of Grenada (2011); GRENLEC (2012).

Diesel-based generation remains the dominant generation method, despite recent small-scale efforts to begin the diversification process. Private small-scale PV installations have been limited. Between 2007 and 2014, only around 70 systems were installed, representing less than 1 percent of capacity. GRENLEC made its first foray into renewables in 2013 with the installation of around 0.2MW of PV systems on Carriacou and at its Grand Anse facility. In light of this slow development, GRENLEC has repeatedly pushed back its goals for the share of

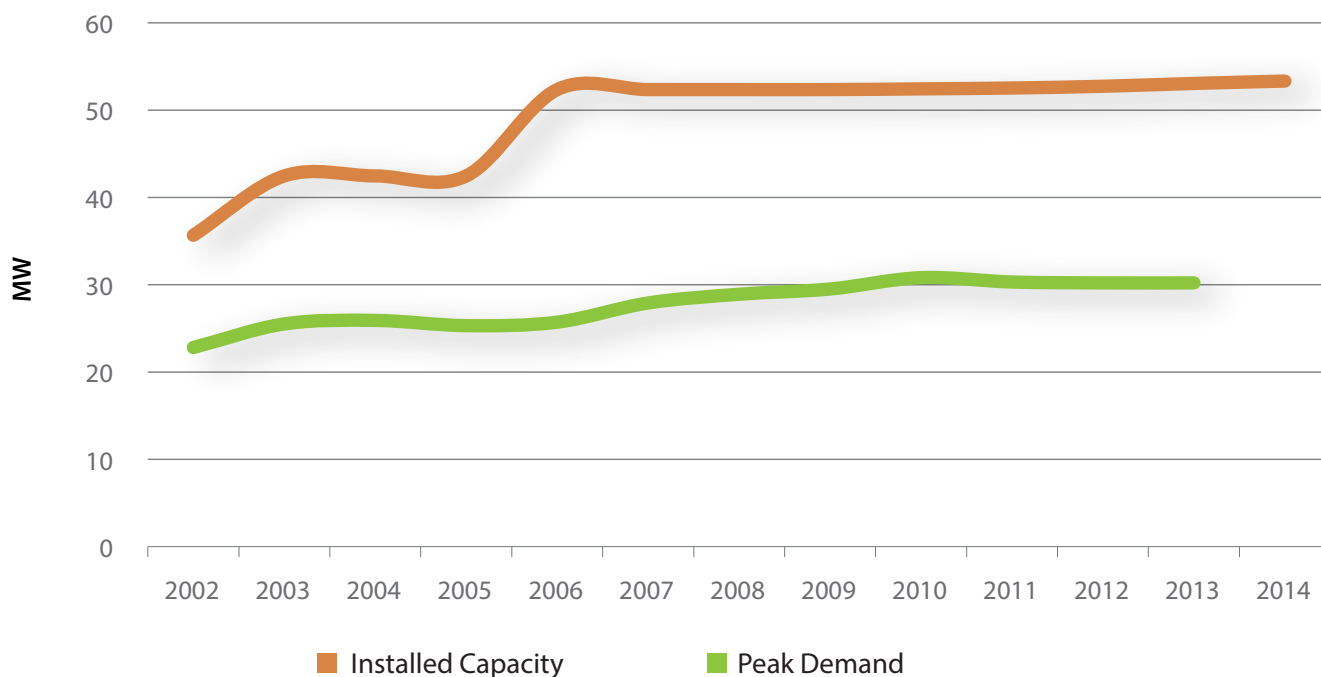
renewable energy as part of the overall mix. Currently, Grenada aims to produce 20 percent of its electricity from renewables by 2017 and 100 percent by 2030 (Worldwatch Institute, 2015). This represents a significant challenge based on the fact that as of 2015 it generates only 0.6 percent from such systems, with 0.4 percent coming from interconnected renewables and 0.2 percent from its own PV systems (The New Today, 2015).

Figure 5 Grenada Installed Capacity by Type and Island, 2002-14



Source: Castalia Consulting (2012); Emanuel et al. (2013); Government of Grenada (2011); GRENLEC (2013a); IRENA, (2012)

Figure 6 GRENLEC Installed Capacity and Peak Demand, 2002-14



Source: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

Input to Electricity Generation

Of the 1072.5 boe/day intended for electricity generation in 2013, 1070 boe/day came from liquid fuels, exclusively diesel, and 2.5 boe/day came from solar energy. In 2013, GRENLEC spent EC\$105.6 million on imported diesel fuels used for the production of electricity. Fuel costs account for two thirds of GRENLEC's total operating expenses (EIA, 2012; GRENLEC, 2013a). The cost of oil imports used for the generation of electricity is substantial, and in 2011 it represented 7 percent of total imports by value and equaled 76 percent of export revenues (Government of Grenada, 2011).

Electricity Matrix

GRENLEC generated 196.7 GWh of electricity in 2013, of which 6.1 GWh were for own use, leaving 190.6 GWh as net generation. It sold a total of 175.8 GWh to 45,765 domestic, commercial, and industrial consumers. Net generation decreased by around 1 percent compared to 2012 and reached the lowest figure since 2008. Electricity sales also decreased by 1.5 percent year over year.

Table 2 GRENLEC Net Generation of Electricity in GWh, 2008-2013

Electricity in GWh	2013	2012	2011	2010	2009	2008
Net generation	190.5	193	196.8	201.4	195.4	189.8
Sales	175.8	178.4	180.9	184.9	178.4	172.4

Source: GRENLEC (2011; 2012; 2013a).

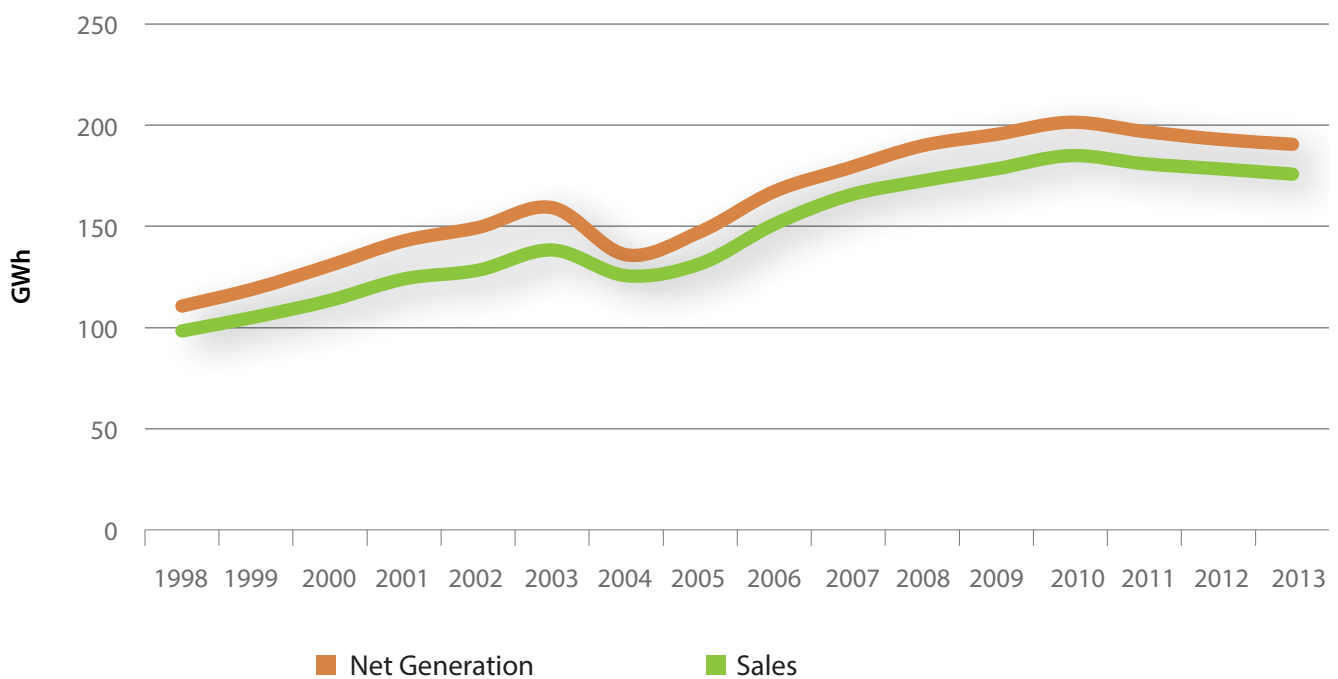
Over the past 15 years, electricity production has sharply increased, with total generation growing by 80 percent from 110 GWh in 1998 to 201 GWh in 2010. About 99.5 percent of households in Grenada are connected to the national grid. Hurricanes Ivan and Emily interrupted the growth trend in 2004 and 2005, respectively, which caused severe damage to the distribution infrastructure and generating equipment. Hurricane Ivan hit the island in September 2004, and the country spent the following months rebuilding the infrastructure.

At the beginning of 2005, 70 percent of the distribution grid had been repaired, but customer levels

stood only at 15,990, almost 60 percent less than before Ivan. By April 2005, this figure had increased to 27,532 customers. Net generation dropped from 159.2 GWh in 2003 to 135.9 GWh in 2004.

In the following year, GRENLEC continued on its path of recovery. The impact of Hurricane Emily was much less severe, as the rebuilt infrastructure proved to be much more resilient. Damages were repaired within three weeks. Production levels climbed significantly but with 147.3 GWh were still about 10 percent below pre-Ivan levels. GRENLEC did not fully recover and surpass the 2003 production figure until 2006, producing 167.2 GWh (GRENLEC, 2005).

Figure 7 GRENLEC Net Generation and Sales



Source: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

The commercial sector dominates Grenada’s electricity consumption, accounting for 55 percent of consumed electricity, followed by the residential sector at 39 percent. Industrial consumption stands at 3 percent and other, including street lighting and government, also accounts for 3 percent. In 2013, GRENLEC had 5,968 commercial customers, 39,762 residential customers, and 35 industrial customers (GRENLEC, 2013a).

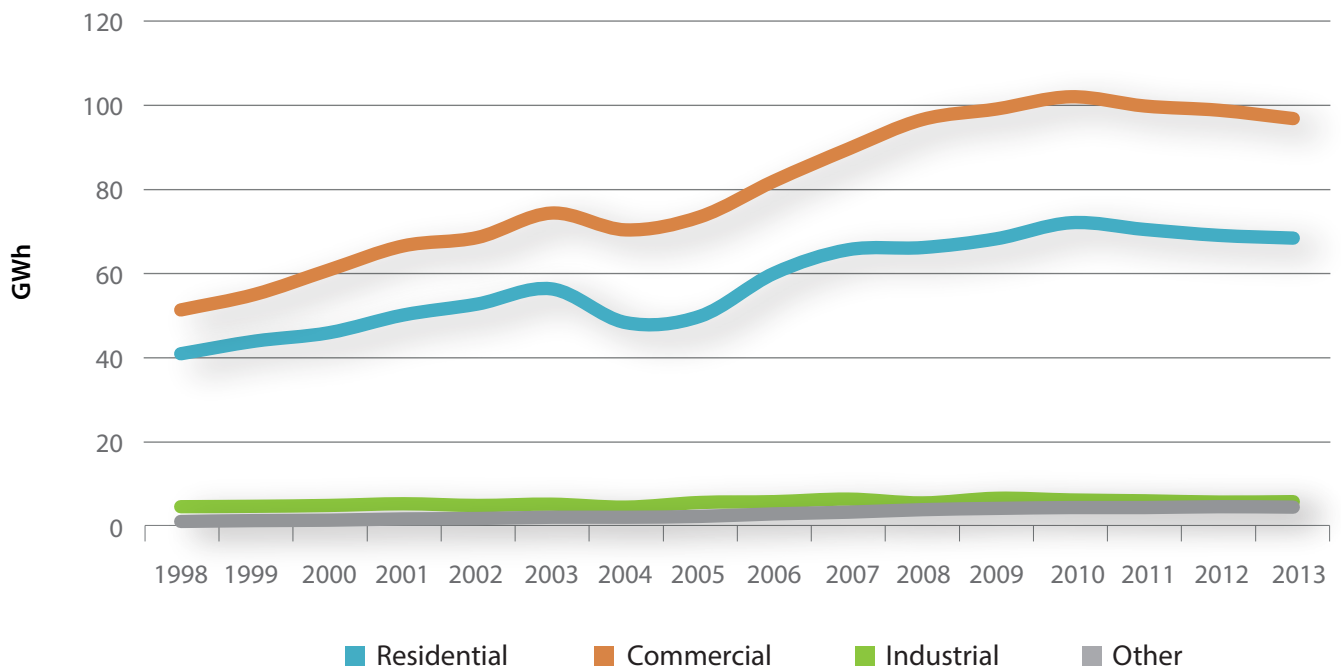
Figure 8 Electricity Sales by Sector, 2013



Source: GRENLEC (2013a).

Consumption by the commercial sector grew at an annualized rate of 4.5 percent between 1998 and 2013, and nearly doubled from 51.4 GWh in 1998 to 102 GWh in 2010, before dropping slightly to 96.8 GWh in 2013. Growth for the residential sector was slightly lower at 3.5 percent annually, which translates into a consumption increase from 41 GWh in 1998 to 68.5 GWh in 2013. Industrial consumption grew at just 1.5 percent and increased from 4.7 GWh to 5.9 GWh over the same period.

Figure 9 GRENLEC Electricity Sales by Customer Type, 1998–2013

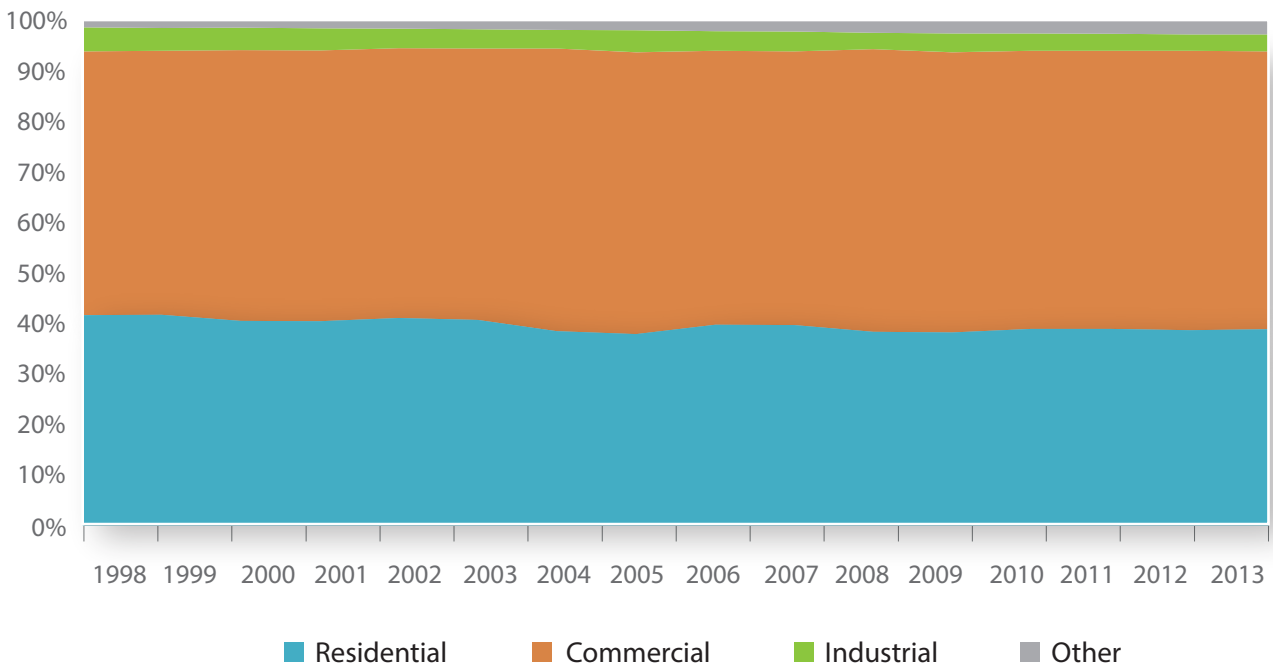


Source: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

The importance of the commercial sector steadily increased between 1998 and 2013. While the commercial sector accounted for 52.3 percent of sales in 1998, it represented 55.1 percent in 2013. Over the same period, the share of the residential sector declined

slightly from 42.7 percent to 38.7 percent in 2012. The share of the industrial sector decreased by roughly a third, from 4.8 percent to 3.2 percent, and street lighting more than doubled, from 1.2 percent to 2.6 percent.

Figure 10 GRENLEC Share of Electricity Sales by Customer Type, 1998–2013



Source: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

Based on demand forecast studies by the World Bank, Grenada will require a substantial expansion of generation capacity over the next decade to meet peak demand. Projected required capacity is slated to double from 53.3 MW today to 107 MW in 2027. Similarly, peak demand is expected to increase drastically from

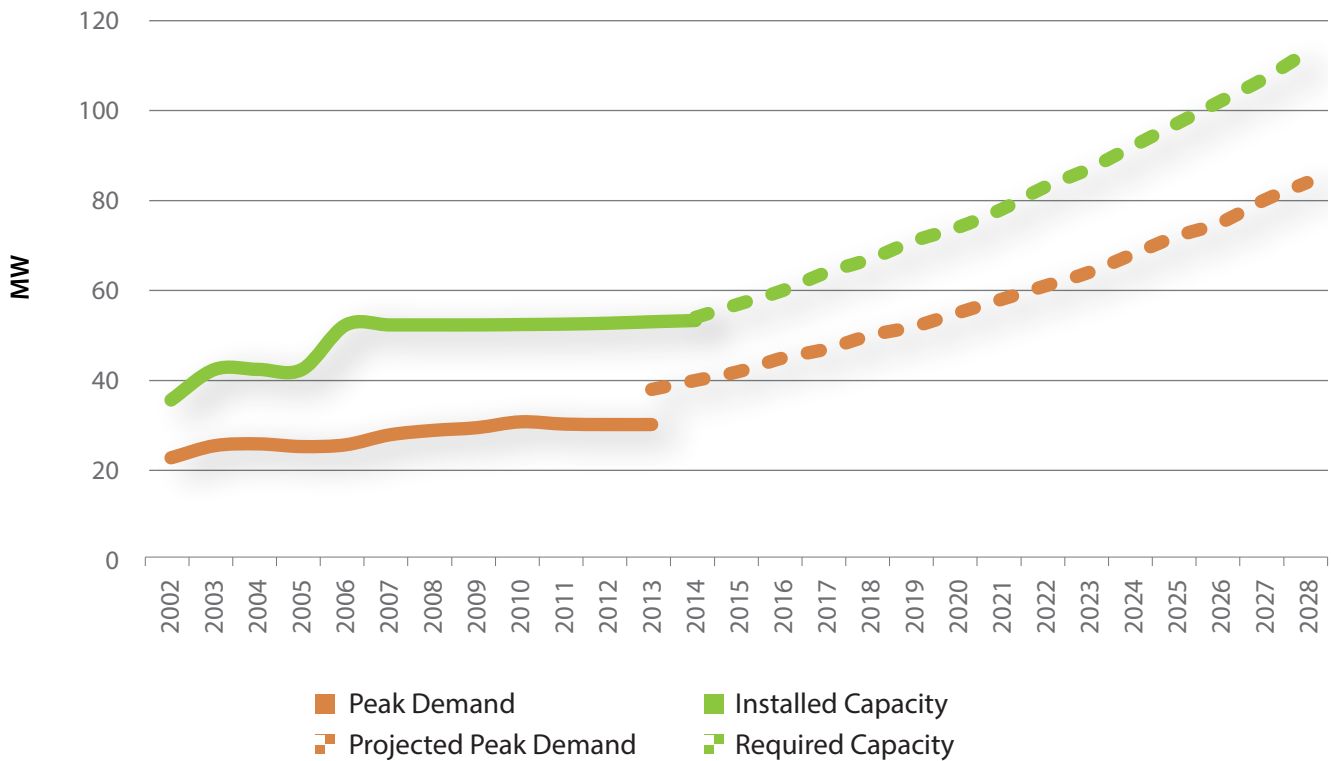
30.2MW in 2013 to 80MW in 2027. Considering that GRENLEC’s sales have remained largely flat since 2008, these growth projections may prove to be too aggressive, and capacity demand and peak demand may experience a more shallow growth path.

Table 3 Grenada’s Projected Capacity Requirement and Peak Demand in MW

	2015	2017	2019	2021	2023	2025	2027
Projected capacity needs	57	64	71	78	87	97	107
Projected peak demand	42	47	52	58	64	72	80

Source: World Bank (2010).

Figure 11 Grenada's Projected Capacity Requirement and Peak Demand in MW



In Grenada, the full range of renewable resources is available with the exception of hydropower.

Table 4 Grenada's Resource Availability

Geothermal	Solar (PV and hot water)	Energy Efficiency	Waste to Energy	Wind	Hydro
✓	✓	✓	✓	✓	

Source: Castalia (2015).

Generation Forecast

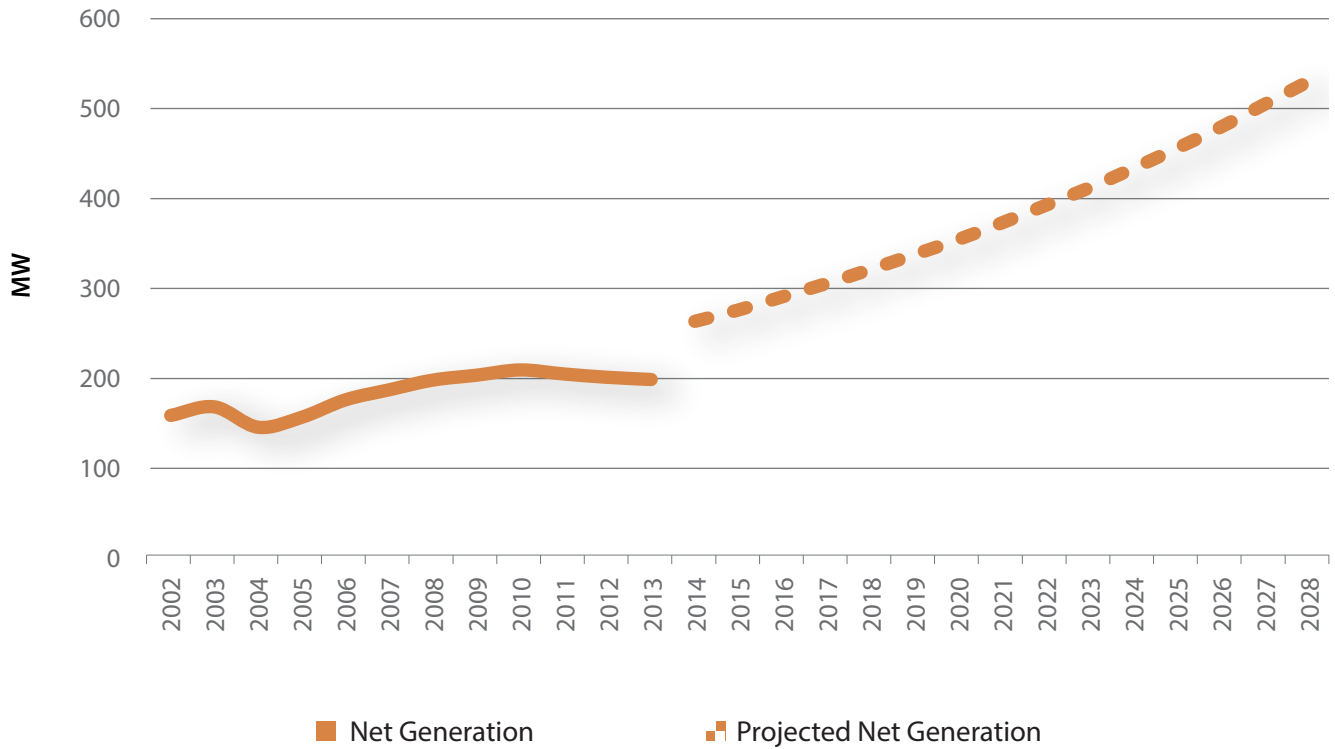
Grenada's projected generation needs are equally projected to grow rapidly, nearly doubling between 2015 and 2027 to 504 GWh. Taking into account, however, that GRENLEC generation has either remained flat or slightly declined over the past seven years, the World Bank's growth forecast is proving too aggressive and demand is likely to grow at a much lower pace over the coming decade.

Table 4 Grenada's Projected Generation Needs in GWh

	2015	2017	2019	2021	2023	2025	2027
Projected generation	270	300	333	369	409	454	504

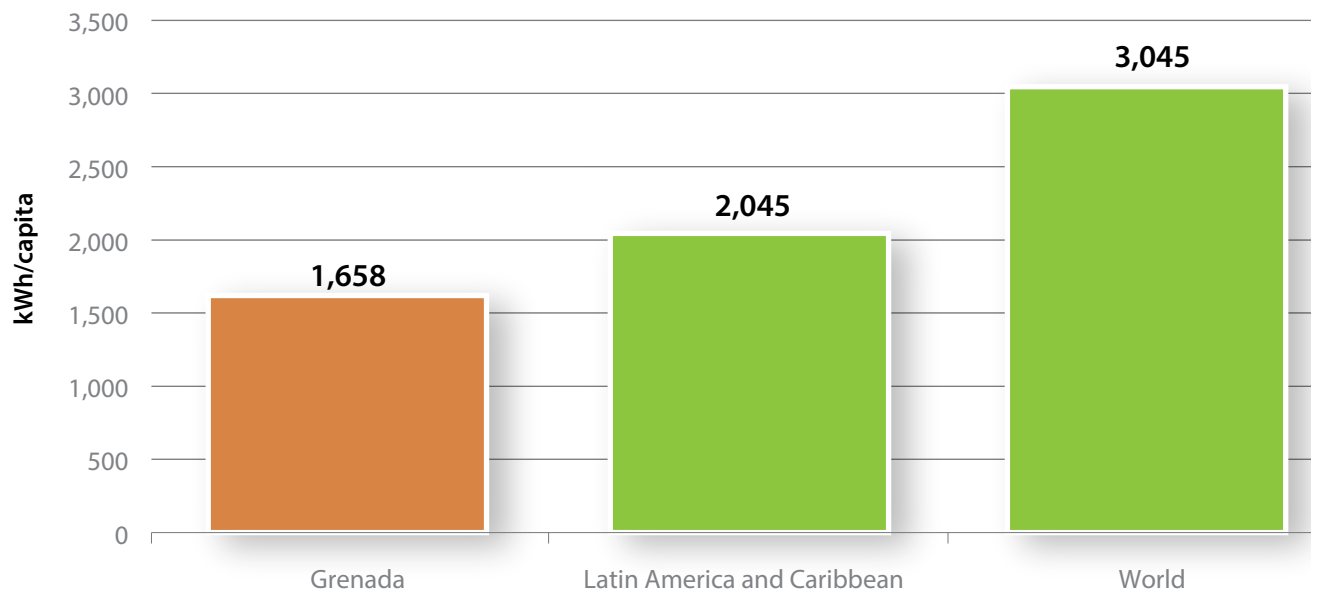
Source: World Bank (2010).

Figure 12 Grenada's Projected Net Generation



Per capita consumption in Grenada stands at 1,658 kWh, about 20 percent below the Latin American and Caribbean average of 2,045 kWh per capita.

Figure 13 Electricity Use per Capita, 2013



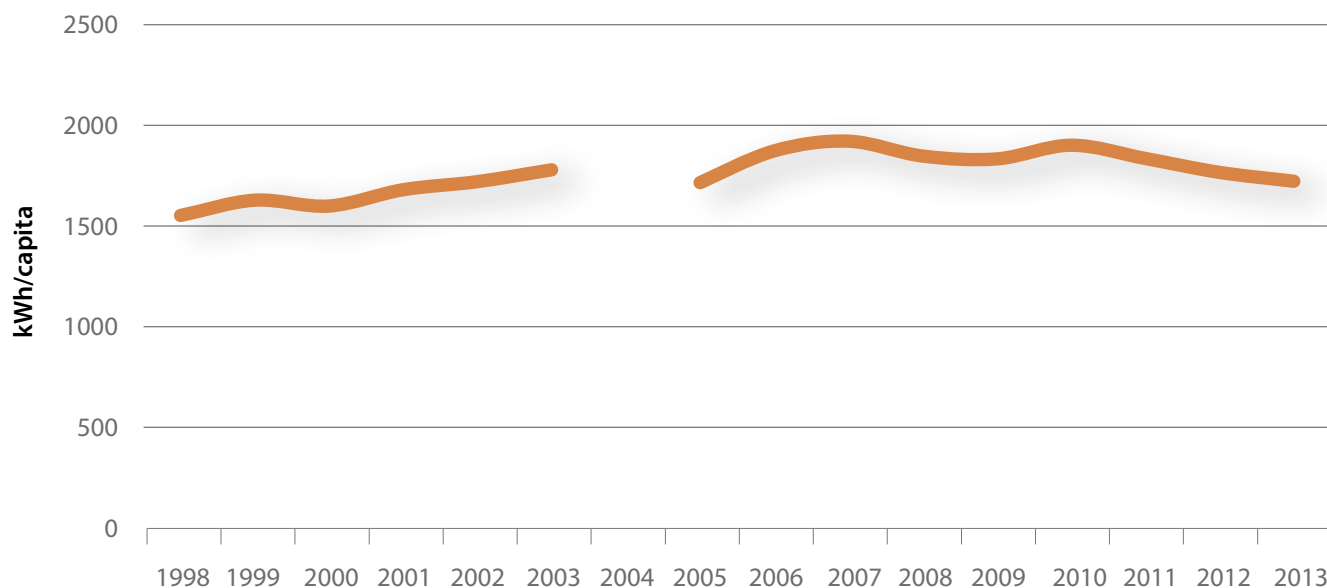
Source: GRENLEC (2013a); UN (2014); World Bank (2014)

Residential per capita consumption of electricity has remained relatively stable over the past 15 years. Between 1998 and 2013, per capita consumption grew by only 12 percent. In 1998, annual consumption stood at 1,552 kWh/per capita. Consumption grew at an annualized rate of 1.8 percent until 2007, when it peaked at 1,921 kWh/per capita.

Consumption later decreased by 10 percent, and in 2013 stood at 1,722 kWh per capita. It is unclear if declining residential consumption over the past five years is due to energy conservation and efficiency measures or if economic trends can help explain declining consumption. Overall, the growth of per capita consumption over the past 15 years is among the lowest in the Caribbean, and GRENLEC’s 80 percent growth in sales can be attributed to an increase in residential customers and to higher average consumption in the commercial and industrial sectors.

Average consumption in the commercial sector increased by 24 percent between 1998 and 2012, from 13.5 MWh per customer to 16.8 MWh. Average consumption in the commercial sector peaked at 18.1 MWh in 2008. Growth in the industrial sector has been the fastest, surging 49 percent between 1998 and 2013 from 108.6 MWh to 168.7 MWh. Average consumption in the Industrial sector peaked at 185.1 MWh in 2007.

Figure 14 Residential Electricity Consumption per Customer, 1998–2013



Source: Sources: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

Note: No accurate data were available in 2004 due to the impact of Hurricane Ivan. GRENLEC recorded a per capita consumption of 3578 kWh for 2004. This data anomaly can be attributed to Hurricane Ivan, and the data point was omitted from the graph above.

Secondary Balance and Final Consumption

Secondary Energy Balance

Grenada imports all oil products.

Final Consumption by Sector

Energy consumption in 2013 totaled 2011 boe/day. The transportation sector consumed 41 percent of all energy, with 835 boe/day. It was followed by the residential sector, with 614 boe/day or 31 percent, and the commercial sector, with 459 boe/day or 23 per-

cent. Industry accounts for 4 percent, with 74 boe/day. Other, mainly street lighting and government consumption, accounted for 29 boe/day or 1 percent (EIA, 2012; Government of Grenada, 2011; GRENLEC, 2013a; IRENA, 2012c).

Figure 15 Energy Consumption by Sector, 2013



Source: Government of Grenada (2011); GRENLEC (2013a); NREL (2015).

The transportation sector consumes the largest share of overall energy due to the high and growing penetration of motor vehicles in Grenada and the importance of the tourism sector and the associated air travel economy. The number of licensed motor vehi-

cles increased from 15,000 in 2000 to over 26,000 by 2009. The penetration of SUVs is high, with 27 percent of vehicle stock contributing to high per-vehicle consumption (Government of Grenada, 2011).

Institutional Organization of the Energy Sector

Current Institutional Structure

The Ministry of Finance, Planning, Economy, Energy and Cooperatives holds a broad mandate with responsibility for the energy sector. Within the Ministry, the Department of Energy and Sustainable Development is responsible for the entire energy, including the electricity subsector, and is tasked with ensuring adequate, reliable, and economical energy services and satisfying projected future demand. It is also responsible for encouraging the use of renewable energy and the promotion of energy efficiency.

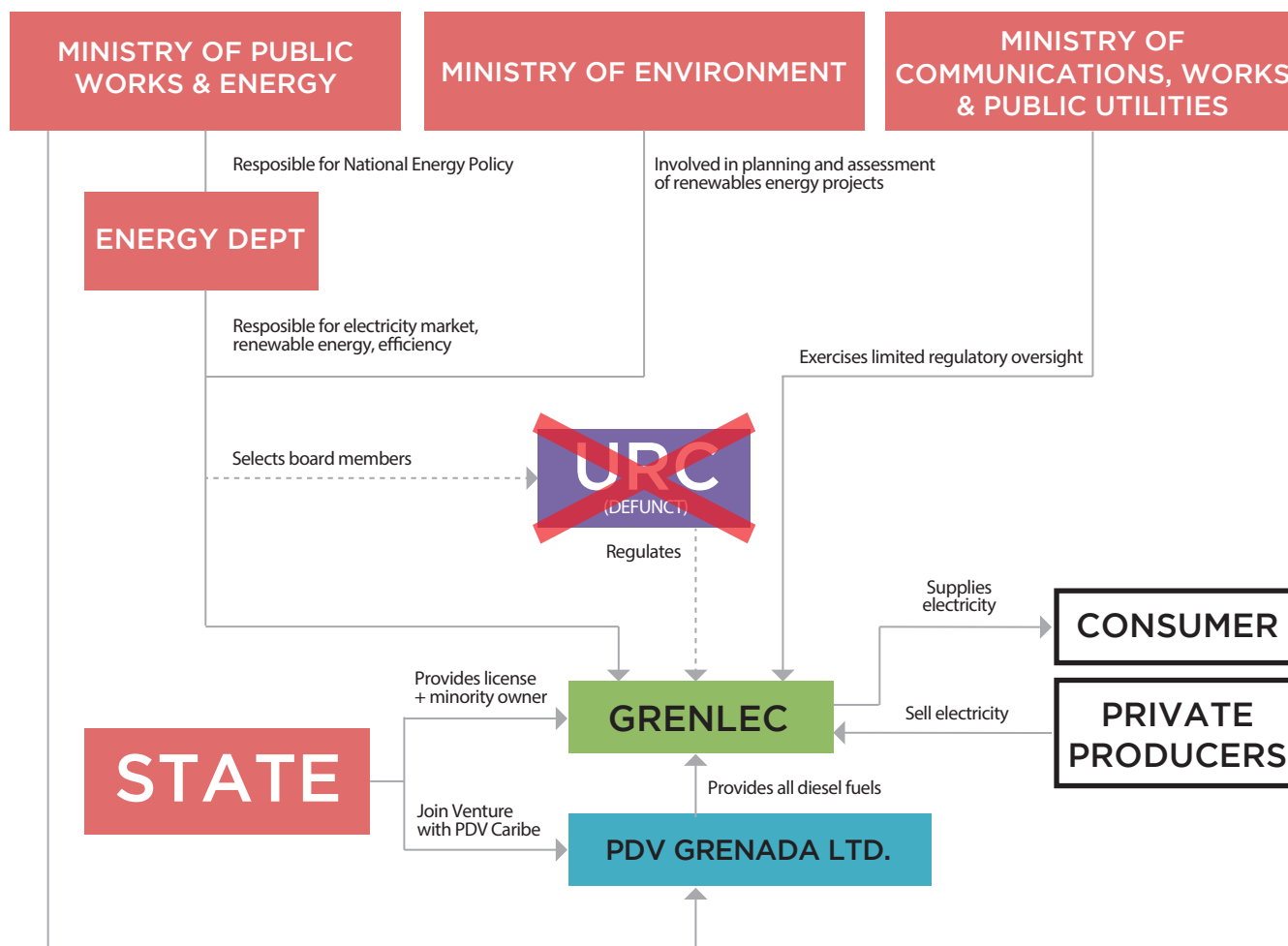
Additional institutional actors are the Ministry of Agriculture, Forestry, Fisheries and Environment, which is involved in the planning, permitting, and implementation of renewable energy projects, and the Ministry of Communications, Works, Physical Development, Public Utilities and ICT, which oversees the electricity sector and in the absence of a formal regulatory commission carries out limited regulatory functions.

Table 5 Institutions and Responsibilities in the Energy Sector

Ministry	Type	Tasks and Responsibilities
Ministry of Finance, Planning, Economy, Energy and Cooperatives	Government ministry	Responsible for overall national energy policy and regulation of import and sale of oil products.
Department of Energy and Sustainable Development	Ministry department	Responsible for energy and electricity market. Leads the development and implementation of renewable energy policy and promotion of new and efficient technologies.
Ministry of Agriculture, Forestry, Fisheries and Environment	Government ministry	Involved in the planning and implementation of renewable energy resources.
Ministry of Communications, Works, Physical Development, Public Utilities and ICT	Government ministry	Oversees the electricity sector and in absence of a regulatory commission carries out all regulatory functions.
Grenada Electricity Services Limited (GRENLEC)	Privately owned, vertically integrated utility	Holds license for the generation, transmission, and distribution of electricity on all three islands.
Grenada Solar Power Limited (GREN SOL)	Privately owned company	Leading solar energy company responsible for the installation of 303kW of rooftop solar systems feeding into the national grid.
Grenada Hotel and Tourism Association (GH TA)	Trade association	Responsible for consuming large amounts of electricity. Interested in moving towards renewable energy resources.

Source: Government of Grenada (2014b); Government of Grenada (2014c); IRENA (2012a); Samuel (2013).

Figure 16 Organization and Functioning of the Energy Sector, 2014



■ Government ■ Government-owned Corporation ■ Majority private-owned Corporation ■ Regulatory

Source: Authors' elaboration based on information from Government of Grenada (2011; 2014b; 2014c); IRENA (2012a; 2012b); Samuel (2013).

Table 6 Key Legislation and Structure of the Energy Sector

Key Legislation and documents	Regulator	Utility	Ownership structure
Electricity Supply Act, 1994	Utilities Regulatory Commission (defunct)	GRENLEC	61.4% WRB Enterprises of which 50% through Grenada Private Power
National Energy Policy, 2011	Ministry of Communications, Works, Physical Development, Public Utilities and ICT (partial) GRENLEC largely self-regulates		13.1% other shareholders 11% Grenada National Insurance Scheme 10% Government of Grenada 4.5% GRENLEC Employees

Source: Government of Grenada, (2014a); National Bank of Grenada (2008); The Gleaner (2013); The New Today (2014).

Ministry of Finance, Planning, Economy, Energy, and Cooperatives

The Ministry of Finance, Planning, Economy, Energy, and Cooperatives exercises general and control and direction over the energy sector. The Ministry is headed by the Minister for Finance and Energy and is divided into ten different departments, one of which is the Department of Energy and Sustainable Development (Government of Grenada, 2014c; Samuel, 2013).

Department of Energy and Sustainable Development

The Department of Energy and Sustainable Development is tasked with ensuring adequate, reliable, and economical energy services aimed at sustaining economic development and meeting all current and future projected demands. The department is responsible for promoting renewable energy technologies and encouraging energy-efficient alternatives. It is also tasked with the promotion of energy efficiency and conservation throughout the entire economy with the aim of achieving optimum economical use of all energy resources. If Grenada were to discover and develop hydrocarbon resources in the future, the department would be responsible for encouraging and facilitating the development of such resources and ensuring that their exploitation occurred in an environmentally sustainable manner. As part of its wide-ranging responsibilities, it also monitors the phasing out of chlorofluorocarbons from the national economy under the Montreal Protocol (Government of Grenada, 2014c; Samuel, 2013).

Ministry of Works, Physical Development, Public Utilities, ICT, and Community Development

The Ministry of Works, Physical Development, Public Utilities, ICT, and Community Development is tasked with protecting and enhancing the nation's investments in infrastructure including roads, bridges, government buildings. In the absence of a functioning regulatory commission the ministry carries out limited regulatory functions (Government of Grenada, 2014c; Samuel, 2013).

Ministry of Agriculture, Forestry, Fisheries, and Environment

The Ministry of Environment is involved in the planning, permitting, and implementation of renewable energy projects. It also leads the effort to promote Clean Development Mechanisms and support climate mitigation projects, including the increased use of renewable energy sources (IRENA, 2012a).

Electrical Inspectorate Unit

The Electrical Inspectorate Unit manages electrical inspections on all islands and conducts examinations and certifications for electricians. It aims at improving the standards of electrical installations. It inspects and tests all new installations prior to connection to the grid, periodically inspects existing installations, and enforces adherence to the electrical codes known as IEE Wiring Regulations (Government of Grenada, 2014b; IRENA, 2012a; Samuel, 2013).

National Energy Policy

In 2011, Grenada passed a National Energy Policy (NEP), which lays out the government's ambitious goal to transition the national economy to a low-carbon future based on utilization of indigenous renewable sources of energy. The policy sets out a 20-year vision, including ambitious but achievable 10-year goals.

The policy serves as a guideline to arrive at a more economically sustainable energy mix deriving at least 20 percent of domestic energy use from renewable energy resources and to reduce greenhouse gas emissions from fossil fuels by 20 percent by 2020. The policy establishes eight specific goals. It aims to: (i) ensure energy security and secure long-term socioeconomic development by making energy available, affordable, and reliable; (ii) achieve energy independence by reducing dependence on imported energy resources; (iii) improve energy efficiency by promoting efficient use, (iv) achieve greater energy conservation during the production and end-use of energy on a per capita basis; (v) promote environmental sustainability by prioritizing clean technologies

to reduce the societal and environmental impact; (vi) ensure sustainable resource exploitation by not exceeding the regeneration capacity of the environment; (vii) control energy prices by ensuring rational and effective market conditions; and (viii) promote energy equity and solidarity by ensuring that all sectors have equal and reliable access to energy at affordable prices today and also in the future.

To achieve these goals, Grenada aims to address institutional and regulatory issues by establishing new legislative frameworks. The key provisions are the establishment of a National Energy Commission to review the achievement of policy targets with stakeholder involvement; the creation of a National Sustainable Energy Office with an adequate mandate and authority; the creation of a regulatory body for licensing,

oversight, regulation and rate setting for the electricity sector; the prioritization of the exploitation of potential geothermal energy resource; the establishment of procedures, standards, and tariffs for small-scale, grid-integrated renewable energy capacity, and the enabling of efficient and economically viable involvement of private investment in the electricity sector.

The government aims to formulate and pass an array of technical and non-technical acts and regulations, including an energy efficiency act, a geothermal act, an oil development act, a revised offshore petroleum act and regulations, and a revised electricity supply act (Government of Grenada, 2011; OAS, 2010; Renewable Energy and Energy Efficiency Partnership Grenada, 2012).

Regulator

The Ministry of Finance, Planning, Economy, Energy, and Cooperatives regulates the energy sector. The

government sets and regulates the retail prices of imported petroleum products (Samuel, 2013).

Institutional Structure of the Electricity Subsector

GRENLEC, the sole provider of distributed utility-scale electricity, dominates the energy sector. The Electricity Supply Ordinance of 1961, which went into effect on January 1, 1961, granted GRENLEC a legal monopoly on the generation, transmission, distribution and sale of electricity for a period of 80 years. The government is currently in the process of overhauling the existing legal and regulatory framework of the electricity sector that has existed since 1994.

In 1994, the government decided to privatize GRENLEC. Through a competitive bidding process, 50 percent of GRENLEC's shares were awarded to WRB Enterprises, a privately owned U.S. company. Following the privatization, government entities retained a 21 percent stake in the utility, with the remaining shares

held by employees, private citizens, and other local and regional shareholders.

Concurrently to relinquishing control and majority ownership of GRENLEC in 1994, the government passed the Electricity Supply Act of 1994, which extended GRENLEC's electricity sector monopoly through December 31, 2073. The government also passed the Public Utilities Commission Act of 1994 with the aim of establishing an independent regulator for the electricity sector. The Commission was only briefly operational, and while the Ministry of Communications, Works, Physical Development, Public Utilities, and ICT conduct some regulatory functions, GRENLEC has been largely self-regulating since 1994.

Existing Legislative and Regulatory Framework

The existing legislative and regulatory framework has enabled a monopolistic, fossil fuel-biased development of the electricity sector, severely hampering the development of renewable energy technologies. Furthermore, the ability of external forces, such as the government, to implement changes to encourage the use of renewable energy is limited under the current framework.

No legislative or regulatory provisions exist for the participation of large-scale independent power pro-

ducers or small-scale private generators in the market. GRENLEC's monopoly extends even to the renewable energy sector, where the Electricity Supply Act of 1994 (hereafter ESA) grants it the right to harness both hydro and solar energy free of charge.

To encourage the development of distributed grid-connected renewable energy, GRENLEC established an interconnection policy in 2007 allowing for up to 1 percent of peak demand to be supplied by renewable energy sources. The policy specified a maximum total

capacity of 300kW with a per-installation limit of 10kW for private suppliers and 100kW for commercial entities. During this pilot phase, GRENLEC introduced a net-metering scheme, which enabled generators to receive credit for the electricity they generated at full retail rate.¹ Grenada's electricity rate of EC\$1.00 during this time meant that GRENLEC lost an estimated EC\$1.35 million of revenue annually. To reduce utility revenue losses, GRENLEC subsequently switched to a net-billing arrangement. This switch to avoided cost compensation has made the installation of PV systems less attractive and has slowed market growth substantially, especially for residential producers (Couture et al., 2015). In 2010, GRENLEC projected that renewable generation would account for 11 percent of installed capacity by 2013-2015 (Government of Grenada, 2011). By the middle of 2015, it accounted for less than 2 percent.

In 2012, GRENLEC moved to phase two of its interconnection policy and allowed for an additional 500kW of distributed renewable energy to be added to the grid. In addition to net billing, GRENLEC introduced a flexible billing option. Under the net-billing agreement, customers were guaranteed a per kW price of EC\$0.45 for a 10-year period, while the rate under the flexible billing option is adjusted annually based on the average avoided fuel costs of the previous year (GRENLEC, 2013b, 2014c). While the program will begin phase three in the near future to allow for additional capacity, once the 800kW are reached it will remain capped at 2.5 percent of annual electricity demand overall (Couture et al., 2015).

Electricity Supply Act of 1994

The ESA governs the electricity sector and grants a monopoly for the generation, transmission, distribution, and sale of electricity to GRENLEC. It was amended in 1998 and 2005. The first document governing the electricity sector was the Electricity Supply Ordinance of 1961, which granted GRENLEC an 80-year exclusive license.

The Ordinance served as the basis for the ESA, which was passed shortly after the government decided to sell 90 percent of its 100 percent stake in the company in 1994. With the passage of the ESA, GRENLEC's license was extended for a new 80-year period until December 31, 2073. The ESA sets the tariff rates that GRENLEC is authorized to charge each class of consumers and further outlines how the fuel surcharge is calculated and describes how rates can be adjusted on an annual basis and fuel charges on a monthly basis. The ESA does not provide mechanisms for potential cost savings from renewable energy generation, such as, for example, due to avoided fuel charges, to be passed on to the consumer (Government of Grenada, 1994a).

- The Act lays out detailed rules for the functioning of the electricity sector. Key provisions are contained in the following articles:
- Article 5 - Gives GRENLEC the power to grant license to independent power producers (IPPs) and specify their duration and geographical extend.
- Article 6 - Requires GRENLEC to maintain 20 percent excess installed capacity above the previous years' average daily peak demand.
- Article 7 - Describes how statutory electricity rates are set and points to the First and Third Schedule for more details.
- Article 13 - Exempts GRENLEC from import duties and taxes on machinery, equipment, vehicles, fuel, lubricants and other materials not destined for resale.
- Article 14 - Allows GRENLEC to carry losses forward indefinitely and set them off against the profits in any subsequent year.
- Article 25 - Permits GRENLEC to harness water or wind power, without charge, for the purpose of providing the public with electricity.
- Article 28 - Grants the government the right to revoke the license at 35 years or 55 years after commencement of the license with a 24 months' notice, but defines severe penalties and the requirement of the government to purchase GRENLEC if it were to invoke this right. Penalties differ depending on if the license is revoked before or after 40 years of service (Government of Grenada, 1994a).

The first schedule defines five classes of service—domestic, commercial, industrial, governmental, and nongovernmental organizations—and describes specific non-fuel charges for each class. The original non-fuel charges set in the ESA were as follows: residential ec\$0.55, commercial ec\$0.58, industrial ec\$0.47, governmental 90

¹ Net metering is the process by which producers feed electricity into the grid at full retail rate with a single bi-directional meter and thus offset their retail electricity purchases from the grid. Producers pay the difference between electricity fed into the grid and electricity drawn from the grid at the applicable retail rate. Under some systems, the customer can "store" electricity in the grid, that is, the meter can go past zero. In net billing, producers install two meters, one for measuring electricity drawn from the grid and one for measuring electricity supplied to the grid. Producers are billed for electricity consumed at retail rate and are paid for electricity produced, typically at less-than-retail rate, up to a limit of usually 100 or 150 percent of self-consumption. Feed-in Tariff: Producers install two meters, one for measuring electricity consumed and one for measuring electricity supplied to the grid. The producer is billed for electricity consumed at the retail rate and is paid for electricity produced at an above-market rate.

percent of the commercial rate, and nongovernmental organization equal to the commercial rate. The rates have since been adjusted. More details can be found in the section on electricity tariffs.

The ESA does not contain legislative or regulatory provisions for the participation of small-scale or large-scale independent power producers to participate in

the marketplace, but it does allow private individuals to generate electricity for self-consumption. The ESA extends GRENLEC's monopoly beyond generation from fossil fuels and includes generation from hydro and solar sources, significantly curtailing the prospects to private investment of development in the renewable energy sector (Government of Grenada, 1994a).

Planned Reforms of the Electricity Subsector

In November 2012, Grenada Private Power Limited (GPP), the majority owner of GRENLEC and a subsidiary of WRB Enterprises, announced its intention to sell its equity stake in the company to Light and Power Holdings of Barbados (LPH), a subsidiary of Emera Incorporated, a Canadian utility and energy company. WRB controls a 61.4 percent equity stake: 50 percent through its subsidiary GPP and 11.4 percent through Eastern Caribbean Holdings. The government saw this potential change in the ownership structure as an opportunity to address the shortcomings of the current legislative and regulatory framework. It pursued a two-pronged approach to achieve this goal: either use its time-limited right to submit a bid to purchase GPP's shares to become the majority owner of GRENLEC or negotiate a new, more favorable ESA/ Successor Agreement with LPH.

The government identified a number of problems with the existing framework. The key shortcomings were: (i) excessive length of GRENLEC's 80-year exclusive license, (ii) unclear limits on ownership structure which undermined the government's goal of limiting ownership by any one entity to 50 percent, (iii) inability of the government to ensure that GRENLEC implements the goals of the NEP and allows renewable energy IPPs, (iv) unattractive guidelines and structure for private investments into small-scale distributed renewable energy, (v) constrained ability to ensure robustness of the utilities assets, (vi) lack of or weak compliance mechanisms or penalties for nonperformance by GRENLEC, and (vii) incompatibility of the current framework with the proposed Eastern Caribbean Energy Regulatory Authority (ECERA) (Government of Grenada, 2013a).

On December 27, 2012 the government and EMERA, the parent company of LPH, agreed to a list of changes to the existing framework, including to: (i) limit GRENLEC's exclusive license to fossil fuel-based generation and to a period of 45 years with 30-year limits of any future owner, (ii) mandate renewable electricity portfolio standards to ensure growing role of renewable energy with strict penalties for non-compliance, (iii) establish Renewable Energy Special Purpose Vehicles (RESPVs) for renewable energy generation from geothermal, wind, solar and waste, (iv) restrict ownership of GRENLEC or RESPVs to 50 per-

cent for any one entity, (v) grant an exclusive RES-PV license for geothermal exploration to entity other than GRENLEC, (vi) establish reasonable feed-in tariffs guaranteed by GRENLEC, (vii) ensure that GRENLEC offers reduced rates for commercial power consumers at the request of the government, (viii) establish a robust independent regulatory authority, either regionally or nationally, with the ability to enforce GRENLEC's compliance with new regulations as part of any ESA successor agreement or amendment (Government of Grenada, 2013b, 2014a; IRENA, 2012a).

As part of the proposed regulatory changes, the Government of Grenada also proposed a new interconnection policy, which outlined several changes to the existing policy. Renewable energy sources were to be initially capped 5 percent of peak generation. Limits could be increased after consultation with GRENLEC ensuring that grid stability would be maintained. Commercial installations would remain capped at 100kW while the capacity for private installations would be raised from 10kW to 15kW.

Producers would be allowed to use the energy they produced and sell excess production to GRENLEC up to a 150 percent of their own monthly consumption. Guaranteed purchase price would be increased EC\$0.53/kWh with a potential review after 5 years of the 10-year contract period. Regulatory control of these feed-in-tariffs would fall under the jurisdiction of the ECERA (Government of Grenada, 2013b).

In April 2014, GRENLEC informed the government that its offer to take back majority control of the utility company was not particularly attractive and that WRB would continue accepting offers from new investors (The New Today, 2014). The government continued its work to reshape the legal and regulatory structure of the electricity sector and in February 2015 presented a draft Electricity Supply Act 2015 and a draft Public Utilities Regulatory Commission Act, which would end GRENLEC's legislatively guaranteed monopoly and fundamentally overhaul the electricity sector. The government's key goals are to increase the supply of electricity from renewable sources and increase the efficiency of the production and use of electricity (Brennan, 2015).

Draft Electricity Supply Bill 2015

The Draft Electricity Supply Bill of 2015 (hereafter ESB) aims to repeal the ESA, end GRENLEC's exclusive license, and introduce a host of comprehensive structural reforms. According to the government, the ESB will lower the barriers to entry for investments and create a competitive energy marketplace, open to domestic and foreign investments for all aspects of the electricity sector, ranging from generation, transmission, and distribution to sale. The new ESB allows for multiple competing utility-scale producers and network operators, with preferential consideration for power producers utilizing renewable energy sources in their generation (Government of Grenada, 2015a; Hewitt, 2015; OECS, 2015).

While the ESB opens the door for a complete liberalization of the market, including distribution, it appears that the bill aims to leave GRENLEC's exclusive license for transmission and distribution intact (Hewitt, 2015). In the bill, the minister is granting extensive powers, including the power to create and oversee the national electricity sector policy including short-, medium- and long-term steps to implement it. Furthermore, the minister is giving the exclusive power to grant, modify, extend, suspend, and revoke licenses and permits and functions as the technical regulator of the sector (Government of Grenada, 2015a).

GRENLEC's Response to the Draft Electricity Supply Bill of 2015

Rather than a drastic and sudden overhaul of the complete electricity sector, GRENLEC explains that the existing framework, including its customer renewable energy interconnection program, and its own initiatives to install utility-scale renewable capacity, represent a more feasible pathway to diversify electricity supply and reduce dependence on foreign oil products. According to GRENLEC, more than 800kW of renewable capacity from PV systems have been installed at over 70 customer sites. Furthermore, GRENLEC has installed around 200kW of PV system capacity and is in the process of finalizing the Carriacou wind farm proposal for a 2MW wind farm installation (GRENLEC, 2015d).

Public Utilities Regulatory Commission Bill

The Public Utilities Regulatory Commission Bill proposes to repeal and replace the Public Utilities Commission Act of 1994. It creates a Regulatory Commission with appointed Commissioners that will function as the economic regulator of the electricity sector initially, with a possible extension of jurisdiction over other sectors in the future (OECS, 2015). Furthermore, the size of the Commission will be reduced from five members to three to five members to allow for its prompt and cost-effective operation. The bill also proposes the eventual transfer of designated regulatory functions to the proposed Eastern Caribbean Energy Regulatory Authority (ECERA). The Commission will be in charge of setting electricity rates for utility-scale license holders and of determining the rate received by self-generators who distribute electricity into the grid. Furthermore, it enforces compliance of all license holder with the rules set out in each respective license, which will ensure service quality and adherence to rates and efficiency mandates. It will also address and resolve consumer complaints. In contrast to the Commission established by the Act of 1994, which was dependent on Parliament to allocate funds for its operation under a vague and ill-defined scheme, this new Commission is envisioned to ensure sufficient operating funds by one or more of the following mechanisms: (i) submit an annual budget request to Parliament, (ii) assess on an annual bases a small percentage fee on the public utilities' gross annual revenues, and (iii) bill public utility companies under its jurisdiction for excess costs of specific proceedings and operations associated with the performance of its mandate (Government of Grenada, 2015b).

Electricity Sector Actors

Grenada Electricity Services Limited

GRENLEC is the sole provider of utility-scale electricity to Grenada, Carriacou, and Petite Martinique. It was originally a subsidiary of the Commonwealth Development Corporation. Its exclusive license originated in 1961 with the passage of the Electricity Supply Ordinance. It has held a monopoly on the generation, transmission, distribution, and sale of electricity since that year and, based on current legal framework, will continue to do so until the end of 2073. It distributes electricity to over 40,000 customers and has a workforce of around 200 employees.

GRENLEC was government owned between 1982 and 1994, when the government sold all but a 10 percent stake

to investors. Today, 61.4 percent of shares are held by WRB Enterprises through its subsidiaries, GPP (50 percent) and Eastern Caribbean Holdings (11.4 percent), with the remaining shares owned by the National Insurance Board (11.6 percent), GRENLEC's employees, and the general public (17 percent) (Emanuel

et al., 2013; Government of Grenada, 2013b; Samuel, 2013). In November 2012, WRB Enterprises first publicized its intention to sell its stake to LPH, a subsidiary of Emera. In May 2014, WRB announced that the government's offer to reacquire GRENLEC was not attractive and that WRB would maintain majority ownership (The New Today, 2014).

Grenada Solar Power Limited

The Grenada Solar Power Limited (GREN SOL) was founded in 2005 and has established itself as the primary solar photovoltaic (PV) supply company in the region. On a per-capita basis, Grenada has the highest amount of grid-connected solar PV in the region. It has also installed systems on Dominica and Saint Vincent and the Grenadines. GREN SOL's efforts began in February 2007 when, as part of a pilot project and after negotiations with the government and GRENLEC, under the 2008 Interconnection Policy, it secured permission to connect a number of small-scale renewable energy systems to the grid. Its first installation was a 20.6kW solar PV system at the Maca Bana resort on Grenada in 2007. Its largest installation to date was a 113kW of ground-mounted solar PV system on the island of Carriacou which was completed in the spring of 2015.

Phase I of the interconnection program allowed 300kW to be connected to the grid, with individual installations not exceeding 10kW for private producers and 100kW for commercial producers. Between 2008-2012, GREN SOL installed 54 systems, with a total capacity of 315kW across the island, and it was subsequently granted a license to add another 500kW to the grid.

The response and growth during Phase II has been slower than during Phase I because the tariff arrangement—either a fixed option under which customers

are paid EC\$0.50 per kWh for a period of 10 years or a variable option under which the return is based on the annual average avoided fuel costs—is less favorable and is seen as too risky, with excessively long time frames for realizing return on investment.

Despite GREN SOL's efforts, penetration as a share of total electricity generation remains very low, contributing only 550MWh, or 0.3 percent, of total electricity consumption in 2011 (Castalia Consulting, 2012; Samuel, 2013). By 2014, small-scale renewable generation contributed 0.6 percent (The New Today, 2015). In addition to GREN SOL's activities, another privately owned firm, ELC Integration Company Solutions, is retailing and installing solar PV systems and small-scale wind turbines on the island (Castalia Consulting, 2012; IRENA, 2012a; Samuel, 2013).

In addition to GREN SOL, a limited number of private companies operate in Grenada's energy sector. Geo F. Huggins and Co. Ltd. is a private company that distributed solar water heaters on Grenada under an agreement with Sunpower Limited of Barbados. Hubbards Ltd. and the Creative House, Ltd. both distribute solar water heater equipment by the Barbadian company Solar Dynamics. ELC Integrations Company Solutions (ELCICS) sells and installs solar PV systems, solar water heaters, and small wind turbines in Grenada (Castalia, 2015).

Table 7 Renewable Energy Support Policies, 2013

Feed-in tariff	Net metering	Renewable portfolio standard	IPPs permitted	Tax credits	Tax reduction/exemption	Public loans/grants
Proposed	✓	Proposed	✓	✓	✓	Proposed

Source: Government of Dominica (2014a; 2014b); Parliament of Dominica (2006); Worldwatch Institute (2015).

Regulator

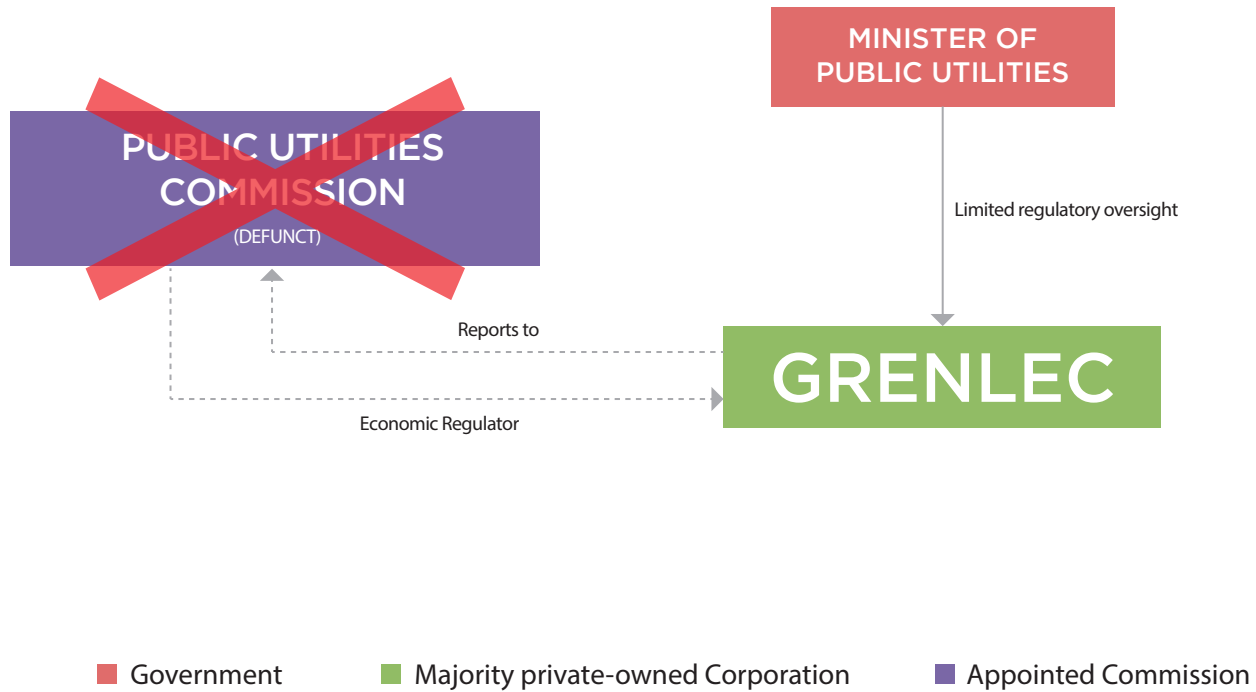
Together with the ESA, the Government of Grenada passed the Public Utilities Commission Act of 1994, which establishes the responsibilities and powers of the Public Utilities Commission (PUC). The PUC, however, was never actually established, in part due

to a lack of funding, as no commissioners were appointed and no actual regulatory body was created. The government plans to create a PUC through the planned passage of the Public Utilities Commission Act. In February 2015, the government published a

summary of the corresponding Public Utilities Commission bill, according to which the PUC would have the authority to set and regulate GRENLEC’s electricity tariffs and approve power purchase agreements between the utility and IPPs.

The regulatory function de facto falls under the Department of Energy and Sustainable Development within the Ministry of Finance, Planning, Economy, Energy and Cooperatives. Here, the Senior Energy Officer is tasked with reviewing and approving any annual electricity rate adjustments (Government of Grenada, 2011).

Figure 17 Regulatory Framework of the Electricity Sector



Source: Authors’ elaboration based on Government of Grenada (2011); IRENA (2012a); Samuel (2013).

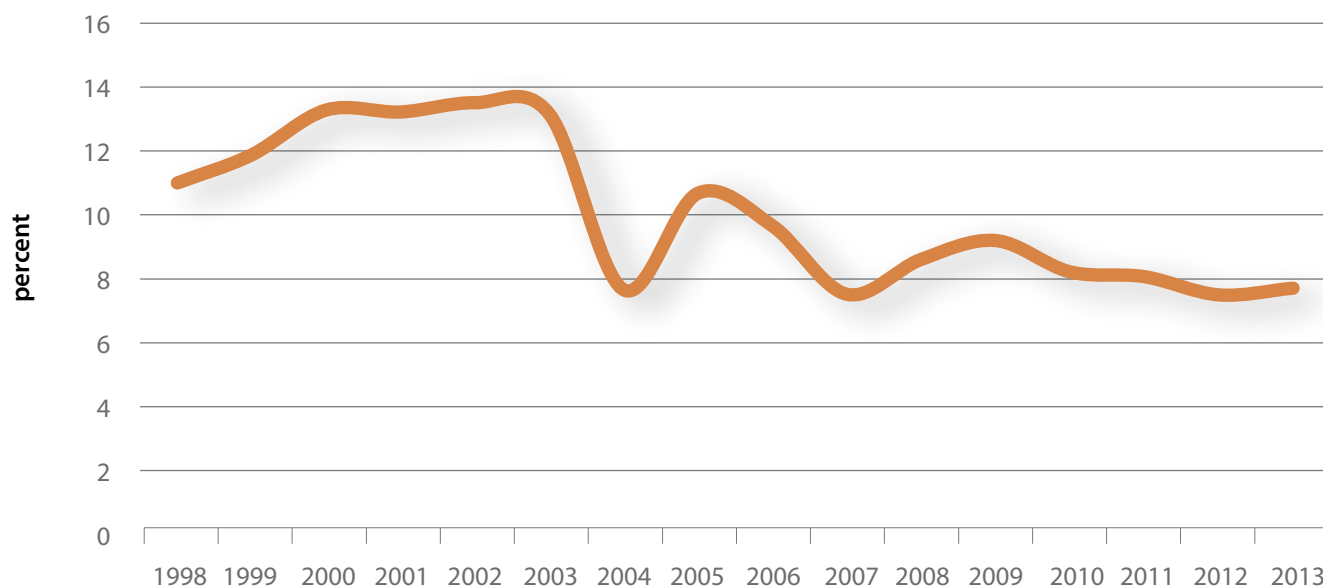
Transmission and Distribution

Following steady increases in electricity demand, GRENLEC began planning the introduction of a 33kV transmission system prior to Hurricane Ivan, and the system became part of the restoration in the hurricane’s aftermath. Today there are two 33kV transmission lines with new substations at Queen’s Park and Grand Anse distributing electricity to the load centers in the southern and western regions and the island’s tourism belt.

Twelve 11kV feeders emanate from the Queen’s Park (7) and Grand Anse (5) substations, traversing the entire island and providing electricity to every village (GRENLEC, 2012; National Bank of Grenada, 2008).

While fossil-fuel-based generation of electricity remains inherently inefficient, GRENLEC has made improvements to prevent losses associated with distribution and transmission of electricity. Between 2000 and 2013, it reduced system losses from 13 percent of generation to below 8 percent (Government of Grenada, 2011, OAS, 2010). GRENLEC’s loss rates have continuously decreased over the past 15 years. Losses as a share of net generation stood at 11 percent in 1998 and peaked at 13.51 percent in 2002. Since then, losses have declined sharply to reach the lowest figure yet of 7.5 percent in 2012.

Figure 18 GRENLEC Losses as Share of Net Generation, 1998-2013



Source: GRENLEC (2002; 2003; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013a).

Electricity Rate

Retail electricity prices in Grenada are comparable to those of other electricity markets in the Eastern Caribbean. The ESA defines five classes of service: domestic, industrial, commercial, government, and non-governmental organizations. The total electricity tariff is composed of a non-fuel charge, a fuel charge, and value-added tax. In addition, residential customers pay an environmental levy above 10kWh, commercial customers pay a fee based on square footage, and industrial customers pay a charge based on horsepower capacity.

The non-fuel charge in Grenada sits at the lower end of the range of electricity prices in the Eastern Caribbean Islands. Taking into account the rising fuel charge, however, high prices place significant pressure on businesses, especially considering Grenada's proximity to Trinidad and Tobago, where larger economies of scale and hydrocarbon resources make electricity available at a fraction of the cost. Total costs are around EC\$1.00 per kWh.

Table 8 GRENLEC Electricity Tariffs and Charges, 2014

Charge	Domestic	Commercial	Industrial	Street lighting
Tariff	\$0.4155/kWh	\$0.448/kWh	\$0.3284/kWh	\$0.3931/kWh
Fuel surcharge (March 2015)	\$0.3793/kWh	\$0.3793/kWh	\$0.3793/kWh	\$0.3793/kWh
Environmental levy	< 99kWh - \$0 99-149kWh - \$5 >150kWh - \$10	n/a	n/a	n/a
VAT	15% non-fuel charge above 99kWh consumption.	15% on non-fuel charge	15% on non-fuel charge	15% on non-fuel charge
Floor area charge (per 50 sq. feet)	n/a	\$0.20 per month	n/a	n/a
Horsepower charge	n/a	n/a	\$2 (per horsepower) Minimum - \$10	n/a

Source: GRENLEC (2015b).

In addition to the fuel and non-fuel charges, there are a number of fees for customers. Domestic customers pay an EC\$5.00 environmental levy for consumption between 99 and 149kWh and EC\$10.00 above 150kWh. Commercial consumers pay an EC\$0.20 fee per 50 square feet of floor space, and industrial customers pay an EC\$2.00 charge per horsepower, with an EC\$10.00 minimum.

The average non-fuel charge has remained stable over the past 20 years. GRENLEC has forgone several rounds of rate increases to which it was entitled under the ESA, and over the past 18 years non-fuel charges increased by only 11.18 percent compared to cumulative inflation of 47 percent over the same period. Its largest rate increase came in March 2012, when rising operating costs required it to increase the non-fuel rate by 3.71 percent.

The non-fuel charge hovered around EC\$0.38 for most of the 1990s and early 2000s before increasing slightly over the past eight years to EC\$0.4146 for domestic consumers, EC\$0.4471 for commercial customers, and EC\$0.3277 for industrial consumers. The fuel charge originally contributed only a small portion to the overall price of electricity, but its share has grown significantly since the mid-2000s. With rising crude oil prices, the fuel charge increased rapidly and reached its peak in 2012 at EC\$0.6519.

Figure 19 Average Annual Non-fuel Charge and Fuel Charge, 1996–2013

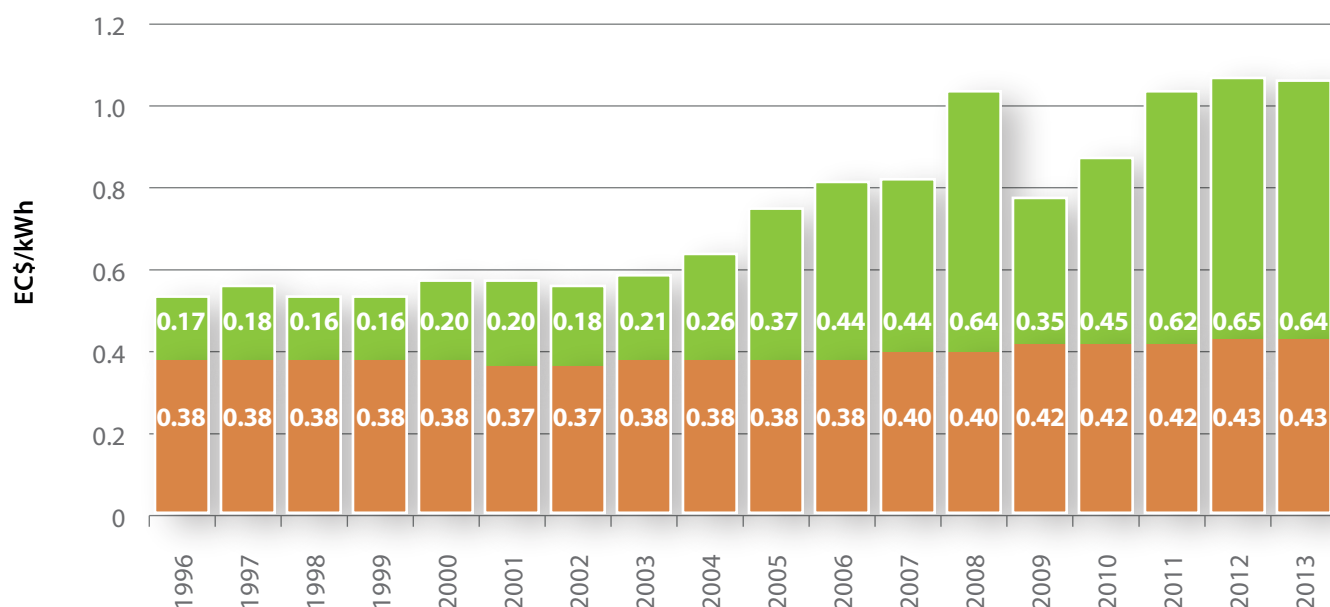


Table 9 Electricity Sector Tariff Regime, 2015

Who sets tariffs?	Who controls tariff changes?	How the tariff is calculated?	How tariff changes are calculated?
GRENLEC, within limits set by Parliament.	GRENLEC, with approval of PUC (defunct).	Rate formula set in the ESA 1994.	Formula changed to allow for "fair" return.
Who monitors and enforces fairness of tariff?	Who can alter terms of how tariff is calculated?	How frequently is tariff revised?	Is there a guaranteed rate of return?
PUC (defunct)	Parliament	Annually	No guaranteed rate. Non-fuel rate adjusted January 1 according to price cap formula and projected sales. Adjustment must be 2% below Grenada's non-fuel inflation rate.

Source: Government of Grenada (1994a; 1994b); GRENLEC (2015d); World Bank (2011).

Table 6 Key Legislation and Structure of the Energy Sector

Key Legislation and documents	Regulator	Utility	Ownership structure
Electricity Supply Act, 1994	Utilities Regulatory Commission (defunct)	GRENLEC	61.4% WRB Enterprises of which 50% through Grenada Private Power
National Energy Policy, 2011	Ministry of Communications, Works, Physical Development, Public Utilities and ICT (partial)		13.1% other shareholders 11% Grenada National Insurance Scheme 10% Government of Grenada
	GRENLEC largely self-regulates		4.5% GRENLEC Employees

Source: Government of Grenada, (2014a); National Bank of Grenada (2008); The Gleaner (2013); The New Today (2014).

Institutional Structure of the Hydrocarbon Subsector

As Grenada does not produce any hydrocarbon resources and has no refining capacity, its hydrocarbon subsector is limited. Grenada signed the PetroCaribe agreement in June 2005 and operates the PDV Grenada joint venture through which it receives around 1000 boe/day, supplying roughly half its oil import needs. PDV Caribe also supplies part of GRENLEC's

diesel needs (GRENLEC, 2007). Petroleum prices are set by the Ministry of Finance, Planning, Economy, Energy, and Cooperatives. The government determines wholesale and retail prices, ensuring that consumer prices at the pump reflect price changes in the international market.

Table 10 Matrix of the Hydrocarbon Sector

Production	Imports	Transformation	Commercialization
	PDV Grenada Ltd.		National Petroleum Company/ PDV Caribe Dominica Limited Sol Petroleum + additional distributors

Transportation

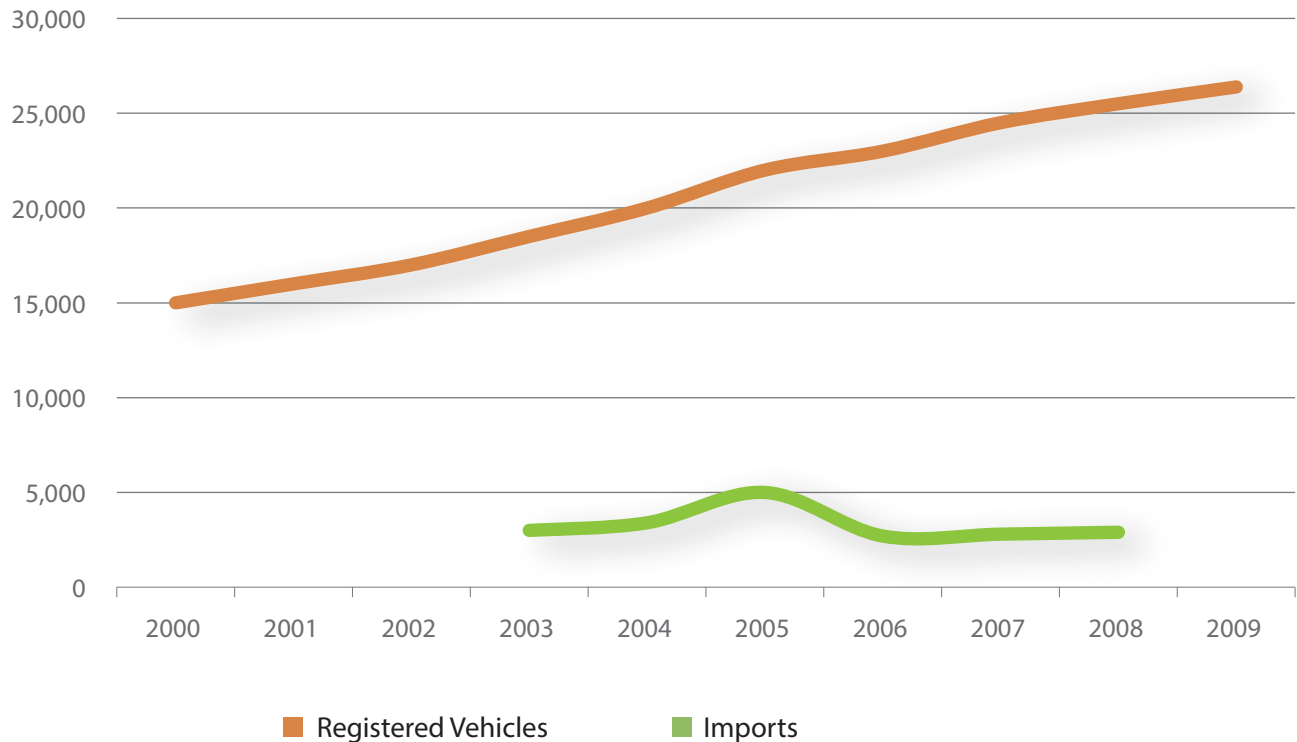
The transport sector accounts for 41 percent of overall energy consumption. Vehicle stock has grown rapidly from around 15,000 registered motor vehicles in 2000 to over 26,387 vehicles by 2009, of which 40 percent are cars.

The complete absence of hybrids, natural gas, or all-electric vehicles in Grenada and the high penetration rate of SUVs (27 percent) contribute to above-average consumption by the transport sector. Grenada places an environmental levy on vehicles above a certain age. Grenada's aging vehicle stock further increases consumption rates, as older cars are on average less fuel-efficient than new cars.

The sector has an average growth rate of about 5 percent, translating to 1,200 new and used imported vehicles per year. In 2009, about 77 percent of vehicle imports were new vehicles, with the remaining 23 percent comprising used car imports.

The NEP recognizes the importance of the transport sector in its efforts to conserve energy and increase energy efficiency and makes mention of the potential to begin converting the islands' motor vehicle stock to an all-electric fleet (Emmanuel et al., 2011; Government of Grenada, 2013).

Figure 20 Grenada Motor Vehicle Stock, 2000-09



Source: Government of Grenada (2011).

Historical Development of the Grenadian Energy Sector

The history of the electricity sector in Grenada began in 1928 when the island was first electrified. The government provided and managed supply under the Public Works Department. Grenada's sole utility company was incorporated on September 27, 1960, and was formally established by an Act of the Grenada Legislative Council on November 7, 1960. It was a subsidiary of the Commonwealth Development Corporation.

In 1960, the sector had a generating capacity of 1.85MW and served approximately 550 customers. With the Electricity Supply Ordinance the following year, GRENLEC received the sole and exclusive license for a period of 80 years. In 1982, the government purchased the Commonwealth Development Corporation's shares in GRENLEC and became the sole owner of the utility, which by this time had a capacity of 8.355MW and served over 10,000 customers.

During the late-1980s, the electricity penetration rate increased as GRENLEC embarked on an expansion

project to electrify and connect a number of villages. The government decided to convert GRENLEC into a public company in 1993, and prepared to sell most of its shares the following year. It maintained a 10 percent share of the company.

In addition to serving the main island of Grenada, GRENLEC also provides electricity to Carriacou and Petite Martinique. Prior to 1960, electricity on Carriacou was only available to the Anglican Church building. Wide-scale electrification on the island began in the mid-1970s, and today the island's electrification rate (99.99 percent) exceeds that of Grenada.

Similar to Carriacou's electricity development, supply on Petite Martinique was originally limited to the church and school on the island. Between 1979 and 1983, electrification increased but was provided on a distributed level with three small generators. In 1983, the island achieved 100 percent electrification and features a high reserve-generating capacity (GRENLEC, 2014a; 2014b).

Methodology for Energy Matrix

Table 11 Energy Matrix

	CR&W	Solar	Electricity input oil products	Electricity consumption	Final consumption by sector
2013	182.5 boe/day	2.5 boe/day	1070 boe/day	295.7 boe/day	
Source	Based on IRENA 2009 figure of 7% of primary energy assuming no significant change 2009-2013.	Based on GRENLEC 2013 Annual Report, -900kW installed PV capacity yielding around 1.7GWh annual	Based on GRENLEC 2013 Annual report gross generation of 196 GWh and heat rate of 15.98kWh/US Gallon	Based on GRENLEC 2013 Annual Report Sales of 175.7 GWH	Calculated based on Grenada National Energy Policy 2011 Petroleum Fuel Consumption by Sector

Source: Authors' elaboration.

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