

Challenges and Opportunities for the Energy Sector in the Eastern Caribbean

Dominica 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	34
Methodology	32
References	33

Acronyms

CDC	Colonial/Commonwealth Development Corporation
CR&W	Combustible renewables and waste
DOMLEC	Dominica Electric Company
GDP	Gross domestic product
GWh	Gigawatt hour
IPP	Independent power producer
IRC	Independent Regulatory Commission
IRENA	International Renewable Energy Agency
Kboe/day	Thousand barrels of petroleum equivalent per day
kW	Kilowatt
kWh	Kilowatt hour
LPG	Megawatt
MW	Megawatt hour
MWh	National Energy Policy
NEP	Sustainable Energy Plan
VAT	Value-added tax

Country Overview: Dominica

The island of Dominica is part of the Windward Islands of the Eastern Caribbean located north of Martinique and St. Lucia. The island is 47 kilometers long and 29 kilometers wide, has a total land area of 751 square kilometers, and is home to a population of 72,003 people. About a quarter of the population lives in the capital city of Roseau (World Bank, 2014).

Map 1 Dominica



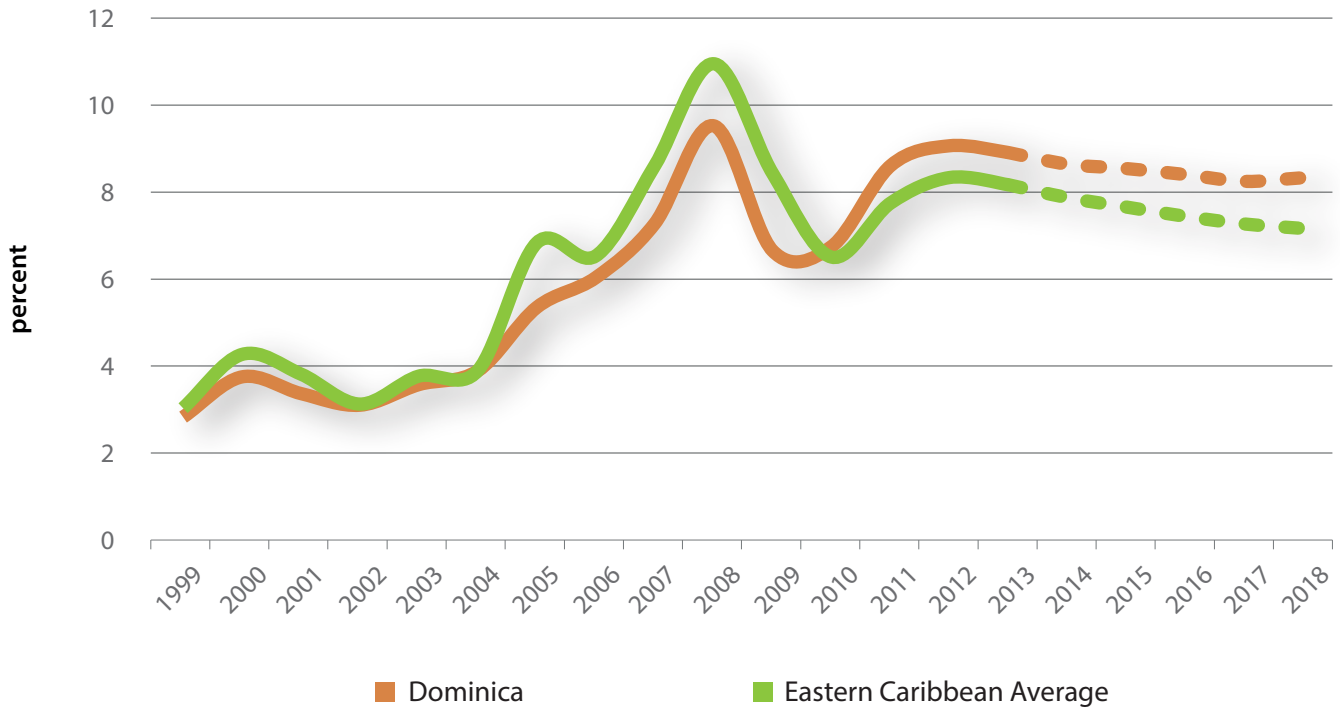
Source: Author's elaboration.

Dominica has a high level of development with a score of 0.717, ranking 93rd out of 187 countries on the 2013 Human Development Index (World Bank, 2014). In 2013, it recorded a national gross domestic product (GDP) of US\$517m, and its annual per capita GDP stood at US\$7,304 (IMF, 2015).

Dominica's economy, similar to the economies of most of its Caribbean neighbors, is disproportionately service oriented and dominated by the tourism and financial sectors. However, the agricultural sector, especially the banana industry, continues to play an important role in Dominica and contributes about 18 percent to the overall GDP and employs 22 percent of the work force (Claude Davis and Associates, 2010; Global Environment Facility, 2013; University of the West Indies, 2013).

Like many island states, Dominica is highly reliant on imported fossil fuels to meet its energy needs. However, due to the declining share of electricity generation from hydropower it's oil import costs recently crept above the Eastern Caribbean average. In 2012, oil imports accounted for 9.0 percent of GDP, slightly above the Eastern Caribbean average of 8.3 percent (IMF, 2013b).

Figure 1 Oil Import Costs as Share of GDP



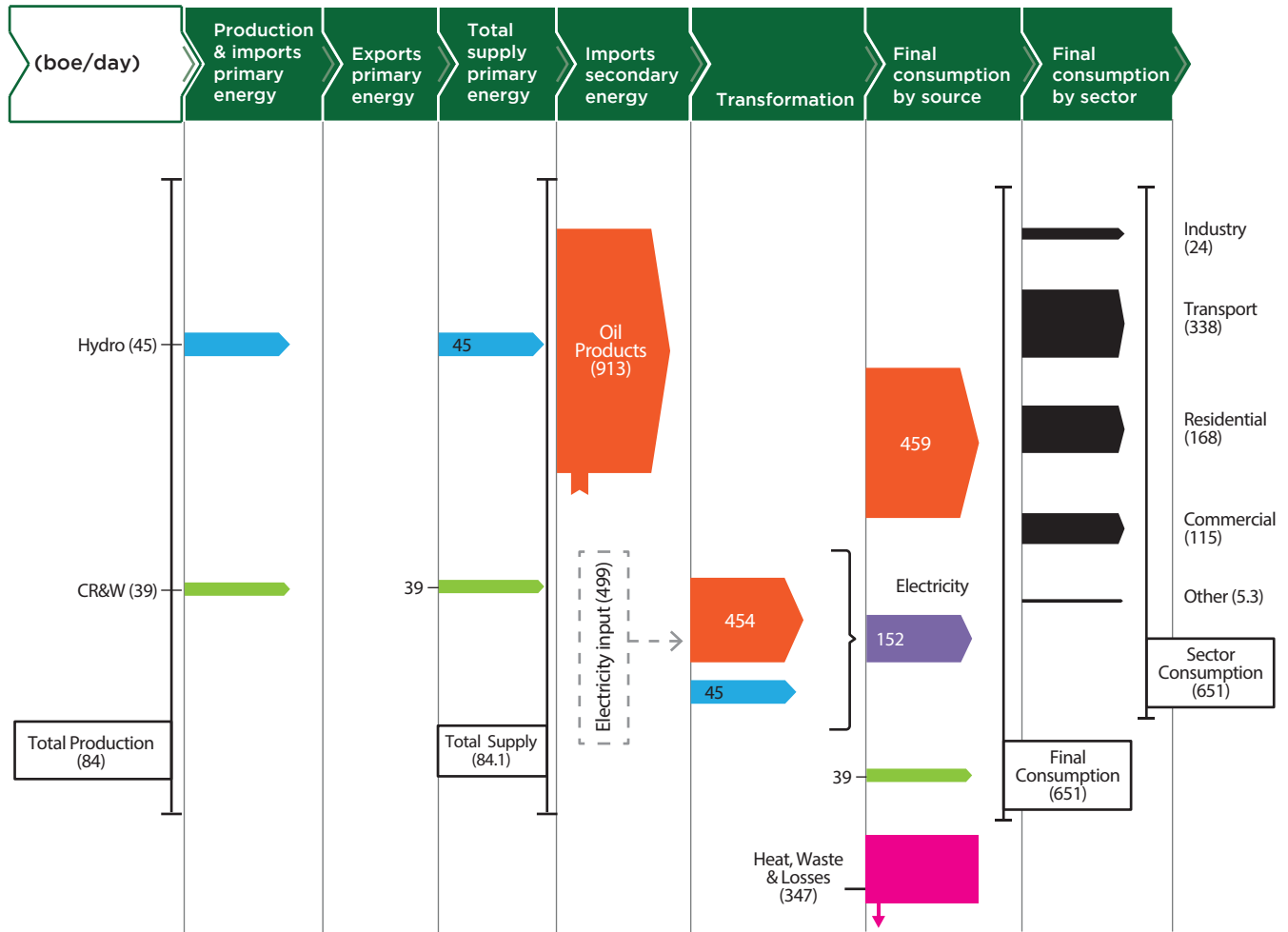
Source: IMF (2013).

The Energy Matrix of Dominica

In 2012, the island nation’s production of primary energy was limited to 84 barrels of oil equivalent per day (boe/day), with 39 boe/day from combustible renewables and waste (CR&W) and 45 boe/day from hydropower. The vast majority of energy—around 92 percent—was imported in the form of oil products. The island nation imported a total of 913 boe/day in 2012. Just over half of oil products (499 boe/day) were used to generate electricity. Hydropower contributed 45 boe/day to the production of electricity. Losses during generation, distribution, and transmission totaled 347 boe/day, leaving 152 boe/day for final consumption. In total, final consumption of Dominica stood at 661 boe/day, of which 459 boe/day were oil products, 146 boe/day were in the form of electricity, and 40 boe/day were in the form of CR&W.

Consumption by sector was as follows. The transportation sector consumed about 52 percent of energy with 338 boe/day, followed by the residential sector with 168 boe/day. The commercial sector accounted for 115 boe/day, followed by the industrial sector with 24 boe/day. Other consumption, such as street lighting, stood at 5.3 boe/day.

Figure 2 Dominica, 2012



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Authors: Malte Humpert.

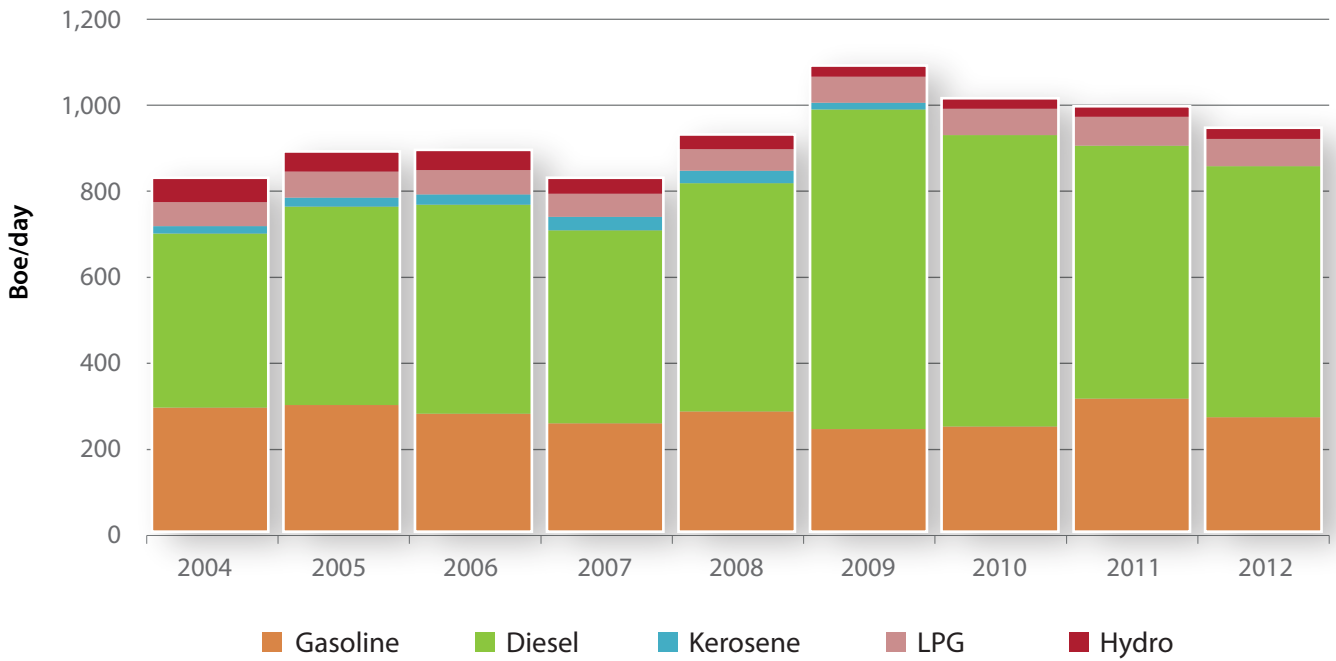
Source: DOMLEC (2013); Government of Dominica (2014a).

Total Energy Supply

The total energy supply (TES) in Dominica stood at 997 boe/day in 2012. Imported oil products made up 92 percent of TES, with the remaining 8 percent coming from CR&W and Hydropower. Both CR&W and hydropower accounted, representing 4 percent in both cases.

While Dominica has no proven fossil fuel resources, it possesses substantial renewable energy potential. Its geothermal resources at the Wotten Waven site may be as large as 120 MW and could satisfy not only the country's own current and future energy needs, but could also allow it to export more than 80 MW to neighboring islands Guadeloupe and Martinique. The island's solar photovoltaic (PV) potential stands at 45 MW, followed by wind potential between 20 and 30 MW. Furthermore, in addition to the installed 6.64 MW of hydro capacity, the island may possess an additional capacity of 8MW (Claude Davis and Associates, 2010).

Figure 4 Total Energy Supply (excluding wood-fuel and other biomass)



Source: Government of Dominica (2014a).

Domestic production

Dominica has significant hydropower resources, representing 4 percent of TES and accounting for roughly 30 percent of electricity production. CR&W, used for cooking and heating, also represents 4 percent of TES.

Figure 3 Share of Total Energy Supply, 2012



Source: DOMLEC (2013); Government of Dominica (2014a).

Dominica does not have known fossil fuel resources. Around 92 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. Diesel, the majority of which is used for electricity production and gasoline, represents over 90 percent of oil products. Liquefied petroleum gas is primarily used for cooking by the residential sector (Government of Dominica, 2014a).

Commercial balance of primary energy

Dominica did not import any primary energy in 2012.

Domestic primary energy supply

The Primary Energy Supply (PES) of Dominica was 84 boe/day in 2012.

Electricity

Installed capacity

In 2013, installed capacity stood at 26.6MW, of which diesel generation contributed 20.1MW and hydropower contributed the remaining 6.5MW. The Dominica Electric Company (DOMLEC), Dominica's sole utility-scale provider of electricity, operates two diesel plants, Fond Co and Sugar Loaf, with capacities of 13.3 MW and 6.8 MW, respectively. In addition, it owns three automated run-of-the-river hydropower plants based along the Roseau River in the Roseau Valley. The Laudat, Trafalgar, and Padu plants have 1.24 MW, 3.52 MW and 1.8 MW of capacity, respectively. Peak load demand stood at 16.78 MW in 2013. Diesel generation provides between 65 and 75 percent of the country's electricity, with the remaining 25-35 percent coming from hydropower. Annual production numbers vary significantly depending on the amount of rainfall, and hydropower capacity is reduced to 3.2MW during the dry season (Government of Dominica, 2014a). In 2013 DOMLEC, produced 35 percent of its electricity from hydro plants, the highest value since 2005 (DOMLEC, 2014b).

In addition to DOMLEC's capacity, a limited number of self-generators are active in Dominica. According to

the Independent Regulatory Commission (IRC), there are currently 115 license holders for self-generation, primarily based on diesel generators (IRC, 2014d). The majority of self-generation capacity is solely for backup purposes, although some entities use it as their main or partial source of electricity.

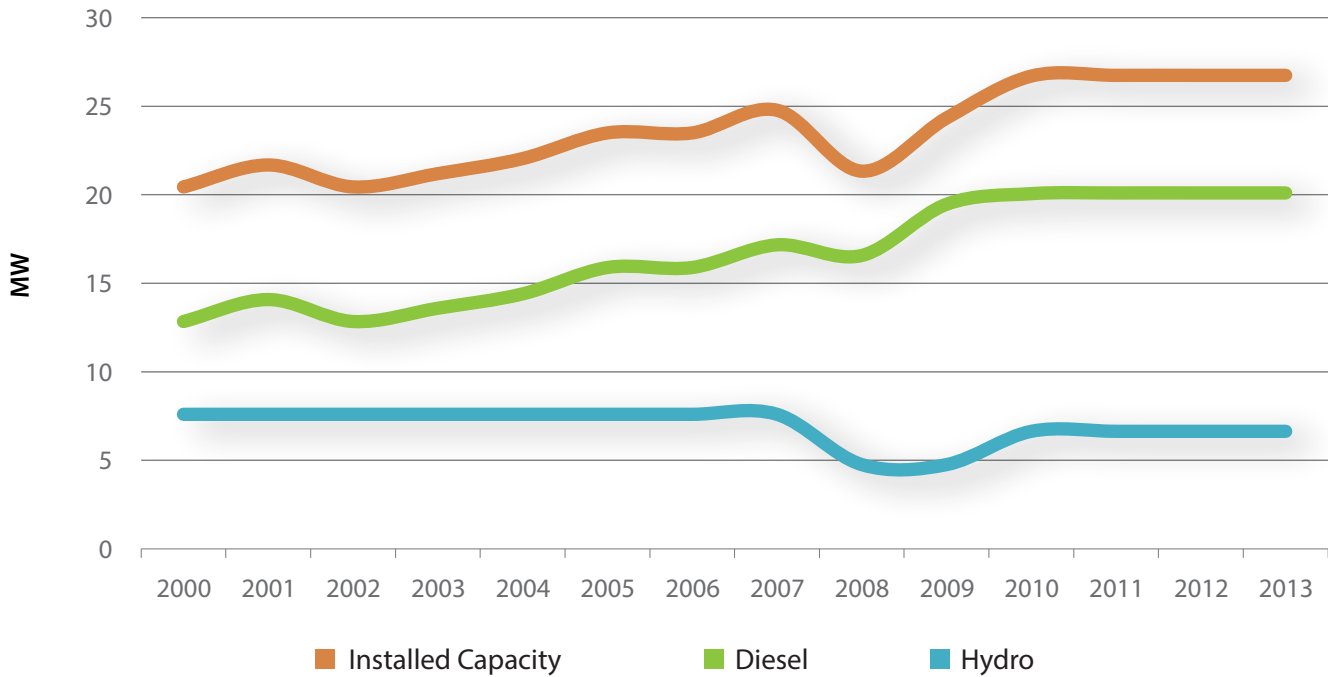
Furthermore, Dominica has three renewable energy installations, which provide electricity to the national grid under Interconnection Service Agreements with DOMLEC (Government of Dominica, 2014a; IRC, 2010). Rosalie Bay Resort operates a 225kW wind turbine, the largest of these facilities. After receiving its original license in 2008, the resort requested permission to interconnect an additional 32kW of capacity in 2012. The wind turbine is expected to produce 598 MWh of electricity annually, of which a share will be fed into the system (OAS, 2010). In addition, there are two PV installations of 50kW and 9kW in Canefield and Castle Comfort, respectively (Government of Dominica, 2014a; IRC, 2010). As of 2015, total installed solar PV capacity stands at 0.775MW (Worldwatch Institute, 2015).

Table 1 Inventory of DOMLEC Power Stations, 2014

Power stations	Type	Capacity	Year built	GWh (2013)
Laudat	Hydro	1.24 MW	No data available	36.705
Trafalgar	Hydro	3.52 MW	No data available	
Padu	Hydro	1.8 MW	Repaired in 2008	
Fond Cole	Diesel	13.3 MW	Upgraded in 2010	63.987
Sugar Loaf	Diesel	6.8 MW	No data available	
TOTAL		26.66 MW		100.752

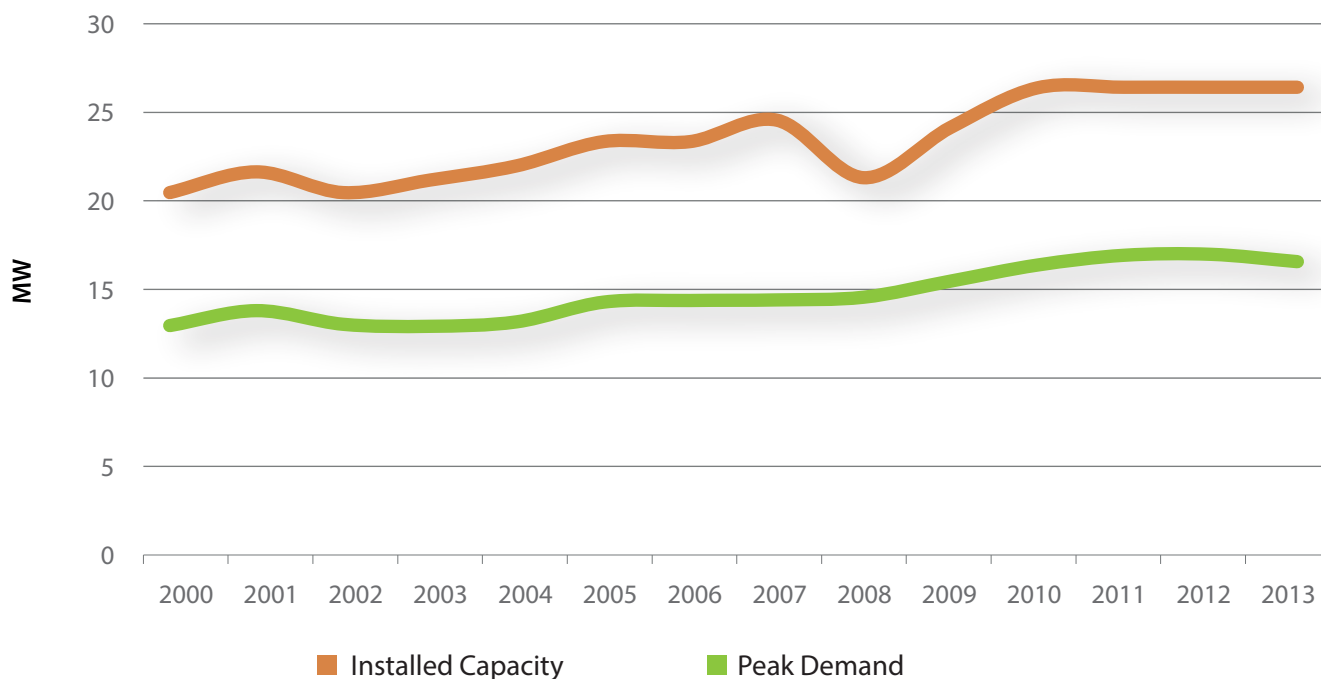
Source: DOMLEC (2013).

Figure 5 DOMLEC Installed Capacity by Type, 2000-13



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

Figure 6 DOMLEC Installed Capacity and Peak Demand, 2000-13



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

Of the 499 boe/day intended for electricity generation in 2012, 454 boe/day came from diesel and 45 boe/day came from hydropower. In total, DOMLEC used 165,662 barrels of diesel fuel in 2012 (DOMLEC, 2013; IRC, 2013c).

Electricity matrix

DOMLEC's legal monopoly as the sole supplier of electricity ended with the liberalization of the market in 2006. The company, however, remains the only utility-scale supplier of electricity as of 2014 and thus continues to dominate the electricity sector in Dominica. DOMLEC generated 100.8 GWh of electricity in 2013, of which it sold 89.4 GWh to final consumers. In addition to its own generation, DOMLEC also pur-

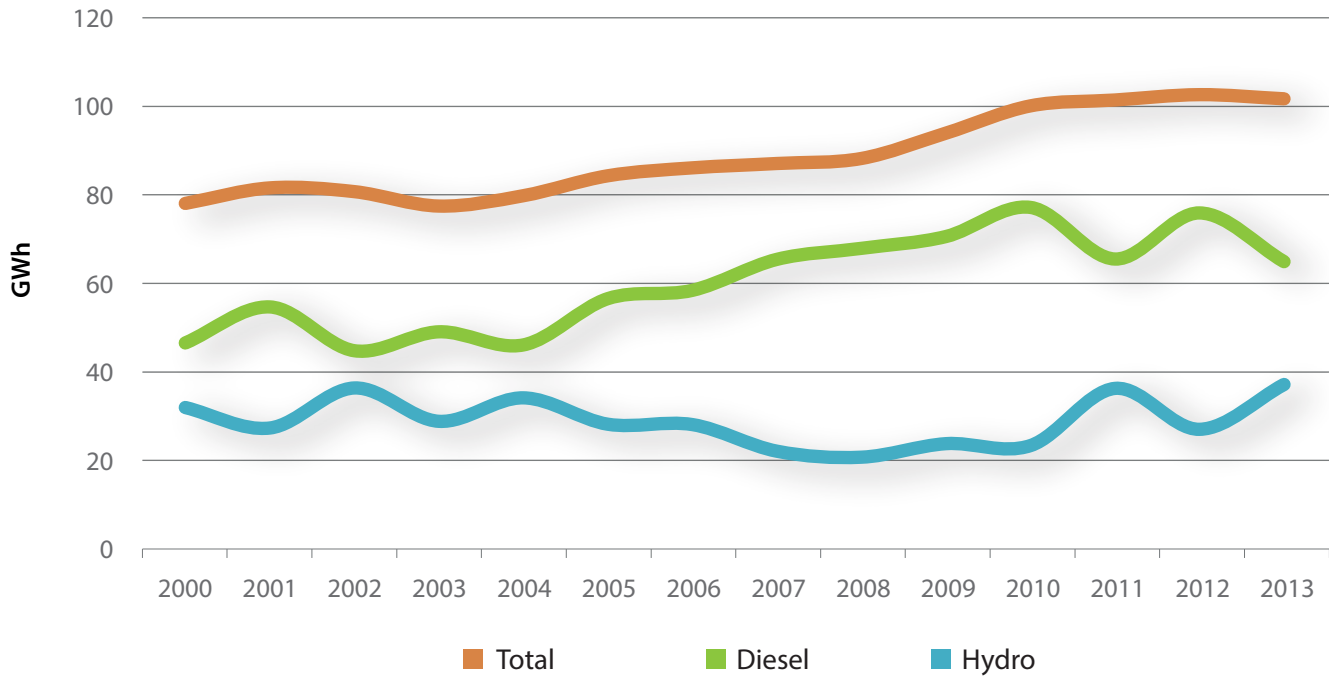
chased 60 MWh of energy from three small-scale independent power producers (IPPs). In 2013 DOMLEC generated 63.9 GWh from its two diesel power plants and 36.7 GWh from its three hydropower plants, a 30 percent increase over 2012 when it produced only 26.7 GWh due to dry weather conditions. The amount of electricity DOMLEC purchases has remained very limited, with 60 MWh in 2013, 117 MWh in 2012, 76 MWh in 2011, and 16 MWh in 2010.

Table 2 Total Gross Generation of Electricity in GWh, 2007-2013

Generation of electricity in GWh	2013	2012	2011	2010	2009	2008	2007
Total	100.8	101.7	100.5	99.2	93.1	87.5	86.4
Diesel	63.9	74.8	64.6	76.0	69.6	66.9	57.6
Hydro	36.7	26.7	35.8	23.1	23.5	20.6	21.9

Source: DOMLEC (2013).

Figure 7 DOMLEC Gross Electricity Generation in GWh, 2000-13



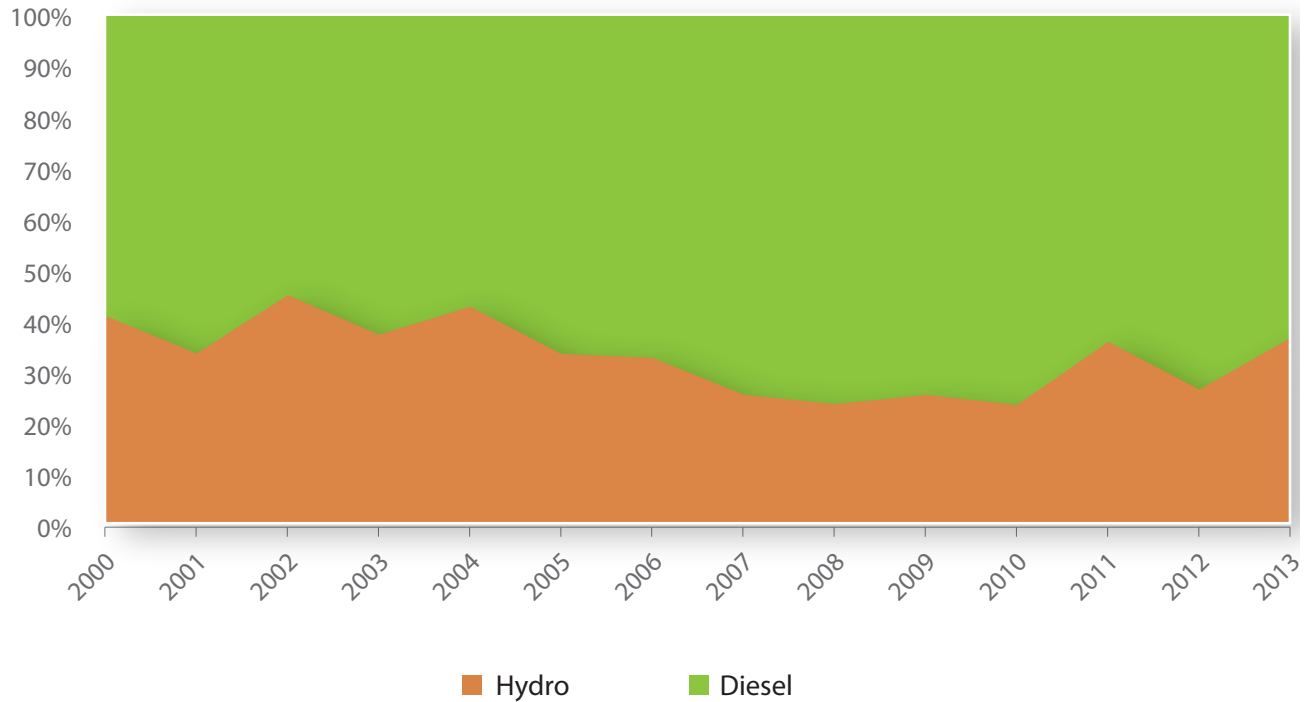
Source: DOMLEC (2002; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013).

While DOMLEC only publishes annual data going back to 2000, third-party reports indicate that hydropower provided at least 50 percent of electricity supply until 1994 and as much as 90 percent in the 1960s (NREL, 2015). As the population and per capita demand increased, however, hydropower alone could no longer provide sufficient capacity, especially due to the seasonality of hydropower and year-on-year variations. In the mid-2000s, water shortages during the dry seasons reduced hydropower capacity by about 50 percent, to 3.6 MW.

Furthermore, the plants were built between 1965 and 1988, raising concerns about the long-term reliability and availability of this source of electricity supply. Following Hurricane Dean in 2007, the Padu power plant was out of commission before it was repaired in 2008. Following the latest upgrade of the Fond Cole plant, the diesel generator capacity increased by an additional 1.28 MW, further reducing hydropower’s share of total installed capacity (OAS, 2010).

While the amount of electricity produced by diesel and hydro plants was very similar until about 2004, the importance of hydropower has decreased since then, and diesel power provided up to 80 percent of electricity in some years. The amount of electricity produced by DOMLEC’s hydro plants saw a decline between 2004 and 2010, in part due to abnormally dry weather conditions and technical issues. In 2013, hydropower contributed around 35 percent of electricity, the highest percentage since 2005 and the highest absolute production figure since at least 2000.

Figure 8 DOMLEC Share of Gross Electricity Generation in GWh, 2000-13



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

According to DOMLEC, residential and commercial consumers dominated consumption with 46 and 43 percent, respectively, in 2013. Industry consumed 9 percent, with other consumption, such as street lighting, accounting for 2 percent. Hotels account for about 1.5 percent of DOMLEC's sales, but as the majority of hotels and some industrial consumers self-generate, their consumption is not included in DOMLEC's official figures (DOMLEC, 2013). According to 2008 figures, the hotel sector alone accounts for 8 percent of total electricity consumption in Dominica (Fadelle, 2012).

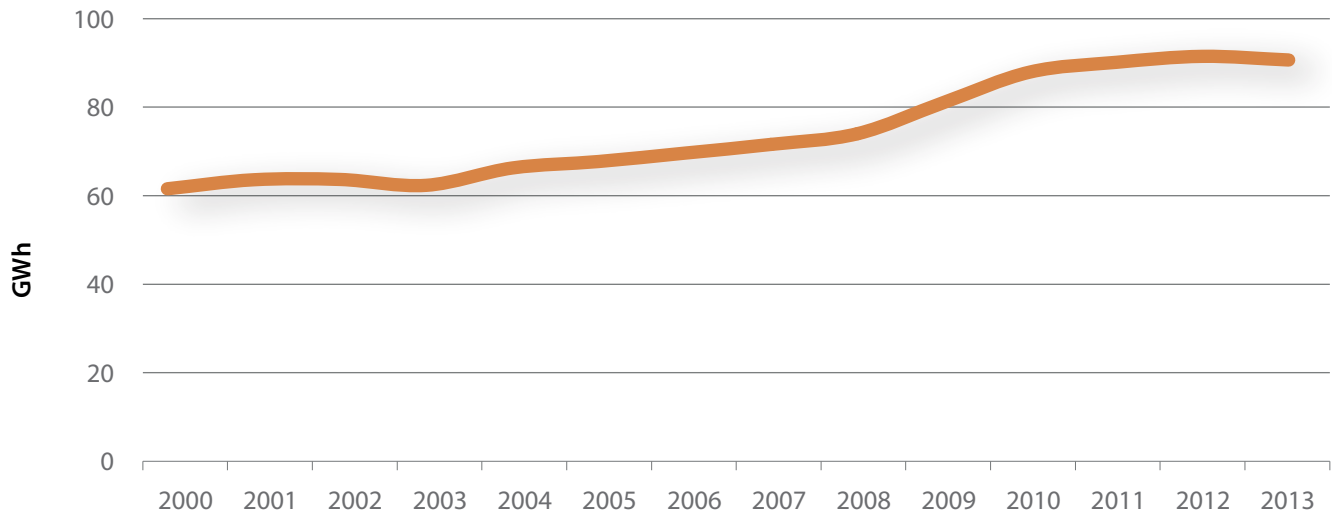
Figure 9 Electricity Sales by Sector, 2013



Source: DOMLEC (2013).

Electricity generation in Dominica increased by 30 percent between 2000 and 2013, with an almost 20 percent increase in the past five years. Electricity sales grew at 2.6 percent annually between 2000 and 2013. Growth was slower between 2000 and 2008 at around 1.7 percent before growing at around 3.6 percent annually between 2008 and 2011. Sales have been flat since 2011.

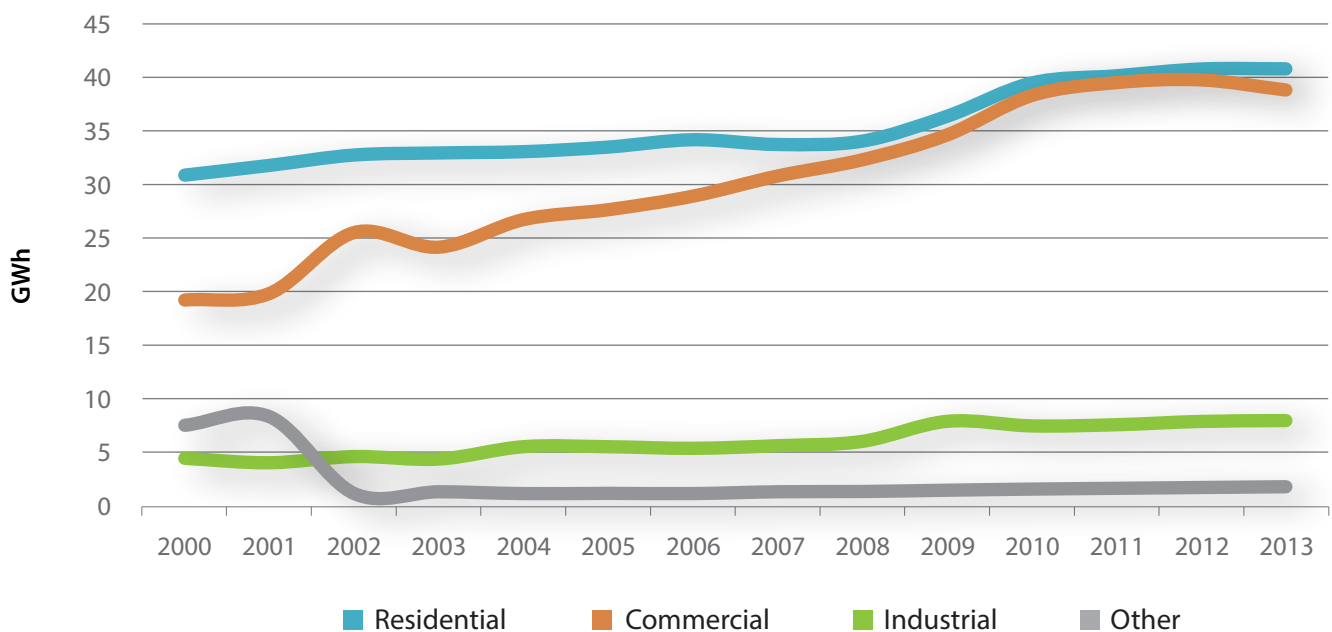
Figure 10 DOMLEC Total Electricity Sales, 2000-13



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

DOMLEC’s sales to commercial customers have steadily increased over the past 13 years and now rival those to residential customers. Sales to the commercial sector doubled from 19.2 GWh in 2000 to 38.8 GWh in 2013. Similarly, industrial sales grew from 4.4 GWh to 8 GWh. Residential sales, while also recording growth, increased at a lower rate, growing from 31 GWh to 41 GWh.

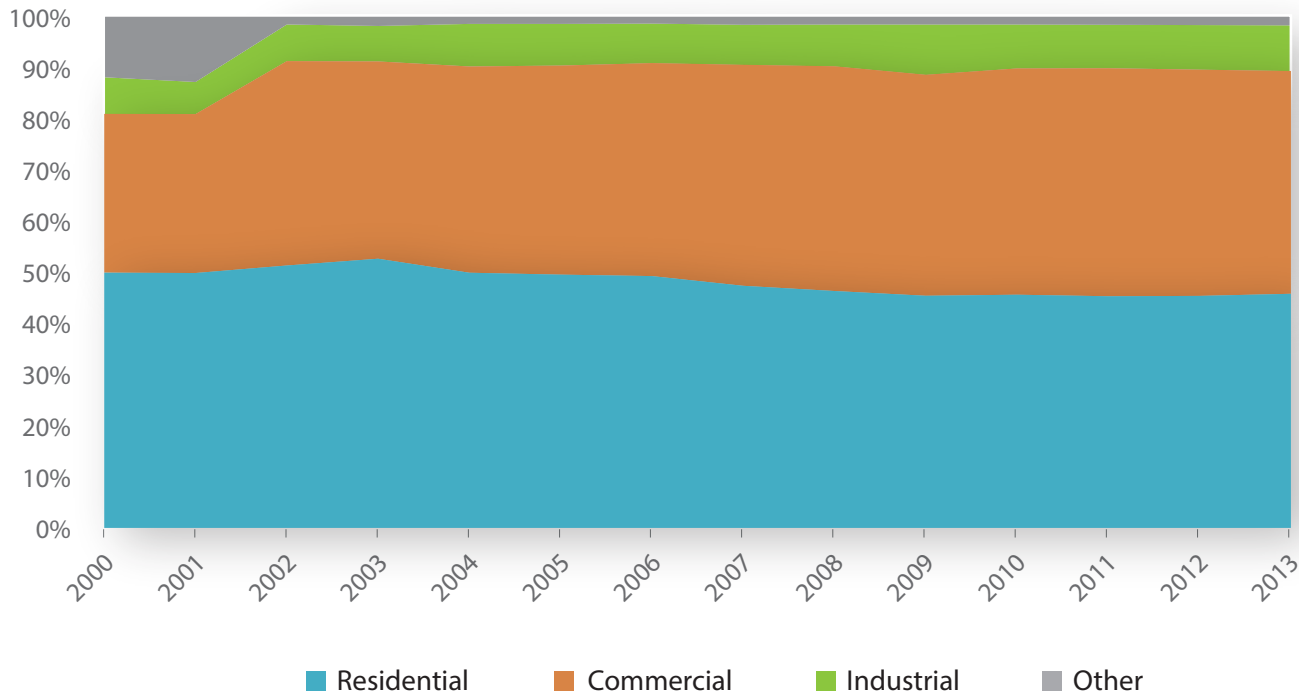
Figure 11 DOMLEC Electricity Sales by Customer Type, 2000-13



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

The importance of the commercial sector has grown steadily in the past 13 years. The commercial sector accounted for roughly one-third of total sales in 2002. It now represents around 45 percent. Over the same period, the importance of the industrial sector as an electricity consumer grew from 7 percent to 9 percent. The share of consumption of the residential sector decreased from 52.5 percent in 2003 to just over 45 percent in 2013.

Figure 12 DOMLEC Share of Electricity Sales by Customer Type, 2000-13



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

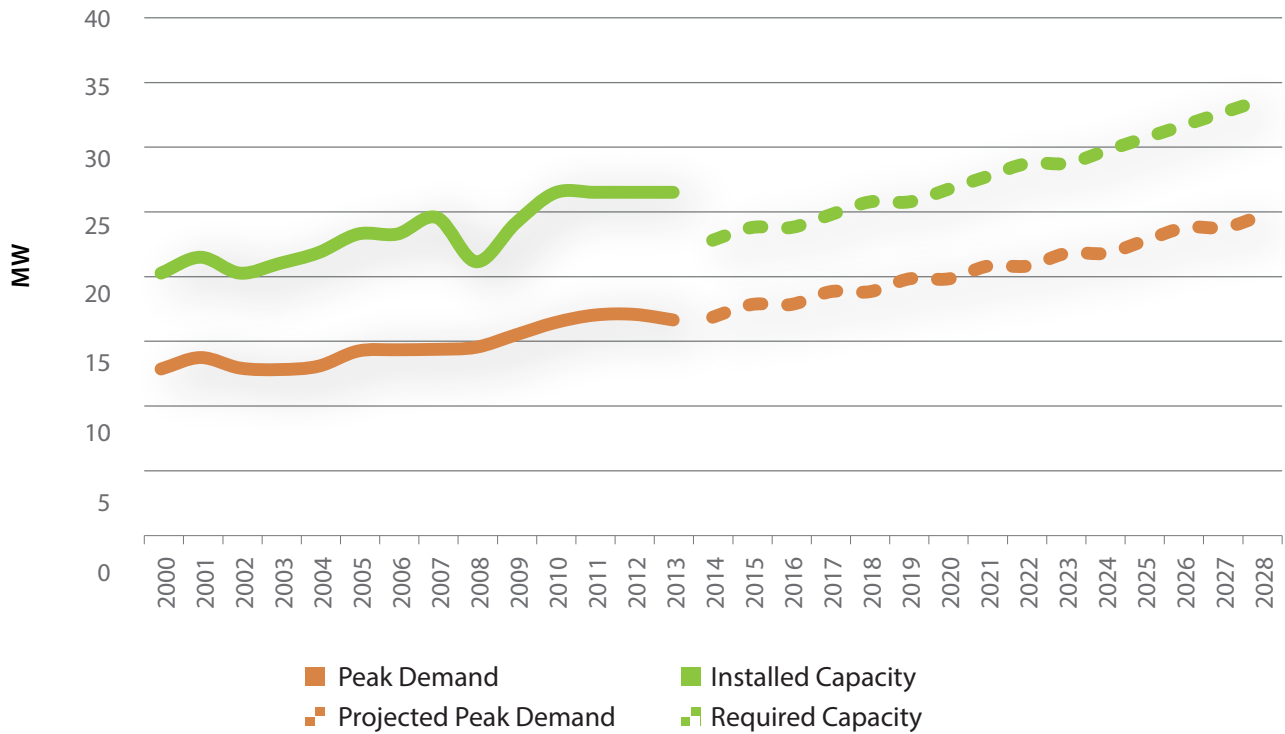
At current trends, DOMLEC's installed capacity will be sufficient until around 2019-20, when additional generation capacity will be required to meet demand. However, due to the high seasonal variability in output from the hydropower plants, the installation of additional capacity may already become necessary before the end of the decade.

Table 3 Dominica's Projected Capacity Requirement and Peak Demand in MW

	2015	2017	2019	2021	2023	2025	2027
Projected capacity needs	24	25	26	28	29	31	33
Projected peak demand	18	19	20	21	22	23	24

Source: World Bank (2010).

Figure 13 Dominica’s Projected Capacity Requirement and Peak Demand in MW



Source: World Bank (2010).

In Dominica, the full range of renewable resources are available, with the exception of waste-to-energy conversion. Together with Saint Vincent and the Grenadines, it is also the only country that already makes use of and has additional hydropower potential.

Table 4 Dominica’s Resource Availability

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

Source: Castalia (2015).

Of the six Eastern Caribbean states, Dominica’s geothermal resources are the most studied and best understood. The country has drilled a production well with the proven capacity to generate 11.4MW, sufficient to meet its current base load demand. The is-

land has proven geothermal potential of 120MW and estimated potential of up to 500MW, which, via interconnection with Guadeloupe and Martinique, could present a significant opportunity for the region.

Generation Forecast

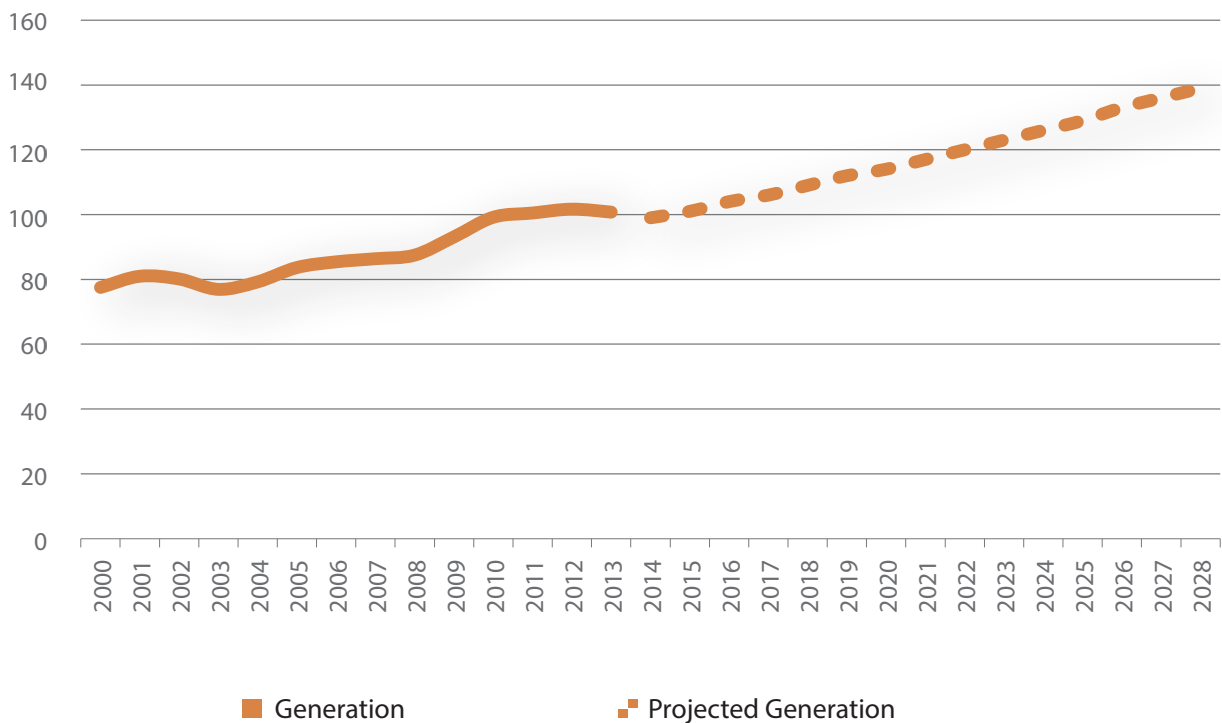
Dominica's gross generation needs are forecasted to grow at an annualized rate of 2.2 percent between 2014 and 2028, slightly above the 2 percent annual average between 2000-2014. Projected generation surpasses 120 GWh in 2020 and reach 139 GWh by the end of the next decade.

Table 4 Dominica's Projected Net Generation in GWh

	2015	2017	2019	2021	2023	2025	2027
Projected generation	101	106	112	117	123	129	136

Source: World Bank (2010).

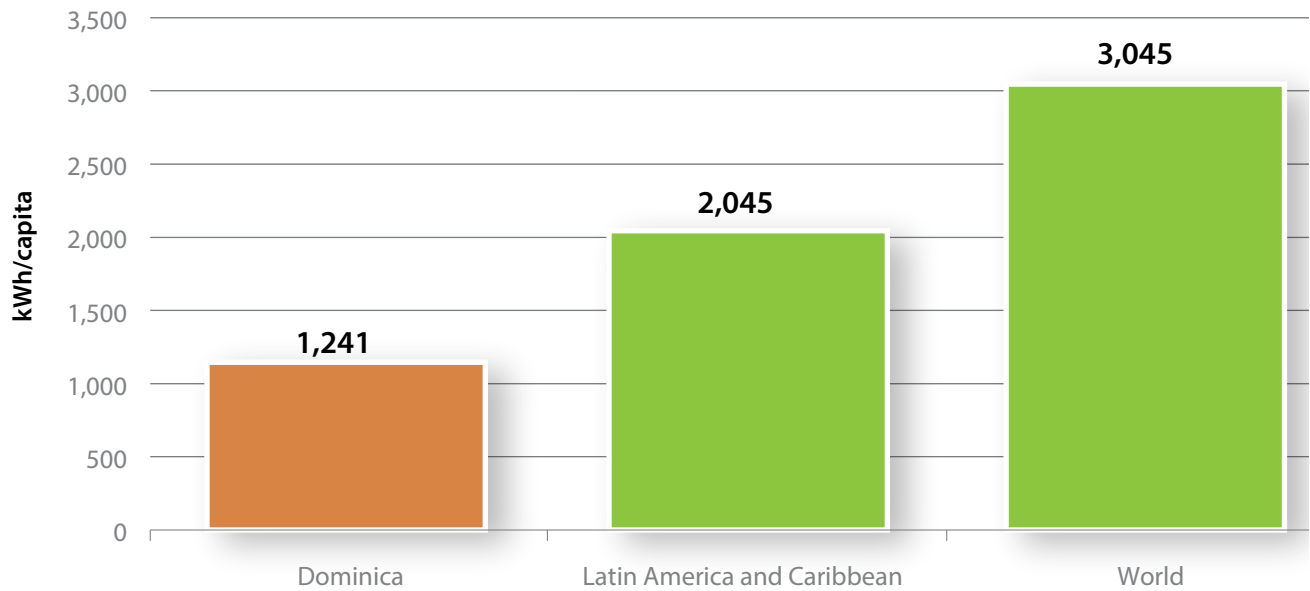
Figure 14 Dominica's Projected Net Generation



Source: World Bank (2010).

Per capita consumption in Dominica stands at 1,241 kWh, well below the Latin American and Caribbean average of 2,045 kWh.

Figure 15 Electricity Use per Capita, 2013



Source: DOMLEC (2013); UN (2014); World Bank (201

Secondary Balance and Final Consumption

Secondary Energy Balance

Dominica imports all of its oil products.

Final Consumption by Sector

Final energy consumption in 2012 totaled 651 boe/day. The transportation sector consumed 52 percent of all energy, with 338 boe/day. The residential sector accounted for 168 boe/day representing 26 percent, followed by the commercial sector with 115 boe/day and 17 percent. Industrial consumption represented 4 percent with 24 boe/day. Other consumption accounted for 5.3 boe/day.

Figure 16 Energy Consumption by Sector, 2012



Source: DOMLEC (2013); Government of Dominica (2014a).

As in most Caribbean states, the transportation sector is the largest consumer of energy. Dominica's tourism sector, which is highly dependent on transportation fuels, mainly from air travel, and the high level of pri-

vate vehicle penetration help explain the significant consumption of this sector (Ministry of Environment, Natural Resources, Physical Planning, and Fisheries, 2009).

Institutional Organization of the Energy Sector

Current Institutional Structure

The Ministry of Public Utilities, Energy, Ports, and Public Service is responsible for all matters related to the energy sector. The Ministry's Energy Unit coordinates all activities related to the development and expansion of electricity production and distribution and is responsible for the expansion of renewable energy sources (Ministry of Public Works, Energy, and Ports, 2014a).

The Ministry of Public Works, Energy, and Ports is responsible for the national infrastructure, including the planning, designing, implementing, monitoring, and coordinating of the energy and electricity sector. The Ministry institutes policies and regulatory measures for the infrastructure sector and is responsible for all government-led or sponsored developments in Dominica. It is made up of nine functional units, including the Energy Unit, which takes the lead on assessing the extent of and the potential for generation of electricity from geothermal resources and has been steering the process of building a geothermal generation plant (Government of Dominica, 2015a). The Ministry is also

in charge of three statutory bodies, one of which is the IRC for the electricity sector (Ministry of Environment, Natural Resources, Physical Planning and Fisheries, 2009; Ministry of Public Works, Energy and Ports, 2014a).

The Ministry of Environment, Natural Resources, Physical Planning, and Fisheries manages environmental and natural resources and conducts urban and rural planning. It also evaluates the environmental impact of energy projects, especially those related to hydro-power and geothermal power, and it must approve the construction of new facilities (Ministry of Environment, Natural Resources, Physical Planning, and Fisheries, 2014).

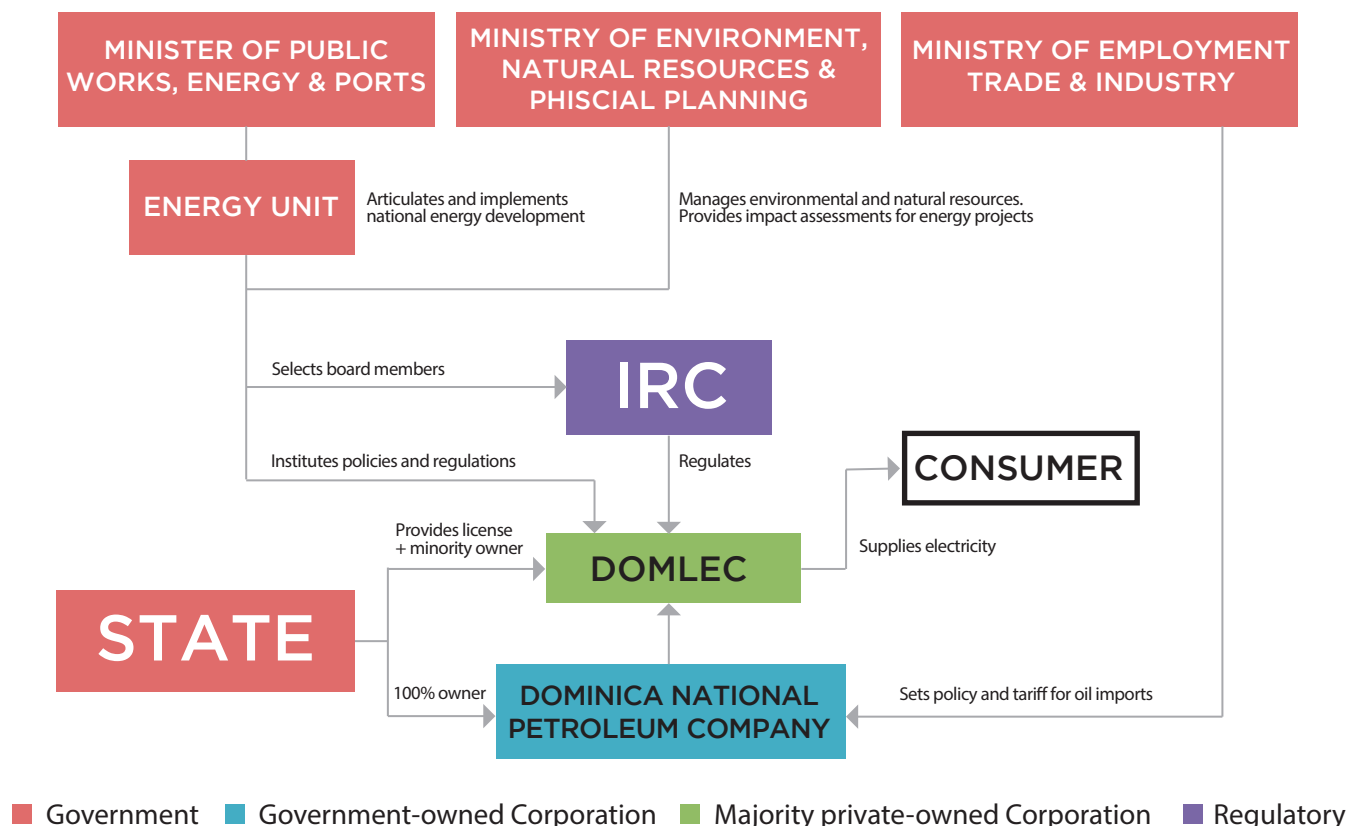
The Ministry of Employment, Trade, Industry, and Diaspora Affairs deals with domestic and external trade policies and as such is responsible for policies relating to the import of oil products, which are used in the electricity and transportation sector (Castalia Consulting, 2012; Ministry of Employment, Trade, Industry, and Diaspora Affairs, 2014).

Table 5 Institutions and their Responsibilities in the Energy Sector

Ministry	Type	Tasks and Responsibilities
Ministry of Public Works, Energy, and Ports	Government ministry	Unit responsible for national energy sector development. Institutes policies and regulatory measures for the energy sector.
DOMLEC	Privately-owned vertically-integrated utility	Holds two licenses: one for generation, supply and sale of electricity and one for transmission and distribution.
IRC	Regulatory agency	Regulates the generation, transmission, distribution, supply, and sale of electricity and report to the Minister.
Ministry of Environment, Natural Resources, Physical Planning and Fisheries	Government ministry	Responsible for managing the environment and natural resources. Assesses environmental impact and approves construction of new energy projects.
Ministry of Employment, Trade, Industry, and Diaspora Affairs	Government ministry	Sets policy related to oil product imports, including those for electricity generation.
Dominica National Petroleum Company / PDV Caribe Dominica Limited	Government-owned oil import company	Requests, receives, consigns, sells, and distributes petroleum products.

Source: BN Americas (2006); Castalia Consulting (2012); IRC (2014b); Ministry of Employment, Trade, Industry and Diaspora Affairs (2014); Ministry of Public Works, Energy and Ports (2014b); Office of the Prime Minister (2013).

Figure 17 Organization and Functioning of the Energy Sector, 2014



Source: Authors' elaboration based on information from BN Americas (2006); Castalia Consulting (2012); IRC (2014b); Ministry of Employment, Trade, Industry, and Diaspora Affairs (2014); Ministry of Public Works, Energy, and Ports (2014b); Office of the Prime Minister (2013).

Table 6 Key Legislation and Structure of the Energy Sector

Key Legislation and documents	Regulator	Utility	Ownership structure
Electricity Supply Act, 2006 National Energy Policy, 2014 Draft Sustainable Energy Plan, 2014 Geothermal Energy Act, 1974 Supplies Control Petroleum Products Order(s)	IRC	DOMLEC	Privately-owned, 52.8% Emera; 20% Dominica social security; 27.2% public at large and employees

National Energy Policy

The National Energy Policy (NEP) of 2011 lays out the government’s position on regulation, legal aspects, pricing and taxation, safety and industry standards, and future expansion plans, including avenues for financing. It also addresses the importance of independent power producers, net metering, renewable energy resources, tariffs, and improved energy efficiency. The policy’s principal objectives are to produce energy in the most economically beneficial way and at the lowest possible cost, to promote access to energy, and to produce energy in a more environmentally sustainable way while at the same time ensuring its reliability. It lists five primary objectives: increased use of domestic energy resources, improved energy efficiency and environmental sustainability, reduced energy costs and tariffs, and extended coverage to all citizens.

The government lists a number of specific policies related to fossil fuels management, electricity supply, and energy efficiency and conservation. To better monitor the currently fragmented fossil fuel storage sector, the government aims to encourage competition to reduce prices, ensure that sufficient storage capacity exists in case of emergencies or delivery delays, and harmonize quality standards throughout the states of the Eastern Caribbean. To reduce the need for expensive diesel powered generators, the gover-

ment will provide incentives to improve efficiencies, facilitate the development of small-scale renewable generation capacity, and put into place the appropriate framework of standards and regulations to integrate renewable energy into the national grid. It also aims to extend supply to rural and underserved communities and to raise awareness for and improve education on renewable energy. Specifically, the policy aims to establish, where feasible, new hydropower projects, continue the exploration of the national geothermal potential, encourage deployment of solar energy technology for new commercial, public, and private buildings, and continue to assess the potential for wind resources. The government plans to improve energy efficiency and conservation through the development of public education programs, the use and appropriate labeling of energy-efficient appliances, the establishment of efficiency and construction standards including retrofits, and the placing of greater emphasis of energy data and statistics in national reports (Government of Dominica, 2011).

In addition to focusing on the consumer side of efficiency, the NEP calls for improved efficiencies on the side of DOMLEC. Here, it is noteworthy that the utility company was able to reduce losses during transmission and distribution from nearly 20 percent 10 years ago to just 8.2 percent in 2013 (DOMLEC, 2013).

National Energy Policy

The government released an updated NEP in 2014. Its key priorities of increasing the use of domestic energy sources, increasing energy efficiency, increasing environmental sustainability, reducing energy costs and tariffs, and extending electricity coverage to all citizens remain unchanged. One significant change is the greater emphasis put on the active promotion of domestic renewable energy sources including hydro-power, geothermal power, solar power, wind power, waste-based energy, and biomass energy. It calls for an increased role for and responsibility of the Energy Unit for renewable energy development and deployment, including creating fiscal and economic incenti-

ves as well as tax rebates to encourage private sector development of renewable energy technologies (RETs). The Energy Unit is tasked with mainstreaming, that is, ensuring that all government actions conform to its sustainable energy objectives, and with collecting and maintain accurate data and information on the energy sector to measure the implementation of policy. In addition, the NEP suggests the creation of the Geothermal Development Unit, which will advise the government on policy relating to the identification, development, monitoring, and evaluation of geothermal energy sources (Government of Dominica, 2014a).

Sustainable Energy Plan

Simultaneously with the updated NEP, the Government published the draft Sustainable Energy Plan (SEP) 2014, the first such plan since the SEP of 2002. The SEP 2014 functions in conjunction with the updated NEP and provides a detailed prescriptive plan of how to convert the national plan into actionable policy. The SEP outlines 39 specific actions aimed at fossil fuels management, electricity supply, energy efficiency and conservation, end-use sector, institutional strengthening, and funding. It defines which ministry or ministries will be responsible for the implementation of the action and specifies in what time period, from ongoing to short and medium to long term.

The SEP 2014 places renewed emphasis on the importance of the IRC in developing and implementing energy sector policy. Specifically, the plan calls on the IRC to: (i) establish system loss targets for transmission and distribution operations of DOMLEC, (ii) establish heat rate targets for diesel-based generation by DOMLEC, (iii) suggest policy measures to provide incentives for consumers to reduce consumption during peak hours, (iv) develop, in cooperation with DOMLEC, a standard offer contract for small IPPs using RET, (v) set the level of compensation to be received for electricity fed into the grid by IPPs, and (vi) cooperate with the Ministry of Public Works and the Ministry of Finance to develop a program of fiscal incentives, stable and fair feed-in tariffs, as well as a streamlined approval process for renewable distributed generation capacity.

In addition, the SEP 2014 calls for the revision and passage of the draft Geothermal Bill of 2013. The Plan sets a detailed timeline for the development of geothermal resources beginning with the suggested passage of the Geothermal Bill in June 2014, the development of specific regulations, followed by technical and economic feasibility studies and updated agreements with DOMLEC for the supply of geothermal energy into the grid. Following these steps, the SEP calls for the opening of a small 10–15MW geothermal plant by June 2016 before transitioning to Phase II, which aims at building a larger 100MW plant by the end of 2017 and exporting electricity to Martinique and Guadeloupe via an interconnection line. This second phase includes the selection of companies to develop the larger plant and install the interconnection line. As of April 2015, this program is behind schedule, as the Geothermal Bill will not be passed before the second half of 2015 at the earliest (Dominica News, 2015c).

Formulation of Policies in the Energy Sector

Overall development of policies in the energy sector, including the NEP and the SEP, is the responsibility of the Ministry of Public Works, Energy, and Ports and, more specifically, the Ministry's Energy Unit. The Ministry is tasked with planning, designing, implementing, and coordinating the energy sector and instituting new policies and regulatory measures. The Electricity Supply Act of 2006 came out of the Ministry.

Regulator

Dominica does not have an overarching or independent regulator for the entire energy sector. The IRC is responsible for the regulation of the electricity sector.

Institutional Structure of the Electricity Subsector

The Electricity Supply Act of 2006 liberalized the electricity sector and ended DOMLEC's role, at least from a legal standpoint, as the sole license holder for the generation, distribution, transmission, and supply of electricity. The Act created the IRC and tasked it with providing licenses for the generation, transmission, and distribution to IPPs where this is economical and cost effective and in the public interest. The IRC aims to promote fair competition in the energy sector and protect the interests of electricity consumers. According to the Act, the IRC operates fully independently and shall not be subject to government influence or control.

In September 2012, DOMLEC entered into negotiations with the IRC to secure new licenses for generation, transmission, and distribution. The company was aiming to secure one single license, non-exclusive for generation and exclusive for transmission, distribution, and supply, while the IRC's goal was to fully separate generation from transmission, distribution, and supply. Negotiations continued throughout most of 2013 and on October 7, 2013 the IRC issued two new licenses to DOMLEC.

The utility company received a non-exclusive license for the generation of electricity and an exclusive license for the transmission, distribution, and supply of electricity. Both licenses started on January 1, 2014, and are valid for a 25-year period. If DOMLEC wishes to transfer the license or shares of it, it needs permission from the IRC. DOMLEC's duties as system operator are to establish sufficient generating capacity to meet system requirements, to do so in the most economical way possible, and to secure long-term supply and reliability by adding new capacity in a timely fashion. DOMLEC was mandated to request a tariff review within nine months of commencement of the licenses. However, the IRC deferred this deadline to May 2015.

According to the IRC, the exclusivity of the transmission, distribution, and supply license contains two exemptions. Under specific circumstances, IPPs would be able to secure a transmission license and build, own, and operate their own transmission interconnector to DOMLEC's grid. Furthermore, developers of energy resources may, for the purpose of cross-border sale of electricity, own, and operate transmission infrastructure to enable such cross-border arrangements. Here, the IRC foresees the potential export of geothermal electricity to neighboring islands and wants to prevent a monopoly position of DOMLEC on cross-border sales (DOMLEC, 2012; IRC, 2013a; IRC, 2013b).

Electricity Supply Act

The Electricity Supply Act of 2006, which replaced the Electricity Supply Act of 1996, is the key legislation governing the electricity sector. The Act resulted from the government's goal to completely overhaul the electricity sector as part of its 2003 economic reform strategy. The strategy's aim was the unbundling of the privately held monopoly in the electricity sector, the creation of successor companies to separate generation and transmission aspects, the founding of several IPPs, and the establishment of an independent regulatory body. The Act achieved most of the original goals, including the creation of the IRC and the theoretical opening of the electricity market to competition. The Act also reduced the length of DOMLEC's exclusive generation license by 10 years, from 2025 to 2015. DOMLEC has since received two new licenses, a non-exclusive one for generation and an exclusive one for transmission and distribution, beginning on January 1, 2014 for a 25-year period.

According to the Act, the IRC performs its duties independently and shall not be subject to direction or control of the government with the exception of having regard to the public interest and overall government policy. The IRC is solely and exclusively responsible for the regulation of all electricity entities and licensees, including all economic and technical aspects, tariff structure, and electricity charges (Parliament of Dominica, 2006).

The development of the country's significant geothermal resources is part of Dominica's Growth and Social Protection Strategy. The government envisions for the country to become a regional energy hub after fully developing this potential. Exploratory drilling and testing of three geothermal wells in the Wotten Waven-Laudat area in the Roseau Valley were completed in 2013 at a cost of US\$12 million. Drilling operations began in 2009 and are guided by the Geothermal Project Management Unit within the Ministry of Public Works, Energy, and Ports. The first production well was scheduled to be opened on June 1, 2014, to move into the flow-testing phase, but the project continues to face delays. The project has faced significant opposition from some residents in the Roseau Valley.

The government aims to build a small geothermal power plant with 15 MW capacity and has contracted Iceland Drilling Company to drill two wells, one for production and one for reinjection. These wells will be located in the Laudat and Lily Valley area. The government hopes to attract private investment to help build a 100-120 MW facility after it has proven feasibility and moved past the higher-risk initial stages of the development (Ministry of Public Works, Energy, and Ports, 2013).

In addition to placing DOMLEC under the direct oversight of the IRC and shortening its license, a change the utility initially tried to have reversed and asked to be compensated for by filing an arbitration claim, the Act also placed a number of new requirements and duties on the company. DOMLEC was required to present an integrated resource plan, including a study on demand forecasts up to 2020, which was to be used by DOMLEC to identify the most cost-effective path forward, including for the consumer, to expand the electricity system (IRC, 2009a; 2012).

Under the Act, generation licenses are not required for the self-generation of electricity from installations not connected to the national grid. However, self-generators must still receive approval and an operating license from the IRC through a streamlined and simplified process. According to the IRC, 115 licenses for self-generation have been granted thus far. The majority of self-generation capacity consists of diesel generators solely used for backup purposes, while a limited number of producers use it as their main or partial source of electricity. Out of 115 licenses, only 10 are for generation of electricity from renewable sources. The Act does not make concrete provisions for feed-in tariffs or a net-metering/net-billing regime, thus limiting the incentive for private small-scale producers to invest in renewable energy technologies to sell or feed excess generation into the national grid.

Interconnection Policy

In addition to self-generation, the IRC allows for the introduction of small blocks of renewable energy into the public electricity system from installations not exceeding 1MW in capacity, as part of the IRC's Policy and Rules for addition of capacity to the national grid (IRC, 2008a). The specific procedures and terms for the interconnection of renewable and alternate energy generation sources owned by third parties are set out in the 2010 Interconnection Policy. Applications for systems with a capacity of less than 5kW will be reviewed on a fast-track basis, while installation between 5-100kW and 100kW-1MW will undergo a full process of determination by DOMLEC, including the need for a distribution facilities impact study to be paid for by the applicant (IRC, 2010).

As of 2014, three renewable energy installations providing distributed electricity to the grid have been built and licensed (IRC, 2012). The largest, with 225 kW, is a wind turbine installation at the Rosalie Bay Resort which began operation in 2008. Following its original license the resort requested permission to interconnect an additional 32kW of capacity in 2012. The wind turbine is expected to produce 598 MWh of electricity annually (OAS, 2010). Furthermore, there are two PV installations of 50kW and 9kW in Canefield and Castle Comfort, respectively. Surplus generation of these installations is sold back to the grid under the terms of the Interconnection Service Agreement with DOMLEC based on the Interconnection Policy (OAS, 2010).

Energy Unit

The Energy Unit coordinates the development and expansion of the electricity sector, including the transmission and distribution network and the development of renewable energy resources. Some of its primary functions and objectives are to: (i) assess the potential for geothermal resources and to establish a geothermal generation plant, (ii) articulate and document the National Energy Policy, (iii) develop a Sustainable Energy Plan, (iv) reform the legislative and regulatory framework of the energy sector and electricity subsector, (v) generate support and awareness for an energy efficiency and conservation program, (vi) create a government-owned supplementary generation plant, and (vii) inspect, test, and maintain electrical installations (Ministry of Public Works, Energy and Ports, 2014b).

Dominica Electricity Services Limited

The Dominica Electricity Services Limited (DOMLEC) is an investor-owned, vertically integrated utility and is the sole supplier of electricity in Dominica. It was incorporated as a limited liability company in 1975. Historically DOMLEC's poor economic performance represented a significant hindrance to Dominica's development, but over the past decade, since the utility became a subsidiary of WRB Enterprise in 2004, its services and track record have improved significantly. DOMLEC has long-reaching experience operating hydro plants and plans to generate 40 percent of electricity from renewable sources by 2017.

It holds two licenses, one exclusive license for the transmission and distribution of electricity and one non-exclusive for the generation of electricity, granted to it by the IRC in October 2013. The licenses came into effect on January 1, 2014 and are valid for a period of 25 years.

DOMLEC operates three hydropower stations, Laudat, Trafalgar, and Padu, as well as two diesel power stations, Fond Cole and Sugar Loaf, which together provide an installed capacity of 26.74 MW. Over the past decade, the company has significantly improved the efficiency of its operation, reducing transmission and distribution losses from nearly 20 percent in 2002 to 8.2 percent in 2013.

While its share of hydropower stood around 25 percent for most of the 2000s due to unusually dry climate conditions and to technical issues at the Padu plant, the share increased to 35 percent in 2013. Nonetheless, it has to contend with significant fuel expenses to purchase imported diesel fuel and spent US\$16 million in 2013 (DOMLEC, 2013).

DOMLEC serves about 35,000 customers with a workforce of 208 employees, which are spread across seven departments responsible for generation, engineering, transmission and distribution, information technology, accounts, human resources and administration, commercial affairs, and the corporate office.

DOMLEC's ownership structure recently changed when Light and Power Holdings, a subsidiary of the Canadian Emera Corporation, purchased Enterprises' 52.8 percent stake, making it the majority shareholder. Dominica's Social Security holds a 20 percent stake, with the remaining 27.2 percent held by the general public and DOMLEC employees (DOMLEC, 2013; DOMLEC, 2014a; Emera, 2013; Government of Dominica, 2014a).

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

The IRC was created through the Electricity Supply Act of 2006. According to the Act, the IRC operates and functions independently of the direction and control of the government and is tasked with ensuring the secure, efficient, and economical operation of the electricity sector, facilitating the promotion of sustainable and fair competition, and protecting the interest of all consumers of electricity. The IRC has been given broad powers, including the ability to create and put into effect new rules and by-laws to accomplish these goals. According to the Act, it is solely responsible and has the exclusive authority to regulate electricity entities and license holders with regard to all economic and technical aspects, including determination of electricity tariffs and charges.

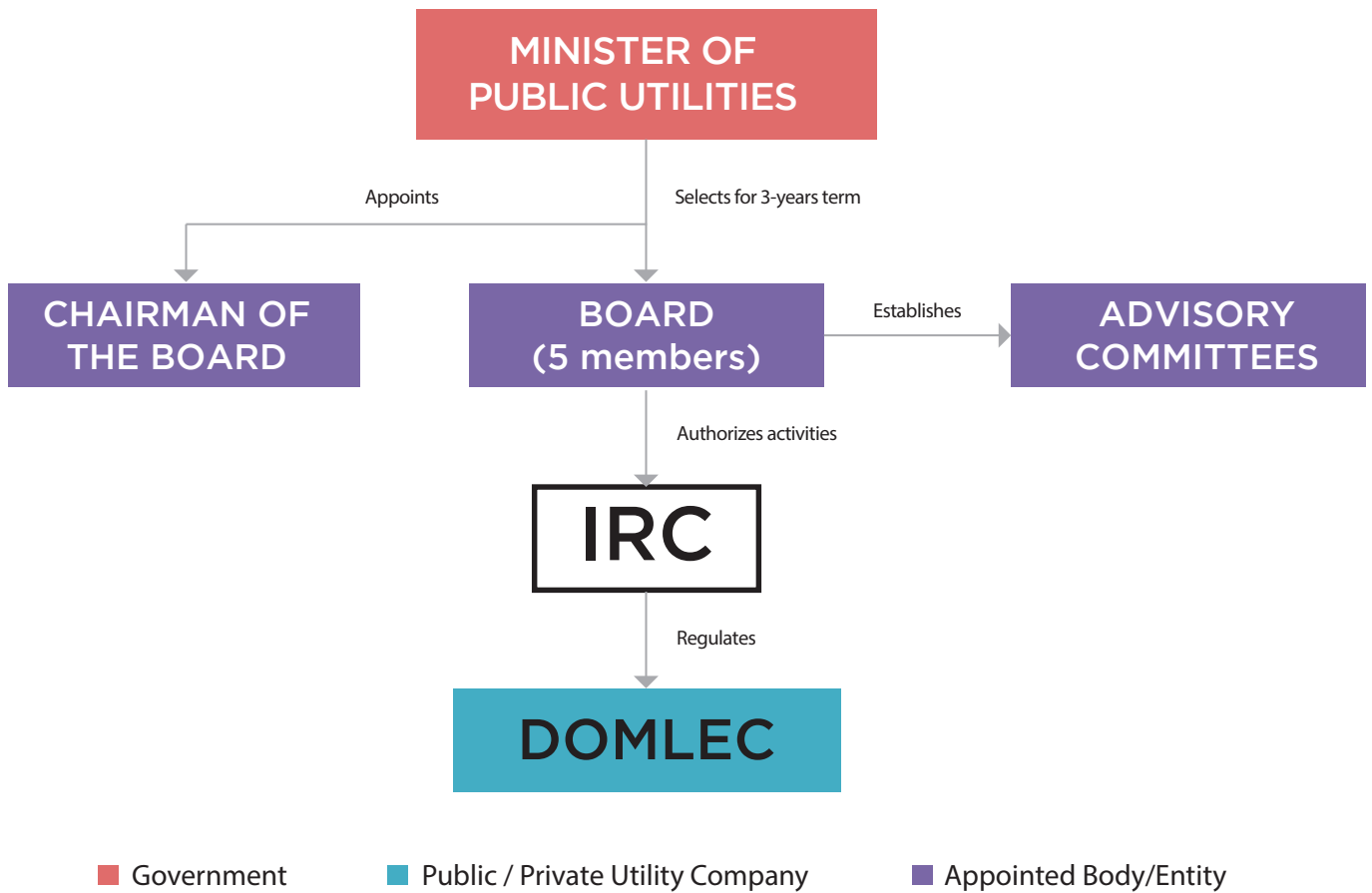
The primary objectives of the IRC are to serve as an independent arbiter, provide a forum for customer appeals, ensure consistent, predictable and transparent regulation, support government policy related to the electricity sector, and cooperate with other agencies to promote and protect a sustainable environment. Some of its key functions are to widen the availability of electricity, promote efficiency throughout the sector, protect the interests of consumers, facilitate competition, issue and monitor licenses, establish and monitor energy efficiency standards, and promote increased regional regulatory and operational cooperation of the electricity sector (IRC, 2014c; Ministry of Environment, Natural Resources, Physical Planning and Fisheries, 2009).

The IRC has been given the authority to direct a licensing regime for all electricity sector participants with generation capacity in excess of 20 kW, all entities transmitting, distributing, supplying, and trading electricity, as well as persons installing and operating electrical installations. The IRC is empowered to directly negotiate licenses with DOMLEC and future IPPs.

A five-member board, whose members are selected for a three-year term by the Minister of Public Utilities in a competitive and transparent procedure, authorizes the IRC's activities. The Minister also appoints one of the members as chair. The board also selects an executive director. Members can be reappointed for one additional term, for a total of six years. The board in turn can establish advisory committees to help gain knowledge and understanding about technical, legal, or economic issues. The committees, however, are not involved in final regulatory decision-making. The IRC executes the decisions of the Board and regulates DOMLEC and IPPs.

Although the IRC has the authority to grant licenses to IPPs, there are currently no utility-scale IPPs operating in Dominica. The IRC operates under an independent budget, which is proposed by the chairman and brought in front of parliament by the Minister. The IRC derives revenue for its budget from licensing and other fees and may also receive subventions from the parliament (Parliament of Dominica, 2006).

Figure 17 Organizational Setup of the Independent Regulatory Commission



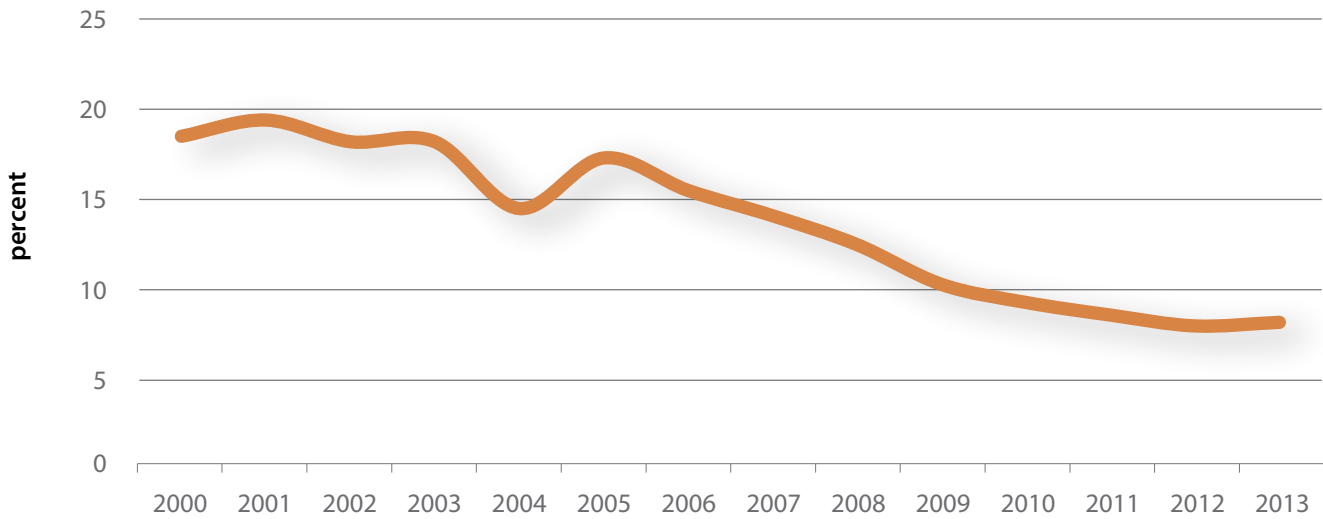
Source: Authors' elaboration based on Parliament of Dominica (2006).

Transmission and Distribution

The transmission and distribution network comprises 403 kilometers of 11kV and 922 kilometers of 230/400V overhead lines. The network serves a customer base of more than 35,300 customers accounting for about 98 percent of the island's population. All generation sources are linked via 11kV inter connectors and, in some instances, via 11Kv distribution feeders.

System losses have historically been among the highest in the Caribbean but, as part of DOMLEC's efficiency goal, losses were reduced from nearly 20 percent in 2001 and 17.3 percent in 2005 to 8.2 percent in 2013. The improvement can in part be attributed to the installation of capacitor banks, the upgrade of 10 primary circuits from single to three phases, modification of 16 secondary circuits to include downsizing of transformers, and load balancing (Ketilsson, 2009). DOMLEC also installed new meters, which may have decreased losses related to inefficient metering (DOMLEC, 2014b). Losses are now in line with or below those in the other Eastern Caribbean countries.

Figure 18 DOMLEC's Losses As Share of Net Generation, 2000-13



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

Electricity Rate

The retail price of electricity in Dominica averaged EC\$1.09 per kWh in 2014 (US\$0.40), among the highest in the Caribbean. Averaged over the course of the year, the fuel surcharge accounted for 37 percent of the retail price. The increasing reliance on expensive diesel fuel and Dominica's rugged and varying terrain requiring extensive transmission and distribution infrastructure both contribute to the high cost of electricity.

Figure 19 Electricity Tariffs and Fuel Surcharges



Source: DOMLEC (2015a; 2015c); Government of Dominica (2014a); NREL (2015).

DOMLEC charges varying rates for residential, commercial, industrial, and hotel customers as well as for street lighting. The pricing structure is similar to the one used by most Caribbean utilities. The total rate consists of a tariff—adjusted annually for inflation—a fuel surcharge adjusted monthly, a load charge for large consumers, and a 15 percent value-added tax (VAT). Residential consumption below 100kWh is exempt from the VAT, and consumption below 51kWh carries a lower tariff. This lower rate and the VAT exemption are the only government subsidies of electricity prices in Dominica. This policy was designed to encourage reduced residential consumption to less than 100 kWh per month per household (OAS, 2010).

Table 8 DOMLEC Electricity Tariffs and Charges, 2014

Charge	Domestic	Commercial	Industrial	Hotel	Street lighting
Tariff	First 50kWh: \$0.578/kWh Above 50 kWh: \$0.67/kWh Minimum: \$2.50	\$0.713/kWh	6am-10pm: \$0.633/kWh 10pm-6am: \$0.581/kWh	\$0.633/kWh	\$0.71/kWh
Fuel surcharge (2014 Avg.)	\$0.40/kWh	\$0.40/kWh	\$0.40/kWh	\$0.40/kWh	\$0.40/kWh
kVA Charge	n/a	\$4.32/kVA	\$4.32/kVA	\$4.32/kVA	n/a
VAT	15% on total cost above 100kWh consumption.	15% on total cost.	15% on total cost.	15% on total cost.	n/a

Source: DOMLEC (2015b; 2015d).

As part of DOMLEC's new transmission, distribution, and supply license, specified under Condition 33, the company was required to file for review of its electricity tariffs by September 30, 2014 (IRC, 2013c). DOMLEC is mandated to file for a review of tariffs every three years, with annual adjustments for inflation (IRC, 2013c). However, at a board meeting in May 2014, the IRC agreed to defer DOMLEC's tariff review application to May 1, 2015 (Dominica News, 2015a). In April 2015, the IRC announced that its discussions with DOMLEC regarding the electricity rates for the coming three years should be over by August 2015 (Dominica News, 2015b).

The IRC cited a number of reasons for the deferral, including a decision not to engage in the very public process of tariff review ahead of the upcoming general election. In the meantime, the IRC continues working with DOMLEC to determine the weighted average cost of capital and the utility's integrated resource plan for 2014–33 and its five-year investment plans, which will in part inform IRC's decision to reviewing and set consumer rates. In April 2015, DOMLEC proposed a return on equity of 14.7 percent, while the IRC suggested 11.4 percent (Government of Dominica, 2015b).

Table 9 Electricity Sector Tariff Regime, 2015

Who sets tariffs	Who controls tariff changes	How the tariff is calculated	How tariff changes are calculated
DOMLEC proposes, IRC needs to approve	DOMLEC submits request every three years. IRC approves or rejects. Annual inflation adjustment.	According to rules and regulations specified by IRC.	BY DOMLEC, according to rules and regulations specified by IRC.
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
IRC	IRC	DOMLEC submit tariff proposal every three years.	Currently negotiating rate of return. Likely to fall between 11 to 15 percent.

Source: Dominica News (2015d); Government of Dominica (2015b); IRC (2008b; 2009b; 2013a; 2013b; 2014b); Parliament of Dominica (2006).

Table 6 Matrix of the Electricity Sector

Generation	Transmission	Distribution
DOMLEC Rosalie Bay Resort Brizee Mart Mr. Blaize Carroz	DOMLEC	DOMLEC

Note: Generation includes IPPs as of 2014.

Institutional Structure of the Hydrocarbon Subsector

As Dominica does not produce any hydrocarbon resources and has no refining capacity, its hydrocarbon subsector is limited. Dominica signed the PetroCaribe agreement in June 2005 and operates the PDV Caribe Dominica joint venture fuel distribution center, through which it receives up to 1000 boe/day (PetroCaribe, 2015). Under the agreement, Dominica had imported more than 600,000 boe, valued at US\$60million by 2012 (Dominica News, 2012). There are currently seven importers in charge of importing and supplying oil products.

Dominica receives petroleum products refined in Trinidad, Curacao, Venezuela, and Panama. Importers and retailers operate under a fixed pricing scheme controlled by the Ministry of Trade, Industry, Consumer and Diaspora Affairs. The government determines wholesale and retail prices, ensuring that consumer prices at the pump reflect price changes in the international market (Government of Dominica, 2014).

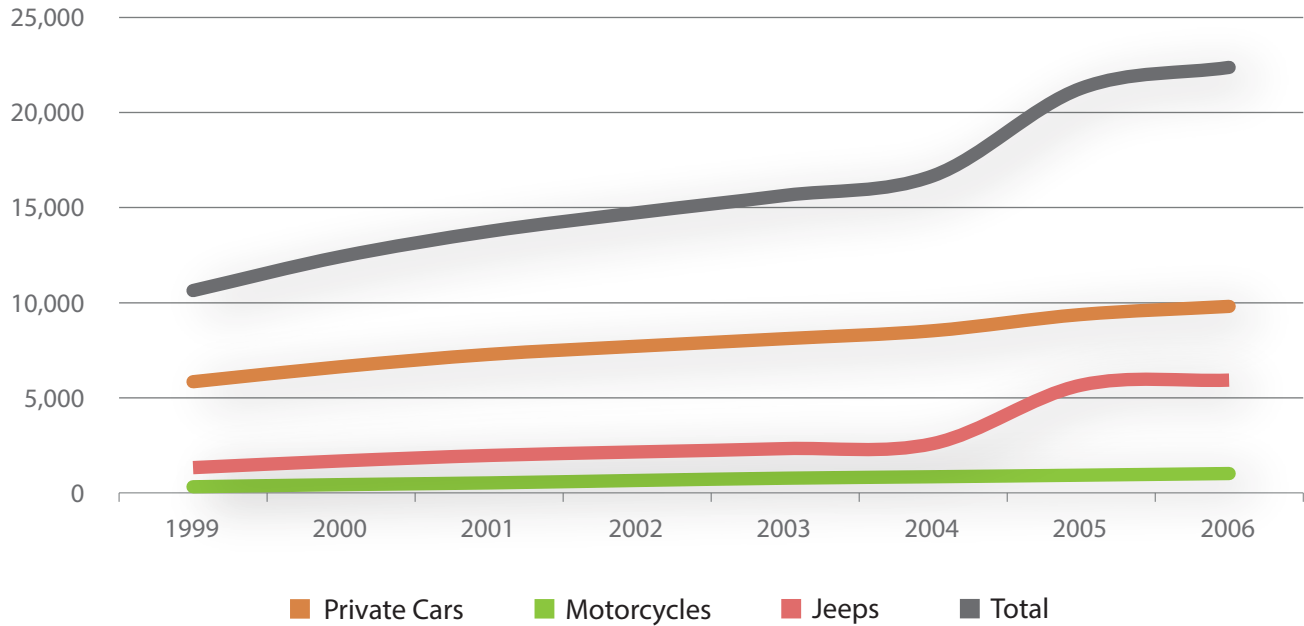
Table 11 Matrix of the Hydrocarbon Sector

Production	Imports	Transformation	Commercialization
	National Petroleum Company/ PDV Caribe Dominica Limited Sol Petroleum + 5 additional importers		National Petroleum Company/ PDV Caribe Dominica Limited Sol Petroleum + 5 additional distributors

Transportation

The transportation sector in Dominica accounts for 52 percent of energy consumption. The penetration of motor vehicles has increased rapidly over the past 15 years. Between 1999 and 2006, the total number of licensed vehicles grew by 110 percent, and private cars saw an increase of 68 percent over the same period. Motorcycle and Jeep ownership, although less common, more than tripled and thus contributed significantly to the overall growth. In 2011, Dominica had about 23,500 registered vehicles, more than double the 2000 figure (Ministry of Environment, Natural Resources, Physical Planning and Fisheries, 2009).

Figure 20 Number of Licensed Motor Vehicles, 1999–2006

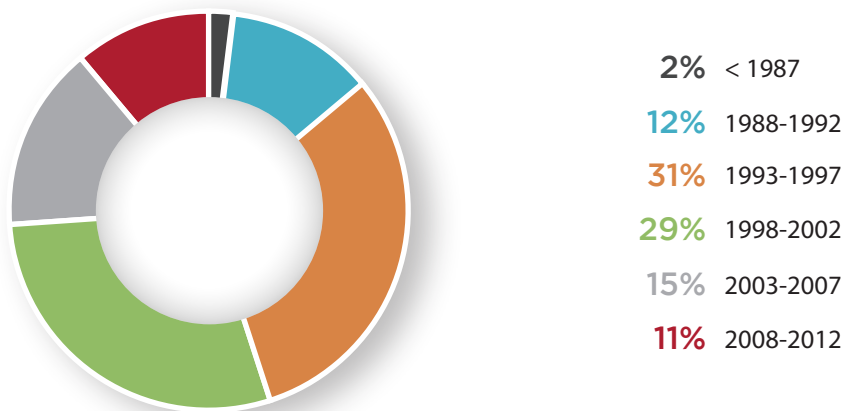


Source: Ministry of Environment, Natural Resources, Physical Planning, and Fisheries (2009).

Public transportation in Dominica remains very limited, in part due to the island’s challenging topography, and where it exists it often consists of unregulated bus routes using inefficient vehicles. In general, energy efficiency in the transportation sector suffers due to the abundance of high fuel-consuming vehicles, especially SUVs. For each new vehicle purchased per year, two used cars are added, further decreasing the

efficiency of the overall mix (Ministry of Environment, Natural Resources, Physical Planning, and Fisheries, 2009). Dominica’s vehicle stock is largely composed of older, larger, and less efficient vehicles. Only 11 percent of vehicles are less than seven years old, and 74 percent of vehicles are 17 years and older, resulting in very high average fuel consumption (Government of Dominica, 2014a).

Figure 21 Share of Vehicle Registrations by Year of Manufacture



Source: DOMLEC (2013); Government of Dominica (2014a).

Historical Development of the Dominican Energy Sector

The energy history of Dominica is primarily a history of the country's electricity sector. The first distributed electricity became available in the area around Roseau in 1905 when a small generating plant began operation. The first hydropower plant was built in the mid-1950s and operated by the Colonial Development Corporation (CDC), which later became the Commonwealth Development Corporation. DOMLEC was founded as a public utility in 1975, and the CDC was the majority stakeholder. The government and the general public held the remaining shares.

The Electricity Act of 1976 established the legal framework for DOMLEC's status as sole vertically integrated utility on the island. The expansion and upgrading of the grid suffered significantly following hurricane David in 1979, which destroyed almost all of the electricity infrastructure and left about 75 percent of the population homeless (DOMLEC, 2014b; Ketilsson, 2009).

The government subsequently purchased the electricity infrastructure for US\$1.00, and DOMLEC took charge with reconstructing it over the next two decades. The government decided to sell its shares back to the CDC in 1996, at the time a hotly debated decision. Simultaneously, as part of the deal, it enacted the Electricity Supply Act of 1996, which granted DOMLEC a 25-year exclusive license and banned the self-generation of electricity.

Furthermore, DOMLEC was guaranteed a 15 percent annual profit regardless of its operating efficiency, thus eliminating virtually any incentive for the company to streamline its operations. Significant improvements came about in 2004, when the CDC decided to sell its shares to WRB Enterprises, a U.S.-based company. In 2013, WRB sold its shares to Emera, a Canadian energy and service company.

The Electricity Supply Act of 2006 ended, at least from a legal standpoint, DOMLEC's role as monopoly supplier. The establishment of the IRC has resulted in improvements in efficiency and reliability (Ketilsson, 2009).

In the initial years after the passing of the 2006 Act and the founding of the IRC, there were no immediate improvements. Electricity costs continued to rise, in part due to increasing world oil prices and to the loss of a portion of DOMLEC's hydro capacity following Hurricane Dean on August 2, 2007.

The start of the IRC was also hampered by a lack of financing and significant delays in selecting members for its board and setting up an office. The largest remaining challenges are full implementation of the NEP and fostering competition in the electricity sector (IRC, 2014a).

Methodology for Energy Matrix

The energy matrix was constructed with data from DOMLEC, the Government of Dominica, and the International Renewable Energy Agency (IRENA). The government's NEP provided information on oil product imports as well as final consumption by sector. IRENA supplied information about production and consumption of CR&W for the year 2009. It was assumed that the share of CR&W did not fundamentally change between 2009 and 2012. DOMLEC's annual report provided information about electricity generation, including inputs, outputs and waste.

	CR&W	Hydro	Electricity input oil products	Electricity consumption	Final consumption by sector
2012	39 boe/day	45 boe/day	454 boe/day	151.6 boe/day	
Source	Based on IRENA 2009 figure assuming no significant change.	DOMLEC annual report hydro production figure	DOMLEC annual report fuel consumption figure	DOMLEC annual report sales figure	Based on NEP 2014

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