ENERGY POLICY AND SECTOR ANALYSIS IN THE CARIBBEAN

2010–2011

Assessing Antigua and Barbuda; the Bahamas, Dominica, Grenada, St. Lucia, St. Kitts and Nevis; and St. Vincent and the Grenadines

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Organization of American States

Energy Policy and Sector Analysis in the Caribbean (2010–2011)

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LCCC Low Carbon Communities in the Caribbean

List of Acronyms and Abbreviations

ACS	Association of Caribbean States
AFD	Agence Française de Développement
AMI	automated metering infrastructure
APC	Antigua Power Company
APUA	Antigua and Barbuda Public Utilities Authority
BEC	Bahamas Electricity Company
bpd	barrels per day
CARICOM	Caribbean Community
CARILEC	Caribbean Association of Electric Utilities
CAWEI	Caribbean Wind Energy Initiative
CCCCC	Caribbean Community Climate Change Center
CDB	Caribbean Development Bank
CEIS	Caribbean Energy Information System
CFL	compact fluorescent lamp
CIPORE	Caribbean Information Platform on Renewable Energy
COP6	Sixth Meeting of the Conference of the Parties
CROSQ	CARICOM Regional Organization for Standards and Quality
CREDP	CARICOM Renewable Energy Department Programme
CREF	Caribbean Renewable Energy Facility
CRETAF	Caribbean Technical Assistance Facility
CSEP	Caribbean Sustainable Energy Project (a consortium of OAS, DSD, CARILEC, CARICOM, and REEEP)
CSME	Caribbean Single Market Economy
CUBiC	Caribbean Uniform Building Code
DCA	Development Control Act
DNI	direct normal irradiation
DOE	U.S. Department of Energy
DOMLEC	Dominica Electricity Services Limited
DSD	Department of Sustainable Development of the Organization of American States
DSM	demand-side management
DTIE	Department of Technology, Industry and Energy
EA	Electricity Act
EAP	energy action plan
ECERA	Eastern Caribbean Energy Regulatory Authority
ECGP	Eastern Caribbean Gas Pipeline
ECPA	Energy and Climate Change Partnership of the Americas
EDF	European Development Fund
EE	energy efficiency
EERE	energy efficiency and renewable energy
EPA	U.S. Environmental Protection Agency

ESA	Electricity Supply Act of 2006
EU	European Union
EUEI	European Union Energy Initiative
EXIM	Export Import Bank of the United States
gal	gallon
GBP	Grand Bahama Power
GBPA	Grand Bahama Port Authority Limited
GDP	gross domestic product
GEA	geothermal exploration and exploitation agreement
GEF	Global Environ¬mental Facility
Geo-Caraïbe	Eastern Caribbean Geothermal Development Project (a consortium including OAS/DSD, AFD, UNEP, ADEME)
German ProfEC	German Professional Energy and Environmental Consultancy
GHG	greenhouse gas
GHI	global horizontal irradiation
GIZ	Gesellschaft für Internationale Zusammenarbeit
GRENLEC	Grenada Electricity Services Company
GRENSOL	Grenada Solar Power Ltd.
GSEII	Global Sustainable Energy Islands Initiative (a consortium of Climate Institute, OAS/DSD, UNIDO, UNF, and other private entities)
GTZ	Gesselschaft fur Technische Zusammenarbeit (German Technical Cooperation Agency)
HCA	Hawksbill Creek Agreement
HFO	heavy fuel oil
HRSG	heat recovery steam generators
HV-AC	high-voltage alternating-current
HVAC	heating, ventilation, and air conditioning
IAA	Investment Authority Act
IBC	International Building Code
ICC	International Code Council
IDB	Inter-American Development Bank
IECC	International Energy Conservations Code
IECC 2009–Tropical	2009 International Energy Conservation Code for the Tropics
IPP	independent power producer
IRC	Independent Regulatory Commission
JPS	Jamaica Public Service Company Limited
kW	kilowatt
kWh	kilowatt-hours
LCCC	Low-Carbon Communities in the Caribbean initiative
LFO	light fuel oil
LPA	Land Planning Act
LPG	liquefied petroleum gas
LUCELEC	St. Lucia Electricity Services Limited
MMSCFD	million square cubic feet per day

MoU	memorandum of understanding
MSW	municipal solid waste
NEP	national energy policy
NETF	National Energy Task Force
NEVLEC	Nevis Electricity Company
NIA	Nevis Island Administration
NOU	National Ozone Unit (to guarantee compliance to the Montreal Protocol, one only established in Grenada)
NREL	National Renewable Energy Laboratory
NSEO	National Sustainable Energy Office
NSEP	national sustainable energy policy
NSWMAA	National Solid Waste Management Authority Act
OAPEC	Organization of Arab Petroleum Exporting Countries
OAS	Organization of American States
OEA	Out Islands Electricity Act
OECS	Organization of Eastern Caribbean States
OLADE	Latin American Organization for Energy
OTEC	ocean thermal energy conversion
PAUG	pay as you go
PDVSA	Petróleos de Venezuela, S.A. (Petroleum of Venezuela)
PGDM	Post-Georges Disaster Mitigation
PMU	Project Management Unit
PPA	power purchase agreement
PUC	Public Utilities Commission
PV	photovoltaic
R&D	research and development
RAEL	Renewable and Appropriate Energy Laboratory
RBS	regional building standards
RE	renewable energy
REEEP	Renewable Energy and Energy Efficiency Partnership
REPS	Renewable Energy Portfolio Standard
RES	renewable energy standard
ROLAC	Regional Office for Latin America and the Caribbean
SEAP	sustainable energy action plan
SECCI	Sustainable Energy and Climate Change Initiative (managed by the Inter-American Development Bank)
SEP	sustainable energy plan
SEU	Sustainable Energy Unit
SIDS	Small Island Developing States
SKELEC	St. Kitts Electricity Department
SLBS	St. Lucia Bureau of Standards
SRC	Scientific Research Council
SVG	St. Vincent and the Grenadines
SWH	solar water heating
T&TEC	Trinidad and Tobago Electricity Commission

TERNA	Technical Expertise for Renewable Energy Application (this is particularly focused on wind energy development)
UNDP	United Nations Development Programme
UN-ECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEC	Unified Network of the Eastern Caribbean
UNEP	United Nations Environmental Program
UNF	United Nations Foundation
UNFCCC	United Nations Framework Convention on Climate Change (also known as the Kyoto Protocol)
UNIDO	United Nations Industrial Development Organization
URCA	Utilities Regulation and Competition Authority
USAID	U.S. Agency for International Development
VAT	value added tax
VINLEC	St. Vincent Electricity Services Limited
WB	World Bank
WIOC	West Indies Oil Company
WIP	West Indies Power (Geothermal Development Company)
WTE	waste to energy

Summary and Recommendations

The Low-Carbon Communities in the Caribbean (LCCC) initiative is jointly implemented by the Organization of American States (OAS) Department of Sustainable Development (DSD) and the U.S. Department of Energy (DOE) National Renewable Energy Laboratory (NREL) under the Energy and Climate Partnership of the Americas (ECPA). Financial contribution is provided by the U.S. Department of Energy and the Caribbean Sustainable Energy Program funded by the European Union Energy Initiative. The LCCC initiative aims to enable project participating countries to implement actions and strategies geared toward increasing the sustainability of their energy supplies and reducing carbon emissions through the development and use of renewable energy (RE) and energy efficiency (EE) technologies.

This report, entitled *Energy Policy and Sector Analysis in the Caribbean (2010–2011)*, provides a baseline of the current energy sector, energy-policy development, and policy implementation, and highlights renewable energy and energy efficiency opportunities in seven assessed Caribbean nations. By documenting each island nation's energy policies, projects, and plans, this report seeks to facilitate discussion and coordinated planning for and among the seven nations.

Table ES-1. Summary of Island Nations Included in This Report

- Antigua and Barbuda (A&B)
- The Bahamas (BAH)
- Dominica (DOM)
- Grenada (GRE)
- St. Kitts and Nevis (SKN)
- St. Lucia (SLU)
- St. Vincent and the Grenadines (SVG)

Item	Value
Land Area	16,500 km²
Population	892,500
Energy Capacity	927 MW
Diesel	758 MW
Hydro	12 MW
Wind	2 MW
Geothermal	None
Solar	174 kW
Biomass/Other	None
Price	U.S. $0.33 per kilowatt-hour
Minimum	U.S. $0.21 per kilowatt-hour (SKN)
Maximum	U.S. $0.46 per kilowatt-hour (DOM)

Sources: CIA 2010; various for supply information and prices.
Note that price is a simple average of 2008 prices, as available.

Energy Policy Development in the Caribbean

All of the island nations discussed in this report are former British colonies and have become independent only since 1970 or later. Development of comprehensive energy policies has been dissuaded by the islands' generally small populations, their proximity to cheap regional oil supplies, the rational creation of single-utility electricity market structure based on one technology (due to low power demands and limited availability of mature off-the-shelf technologies), and a limited awareness of and capacity for the evolution and application of energy efficiency and renewable energy technologies coupled with the fact that most utility companies started as private ventures without specific government portfolios. The growing concern of climate change and the oil price shocks of the recent decades have led to a heighted focus on energy matters.

Until recently, the approach generally was based on the maintenance and incremental expansion of existing capacity—which has been diesel, fuel oil, or other distillate. Two notable exceptions are Dominica and St. Vincent and the Grenadines, where geography has allowed hydropower to be used to some extent. The relatively high cost of undersea transmission, the small difference in cost of power from one island to another, the islands' dependence on imported fuels, and the limited formal dialogue among neighboring independent states around regional energy integration and security (among other reasons) led to island-isolated grids and natural monopolies, with a single utility on each island responsible for production, transmission, and distribution of electricity. The simple production technology and lack of competition meant that utilities largely could pass on their only variable cost—fuel—to their customers via a simple surcharge. As oil prices have increased in the last decade, however, this situation has led to dramatic rises in the price of electricity and increased public concern.

As oil prices rose dramatically from 2004 to 2008, a series of bilateral market agreements between each Caribbean state and Petróleros de Venezuela, S.A. (Petroleum of Venezuela) (PDVSA), the Venezuelan state oil company, were established. These agreements, known collectively as PetroCaribe Treaties, have enabled Caribbean states to purchase oil on conditions of preferential payment (PDVSA 2009). Attempts to minimize price volatility have proven more difficult, as the island governments and utilities do not have significant profit margins or financial means to decrease the fuel surcharge. Island governments can reduce the price impact by relieving import taxes on fuels, as was done temporarily in the Bahamas in 2008 (Wilson 2009, p. 21). The only utility confirmed to practice hedging against volatile fuel prices is St. Lucia Electricity Services Limited (LUCELEC), but it only began doing this as part of the normal course of doing business in 2009 (LUCELEC 2009, pp. 14–15). The result of both the Bahamian and St. Lucian efforts to reduce price impacts presently are not known.

To address of the need to efficiently satisfy the region's energy need, in 2008 the Caribbean Community (CARICOM) established an energy program tasked with coordinating regional initiatives in energy-sector development. Thus far, the energy program is drafting a regional energy policy, has assisted some countries with the development of national energy policies, and has sought out both governmental and nongovernmental international development partners for support. The energy program also has developed a framework for the Caribbean Sustainable Energy Roadmap and Strategy (a regional sustainable energy plan), which is meant to be a platform for engaging stakeholders in discussion about potential technologies, investment requirements, and policy gaps.

In 2008, the Organization of American States also launched its European Union–funded Caribbean Sustainable Energy Program designed to accelerate the transition toward cleaner, more sustainable energy use in the seven countries being assessed in this study through a comprehensive approach to mitigate the governance and management obstacles (including addressing the need for national energy policies and action plans) that impede the development and use of sustainable energy (renewable energy and energy efficiency) in the region.

Several island nations have begun the process of addressing their energy constraints and needs. Barbados, for instance, developed a national energy policy (NEP) in 2007, and Jamaica finalized one along with a national renewable energy policy (in 2010). These policies mandate that the utilities incorporate local energy resources into their integrated resource planning. The policies also call for the diversion of funds to incentive programs and other fiscal projects to further the enablement of efficiency measures and the rational use of local energy resources. Such policies are useful in providing direction for the energy sector amidst a frequently changing political landscape and for creating a framework for progress. Often, though, the policy follow-through and implementation can be problematic, as is further discussed in the individual country assessments.

Energy Policy Frameworks

The conceptual distinction between different energy policy frameworks often is unclear. Motivated by Loy and Wilson's comprehensive reports, this report distinguishes the frameworks using the following working definitions.

National Energy Policy

A national energy policy (NEP) is strategy with high-level short-term, medium-term, and long-term statements of a nation's goals and direction of policy regarding its energy supply and consumption. A NEP should establish the institutions to carry out energy policy, and include the scope of their responsibilities. The NEP should be developed with input from multiple stakeholders, including existing utilities and energy suppliers, consuming industries in the economy, and community groups. This path leads to a NEP being less likely to be political in nature, although it usually requires approval by a national legislature or another top-level government body.

Energy Action Plan

An energy action plan (EAP) is a strategy or set of actions intended to achieve or work toward achievement of the energy goals, especially during the medium and short term (e.g., within 5 to 10 years). The strategies and actions that comprise the plan detail short-term programs and incentives, and specify which government ministries or regulators are responsible for carrying out the actions. This plan can be a statement by the elected government in power and usually requires approval by a national legislature or other top-level government body.

Sustainable Energy Plan

A sustainable energy action plan (SEP) (Loy 2007, pp. 18, 22) is virtually synonymous with an EAP, except that the SEP is intended to focus on the energy plan as relating to sustainability and environmental policy. A SEP typically includes specific sustainability criteria to enable the prioritization of proposed actions. A thorough SEP considers the economic, societal, and environmental consequences of energy decisions.

Stakeholders

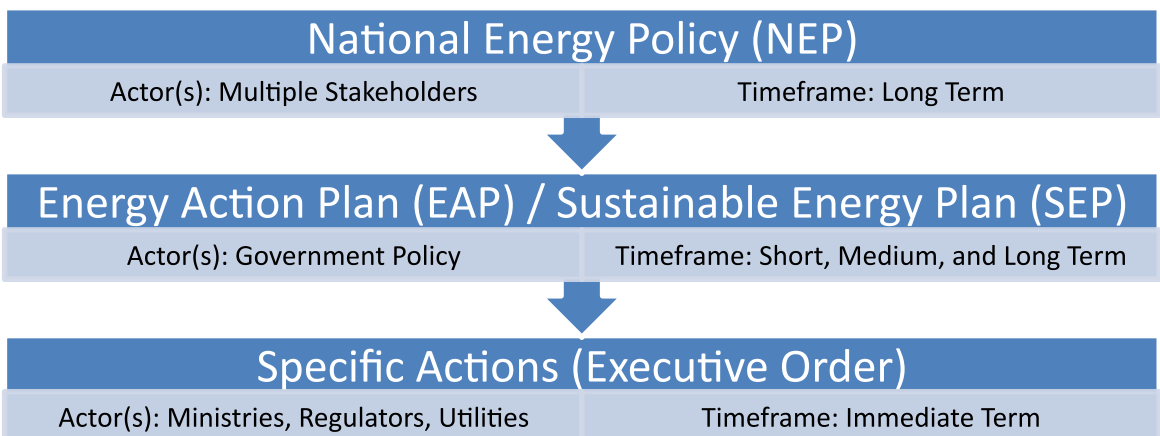
Traditional stakeholders for energy policy include government bodies, established electrical utilities, independent regulatory authorities, and consumer organizations. As the Caribbean energy sector transforms, independent power producers are emerging. These stakeholders must work together to maintain the financial stability of the governments and utilities and to protect the interests of the energy users, especially residents, commercial and industrial customers, and the hospitality industry.

Due to the typical electricity market structure found in the Caribbean, the governments of many nations historically have lacked any energy-specific policy-making bodies. Instead, after utilities were given license by an act of government, they were left to operate independently, as the developing nations dealt with other priorities. Recently, as nations have begun to develop more long-term energy policies, energy-specific government agencies have been created in a variety of ways. Some are based on the executive government in power, some on energy-policy committees, and others are based on energy-policy laws and acts. In some nations the energy-policy body is hosted within other offices or programs having only an incidental relationship to energy policy, such as standards boards; outreach programs; or finance, environmental, or agricultural ministries.

Policy Implementation

Comprehensive national energy policy and supporting short-term plans and efficient policy implementation are critical needs in the Caribbean region. The island nations, however, face many challenges to implementing and adopting energy policies. The organizational structure of the policy framework is depicted below. It illustrates the sequence of information or directives, as well as the responsible party and time frame for each component of the framework. Thus, if some of the responsible parties are nonexistent or unequipped to handle such responsibilities then there is an inherent limitation to policy implementation.

In many island states, for instance, there is no independent utility regulator and, in some cases, there is no energy portfolio in the government office. International experience shows that often it is these regulators who are able to help provide direction or act as an impetus for utility consideration of alternative energy sources or the legal framework for introducing competition at some level of the power-sector supply chain. Thus, important to the development of useful national or regional energy policies and programs are the acknowledgement and consideration of the different legislative, regulatory, and commercial needs of the individual islands.



Status of Energy Policies

The status of energy policies in the scope of this report is summarized below. Most of the nations with energy policies and plans have developed their policies with help from international policy consultants. In recent years, both the Caribbean Renewable Energy Development Program (CREDP/GTZ) and Organization of American States–Caribbean Sustainable Energy Project (OAS-CSEP) have been instrumental in building up expertise for the development of energy policies and plans.

Table ES-2. Energy Policy Summary as of December 2011

Nation	NEP		EAP / SEP		Notes
	Status	Date	Status	Date	
Antigua and Barbuda	Adopted	Nov 2011	-	-	NEP includes an action plan
Bahamas	-	-	Final	Sept 2010	The Energy Policy statements normally included in a NEP form integral part of the 1st (Nov 2008) and 2nd Reports ((EAP) of the National Energy Policy Committee (established in 2008)
Dominica	Draft	2011	Draft	2011	
Grenada	Adopted	2011	-	-	NEP includes an action plan
St. Kitts and Nevis	Draft	2011	Draft	2011	As per December 2011, the NEP and EAP were being finalized
St. Lucia	Adopted	June 2010	Adopted	2006	SEP (GSEII) approved before conclusion of NEP
St. Vincent and the Grenadines	Adopted	Feb 2009	Adopted	April 2010	First SIDS among project countries to adopt both NEP and EAP

The evolution of energy policy and plan development has taken different courses in each island, where most notably St. Lucia started with the adoption of a Sustainable Energy Plan prior to elaborating a comprehensive National Energy Policy, this marks the difference in perception of policies versus plans.

Electricity Markets

Power Generation Utilities

Utilities in the scope of this report and throughout the Caribbean region historically are government-licensed monopolies, responsible for production, transmission, and distribution of electricity among island-isolated grids.

Table ES-3. Utility Summary

Nation	Utility	Ownership	Legal Authority	IPP Allowed	Self-Generation Allowed
Antigua and Barbuda	APUA	Government department	Act (perpetual)	By contract with utility	No
Bahamas	BEC	Government corporation	Act of 1956 (perpetual)	Only on private islands	No
	GBC	Joint venture of foreign utilities	Act (2054)	No	No
Dominica	DOMLEC	Public-private corporation including foreign utilities	License (2015)	Yes	Yes
Grenada	GRENLEC	Public-private corporation including foreign utilities	License (2041)	By license from utility	Yes (<10 kW net-metering with a cap of 1% peak demand)
St. Kitts and Nevis	SKELEC	Government department	Act (perpetual)	By license from utility	No
	NEVLEC	Government corporation	Act (perpetual)	By license from utility	Wind and solar PV only
St. Lucia	LUCELEC	Public-private corporation including foreign utilities	Act (2045)	Yes	Yes
St. Vincent and the Grenadines	VINLEC	Government corporation	Act (perpetual)	By license from utility or on private islands	By license from utility

Sources: Refer to sections on each nation.

Electricity Supply

The following table summarizes the energy supply for the nations in this report. Tables in the corresponding sections on each nation contain more detailed information as available, typically from the utility. Although the table below shows contributions from distributed generation, those in the sections on each nation show the utility contributions only.

Table ES-4. Energy Supply

Nation	Generation Mix					Total Capacity (MW)	Net Sales (GWh)	Average Price in 2008 ($ / KWh)
	Diesel / Oil (MW)	Gas (MW)	Hydro (MW)	Wind (kW)	Solar (kW)			
Antigua and Barbuda	90.20					90.20	222	0.35
The Bahamas	429.80	155				584.80	1,536	0.31
Dominica	17.17		6.42	225	Some	23.82	74	0.43
Grenada	51.00			80	74	51.15	189	0.37
St. Kitts and Nevis	50.80			1,600		52.40	45	0.30
St. Lucia	76.00				100	76.10	315	0.32
St. Vincent and the Grenadines	43.30		5.2			48.50	123	0.36
Total	758.27	155	11.62	1,905	174	926.97	2,503	0.31

Values for 2008. Includes distributed generation, where known.
Sources: Refer to sections on each nation.

Generation and Fuel Efficiency

In the Caribbean region, the most common generation technology currently used is medium-speed/low-speed internal combustion engines running on diesel or heavy fuel oil. Although such generators generally are reliable and easy to maintain, their typical generation efficiency is 30% to 40% (Nexant 2010, p. 8.10). These percentages can be improved by updating the equipment to new, more efficient systems or by adding heat recovery steam generators (HRSG) to drive steam turbines. These modifications can improve efficiency by 10 to 20 percentage points. Fuel efficiency measures in terms of kilowatt-hour (kWh) yielded per imperial gallon of diesel fuel used are included in this report where available.

The few hydro plants operating in Dominica and St. Vincent and the Grenadines (SVG) have opportunities to produce power more efficiently as well. The *World Bank Report* estimates that hydro plants in Dominica operate at 50% capacity factor, and those in SVG run at only 30% (Nexant 2010, pp. 5.3, 5.8). This source also discusses the efficient operation of both fossil-fuel and renewable generation technologies utilized in the region (Nexant 2010, pp. 8.4–8.31).

Transmission and Distribution Efficiency

In transmission and distribution, the transmission losses are easily measured and reported with effective metering at generation, transmission, and end-use points. These measurements are critical if utilities are to quantify and reduce technical and nontechnical distribution losses. In some instances, however, it is difficult to measure system efficiency. In St. Kitts and Nevis, government use of electricity is not metered. It has been reported that nontechnical losses in Nevis amount to more than 20% (Wilson 2009, p. 99).

Historical analysis of transmission losses in the Caribbean shows an increment of losses during the past 30 years (*see* Figure ES-1, Figure ES-2). This situation must be addressed by governments and utilities to improve the transmission efficiency and reduce burden expenditures.

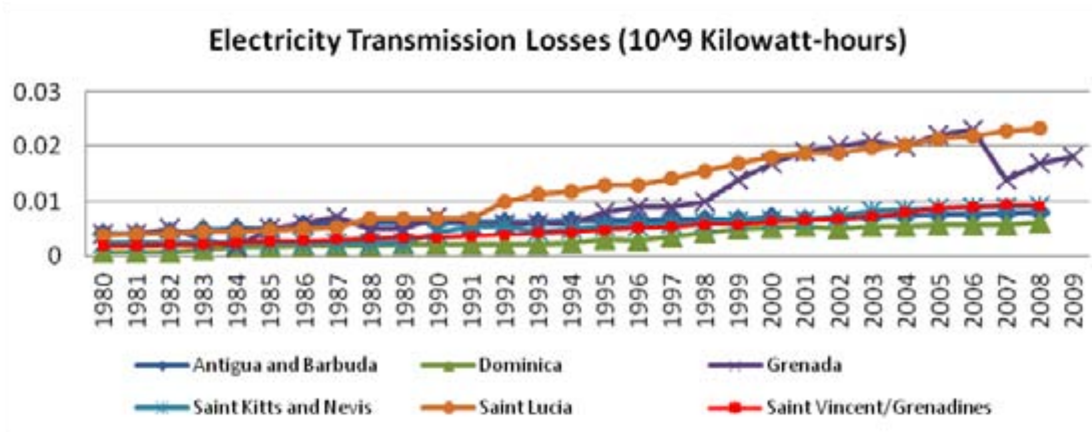


Figure ES-1. Transmission losses, excluding the Bahamas

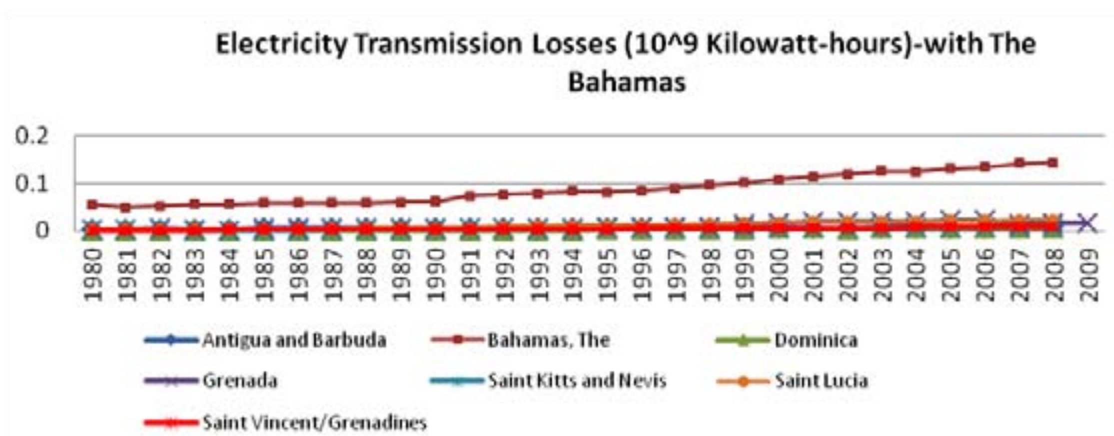


Figure ES-2. Transmission losses, including the Bahamas

Energy Efficiency

Improvements in efficiency directly reduce the demand for power, which reduces use of fossil fuels and facilitates progress toward low-carbon communities. Improvements in energy efficiency can lead to economic activity and growth without requiring new energy generation capacity to be added (Nexant 2010). Utilities always have the opportunity to decrease fossil fuel use, and hence minimize carbon emissions, by making efficient use of existing capacity. Supply requires efficient use of fuels in generation, minimization of transmission losses, and reliable measurement at the point of use.

Building Codes

Historically, energy efficiency has not been addressed in building codes in the Caribbean. Instead, much of the focus has been on safety and minimization of damage from hazards such as fires, hurricanes, earthquakes, and other disasters. The lack of implementing or enforcing building codes presents an opportunity to substantially improve energy efficiency in the Caribbean. As a point of reference, energy use in buildings typically accounts for one-third of all types of energy—and two-thirds of all electricity—consumed in the United States. Carefully designed and consistently enforced building codes and standards can lead to cost-effective reduction of energy demand (EPA 2007).

Two model building codes, the Caribbean Uniform Building Code (CUBiC) and the Organization of Eastern Caribbean States (OECS) Code, were developed during the 1980s by CARICOM and OECS, respectively (Wason 2002). Model versions of these codes are not readily available; however, several unofficial versions are available, and are listed below.

- Grenada draft building code, based on OECS code, hosted by Caribbean Disaster Mitigation Project of OAS at: http://www.oas.org/CDMP/document/ gda_code/codedocs.htm (OAS 2001)
- St. Lucia building code, based on OECS code, available on a builder's website at: http://foshlaninc.com/knowledgebase/slu_building-codes/codepreface.htm (Foshlan 2005)
- Trinidad & Tobago Small Building Code, based on CUBiC draft: http://www.astm.org/SNEWS/JANUARY_2004/harnarine_jan04.html (Board of Engineering 2008)

The Association of Caribbean States (ACS) performed an assessment of seismic and wind codes in 2003. The study compared the seismic and wind building codes of CUBiC, OECS, other Caribbean islands, and Central America. It found that the OECS seismic code is based on Structural Engineer's Association of California (SEAOC) codes, with some sections from the Uniform Building Code (UBC), Applied Technology Council (ATC) codes, and New Zealand codes. The wind code is adapted from International Organization for Standardization (ISO) Technical Committee 98 (ACS 2003).

The International Energy Conservations Code (IECC) is another well-documented set of building codes that has found use in islands elsewhere. Hawaii and Puerto Rico have found the 2006 and 2009 versions of this code to be useful and applicable. (*See* http://www.dsireusa.org/incentives/ incentive.cfm?Incentive_Code=HI11R&RE=1&EE=1; http://bcap-ocean.org/news/2011/ february/25/puerto-rico-adopts-2009-iecc-and-eight-other-model-codes.)

Building Code Adoption and Enforcement

The Post-Georges Disaster Mitigation program (PGDM) was sponsored by the U.S. Agency for International Development (USAID and OAS) from 1998 to 2001. It surveyed the status of building codes in the Caribbean OAS Member States, including islands within the scope of this report.

The PGDM matrix (Status of Building Codes in the Caribbean (as of August 2001) http://www.oas.org/pgdm/document/codemtrx.htm) provides a useful (though outdated) snapshot of code status, availability, and enforcement (Wason 2002).

As model codes, CUBiC and the OECS code were intended to be adapted for local use, approved by the government, and locally enforced by each country. The government of St. Lucia appears to have led the OECS in local adoption, and several sources refer to the OECS code and St. Lucia's interchangeably (ACS/EIRD 2003). Other OECS nations—including Antigua and Barbuda, Dominica, Grenada, and St. Kitts and Nevis—have drafted local versions of the codes. Unfortunately, many island governments have failed to pass regulations to formally adopt these codes, leaving them ignored or unenforced at a local level (Wason 2002).

Current Building Code Development Efforts

During the last decade, CARICOM has made an ongoing effort to replace CUBiC with a new regional standard, based on the International Building Code (IBC) model of the International Code Council (ICC) (Caribbean Development Bank 2007). The model code, called the Regional Building Standards (RBS), is being drafted by the CARICOM Regional Organization for Standards and Quality (CROSQ). Following the completion of an updated model code, CROSQ intends to provide training and promote adoption throughout the Caribbean to facilitate safer and more efficient design of buildings in the region.

The CROSQ is attempting to bring consensus and buy-in among local building control agencies through national technical subcommittees and national standards bodies of member states (CROSQ 2009). The National Technical Sub-Committee of St. Lucia exemplifies the collaborative nature of this effort, as it includes professional organizations composed of engineers, architects, and contractors; private interests; and government ministries. The St. Lucia committee met in 2009, but the status of other national subcommittees remains unknown at this time (St. Lucia Bureau of Standards 2009).

The 2009 International Energy Conservation Code for the Tropics (IECC 2009–Tropical) (IECC 2009, IGCC v.1, ASHRAE 90.1 2007, 55-2004, 62.1 2010) is a model code that was developed with input from Hawaii and other islands, and it should be considered for other Caribbean islands as well (Quinones & Rockenbaugh 2010, pp. 15, 26). The code provides the minimum requirements for the energy-efficient design of buildings. It contains adaptations of internationally accepted building codes relevant to tropical climates, including mandatory provisions and requirements for building envelopes, ventilation, air-conditioning, and lighting. A sample tropical code is available from the Commonwealth of the Northern Mariana Islands (CNMI 2010).

Electrical and Lighting Codes

Standards for electrical equipment and lighting do not appear to be readily available for most nations included in this report. The nation of St. Lucia, however, published a list of standards titles which includes electrical systems and lighting. Although some standards are marked as "mandatory St. Lucia National Standards," it is unknown whether these standards are enforced or to what degree they are utilized (St. Lucia Bureau of Standards 2010, pp. 3–4).

Appliance Standards

In Grenada, the National Ozone Unit (NOU) program promotes the use of ozone-friendly air-conditioning, coolants, and other building equipment. The NOU is run by the Ministry of Finance to enact Grenada's compliance with the Montreal Protocol. The NOU sets policy on ozone-depleting substances, trains refrigeration and HVAC technicians, and conducts public awareness initiatives (NOU 2010). Although other nations described within the scope of this report are subject to the Montreal Protocol (part of the Kyoto Protocol), it is unknown whether similar outreach programs exist elsewhere.

Energy Supply Outlook

Fossil Fuels

All of the islands discussed in this report are signatories to PetroCaribe, a program for purchasing oil from Venezuela with preferential payment conditions, such as low-interest loans for short-term (month-to-month) financing. In PetroCaribe, each nation individually enters a bilateral market agreement with Petróleros de Venezuela, S.A. (Petroleum of Venezuela) (PDVSA), the state oil company of Venezuela. As the financing agreements generally extend for 25 years, (PDVSA 2008), the use of fossil fuels can be expected to remain a significant source of energy in the Caribbean.

To provide future additions to capacity, the *World Bank Report* projects the optimal life-cycle technology mixes of each nation in this study, except for the Bahamas. Termed “least cost fuel combinations,” these can be considered *as business-as-usual forecasts in the absence of renewable capacity development and electrical grid interconnections* (Nexant 2010, p. 1.6; Jones and Kammen 2011). This World Bank report recommended the following “least cost” additional generation.

- Antigua and Barbuda, Grenada, and St. Vincent and Grenadines (SVG): 10-MW diesel for peaking and mid-range duty, and a 10-MW coal-fueled circulating fluidized bed plant for base load duty.
- Dominica, St. Kitts, and Nevis: 5-MW diesel for peaking, mid-range, and base load duty.
- St. Lucia: 20-MW gas turbine for peaking duty, delivered via the proposed Eastern Caribbean Gas Pipeline from Trinidad, and 20-MW diesel for mid-range and base load duty (Nexant 2010, p. 1.6).

Shipment and storage add to the costs of fossil fuels, especially in the Lesser Antilles, where fuel demand is small compared to larger continental markets and larger islands such as Hispaniola, Jamaica, and Puerto Rico. Many of the islands have limited storage, leaving them vulnerable to interruptions due to weather or to worldwide oil market fluctuations. However, some large oil storage and transportation facilities exist in the region, including the following:

- Antigua hosts the West Indies Oil Company (WIOC), a terminal with storage for 200,000 barrels of refined products; half is leased to PDVSA per PetroCaribe (Nexant 2010, p. 7.21).
- Guadeloupe (France) has finished products storage for 630,000 barrels (Nexant 2010, p. 7.21).
- Martinique (France) has a refinery with 503,000 barrels of storage for finished products (Nexant 2010, p. 7.21).
- St. Lucia hosts a 9,000,000-barrel transshipment terminal owned by Hess Oil, with some capacity used to deliver products per PetroCaribe (Nexant 2010, p. 7.21).
- St. Eustatius (Netherlands) hosts a 13,000,000-barrel regional storage facility for crude and refined products (Nexant 2010, p. 7.22).
- The Eastern Caribbean Gas Pipeline (ECGP) is a proposed undersea natural gas pipeline that would export 50 million square cubic feet per day (MMSCFD) to Barbados and 100 MMSCFD to Martinique, Guadeloupe, and St. Lucia (Nexant 2010, pp. 7.6–7.11).

Renewable Energy

Resources for renewable energy are abundant throughout the Caribbean, and many can be accessed in the short term. Every island nation in the scope of this study has extensive wind and solar resources, and several have significant geothermal potential. In the long term, development of biomass energy and biofuels is possible given a concerted economy-wide effort, and ocean energy could be exploited in vast quantities once these technologies mature (Loy & Farrell 2005, p. 9).

The Caribbean region has geographical and geological features that lead to unique opportunities for renewable energy technology implementation. Primarily, the active geological zone of the eastern Lesser Antilles chain offers a geothermal powerhouse. Throughout the Caribbean, the winter peak in wind coincides with the seasonal low in solar; in both cases the variations are modest compared to many parts of the world (Kammen 2010, p. 2).

Current Renewable Energy Development

Every nation discussed in this report is considering utility-scale wind power exploitation, and nations with legacy geothermal exploration either are developing these resources or are on course to do so in the near term. Currently, no utilities or independent power producers (IPPs) are considering utility-scale solar or biomass for electrical power production. Note that St. Lucia and Grenada are currently pursuing a waste-to-energy plant. The following table summarizes the RE projects under development as of 2011; those which show an expected capacity in megawatts are either indicated as resource potential or are expected to be complete by 2012/2013.

Table ES-5. Renewable Energy Projects (2011)

Nation	Hydro	Wind	Geothermal	Other Renewable Energy	Expected Capacity (MW)
Antigua and Barbuda	—	CREDP/GIZ measuring 4 sites on both islands since 2010			—
The Bahamas	—	Utility measuring 7 sites on Grand Bahama		2012 Start of OTEC Resource Assessment (Deep Water Cooling–phase 1) of 2 sites	—
Dominica	1.18 MW being rebuilt at Padu plant, after being down since 2007	3-MW to 6-MW potential, utility measuring 7 sites to confirm site	West Indies Power is drilling exploration wells		4.18 to 7.18
Grenada	—	1-MW wind farm planned in Caraiccou island, to be completed by 2013; 3-MW to 6-MW potential, utility assessing 3 sites on Grenada	20 MW (phase 1) based on utility feasibility study in 2009 (Geothermal Development Bill / Concession Agreement being drafted)		21
St. Kitts and Nevis	—	5.6-MW wind farm planned in St. Kitts, to be completed in 2013	10-MW (phase 1) plant planned in Nevis		15.6
St. Lucia	—	15 MW wind farm at Sugar Mills site being assessed	12 MW (phase 1) to be developed (concession agreement signed / due diligence completed)		27

Nation	Hydro	Wind	Geothermal	Other Renewable Energy	Expected Capacity (MW)
St. Vincent and the Grenadines	Utility tendering offers for expansions and new 1.19-MW plant	7-MW wind farm planned at Ribishi Point site, to be completed in 2013 (tendering process completed)	Unknown IPP signed new exploration agreement 1/2010		6.2
Expected Capacity (MW)	2.4	31.6 to 34.6	42	—	76 to 79

Does not include distributed generation.
Wind info source: Jargstorf May 2011, p.2)
Other Sources: Refer to sections on each nation.

Potential for Future Renewable Energy Development

Detailed discussion on potential for RE development is included for each technology in the following sections, and by location in the section for each nation. The installed costs of available RE technologies (Syngellakis, 2011, p.19) are shown in Table ES-6; generation costs are shown in Table ES-7.

Table ES-6. Installed Costs of Renewable Energy Technologies (Syngellakis, 2011, p.19)

Technology	Cost Range in U.S. $ per kW
Grid-Connected Solar PV	$4,500–$14,000
Off-Grid Solar PV	$10,000–$34,000
Micro-Hydro	$4,000–$23,000
Small-Hydro	$1,800–$4,000
Small-Scale Wind	$4,000
Large-Scale Wind	$3,300
Small-Scale Biomass	$3,500–$6,000
Diesel	$800–$1,500

Table ES-7. Generation Cost in Pacific Islands (Syngellakis, 2011, p.30)

Technology	PICs Range of Cost in U.S. $ per kWh	International Costs (REN21) in U.S. $ per kWh
Grid-Connected Solar PV	$0.35–$0.70	$0.17–$0.34
Off-Grid Solar PV	$1.50–$2.50	$0.40–$0.60
Large-Scale PV and Battery	$0.75	$0.25–$1.00
Large-Scale Wind	$0.14–$0.18	$0.05–$0.09
Coconut Oil	$0.34–$0.38	$0.30 – $0.80 (biofuel/biodiesel)
Biomass Gasification	$0.16–$0.22	$0.08–$0.12
Landfill Gas	$0.18	$0.18

Technology	PICs Range of Cost in U.S. $ per kWh	International Costs (REN21) in U.S. $ per kWh
Urban Diesel	$0.15–$0.49	$0.15–$0.49
Rural Diesel	$1.00–$2.50	$1.00–$2.50

The total technical potential for RE development is summarized by region in Table ES-8, below.

Table ES-8. Technical Potential for Renewable Energy Development

Nation	Hydro (MW)	Wind (MW)	Geothermal (MW)	Solar PV (MW)	Biomass (MW)	Total Potential (MW)
Antigua and Barbuda	None indicated	400	None indicated	27	Unknown	427
The Bahamas	None indicated	15	None indicated	58	Unknown	73
Dominica	17	30	300	45	Unknown	392
Grenada	0.5	5	Unknown	Unknown	Unknown	5.5
St. Kitts and Nevis	None indicated	5	300	16	10	331
St. Lucia	0.2	40	170	36	Unknown	246.2
St. Vincent and the Grenadines	10	8	100	23	4	145
Total	27.7	503	870	205	14	1,619.7

Includes distributed generation.
Sources: Refer to sections on each nation.

Hydro

Hydro plants have provided power to Dominica and St. Vincent and the Grenadines since the mid–twentieth century. In the Caribbean region, hydro also is utilized in the Dominican Republic, Haiti, and Jamaica (Nexant 2010, p. 8.19).

Kramaku River, St. Vincent and the Grenadines

Few of the remaining nations in this study are considered to have appreciable hydro resources. Typically, these nations do not have the proper geography for hydropower. Although current hydropower technology can be applied to even small streams, poor agricultural management techniques have reduced the potential use of this energy source (Nexant 2010, p. 8.19).

Wind

Wind is a favorable resource in the Caribbean region because the climate consistently brings warm trade winds from the east (Posorski & Werner 2009, p. 51). Wind in the region exhibits less seasonal variation as compared to many parts of the world (Kammen 2010, p. 2). The ideal size of wind turbines for typical Caribbean grids is 500 kW to 2,000 kW, with rotor diameters of 40 m to 60 m and tower heights of 50 m to 60 m. The design of this size turbine matured in the 1990s (Jargsdorf 2008, p. 24).

Every nation falling within the scope of this report is considering utility-scale wind power exploitation. The largest proposed project so far is the planned 12.6-MW Sugar Mill/Rouane Estate wind farm in St. Lucia. The first 2.2-MW wind farm and independent power provider (IPP) in the Eastern Caribbean was officially commissioned in Maddens, on the island of Nevis, in August, 2010.

2.2 MW Maddens Wind Farm on Nevis, commissioned in August 2010 (St. Kitts and Nevis)

Wind measurements are just beginning to be recorded in the Bahamas, where CREDP/GTZ is not active but the local utility has interest. In Antigua and Barbuda, CREDP/GTZ started wind assessments in 2010. In Grenada, Dominica, and St. Vincent and the Grenadines (SVG), CREDP/GTZ has provided technical support for several years, and utilities are pursuing development.

In comparison, the first commercially operated wind farm in the region was commissioned in 1993 which is a 3 MW Wind Farm at “Tera Cora” on Curacao (12 250kW NedWind Turbines) followed by the 9MW Wind Farm at “Playa Canoa” commissioned in 2000. One of the largest wind projects in the Caribbean region is the Wigton wind farm in Jamaica, which was completed in 2004 and has a capacity of 20.7 MW (Wigton Windfarm 2004) which it is expanding to 38.7 MW (Wigton Windfarm 2010). Additionally, Aruba presently has the largest wind farm in the region with 30 MW (10 3-MW Vestas Turbines) installed and commissioned in 2009. These systems demonstrate that utility-scale wind can be deployed economically in the region.

30MW Vader Piet Wind Farm, Aruba

Besides direct grid power, desalination by wind power also is being studied on the SVG island of Bequia (Government of St. Vincent and the Grenadines 2010, p. 35). If this application appears feasible, then it might be useful on other smaller islands throughout the region.

Barriers to using wind power in the Caribbean include the region's weather risks, as well as high capital costs due to relatively small plant sizes, and difficulty in site access and land acquisition. The primary risk to wind turbines installed in the Caribbean region is the threat of hurricanes with high shear wind speeds. There are two main tactics for dealing with this risk—insurance and design. Utility-scale systems in the Caribbean should be insured just like any other major capital expenditure. In the event of damage from a larger hurricane, the repair of the wind turbines is covered by insurance. Of course, better design can reduce the potential for damage and the associated insurance premiums. Wind turbines are being designed with strengthened components, and some with tower or with nacelles that can be tilted and quickly raised or lowered (Jargsdorf 2008).

Capital costs for wind energy can be significant for small wind projects because these systems do not take advantage of the economies of scale. The Caribbean Wind Energy Initiative (CAWEI) is a CREDP program to reduce costs for Caribbean wind projects by aggregating equipment orders (up to 50 MW) and modifications for hurricane risks reduction (Jargsdorf 2008, pp. 56, 59). Participants in CAWEI included Barbados, St. Lucia, and St. Vincent as of 2008 (Clarke 2008, p. 18).

Site identification and acquisition also are barriers to wind farm development. As an example, Dominica has been considering wind development since 2003, completing measurements at several sites (Loy 2009, p. 10). The utility has not been able to develop the best sites, however, because this would require purchasing many small land parcels, some of which have disputed ownership (DOMLEC 2008, p. 21).

Jargsdorf recommends that island governments should mitigate conflicting land-use interests by establishing wind development zones, following multiple-stakeholder input (Jargsdorf 2008, p. 58).

Geothermal
The potential for geothermal energy exists primarily on the volcanic Leeward Islands and Windward Islands that separate the Caribbean Sea from the Atlantic Ocean. Resources in St. Lucia have been explored since the 1960s (Loy & Farrell 2005, pp. 40–41), and in Dominica since the 1970s (Loy & Farrell 2005, p. 14). The U.S. Department of Energy conducted regional geological studies in the 1990s (Huttrer 2005) and revised them in 2008 (Joseph 2008). Additionally, the Organization of American States led the Geo-Caraïbes development program during the 2000s.

A 10-MW plant planned to be built in Nevis could mark a milestone as the first commercial geothermal plant to be under construction in the region. The project is being developed by West Indies Power, which intends to become a regional geothermal IPP.

Geothermal slim-hole drilling, Nevis (St. Kitts and Nevis)

Following completion of the Nevis plant, West Indies Power is planning to develop resources in Dominica, as well as expand its capacity in Nevis to serve St. Kitts (West Indies Power 2009). The St. Kitts and Nevis project was expected to come online during the first half of 2011 (Caribbean Net News 2010). For unknown reasons, as of December 2011 this planning had not yet materialized.

Geothermal power development has huge site-specific geological uncertainties, which make site selection, resource assessment, and financing difficult. Problems with site geology are an issue in St. Lucia, for example, where carbon dioxide and corrosive discharge have been found in exploratory drilling (Coles 2004, pp. 7–9).

Geothermal Steam, Nevis #3 Slim Hole Site, Nevis (Source: Small Ship Cruises.com)

Financial and policy barriers also have held up exploration efforts in St. Lucia, St. Vincent, and Dominica in the past. In each case, the government agreed to grant rights to geothermal resources, but the firms were unable to finance exploratory drilling for several years. Furthermore, the lack of agreement between the utility and the geothermal developer on how the latter can operate as an IPP presents another barrier. For example, West Indies Power (WIP) currently is negotiating in both St. Kitts (West Indies Power 2010) and Dominica, but no power purchase agreement (PPA) is yet available (DOMLEC 2008, p. 21). In St. Vincent, the government reached a 30-year agreement, but neither the terms nor the identity of the IPP were made public (Government of St. Vincent and the Grenadines 2010, pp. 22, 32).

Solar

The Caribbean region has opportunities for a range of solar energy technologies, primarily distributed solar water heating (SWH) and photovoltaics (PV). As noted, solar exhibits little seasonal variation, and is countercyclical to wind over the course of the year (Kammen 2010, p. 2). As part of this work, NREL contracted with Clean Power Research (www.cleanpower.com) to develop solar irradiance maps based on data from 1998 to 2010. These maps use a modified version of the Perez diffuse-irradiance model (Perez 1987, 1994) to estimate the solar energy reaching the earth's surface by analyzing satellite data. The method estimates global horizontal irradiation (GHI) (i.e., the total solar irradiation; the sum of direct, diffuse, and ground-reflected radiation) and direct normal irradiation (DNI) (i.e., the irradiation that comes directly from the sun). The global horizontal irradiation is important for solar PV systems and the direct normal irradiation is important for concentrating solar systems (Hollingsworth 2010).

All of the islands studied had a good-to-excellent solar resource for photovoltaics with GHI exceeding 5.5 $kWh/m^2/day$. This is comparable to the GHI resource found in the southwestern United States. The GHI in the Bahamas was somewhat less, but the high electricity costs in these islands means that solar PV systems likely still are economical. The solar data indicates that flat-panel solar photovoltaic and solar hot water systems should perform well in the region. For most islands, the leeward side of the island had a poorer solar resource that the windward side.

Solar Water Heaters installed on Flamboyant Hotel, Grenada

Solar Water Heating

Solar water heating has significant untapped market potential throughout the region. Although SWH is most successful in Barbados, it also is common in Dominica, Grenada, and St. Vincent and the Grenadines, among other places (Loy & Farrell 2005, pp. 14, 22, 59–60). Installations of SWH typically are in large residences and hotels. This might be due to these customers having a better awareness of the economic benefits, larger construction budgets, or both. A market study conducted by CREDP/GTZ in Dominica, St. Lucia, and St. Vincent revealed substantial latent demand in the hospitality sector, but this study is not available in the public domain (Loy 2007, p. 140). The energy policies of many countries discussed in this study intend to increase SWH usage, using the Barbados experience as a model. The nation of St. Vincent and the Grenadines intends to ban electric heating technologies entirely (Government of St. Vincent and the Grenadines 2010, p. 21).

Photovoltaics

The region has a smattering of PV installations, particularly in Grenada and St. Lucia. Both of these islands have active PV vendors in the marketplace, and their utilities each have instituted net-metering policies allowing up to 10 kW of self-generated power to be returned to the grid. The total PV capacity for the region as a whole is not well reported because PV is installed in some isolated self-generation systems. A few demonstration PV systems exist, including at least three government sites in St. Lucia (LUCELEC 2010, p. 3) and one installation at an isolated national park in Dominica (Loy 2007, p. 9.25). Among utilities and IPPs, only GRENLEC has discussed consideration of utility-scale solar PV (Hosten 2009, pp. 16, 20). Conversely, every nation included in this report calls for increased market penetration of PV as part of its energy policy or plan.

PV Systems installed on the building of the National Trust, Pigeon Island, St. Lucia (Source: SunnyPortal.com)

The GHI radiation available to the region exceeding 5.5 kWh/m^2/day is comparable to the GHI resource found in the southwestern United States and, given the higher prices of power in the Caribbean, deployment of PV should be economical.

Concentrating Solar Power
Nexant estimates that up to 7.5 acres of land would be required per megawatt of concentrating solar power; with a CSP plant requiring at least 15 MW to achieve reasonable economies of scale. This means that such a plant would require at least 90 acres, making land acquisition a challenge (Nexant 2010, pp. 8.33–8.34). The land issue combined with the good—but not excellent—solar resource suggests that deployment of CSP systems still has some challenges to be resolved.

Barriers to using distributed photovoltaic include the need for a clear interconnection policy. This is important in encouraging customers to add PV to their residences or buildings because most customers already are connected to the grid (Loy 2007, p. 135). An example of effectively overcoming this barrier is in Grenada, where GRENLEC introduced its interconnection policy in 2008. The utility's policy contains technical instructions for connection to the grid as well as details on net-metering rules (GRENLEC 2008).

In each country with policy intended to promote SWH, there might be fiscal or other barriers that prevent SWH adoption rates from approaching those of Barbados, the commonly accepted model for this technology. Although incentives are in place for SWH in many countries, such as the Bahamas (Wilson 2009, p. 35), for example, no energy policy has called for a corresponding tax increase on electric devices, as was done in Barbados (Loy & Farrell 2005, p. 60).

Biomass

Many of the nations in this report have seen their economies transition from being based in agriculture, through tropical crops such as sugarcane, to being dominated by tourism and services. Some remaining agriculturally dominated islands include Grenada, which continues to be a worldwide source of nutmeg and mace, and St. Lucia, which exports bananas, cocoa, and coconuts (CIA 2010). With agriculture having shaped the history of the Caribbean region, however, for many islands the use of biomass crops as energy sources could be as meaningful in regard to their history as to their future.

Former sugarcane lands near Sandy Point, St. Kitts and Nevis

Biomass sources contain energy stored through biological processes—such as photosynthesis—which can be converted to electricity or heat through incineration, gasification, or other means. Domestic heating and cooking are presumed to use a large amount of biomass in traditional roles (Posorski & Werner 2009, p. 61), and market-scale uses of biomass sources generally are divided into four categories.

- Forestry residues (wood): Wood and milling residues, waste from logging operations
- Agricultural residues: Waste cellulose from farming operations or food processing, including bagasse, nuts, shells, and husks
- Energy crops: Agricultural crops and trees grown specifically for energy production

- Waste: Municipal solid waste (MSW), source-separated organic and food waste, landfill gas, and animal waste

A survey of biomass energy studies reveals that a variety of ideas has been considered recently, but each appears to be on an individual-island basis. In 2007, a comprehensive study assessed the sugarcane-to-energy potential after the closure of the sugar manufacturing company in St. Kitts and Nevis (OAS 2007). Also in Belize, the OAS performed a detailed prefeasibility analysis of the biomass-to-cellulosic ethanol potential (OAS 2009). No other studies have been performed to quantify the traditional uses of biomass.

Wood

No logging operations or wood-sourced energy processes are found the countries in the scope of this study. Use of this type of biomass would likely be difficult given the scarcity of land and unique nature of the region.

Agricultural Residues

There could be an opportunity for biogas production from nutmeg shells in Grenada, but this has not been studied in detail (Loy & Farrell 2005, p. 23).

Energy Crops

Sugarcane biomass for electricity was found to be economically feasible on St. Kitts and Nevis under prevailing conditions, from a 2007 study by OAS (de Cuba & Rivera-Ramirez 2007). This endeavor was not continued due to competing land-use priorities. In 2008, it was halted due to the continued reduction of available sugarcane lands to secure critical feedstock mass for any biomass-to-energy scenario.

Jatropha Curcas, Belize

Jatropha curcas (Barbados nut) for electricity was studied on SVG in 2009 by GFA Envest GmbH and Caribbean Bio-Energy Technology Ltd. The study concluded that although *jatropha curcas* does not exist in sufficient quality for biogas, other feedstocks might be usable, with potential for up to 4 MW from such a plant (Government of St. Vincent and the Grenadines 2010, pp. 22, 36).

Waste-to-Energy and Landfill Gas

Covered saturated landfill, St. Kitts and Nevis

Landfill gas has been studied in the Bahamas and St. Lucia. On Grand Bahama Island, a 2008 study by the island's utility indicated that there exists up to 1 MW of potential capacity (Wilson 2009, p. 35). In St. Lucia, landfill gas has been studied at two sites, but feasibility is inconclusive (Loy & Farrell 2005; LUCELEC 2009). Furthermore, poultry litter use was studied in St. Lucia by the Global Sustainable Energy Islands Initiative (GSEII), but proved not to be economical (GSEII 2009). Banana trees, municipal waste, and other waste sources for biogas electricity production in SVG were studied in 2009 by GFA Envest GmbH and Caribbean Bio-Energy Technology Ltd. The study concluded that there is potential for generating up to 4 MW from a plant utilizing these sources (Government of St. Vincent and the Grenadines 2010, pp. 22, 36). In 2010, a waste-management report sponsored by the Caribbean Development bank was finalized with specific recommendations regarding waste management alternatives including exploring the waste-to-energy potential in Grenada.

A 16.5-MW, waste-to-energy (WTE) plant is planned for the U.S. Virgin Islands. This plant will burn municipal solid waste and other renewable fuels to generate steam and power. The groundbreaking for this plant was scheduled for 2011. As of September 2011, the construction of the WTE plant was placed on hold due to delays in processing the lease agreements (Leedy 2011).

Other ideas that require study for feasibility include an incentive program for solar dryers and biodigesters for agricultural wastes in Grenada (Burke 2009), and a crop waste to syngas pyrolysis program for St. Kitts and Nevis (GSEII 2009) among other small islands in the region dealing with saturated landfills and limited sites for new locations.

Biofuels

This report is focused on electricity production and efficiency, therefore the use of biofuels for transportation was not researched in depth; however, the relevant research revealed the following.

- *Jatropha curcas* (Barbados nut) and other feedstocks for biofuels were studied on SVG in 2009 by GFA Envest GmbH and Caribbean Bio-Energy Technology Ltd. The study concluded that biomass resources on SVG were insufficient for biofuels production (Government of St. Vincent and the Grenadines 2010, pp. 22, 36).

- Sugarcane biomass for biofuels was not found to be economically feasible on St. Kitts and Nevis, from a 2007 study by OAS (de Cuba & Rivera-Ramirez 2007). One area requiring added attention, however, is the combination of locally produced or imported biofuels for a combination of liquid fuels for transportation and gasified waste materials for electricity (Lemoine et al. 2010).
- The Bahamas is planning a study on the reuse of cooking oil, presumably as biodiesel (NEPC 2008, p. 31).

Ocean Thermal Energy Conversion

Due to the geographical location within the 23.5 degrees northern latitude (Tropic of Cancer) (*see* Figure ES-3), the unique volcanic landscape, the bathometry of the coastal waters of the Caribbean islands assessed in this report, and the present fossil-fuel price developments, ocean thermal energy conversion (OTEC) is becoming a more frequently hinted-at technology that merits serious consideration. Examples are the rejuvenated interest by multinationals, such as Lockheed Martin investing in furthering OTEC research and development efforts.

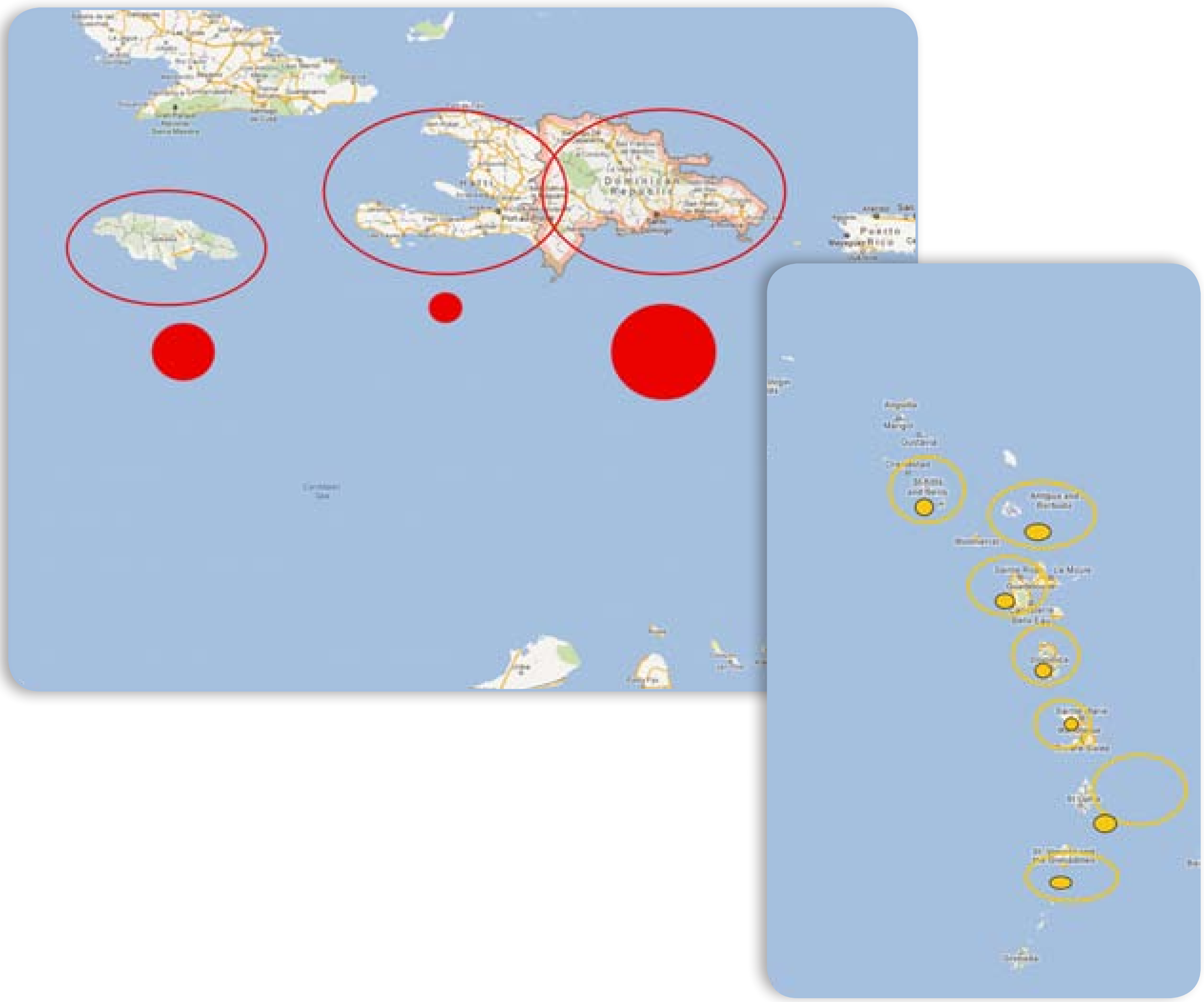
OTEC Pipeline for accessing deep cold water (source: OTE Corporation)

As of November 2011, the Bahamas announced its commitment to exploring the viability of installing an OTEC plant in its territorial waters and signed a memorandum of understanding (MoU) with a developer for the assessment of building a 20-MW to 30- MW OTEC plant.

Electrical Interconnections

Many of the nations included in this report have excellent geothermal resources and, therefore have the potential to become net energy exporters. The *World Bank Report* considers the following submarine electrical cable interconnections in detail and summarizes their economic potential.

- Nevis–St. Kitts: 50 MW, 5 km, geothermal power export—highly economical; (West Indies Power 2010)
- Nevis–Puerto Rico: 400 MW, 400 km, geothermal power export—highly economical if displacing diesel; not economical if displaced fuel is natural gas (Nexant 2010, p. 1.8)
- Nevis–U.S. Virgin Islands, 80 MVA, 320 km—only marginally economical for displacing diesel (Nexant 2010, p. 1.8)



The following interconnections have been proposed, but their feasibility has not yet been studied.

- Dominica–Guadeloupe and Martinique: 40 MW, 55 miles each; pending geothermal exploration in Dominica (Fadelle 2009, p. 27; McDonald 2009)
- St. Lucia–Martinique, 50 miles; pending geothermal exploration in St. Lucia (McFadden 2010)
- Nevis–Antigua and Barbuda, 55 miles (Huttrer 2005)

Some interconnections have been proposed but are not considered to be economically feasible. A St. Vincent–Grenadines utility study on the feasibility of interconnecting the small grids among the Grenadine islands in early 2009 found it was not cost effective (Government of St. Vincent and the Grenadines 2010, p. 28). The following regional interconnections have been studied and are considered feasible.

- Dominica–Martinique: 100 MW, 70 km—geothermal power export, marginally economical if displaced fuel is gas from the Eastern Caribbean Gas Pipeline; more economical if displaced fuel is more costly (Nexant 2010, p. 1.8)
- Dominica–Guadeloupe: 100 MW, 70 km—geothermal power export, moderately economical if displaced fuel is gas from ECGP, more economical if displaced fuel more costly (Nexant 2010, p. 1.8)
- Saba–St. Maarten: 100 MW, 60 km—geothermal power export, highly economical if displaced fuel is distillate and St. Maarten can accept 100 MW (Nexant 2010, p. 1.8)

Conclusions

The Caribbean islands possess a great potential for power generation from renewable energy sources and improvements in energy efficiency. Many of the islands in the eastern Caribbean have excellent geothermal prospects, and all boast tropical climates presenting consistent wind and solar resource availability. Although the measurable impact on carbon emissions might be small as compared to the world as a whole, these islands present opportunities to demonstrate renewable energy, energy efficiency, and low-carbon energy practices and technologies that could scale up to make a great impact on the rest of the world. Apart from the environmental benefits, another major opportunity is the reduction of dependence on imported fossil fuels for power generation and use as transport fuel. The high cost of this foreign-sourced power has been a drain on island economies for decades.

Based on the regional energy-policy assessment, there exist a number of energy policy assistance entities or initiatives such as the CARICOM Energy Program, OECS, OAS CSEP, CREDP/GIZ, and UN entities that have been critical to the development of Caribbean-wide regional policy documents and projects. Unfortunately, the current reality in the nations under the scope of this study is that very limited renewable energy technologies have been deployed, with some exceptions as the Maddens Wind Farm on the island of Nevis. In recent years, some of the region's island governments have increased their efforts, and several national energy policies or sustainable energy plans call for a re-evaluation of the current utility generation capacity mix and the current energy sector mode of operation and management.

It is important to continue the programs that provide the technical support to address the prevailing barriers toward sustainable energy development in the region. The wide range of activities covered by such programs, however, often diminishes the effectiveness of these programs due to program overlap and occasional conflict. Currently, it is difficult to assess the effectiveness of ongoing programs such as the CARICOM Energy Program, the CREDP/GIZ, and the OAS CSEP as these programs are relatively new. In the next decade, an evaluation of the impacts more likely will be possible. Meanwhile new initiatives are being launched, including the Energy and Climate Partnership of the Americas' Caribbean Initiative (ECPA Caribbean Initiative) that should serve as continuum and support, and be a complementing mechanism to existing programs.

During the past 30 years, the energy policies introduced in the seven project countries have not lead to intended changes in the energy sector. A common feature among the project countries is that—after 30 years of efforts and attempts to change the course of the energy sector towards a sustainable energy scenario—all of the islands remain greatly dependent on imported fossil fuels. For real change to occur, energy development must be considered to be a matter of national security.

Recommendations

This report makes the following recommendations to improve national and regional energy policy development. To make an impact, strategic energy plans (NEPs and SEPs) must be published and made available publically.

Of course, having a plan is not enough. Governments should develop the supporting capacities and regulations required to ensure implementation. On many islands, there is a lack of direct government oversight of utility operation. There often is little regulation and minimal legislation to bind utilities to a certain standard of operation. Furthermore, there also often are few binding industry codes (e.g., building codes, efficiency codes, interconnection standards) to govern growth. Without addressing such potential deficiencies, any other national and regional energy policy will be stalled, and progress will be slow.

Caribbean islands have the potential to lead the world to a new energy future, but this will not happen without consistent, thoughtful policies and plans. For each nation, a statement of energy policy complemented with a plan of action and, in some cases, targeted renewable energy development laws (e.g., geothermal development bills), have become key instruments for making progress toward fulfilling a country's energy potential.

Caribbean nations that do not have both an updated national energy policy and energy action plan should consider formalizing energy policies by drafting these documents. Organizations such as CREDP/GTZ and OAS/CSEP should be leveraged for the development of these plans, as these organizations have expertise in policy development and considerable experience in the Caribbean. Additionally, the support organizations should strive to better communicate and coordinate with each other regional organizations to facilitate a clear understanding of energy policy concepts as applied to the Caribbean.

Nations that are developing or revising energy policy can look to specific attributes of other NEPs and EAPs used in the Caribbean region as examples. Some important attributes are listed below.

- Governments and stakeholders should identify sources of funding and expertise in their EAP. The draft NEP of the Bahamas and adopted EAP for SVG both identify sources of international expertise and funding for proposed projects (NEPC 2008, pp. 14–26, 28; Government of St. Vincent and the Grenadines 2010, pp. 26, 29).
- Governments and stakeholders should prioritize between the near-term and long-term actions defined in an EAP. Some plans drafted in the early 2000s, such as the SEPs created by St. Lucia and Grenada, specified actions but did not set priorities among them. More current plans, such as the EAP for SVG, delineate short- , medium- , and long-term actions. Early wins are important in developing credibility and maintaining support for any multiyear plan.
- Experts should create a baseline and forecast or back cast possible energy scenarios. If critical data is available, then scenario forecasting provides a useful means to understand the possible impact of various actions, policy decisions, and outcomes. It is especially important to formulate a business-as-usual scenario to provide a baseline. By developing a baseline, stakeholders are able to test and

assess the trade-offs of proposed policies, plans, and actions. The EAP for SVG—prepared with the assistance of CREDP/GTZ and OAS/CSEP—forecasts possible energy scenarios in the nation up to 2030 (Government of St. Vincent and the Grenadines 2010, pp. 26, 29).

- Government policy should allow for new technology and markets. The possibility of widespread solar water heater adoption or advances in ocean power technology, among other possible developments, could present governments with unforeseen energy issues, for better or worse. As an example, the Geothermal Resources Development Ordinance in Nevis prepared with the assistance of OAS/GSEII acts as a general NEP for that island. Although it was drafted to address geothermal development, the law was subsequently found to be useful as the nation's general energy policy (Wilson 2009, pp. 100–101).

This report makes the following recommendations to improve efficiency in electricity supply:

- Governments can enact environmental regulations to address fuel waste. Governments concerned with waste of fuel should enact environmental regulations to compel managerial accountability and best practices for utilities and other companies involved in fuel transportation, storage, and generation. This is a particular concern for the Bahamas, their NEP draft reports that spills and leaks in storage equipment contribute to excessive losses of fuel (NEPC 2008, p. 9).
- Utilities should report their fuel efficiency (heat rates) and work together to improve efficiency of existing generation. Utilities should consider investing in more efficient generators and heat recovery steam generators. Updating old generators or adding HRSGs can improve the efficiency of these systems by 10% to 20%. Modern generators also are better able to match the variable demand caused by intermittent sources of renewable energy, such as wind and solar. In Jamaica, for example, more than 50% of the Jamaica Public Service Company Limited (JPS) capacity is more than 30 years old, and the average thermal efficiency of the JPS plants is 28%. Most of these plants are oil fired and combustion plants. To benefit from increased fuel and process efficiency, the JPS currently is procuring new capacity that includes wind turbines and approximately 200 MW of combined-cycle natural gas plants.
- Governments and utilities can work toward better end-use metering. Improved metering helps minimize technical and non-technical losses. Some island nations, such as Palau, have found that prepaid metering systems reduce customer default and encourage energy conservation by allowing the user to see energy use in real time. In 2006, for example, the Trinidad and Tobago Electricity Commission (T&TEC) developed a plan to install more than 40,000 automated meters across its customer base. These meters allow for advanced functionality, such as outage notification, hourly meter reads, and load-profile data, improving distribution efficiency as well as metering-billing efficiency. By 2008, sixteen-thousand meters had been installed.
- Water conservation should be considered. It takes energy to move and treat water. On islands where desalinization is required, large quantities of energy are spent generating drinking water. Water conservation and rainwater collection are two tactics that can help island nations reduce energy use. Residential water provision through rain water harvesting is particularly popular in the US Virgin Islands (USVI) where since the 1930s there has been a mandatory law in the building code requiring private residence and businesses to construct cisterns for the capture and storage of rainwater from rooftops for domestic water supply. Cistern building is now a standard component of residential construction, so much so that currently only about 20% of residential electricity customers also have a water connection. This amounts to long term cost savings for residents and also reduces the demand on the utility's desalination plants, reducing energy use. Other islands such

as Bermuda, Turks and Caicos and the Bahamas also place heavy importance on the benefits of rain water harvesting

This report makes the following recommendations to improve energy efficiency in buildings:

- Governments and professional organizations should publicize current building standards, even if the standards currently are not enforced.
- A base energy code—such as the IECC 2009-Tropical—should be adopted and promoted.
- Outreach programs or professional organizations should improve training and education on current building efficiency best practices and guidelines. Notwithstanding the Regional Building Standards efforts underway, those who currently design, construct, and remodel buildings should be aware of current codes, best practices, and guidelines for their locality.
- The CROSQ should ensure that the Regional Building Standards address energy efficiency in buildings and appliances. Resources and experts in building efficiency—such as those developing energy codes at the DOE, and the Engineering Tools & Screenings group at NREL—can engage with CROSQ and the national subcommittees to facilitate the progress of the Caribbean RBS efforts currently underway. The standards should include energy codes such as the Tropical Code, as well as processes to ensure adoption and enforcement by each island nation.
- Experts should analyze the market benefits and costs of implementing standardization. Such a study would seek to understand whether past efforts at standardization failed due to policy issues or economic issues (such as the small market size of Caribbean nations). The study also could make recommendations on which aspects of RBS to prioritize, and how to ensure local adoption and enforcement.

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1 Introduction

Table 1. Summary of Countries in this Report

- Antigua and Barbuda (A&B)
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- Dominica (DOM)
- Grenada (GRE)
- St. Kitts and Nevis (SKN)
- St. Lucia (SLU)
- St. Vincent and the Grenadines (SVG)

Item	Value
Land Area	16,500 km²
Population	892,500
Energy Capacity	927 MW
Diesel	758 MW
Hydro	12 MW
Wind	2 MW
Geothermal	None
Solar	174 kW
Biomass/other	None
Price	U.S. $0.33 per kilowatt-hour
Minimum	U.S. $0.21 per kilowatt-hour (SKN)
Maximum	U.S. $0.46 per kilowatt-hour (DOM)

Sources: CIA 2010; various for supply and price.
Note that price is a simple average of 2008 prices, as available.

The Low-Carbon Communities in the Caribbean (LCCC) initiative is jointly implemented by the Organization of American States' (OAS) Department of Sustainable Development (DSD) and the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL) under the Energy and Climate Partnership of the Americas (ECPA). The goal of this effort is to enable project countries to implement actions and strategies geared toward increasing the sustainability of their energy supplies and reducing their carbon emissions through the development and use of renewable energy (RE) and energy efficiency (EE) technologies.

This report, *Energy Policy and Sector Analysis in the Caribbean (2010–2011)*, provides a baseline of the current conditions in the respective energy sectors by highlighting the evolution of energy policy development and current status, the conditions and performance of the energy sector, and the renewable energy and energy efficiency opportunities in seven assessed Caribbean islands. The island nations included are Antigua and Barbuda, the Bahamas, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

By documenting each island's energy policies, projects, and plans, this report seeks to facilitate discussion and coordinated planning for and between the seven nations. Furthermore this report summarizes the energy outlook for the region, including possible island interconnections. Finally, the report aggregates recommendations on renewable energy and energy efficiency opportunities.

1.1 Motivation

Small island developing states (SIDS) in the Caribbean face unique challenges associated with the generation and use of energy. Most Caribbean island nations depend almost exclusively on imported petroleum for their electrical generation and transportation needs. This significant level of dependence leaves these countries vulnerable to the volatility of international oil prices and results in a tremendous drain on capital for imports. Likewise, Caribbean islands are particularly vulnerable to the environmental impacts associated with fossil-fuel consumption, such as the rising sea level, coral bleaching, and the increased strength and frequency of hurricanes.

Although each country has a unique set of economic and energy sector conditions, they all share several common characteristics that are critical to understand in this analysis. These include the following.

- Small population size (population size range 45,000 to 330,000)
- Low to moderate income levels
- Single monopoly electric utilities (whether state or private)
- Small overall electricity generation capacity (installed capacity range 22 MW to 140 MW)
- Isolated grids
- Petroleum dominates as fuel for power generation (only Dominica, St. Kitts and Nevis, and St. Vincent and the Grenadines have small-scale grid-installed renewables and small hydro)
- High average electricity costs (U.S. $0.21 to U.S. $0.46 per kilowatt-hour)

Despite its dependence on imported fossil fuels, the region demonstrates great potential for the use of sustainable energy alternatives. Most Caribbean islands have significant RE resources——including solar, wind, geothermal, hydro, maritime, waste-to-energy, and biomass—that can be used on a cost competitive basis for power, heating and cooling, and transportation applications. Further, there exist tremendous opportunities to reduce energy consumption through energy efficiency measures.

Renewables and energy efficiency are not common in the region due to several barriers, all of which largely are unrelated to the available resources or technical potential. These barriers include the following.

- **Policy**: Current policies and regulations favor traditional resources—fossil fuels and diesel generation systems
- **Institutional**: There is typically a lack of in-country institutional knowledge associated with aspects of clean energy project design, development, implementation, and operation. The entities of the existing utility structure in the project countries—composed of single utilities and electric monopolies— are often resistant to independent power producers and generally are resistant to transitioning away from conventional fossil fuel–powered generation.
- **Management and Capacity:** There exists a lack of capacity among energy sector stakeholders (government, utility, and key consumers) to adequately manage the energy sector and to participate in a transition to new energy systems.
- **Finance:** Affordable financing for clean energy projects is difficult to acquire. It is particularly challenging to find funding for project preparation (pre-feasibility and feasibility) preparing “bankable” documents.
- **Awareness:** The lack of understanding of the costs, benefits, and applications of renewable energy and energy efficiency technologies is another substantial barrier.

High energy costs, isolated grids, and abundant renewable energy resources make island nations uniquely situated to demonstrate the benefits of deploying energy efficiency and renewable energy at scale. Islands have the potential to take the lead and to show the rest of the world how to transform our shared energy future.

Island nations are ideal for energy analysis both economically—as they often form small discrete markets—and technologically, because they consist of isolated electrical-grid systems. Significant energy costs and the reliance on uncertain sources of foreign fuel are two factors that generally drive islands' desire to deploy EE and RE quickly. For this reason, islands should have aggressive sustainability goals. Plus, their relatively small size should aid islands in achieving these ambitious goals more quickly and at a cost less than that of similar goals in larger nations. These factors provide a unique opportunity for islands to demonstrate a transformed energy economy and to showcase how to identify and eliminate the technical, financial, and policy barriers to high penetration of EE and RE technologies.

A transformation of island's energy use is critical to the economic future of the Caribbean nations. Reliance on foreign sources of energy diverts critical funds off-island, and continues to be a major contributing factor in the depression of island economies. The volatile price of electricity discourages foreign investment and the formation of new businesses. Over time, climate change and other human impacts on ecology could dramatically affect small islands, as hurricanes intensify in strength and frequency, acidic oceans bleach coral reefs, and sea levels rise (Roper 2007).

On a more positive note, many islands possess abundant renewable energy resources. The consistent solar regime and tropical northeast trade winds represent abundant, largely untapped sources of energy. Many of the volcanic islands in the eastern Caribbean also have excellent geothermal prospects, and all of the Caribbean islands have the potential to develop solar, wind, biomass, and waste-to-energy as renewable energy resources.

Energy efficiency is another promising area that should be pursued in the Caribbean. Energy-efficient homes could take advantage of moderate climate, well-placed shading, and prevailing winds to reduce air-conditioning loads. More efficient vehicles can reduce dependence on foreign oil, and there is the opportunity to use plug-in vehicles on islands where other large, untapped renewable resources (such as geothermal sources) are available and "range anxiety" (the fear that a vehicle has insufficient range to reach its destination and thus would strand the vehicle's occupants) is not a concern.

1.2 Methodology

Several programs and initiatives have assisted Caribbean states in addressing sustainable energy development challenges. More recent initiatives include the Caribbean Community (CARICOM) Energy Program, the Caribbean Renewable Energy Development Program, and the Caribbean Sustainable Energy Programme (CSEP)—all of which have been involved in supporting the creation of national energy policies and action plans in the countries falling within the scope of this report.

There have been some successes in the preparation of these instruments, and in the general thrust towards the effective development, implementation, and management of renewable energy solutions. There are significant challenges, however, which have served to hinder the sustainability of past and current energy policy initiatives. Thus, the LCCC team has sought to conduct an energy policy analysis with a view to understanding and addressing the policy and technical challenges that the region faces.

1.3 Energy Policy Analysis

The approach of the policy analysis is key to discerning how best to support these countries as they seek to strengthen their policy framework. As CSEP is a key partner to the LCCC Project, particular attention is placed in the contribution CSEP has brought to the regional policy development arena.

The analysis will seek to answer or address the key issues or questions including:

- The degree to which past and present energy policies have rendered any positive results;
- The value, benefit and results of past and ongoing initiatives;
- The added value CSEP has brought to the fore; and
- Factors hindering effective implementation.

The latter is a key focus of this study to identify prevailing barriers to the increased deployment of RE and EE technologies to guarantee a low-carbon economic development. Thus, the methodology employed in addressing these questions/issues is as follows.

1.3.1 Assessment of National Governance Frameworks

Extensive analysis of the governance frameworks for energy management in the Eastern Caribbean States and the Bahamas has been performed by CARICOM, OECS, Caribbean Renewable Energy Development Programme (CREDP)/GIZ (Gesellschaft für Internationale Zusammenarbeit), Caribbean Association of Electric Utilities (CARILEC), United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC), United Nations Development Programme (UNDP), the Scientific Research Council (SRC)/Caribbean Energy Information System (CEIS), and others. As noted, CREDP, CREDP/GIZ, and CARILEC conducted a "Baseline Study of Energy Policies and Legislation in Selected Caribbean Countries," and a study of "The Status of Energy Policy in selected Caribbean Countries." The UNDP/SRC/CEIS group prepared an "Impact Assessment Survey of Recent Energy Interventions on the Security and Sustainability of the Caribbean Energy Sector." It would not be helpful for the present study simply to repeat the assessment for the countries examined without including more. Instead, this aspect of the study provides a review of the findings of the prior country assessment/analysis conducted, conducts an assessment/analysis for OECS countries that were not covered by the abovementioned studies, analyzes the recently developed or adopted national energy policies and action plans (where applicable), identifies lessons learned, and provides recommendations for the way forward.

1.3.2 Backcasting

To have a complete understanding of the current state of energy laws and policies in the respective island nations within the scope of this study and in the wider Caribbean—particularly in OECS countries and the Bahamas—it is important to trace their development and map their evolution. This is key to identifying what events or drivers, whether on the national, regional, or international levels, were instrumental in triggering or guiding the development of national renewable energy policies. By adopting this approach, the question then arises as to how far back in time such an assessment should go. Through the examination of key events in history at the national or international levels as they concern fossil fuels, environmental management, and economic challenges, an appropriate timeframe of 40 years was established—taking into account that all the island nations under review in this study are former British colonies and have become independent only since the 1970s or later.

The backcasting method should prove useful in ascertaining the events that triggered or influenced renewable energy policy development in the region and highlight the differentiated policy development per beneficiary country. The implementation of the backcasting method in this analysis includes the identification of long-term sustainability criteria and an assessment of the present conditions and performance of the project countries' energy sectors as they concern these criteria against statistical data from the energy sector. The approach will assist in clearly identifying the potential impacts of the policies adopted and implemented by the governments in the countries include in the present study.

This analysis was supported by information gleaned through an extensive literature review, including relevant laws and policies, and by other data gathered by CARICOM, OECS, CARILEC, CSEP, CREDP/GIZ; surveys/questionnaires; and consultations with national, regional, and international partners and stakeholders where necessary. Where there significant gaps were found in the data, in-country meetings were conducted. The analysis concludes with a set of recommendations/best practices for the development of a sustainable renewable energy governance/management framework in the respective countries.

2 Regional Energy Policy Development

The impetus to develop energy policy in this region often has been a global energy crisis. The first of these were the oil crises of 1973 and 1979. The 1973 oil crisis was precipitated by the imposition of an oil embargo by the Organization of Arab Petroleum Exporting Countries (OAPEC) which disrupted the supply of oil and drove up the prices. Many countries heavily dependent on fossil fuels plunged into a recession and faced high inflation. Again in 1979 political challenges disrupted the supply of oil increased its prices.

There is not much literature available in the public domain discussing the impact of the crisis on Caribbean economies, which were, at the time quite fragile. At the time of the oil crises, countries of the region were either newly independent or on the verge of independence from their colonizers. Attempts at a West Indian Federation failed only 10 years prior. Thus, countries of the region—although filled with hope for the prospects of the future—felt vulnerable, politically, economically, and socially. In Dominica, the 1979 oil crisis contributed to an increase in 1980 of the consumer price index by 30.5% over the previous year (Library of Congress 1987) (natural events, such as Hurricane David, also contributed). According the Library of Congress *Country Study of the Caribbean*, "the international economic recession caused a reduction in investment, especially after the 1973 and 1979 oil price shocks. Bahamian independence in 1973 also caused a certain amount of uncertainty, contributing further to reduced foreign investment" (Library of Congress 1987). These events led to the creation of the Regional Energy Action Plan in 1983 (discussed in more detail below), which was designed to help countries address their energy challenges and post-oil crises.

The second and more recent oil crisis took place in 2008, and impacted Caribbean countries significantly. Some governments tried to dull the impact of increased power costs through subsidies. Also during this time, dialogue on energy security and independence through the exploitation of indigenous and renewable resources gained traction. Countries began to review energy policies and plans, resulting in differentiated levels of completion, adoption, and implementation, and energy-sector reform is currently a priority. This oil crisis could be considered one of the principle triggers of the many energy crises faced by the Caribbean countries analyzed in this report. Figure 1 shows the periods when oil prices have been extremely high. Particular attention should be focused on the years 1973, 1979, and 2008, when prices were more than $100 per barrel, making electricity production and transportation in the Caribbean countries unsustainable, and burdening the national economies.

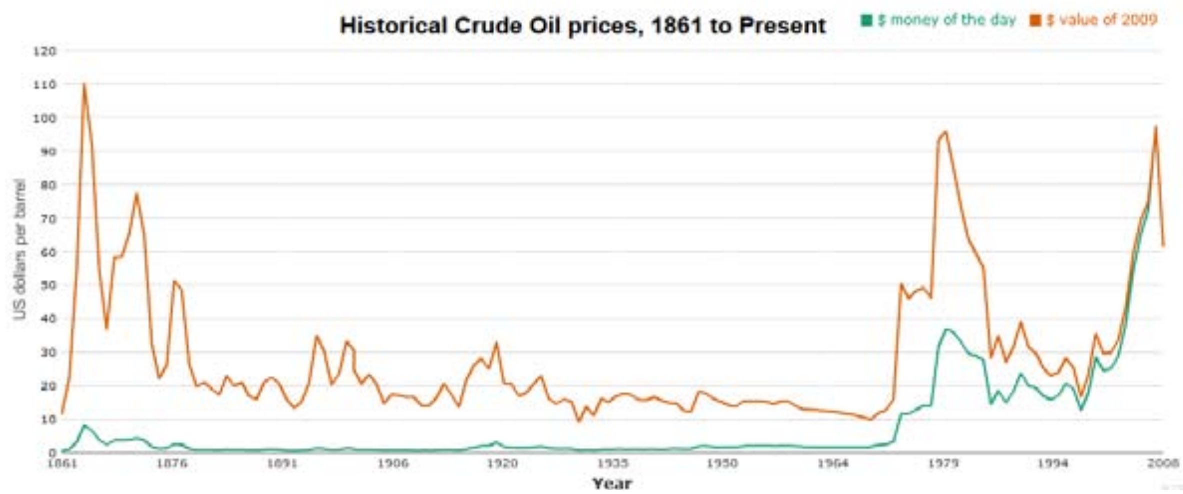

Figure 1. Global historical average price of oil (Source: BP Statistical Review 2010)

This policy study examines key regional initiatives, including the role of regional and international agencies as they concern the energy sector, and traces their development. Next assessed are the national energy governance frameworks of the seven countries included in this study. The assessment not only identifies the frameworks but also speaks to challenges, gaps and weaknesses, and key lessons learned. The role of CSEP in supporting effective governance in national and regional energy frameworks also is assessed, including an examination of the added value CSEP provides. An inventory of the legal, policy, and regulatory framework in the respective project countries also is included.

2.1 Regional Initiatives

2.1.1 Regional Energy Action Plan (1983, CARICOM)

In response to the oil crisis of the 1970s, the Caribbean Community designed the Regional Energy Action Plan (REAP). Prior to the design of the plan, activities were underway in the region to help guide countries through the bleak days of the oil crisis. The newly formed Caribbean Development Bank (CDB), for example, took on the task of providing technical assistance to countries across the region to adopt efficiency measures and consume less energy (Singh 2009). Through the activities of the CDB including the activities of the Caribbean Alternative Energy Systems Project (CAESP) with USAID[1] (Singh 2009) and the CARICOM, a framework for technical cooperation and capacity building on renewable/alternative energy and energy conservation was established.

The framework, along with initiatives that were being developed and implemented on a national level in countries across the region presented a starting point for the development of a more comprehensive, overarching, collective approach or strategy to address energy issues in the Caribbean. Subsequently, the REAP was conceived by CARICOM heads of government in 1982. The leaders envisioned REAP as an

> *[O]pportunity to promote security of intra-regional supplies and markets of petroleum products and seek to develop alternative sources of energy within the Region; and give support to the strengthening of regional institutions so as to enable them to give increased support to Member States in their efforts to undertake effective energy planning, conservation and development of alternative energy sources. [The objective*

[1] Agreement entered into on August 29, 1979.

was to] . . . alleviate within the shortest possible time, the adverse impact of the energy crisis on Caribbean economies, while laying the basis for a more coordinated and rational development of the energy resources of the region (ECLAC 2011).

The REAP, however, had limited success due to major challenges in resource mobilization to support its implementation. The REAP was envisioned as a more programmatic approach, although, at that time, "energy considerations were incorporated into project lending in other sectors and the design of agricultural projects, included considerations such as energy self sufficiency through the use of biogas or biomass resources" (Syngellakis 2011).

2.1.2 San Jose Accord (1980)

Due to a second international oil crisis in 1979, Mexico and Venezuela, through the San Jose Accord, agreed to supply on concessionary terms 160,000 barrels per day (bpd) of crude oil to 11 non-oil-producing and net importing Central American and Caribbean countries at a discounted price. Among the provisions of the Accord is that payments would be deferred on 20% of the cost of the oil at a low interest rate, and the savings be applied for socio-economic development projects. The Agreement was renewed by the supplying countries more than 20 times, when tense political relations between Mexico and Venezuela (Nevaer 2007) led to the birth of the PetroCaribe Agreement between the beneficiaries and Venezuela, with Venezuela as the sole oil supplier (PetroCaribe Energy Cooperation Agreement 2005).

2.1.3 PetroCaribe (2005)

In 2005, 13 countries from Central America and the Caribbean, including members of the OECS[2] and the Bahamas, signed on to the PetroCaribe Energy Cooperation Agreement with the Government of Venezuela. According to the Agreement, Petrocaribe is the executing agency for "energy policies and plans, aimed at the integration of the Caribbean peoples, through the sovereign use of the energy natural resources for the direct benefit of their people. In that sense, PetroCaribe will be in charge of coordinating and managing all aspects related to the energy relations at the signatory countries, in accordance with this Agreement" (PetroCaribe Energy Cooperation Agreement 2005).

One of the key cornerstones of the Agreement is supporting member or beneficiary countries in developing social and economic programs, therefore the Agreement established the Alba-Caribe Fund to finance such initiatives. Also, as per the Agreement, Venezuela agrees to transport the supplies through PDV Caribe directly to the beneficiary at no additional cost. The rationale for this approach is that, by eliminating intermediaries and forgoing such costs, the savings gained will be channeled to the development programs in the beneficiary countries. Moreover, PDV Caribe under Section III(5) "will also have the responsibility of organizing a logistic network of ships, storage spaces and terminals, including, wherever possible, refining and fuel and by-products distribution capabilities, giving priority to countries in most need" (PetroCaribe Energy Cooperation Agreement 2005).

Most importantly, the Agreement specifies the concessionary terms upon which the oil will be supplied. Thus, it outlines the barrel price and the percentage to be financed, and provides that, when the barrel price is less than U.S. $40 there is a deferred payment period of 17 years; and when it exceeds U.S. $40 per barrel the payment period is extended to 25 years at 1% interest. The Agreement provides that beneficiaries may make partial payments in goods and services at preferential prices. Products to which preferential prices apply include sugar and bananas.

[2] Except St. Lucia, which signed in 2006.

Finally, with a view to supporting energy efficiency in the beneficiary countries, PetroCaribe proposes to "negotiate credits and exchange technologies so that the benefited countries could develop programs and highly efficient systems in terms of energy consumption, as well as other means that would allow them to reduce their oil consumption and extend the offering of the service" (Singh 2009).

Whether and to what extent PetroCaribe has been successful or beneficial depends on who is asked. Beneficiary countries have come to rely on the preferential arrangements provided by the Agreement and sing its praises. In addition to the stability and reliability the supply brings to beneficiary countries, PetroCaribe has provided assistance in developing tangible, useful infrastructure locally. For example, in 2010 St. Kitts and Nevis was the beneficiary of a 6,000-tonne storage tank under the initiative. An additional six tanks are scheduled to be built in the coming years. According to the Permanent Secretary in the Ministry of Energy,

> *An increase in the storage capacity is necessary, given the disruptions to trade in supplies, especially during the hurricane season when rough seas prevent shipping of gas oil to the various countries . . . this fuel tank which is being provided to the ministry of energy is an integral part of the framework of the PetroCaribe agreement. This is designed to provide a platform for the development of energy policies that would directly benefit the people of St. Kitts and Nevis.*[3]

Also in 2010, Prime Minister Baldwin Spencer of Antigua and Barbuda spoke to a local audience and touted the benefits and savings from PetroCaribe —amounting to U.S. $200 million dollars over a 5-year period. Among the benefits have been improvements of various local infrastructures, creation of a senior utility-subsidy program, allocation of funds for hurricane relief, and the transportation of cooking gas to Barbuda.[4]

PetroCaribe, however, also has been regarded as an initiative that encourages energy dependence and, given that it is a subsidy, does not in fact encourage energy efficiency. It has also been viewed as a tool to exercise political influence in beneficiary countries. The respite from general market volatility offered by the initiative might become upset by social, economic, and political challenges in Venezuela. Given that any oil supplied under the Agreement is subject to CARICOM's Common External Tariff, and considering the deferred payment scheme, countries could incur significant debts over time.

Potentially more challenging is the impact of the initiative on regional integration and cooperation efforts among CARICOM member states. It has been argued that the initiative only serves to undermine trade and economic cooperation among CARICOM. Former Prime Minister of Trinidad and Tobago, Patrick Manning, warned that private oil firms would not be able to compete with PetroCaribe, thereby forcing them out and leaving only a single supplier.[5] Manning warned that Trinidad and Tobago would cease supplying oil to its CARICOM neighbors if the PetroCaribe arrangement remained unchanged, and that Trinidad and Tobago might not be willing to offer guarantees to those countries seeking to

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[3] "St. Kitts Benefits from PetroCaribe Deal." Jamaica Gleaner. October 6, 2010. http://jamaica-gleaner.com/gleaner/20101006/business/business91.html. Accessed August 7, 2011.
[4] http://www.youtube.com/watch?v=Knc30eIWybw. Accessed August 7, 2011.
[5] http://www.bbc.co.uk/caribbean/news/story/2006/01/060111_petromanning.shtml. Accessed August 7, 2011.

purchase oil if PetroCaribe fails.[6] Despite the benefits of PetroCaribe, power generation and transport fuel costs in the reviewed island nations remain among the most expensive on the planet.

2.1.4 Caribbean Community Renewable Energy Development Programme (1998)

The CARICOM Renewable Energy Development Programme (CREDP) was conceived with the support of 16 Caribbean countries, UNDP-GEF, CARICOM, Gesselschaft fur Technische Zusammenarbeit ("German Technical Cooperation," GTZ, now GIZ), and the OAS through its Global Sustainable Energy Island Initiative (OAS/GSEII). The seven island nations covered in this report are among the member nations.

The objective of CREDP is to:

- Reduce greenhouse gas emissions by removing barriers to the development of renewable energy, thereby fostering RE development and commercialization;
- Develop and implement programs and activities that create sustainable renewable energy industry; and
- Create a framework in which national and regional activities and initiatives on renewable energy development are mutually supportive.

Among the intended initiatives of the project were:

- An analysis of the barriers to renewable energy development and commercialization;
- The design of a finance mechanism for renewable energy projects by creating the Caribbean Renewable Energy Facility (CREF) to "provide long-term debt for projects that are financed on-balance sheet (i.e. corporate finance), as well as off-balance sheet (i.e. limited recourse project finance)"[7];
- The establishing of a commercial loan guarantee mechanism;
- The design of a Caribbean Technical Assistance Facility (CRETAF); and
- The development of renewable energy investment projects.

CREDP has made significant progress since it was established, including:

- Reviewing existing legislative policy and pricing structures;
- Coordinating the CARICOM Task Force on Regional Energy Policy and contributing to the draft and dissemination of the policy;
- Providing technical assistance to the OECS Secretariat for the development of a sub-regional policy framework;
- Providing a template power purchase agreement and other transactional documents;
- Providing grant funds through CREDP/GTZ to assist individual projects in resource assessments and feasibility studies; and
- Providing capacity building and training programs for individuals, government officials, utility companies, and other entities.

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[6] Ibid.

[7] "Caribbean Renewable Energy Development Programme, United Nations Development Programme—Global Environment Facility, Project Document," 2. http://www.caricom.org/jsp/projects/CREDP_Project_Document.pdf. Accessed February 6, 2012.

Further, CREDP has supported some participating countries in the drafting of a national energy policy (e.g., Dominica), assisted St. Vincent and the Grenadines in the draft of an energy policy statement, and conducted an analysis on the policy options for several countries.

Regarding this exercise in particular, the extensive “Baseline Study of Energy Policies and Legislation in Selected Caribbean Countries,” undertaken by CREDP, and the joint study of CREDP/GIZ and CARILEC, *The Status of Energy Policy in Selected Caribbean Countries*, have proven instrumental in developing a greater understanding of the legal and regulatory framework governing energy sectors in select countries, energy sources and the electricity sector, the financial structures governing energy or renewable energy management and development, and barriers to development and implementation.

CREDP, however, has experienced some significant setbacks regarding the development and implementation of a sustainable financing mechanism. Activities for the development of the CREF and CRETAF were halted in 2006. No budget was provided for the design of the loan guarantee mechanism, and the proposed alternative USAID Development Credit Authority proved unfeasible (CARICOM 2008). Lastly, it would have been useful if the studies conducted by CREDP and CREDP/GIZ covered all the project’s beneficiaries to provide a more comprehensive picture of the circumstances surrounding renewable energy development in the Caribbean.

2.1.5 Organization of American States Global Sustainable Energy Islands Initiative (2002, Ongoing)

The Global Sustainable Energy Islands Initiative (GSEII) was launched at the Sixth Meeting of the Conference of the Parties (COP6) to the United Nations Framework Convention on Climate Change in November 2000, for the purpose of supporting SIDS in the transition to sustainable energy. The goals of the initiative include: reducing dependence on fossil fuels and eliminating related trade deficits, securing energy independence, reducing greenhouse gas emissions, and encouraging private investment and trade. Dominica, Grenada, St. Kitts and Nevis, and St. Lucia are among the project countries, and the Organization of American States counts as one of its global partners and principle executing agency within the Caribbean region.

The strategy of the GSEII involves assisting project countries in the development of sustainable energy plans and other policies, capacity building, and project identification and development. In 2003, the OAS/GSEII prepared the “Draft Sustainable Energy Plans for Dominica, Grenada, and St. Lucia,” and in 2006 developed a plan for St. Kitts and Nevis. Other accomplishments included a study of line losses in the Dominica Electricity Services Limited (DOMLEC) energy distribution system (Dominica); solar water heater promotion (St. Kitts and Nevis); energy audits; and a training project for the hotel industry (St. Lucia).

Over the past decade, GSEII has evolved into an ad-hoc mechanism allowing the several consortium partners—including the Climate Institute, AOSIS, ESG, and UNIDO—to build upon past efforts and activities in the Caribbean, and increasingly voicing and contributing to the international awareness of SIDS to influence global climate change mitigation. Despite the past accomplishments of GSEII, the actual adoption of the policy instruments noted here did not materialize under the program. Nevertheless, GSEII was instrumental in laying the foundation for the creation and design of the Caribbean Sustainable Energy Program. Later initiatives supported the redrafting and amendment of those same instruments produced under GSEII.

2.1.6 Caribbean Sustainable Energy Program (2008, Ongoing)

In 2008, the OAS officially launched the European Commission–funded project, "Increasing the Sustainability of the Energy Sector in the Caribbean through Improved Governance and Management." The working title for the project is the Caribbean Sustainable Energy Program. The program is being executed by the OAS, and draws on the support of CSEP partners, including the Caribbean Energy Utility Services Corporation, the Caribbean Community Secretariat, the Caribbean Renewable Energy Development Programme (including collaboration with GIZ), and the Renewable Energy and Energy Efficiency Partnership (REEEP). The CSEP is designed to accelerate the transition toward cleaner, more sustainable energy use in the same seven countries reviewed in this study. This is to be accomplished through a comprehensive approach to mitigate the governance and management obstacles (including addressing the need for national energy policies and action plans) that currently impede the development and use of sustainable energy in the region. The role of the CSEP in energy policy development—and whether and to what extent it has added any value to sustainable energy development in the OECS and the Bahamas—is discussed below.

2.1.7 Other Initiatives

There are multiple short-term initiatives and projects being implemented by multiple regional and extra-regional entities in the Caribbean, of which some are described in Appendix A. Among these, the Low Carbon Communities in the Caribbean initiative differs in that it has a narrowed scope focused on providing technical assistance to selected nations with the goal of supporting the deployment of renewable and energy efficiency projects. The LCCC phase one project is being implemented with financial support from the U.S. DOE and EUEI (donor entities), NREL (technical assistance entity), and matched with the OAS (regional multilateral organization) to provide targeted assistance in line with existing (draft) national energy policy and action plan priorities and targets of the respective project countries.

The recently launched Energy and Climate Partnership of the Americas' Caribbean Initiative (2010, ongoing) is designed to assist this process of improving regional integration among nations, and among donor agencies, technical assistance entities, and other relevant entities. It also is intended to facilitate the matchmaking between donors, specialized technical entities, multilateral organizations, regional governments, and the private sector once bankable projects are identified.

2.2 Evolution of Petroleum Consumption

The global oil crisis significantly impacts domestic oil consumption in the Caribbean. This makes it difficult to determine whether the efforts outlined above have had demonstrable impact. In general, the oil consumption in the region has increased, as illustrated by Figure 2 and Figure 3. In an attempt to confirm the correlation between oil consumption and international oil price, the price per country was calculated. The correlation was calculated with a 3-year moving average with the aim of identifying volatility of prices versus consumption rate.

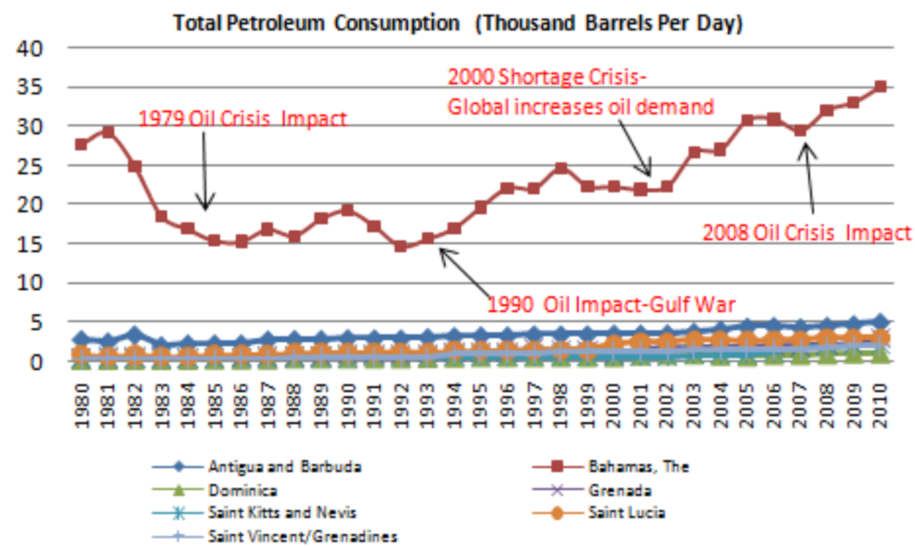

Figure 2. Total petroleum consumption, including the Bahamas

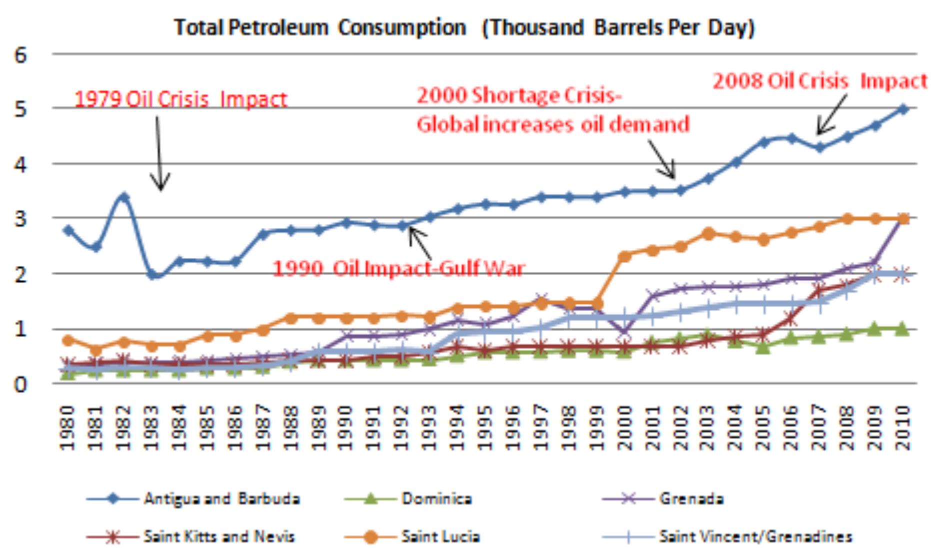

Figure 3. Total petroleum consumption, excluding the Bahamas

The results confirm the extremely high dependence of domestic oil consumption rates in the seven assessed Caribbean islands to the global oil prices, and showcase how susceptible the Caribbean economies are to price rise and volatility. More detailed analyses supporting this statement are provided in the respective country energy sector analyses discussed in the following sections. These results also highlight the urgency of addressing energy fuel import dependency or placing energy security high on the national development agenda, and taking action in the short term due to costing and possible fuel supply shortages and disruption, including peak oil shortage in the coming years.

3 Assessment of Energy Sectors

The following sections assess the national energy policy and sector conditions of the seven selected nations. The aim is to identify what events or drivers were instrumental—whether on the national, regional, or international levels—in triggering or guiding the development of national renewable energy policies.

The governance frameworks for energy management in the seven project countries have been thoroughly analyzed by CARICOM, OECS, CREDP/GIZ, CARILEC, ECLAC, UNDP, the Scientific Research Council (SRC)/Caribbean Energy Information System (CEIS), and others. It would not be fruitful for this study simply to repeat these excellent assessments. Instead, this aspect of the study reviews the current energy sector conditions and performance, reviews findings of the prior country assessment/analysis conducted, presents an assessment / analysis for the countries that were not covered by the previous studies, analyzes the recently developed or adopted national energy policies and action plans where applicable, identifies lessons learned, and provides recommendations for the way forward.

3.1 Antigua and Barbuda

Item	Value
Land Area	443 km^2 (total) 280 km^2 (Antigua) 161 km^2 (Barbuda)
Population	86,754 (July 2010 est.)
Energy Supply Diesel	90.20 MW
Energy Price	U.S. $0.3778 per kilowatt-hour

Sources: CIA 2010 ; Nexant 2010, p. 5.3 ; Contreras 2010.
Note: Supply includes distributed generation.

Antigua and Barbuda is a Leeward twin-island nation of 442.6 km^2, with Antigua at 280 km^2 and Barbuda at 161 km^2. The latest estimate of its population is 87,884 people, and the gross domestic product (GDP) per capita is $16,400 (CIA 2010). The services sector accounts for 74.3% of the GDP, and the industrial and agriculture sector 22% and 3.8%, respectively.[8] Tourism accounts for 60% of the GDP, and investments approximately 40%.[9] Antigua and Barbuda have had some success in reducing a debt-to-GDP ratio from 120% to 90% from 2004 to 2008,[10] but debt soared to 130% at the end of 2010, due to the 2008 economic crisis. Although the economy experienced at 12% growth from 2003 to 2007 due to increased construction and tourism, the 2008 crisis hit the country hard and it has since struggled to recover.

[8] "St. Kitts Benefits from PetroCaribe Deal." Jamaica Gleaner. October 6, 2010. http://jamaica-gleaner.com/gleaner/20101006/business/business91.html. Accessed August 7, 2011.
[9] Ibid.
[10] Ibid.

3.1.1 Energy Sector Outlook

3.1.1.1 Government Agencies

The Sustainable Energy Desk within the Office of the Prime Minister is responsible for providing leadership on the energy policy and enacting the National Sustainable Energy Policy, following its approval. The National Energy Task Force has been commissioned to draft an energy policy (Government of Antigua and Barbuda 2009).

3.1.1.2 Utilities and Independent Power Producers

The utility, Antigua Public Utilities Authority (APUA), is a government agency responsible for production, transmission, and distribution of electricity to both islands. Although government policy on self-generation is unknown, independent power producers are allowed to exist by contract with APUA. The Antigua Power Company (APC) is an independent power producer (IPP) that has supplied power to the APUA grid since 1996 (Antigua Public Utilities Authority 2004).

3.1.1.3 Sustainable Energy Desk

The Prime Minister of Antigua and Barbuda established both the Sustainable Energy Desk and the National Energy Task Force in early 2010. The National Energy Task Force is commissioned to develop the National Sustainable Energy Policy (NSEP) with assistance of OAS/CSEP project, and includes government, business, financial, and utility stakeholders.

3.1.2 Electricity Market

3.1.2.1 Utilities

The Antigua Public Utilities Authority (APUA) operates as a monopoly over both islands of Antigua and Barbuda, serving the nation's production, transmission, and distribution of electricity (Antigua Public Utilities Authority 2004). The APC is a privately owned power generator and is chaired by a local politician and businessman (Simon 2005; Caribbean Professionals Directory 2009). It is effectively an IPP operating a set of diesel generators (Antigua Public Utilities Authority 2004).

3.1.2.2 Electricity Generation

Electricity on Antigua and Barbuda is provided by a combination of leased generators and a diesel-fueled IPP, in addition to the utility's own capacity. The total share of capacity contracted by the utility has grown from 40% in 2004 (Antigua Public Utilities Authority 2004), to 62% in 2009 (Nexant 2010, p. 5.3). Over the years, supply by APC has grown, as APUA has chosen the IPP to replace its own aging plants to supplement new investments in its own equipment. This transition has caused some power supply and political problems in the past, but these appear to have been resolved (Hadeed 2005; Spencer 2008). The APUA leases generators from West Indies Oil Company (WIOC), a regional oil products terminal in Antigua, and Aggreko, an international power-generator rental company (Aggreko 2010). One of the APUA plants is a combined power and desalination plant (Antigua Public Utilities Authority 2004).

Table 2. Antigua Public Utilties Authority Power Plant Description and Performance

Item	Value	Notes
Plants	7	All diesel generators; combination of plants owned by APUA, APC, and leases from WIOC, Aggreko.
Capacity (MW)	90.2	Antigua has 12 MW owned by APUA, 43 MW by APC, 13 MW leased. Barbuda has 7.2 MW owned by APUA. APUA is planning for 10 MW diesel, 10 MW CFB, 1.5 MW wind, and 0.5 MW solar by 2014.
Peak Demand (MW)	52.9	Forecast 3.3% annual growth from 2009 to 2023.
Total Electricity Generated (GWh)	317.0	Forecast 3.9% annual growth from 2009 to 2028. Transmission losses were 38% in 2007; expected to decrease significantly to 10% after 2011.
Total Electrical Sales (GWh)	221.9	
Unit Retail Price (U.S. $ per kilowatt-hour)	0.3778	Calculated for General Purposes Tariff, including fuel surcharge, for December 2009.

Values current for 2008, except retail price.

Sources: Nexant 2010, pp. 5.3, 5.9, 6.2, 6.17; retail price, Contreras 2010.

Figure 4 describes the historical electricity generation in Antigua and Barbuda. During the last 30 years, the growth of electricity generation has been continuous and strong despite the increase of oil prices in the same period (*see* Figure 5).

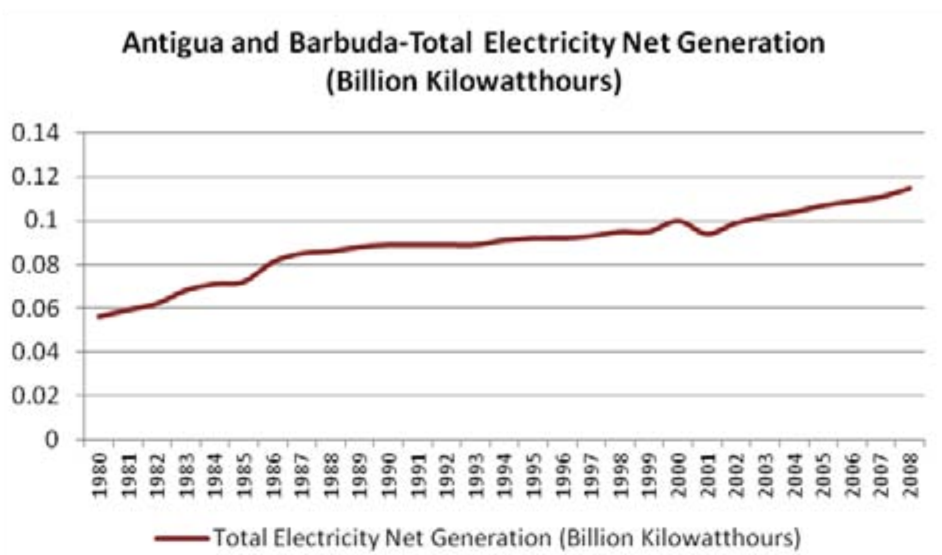

Figure 4. Electricity generation on Antigua and Barbuda

3.1.3 Electricity Prices

Consumers in Antigua and Barbuda face costs consisting of a tariff and a fuel surcharge per unit of electricity that is subject to a minimum monthly total. The fuel surcharge passes the cost of fuel to the consumer, with an average of U.S. $0.2198 per kilowatt-hour from January 2008 to March 2010, peaking in August 2008 at U.S. $0.3630 per kilowatt-hour. The tariff structure includes a general purposes tariff as well as customer-specific tariffs for residential, commercial, and industrial customers at different monthly consumption tranches. Using the general purposes tariff and assuming the minimum consumption, the typical price of electricity in Antigua and Barbuda is U.S. $0.3778 per kilowatt-hour (Contreras 2010).

3.1.4 Electricity Demand

Figure 5 shows electricity consumption during the last 30 years. The electricity demand versus supply ratio has been very small, which creates a delicate situation if there is a shortage of oil supply to satisfy basic energy needs. An extension of the trend observed in the figure will be complex to sustain in the mid and long term without a change in the energy matrix as an effective way to respond to the current oil prices trend.

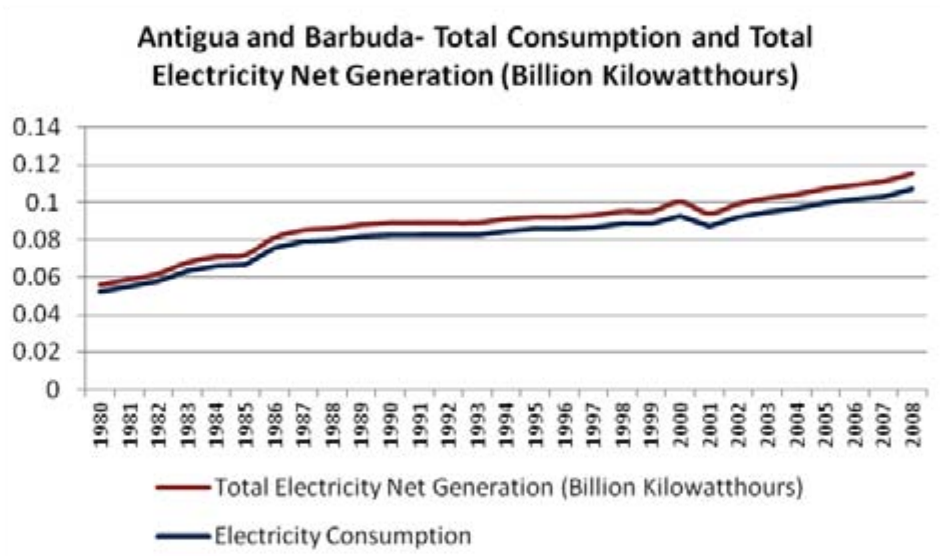

Figure 5. Consumption and generation of electricity on Antigua and Barbuda

3.1.5 Energy Efficiency

Inefficiency of electrical supply appears to be a significant problem for the APUA. Transmission and distribution losses were 24% in 2010 (Antiguan Power and Utility Authority March 2010). Furthermore, no demand-management initiatives are known to exist.

3.1.6 Building Codes

The nation has adopted the OECS model building codes, but the codes generally do not appear to be enforced in Barbuda (Benjamin 2001). A World Bank study remarked that, in both Antigua and Barbuda, effectively "no inspections are carried out" during construction (The International Bank for Reconstruction and Development 2006).

The Physical Planning Act of 2003 gives the government administrative power to regulate "the design and construction of buildings and the provision of services, fittings, and equipment," including "materials, insulation, lighting and ventilation of rooms; electrical installations, wiring and supply of electricity" (Parliament of Antigua and Barbuda 2003, p. 63). It is not known, however, whether this law has been implemented to establish building codes, or whether the current minister of physical planning is working with the Sustainable Energy Desk or National Energy Task Force on this issue.

3.1.7 Energy Supply Outlook

3.1.7.1 Fossil Fuels

Antigua is host to the West Indies Oil Company (WIOC), a regional oil products terminal, and the nation participates in PetroCaribe (Daniel 2009). The WIOC hosts 200,000 barrels of storage, of which half is leased to the Venezuelan state oil company, Petróleos de Venezuela, S.A. (Petroleum of Venezuela) (PDVSA) for use by other islands, in accordance with PetroCaribe (Nexant 2010, p. 7.21

3.1.7.2 Renewable Energy

Screening curve comparisons by Nexant indicate that renewable sources (particularly wind) are favorable when compared to fossil-fuel sources (including coal, oil, and natural gas) at certain capacity factors (Nexant 2010, pp. 11.6, 11.22). Scenario analysis shows that development of wind capacity would benefit Antigua and Barbuda regardless of future fossil-fuel development (Nexant 2010, p. 14.2).

Table 3. Antigua and Barbuda Renewable Energy Potential

Technology	Value
Hydro	None indicated
Wind	400 MW
Geothermal	None indicated
Solar	27 MW
Biomass and Other	Unknown

Source: Nexant 2010, p. 8.36

3.1.7.2.1 Hydro

Antigua and Barbuda do not appear to have any appreciable hydro resources. Water management already is a major concern because of limited natural freshwater resources (CIA 2010).

3.1.7.2.2 Wind

The reported 400-MW wind potential in Antigua and Barbuda is very speculative, as this estimate is greater than that of any other country in the region. The GTZ/CREDP currently is installing four meteorological towers to measure wind resources across Antigua and Barbuda (Government of Antigua and Barbuda 2010).

3.1.7.2.3 Geothermal

Antigua and Barbuda do not appear to have any appreciable geothermal resources.

3.1.7.2.4 Solar

Antigua and Barbuda have good solar resources for flat-panel PV and solar hot water systems, with GHI averaging more than 5.7 kWh/m^2/day. The DNI resouce is far poorer, suggesting that concentrated solar would not perform well in this region. See http://www.ecpamericas.org/initiatives/default.aspx?id=31 for full-page copies of the GHI and DNI solar maps.

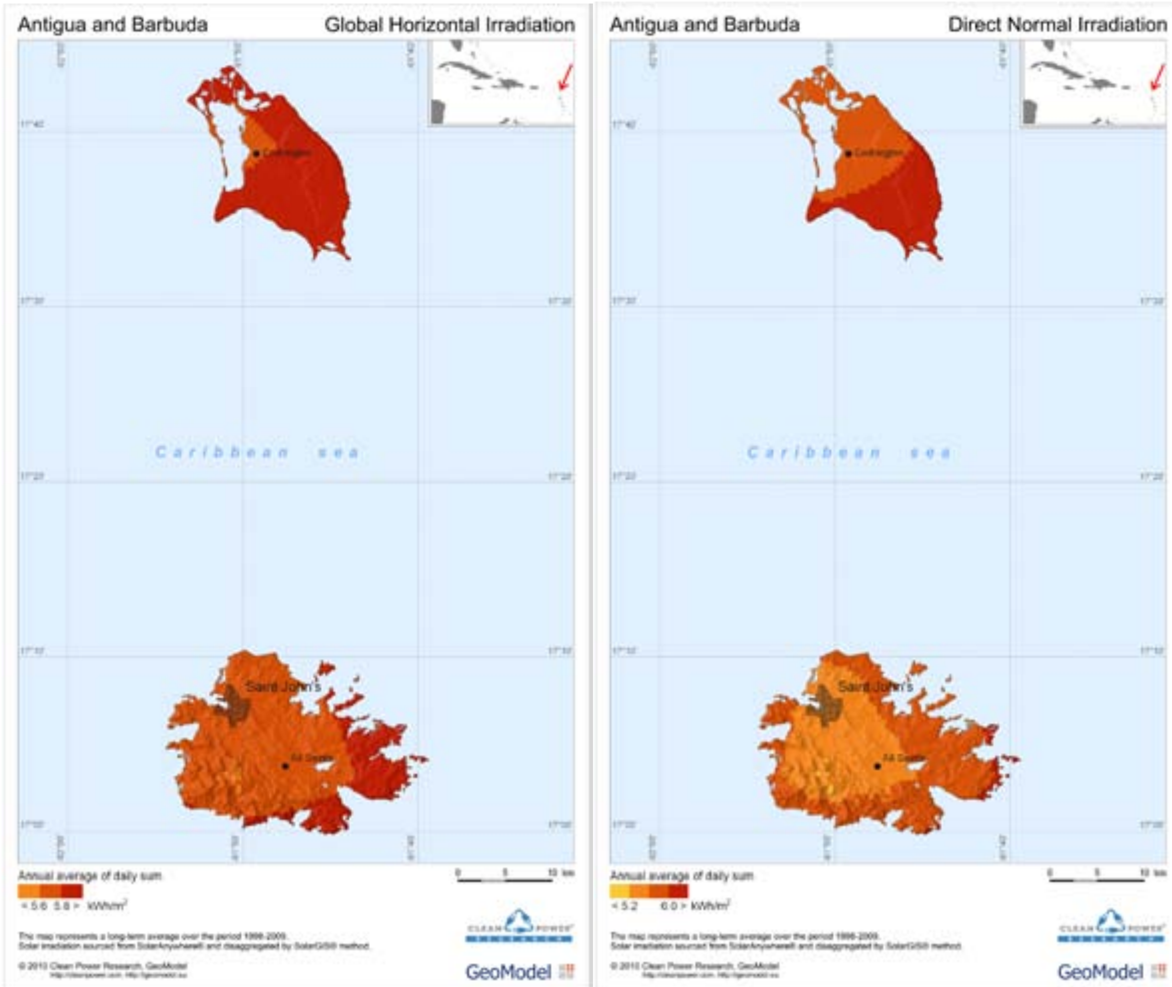

Figure 6. Solar maps of Antigua and Barbuda[11]

In 2011 the Antigua and Barbuda Energy Desk has engaged with the ECPA Caribbean Initiative in developing a 5kWp demonstration Solar PV-diesel hybrid system to be located at the Shirley Heights National Park. The aim is to showcase the technology to the general public and serves as a learning experience for the Antigua Energy Desk in the design, acquisition, installation, operation and monitoring of the system.

3.1.7.2.5 Biomass and Other

The biomass resources in Antigua and Barbuda have not been studied or estimated. Some aspects of agriculture, such as water management and clear-cutting of trees, already are major concerns due to limited natural freshwater resources (CIA 2010).

3.1.7.2.6 Interconnections

The proximity of Antigua and Barbuda gives the nation an opportunity to import electricity from geothermal sources in Nevis, approximately 55 miles to the south (Huttrer 2005).

[11] Clean Power, GeoModel (2010), see for more information: http://www.cleanpower.com/Home

3.1.8 Energy Policy Framework

At the time that the studies discussed were conducted, Antigua and Barbuda did not participate in the CREDP project, and so it was not addressed in the CREDP studies. The country also did not participate in the UNDP/SRC/CEIS initiative. The current study uses data found in Antigua and Barbuda's Draft National Energy Policy, OAS-CSEP mission reports, and other sources.

The government recently has made important strides in its energy policy, establishing a Sustainable Energy Desk and commissioning a National Energy Task Force to develop a national sustainable energy policy. Although the potential of most renewable energy sources currently are unknown, Antigua and Barbuda begun an assessment of wind resources by installing four meteorological towers in June 2010, as of December 2011 no updates were available.

3.1.9 Energy Sector Regulatory Framework Analysis

Antigua and Barbuda rely heavily on fossil fuels to meet energy needs, particularly electricity generation and transportation. Other fuels utilized for energy needs include gasoline, jet kerosene, gas, oil/diesel, heavy fuel oil, and liquefied petroleum gas (LPG) (Government of Antigua and Barbuda (2010c). The country's energy costs in relation to GDP and GNP towers above other OECS members (Government of Antigua and Barbuda (2010c). According to the Draft National Energy Policy,

> *[D]uring the period 2005 to 2009 total sales by the West Indies Oil Company (WIOC) averaged 12% of the national GDP. In 2008, the sales revenue peaked at 15% of GDP. This translates into unsustainable demands on the country's foreign exchange reserves with the previously referenced study from 2005 showing that energy costs consumed one-third of the country's foreign exchange. (Singh 2009)*

Further, until recently, the government has subsidized the retail price for fuel which significantly reduced electricity bills in comparison to the rates of other OECS members.

3.1.10 Legal and Regulatory Framework

The legislative framework for the energy sector in Antigua and Barbuda is as follows.

3.1.10.1 Public Utilities Act (1973)

Section 3 of the Public Utilities Act established the Antigua Public Utilities Authority (APUA) and Section 5(1) grants APUA the "exclusive right to generate, distribute, supply and sell electricity within Antigua and Barbuda and to perform services incidental thereto." The APUA also is empowered to grant licenses to others "to generate and supply electricity at any place within Antigua and Barbuda" (Section 5(2)). The Act also provides under Section 15(1) that utility prices charged by APUA must be in accordance with tariffs fixed by the Cabinet. Other notable sections include Section 40 which provides that the Minister may, after consultation with APUA make regulations on "(a) the methods of determining the charges payable by customers for the consumption or use of public utilities; (f) the system and mode of electricity supply"; and Section 41 which empowers APUA to make regulations on, for example, "(a) the methods of making application for a supply of public utilities; (e) the prevention of the misuse or waste of electrical energy."

The Act however, does not reflect current trends in energy sector reform. The monopoly granted by Section 3 run counter to current trends which involve a movement toward unbundling and privatization as a more efficient, transparent means of sustainable energy management. Further, the Act does not make provisions for an independent public utilities body/commission to regulate electricity entities by ensuring secure and efficient energy supply, and regulating prices charged to consumers. In fact, what is observed from Sections 40 and 41 is that the government/APUA regulates itself. Dominica's recent revision of its Electricity Supply Act provides useful examples as to how best to incorporate these reforms into legislation.

3.1.10.2 Petroleum Act (1949)

In essence, The Act provides rules for the importation and storage of petroleum into Antigua and Barbuda. Section 6 provides, for example, that the Minister is responsible for providing storage for imported petroleum. It indicates where petroleum may or may not be stored, and Section 12(1) empowers the Comptroller of Customs to grant licenses to "any person to deal in or sell petroleum in accordance with the prescribed regulations" (Government of Antigua and Barbuda 1949).

3.1.10.3 Minerals (Vesting) Act (1949)

The Act provides that all minerals, including coal and lignite (which include brown coal), in, on, or under the land regardless of ownership or tenure, belongs to the Crown (Section 3), and any mining of such minerals requires a license from the Cabinet (Section 4) (Government of Antigua and Barbuda 1949).

3.1.10.4 Draft National Energy Policy (2010)

The Government of Antigua and Barbuda, conscious of the country's exclusive dependence on fossil fuels and vulnerability to volatile energy markets and thus increased energy costs, has taken measures through the preparation of a national energy policy to address these issues. As a "preamble" to the national energy policy (NEP), the government states the strategic intent of the NEP as being to "create a stable, efficient and sustainable energy sector that fosters national economic and social development by establishing an enabling environment that exploits indigenous energy resources and reduces the total dependence on fossil fuels."[12] The principal goals for achieving this strategic intent are listed below.

- Reduce energy costs, which includes "prepar[ing] and implement[ing] a systematic utility cost reduction plan to reduce and sustain overall utility costs."
- Diversification and efficient use of energy sources, which includes "provid[ing] an enabling legal and regulatory framework for the deployment of RE technologies with particular emphasis on wind, solar and biofuels."
- Increase electricity reliability, which includes "strengthen[ing] the grid stability to reduce the number and duration of operational disturbances and strengthen the energy infrastructure to enable faster recovery from disruptions to the energy supply."
- Enhance environmental protection, which includes "introduc[ing] regulation that defines and clarifies the Environment Division's role and authority in coordinating all national energy permits and environmental reviews for Electricity Transmission facilities."
- Stimulate new economic/business opportunities, which includes "develop[ing] mass production technology for low-cost, high-quality photovoltaic cells and establish[ing] the learning and technology for evaluation so as to disseminate photovoltaic cells as a viable business opportunity."

The means and pathways for achieving these goals also are elaborated upon and include renewable energy, energy efficiency and savings, infrastructure and utility management, transport and cleaner fuel options, and public education/marketing.

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[12] *Supra* note 8, at 14.

3.1.11 Analysis

The strategic intent of the country's national energy policy could be improved or extended in few ways. Regarding the diversification and efficient use of energy sources, a clear sub-goal should be the provision of an enabling legal and regulatory framework for the deployment and use of renewable energy and renewable energy technology, with particular emphasis on wind, solar, and biofuels. Further, in terms of electricity reliability a sub-goal could be the development and promotion of a distributed energy policy that would allow for privately owned "behind the meter" RE systems, perhaps through the establishment of feed-in tariffs. Moreover, the environmental protection goal should include provisions to the harmonization of the NEP with other environment-related policies, including land-use policies.

The approach of the drafted NEP is to present Antigua and Barbuda's energy policy for major sectors (i.e., power, transportation), other uses of energy, and implementation and monitoring. As presented, the national energy policy is subdivided into several sections; energy sources, energy efficiency management, legal and regulatory framework, and institutional framework. These sections are discussed below.

3.1.12 Energy Sources

3.1.12.1 Fossil Fuels and Non-Renewable Sources

A notable absence from the policy statements is a commitment that the government will reduce the country's nearly 100% dependence on fossil fuels.

3.1.12.2 Renewables

It is recommended that the government periodically review and update RE mandates and indicate clear roles and responsibilities, including a hierarchy/chain of responsibility/accountability.

3.1.12.3 Emerging Technologies

A frequent complaint about government policies is that they oftentimes are not accompanied by resource commitments. It is recommended that the government commit resources toward the implementation of these policies, and that it also encourage the local development of renewable energy technology.

3.1.13 Energy Efficiency Management

3.1.13.1 Supply Side

The government should consider strengthening this section by establishing monitoring, reporting, and evaluation mechanisms to ensure compliance with standards—including those pertaining to emissions. Further, the government should develop, implement, and enforce local standards in lieu of or complementary to those developed and promulgated through regional initiatives.

3.1.13.2 Demand Side

The government also should consider establishing an independent regulatory commission to ensure transparency and accountability among stakeholders and to develop, implement, monitor, and enforce demand-side management (DSM) regulations, including those related to tariff setting and consumer complaints. It also is recommended that the government explore other alternative DSM technologies at the domestic, commercial, and industrial levels, in addition to the solar water systems listed.

3.1.14 Legal and Regulatory Framework

This section outlines the policy on various legislative instruments including the Public Utilities Act, Land Planning Act (LPA), Investment Authority Act (IAA), Development Control Act (DCA), and the National Solid Waste Management Authority Act (NSWMAA). The government also should consider developing other environmental legislation and regulations, with a view to eliminating gaps in the overall legislative and regulatory framework, and harmonizing these instruments where appropriate for the purpose of ensuring comprehensive sustainable development. Other relevant legislative, policy, or regulatory instruments include the following.

- Petroleum Industry (Encouragement) Act (1963)
- Land Development and Control Act (1977)
- Land Acquisition Act (1958)
- National Solid Waste Management Authority Act (2005)
- Vehicles and Road Traffic Act (Part II) (1947)
- Transport Board Act (1995)
- An Act to amend the Transport Board Act (No. 22 of 1998)
- Environmental Protection Levy Act—Schedule Part I (2002)

See http://www.laws.gov.ag/acts/volume5.htm for more detailed provisions on many of the abovementioned legislation, regulations, and policies.

3.1.15 Institutional Framework

The current institutional framework for energy management includes the ministry in charge of public utilities (APUA), the Energy Desk established in the Office of the Prime Minister, and a National Energy Task Force responsible for producing and implementing the NEP (Government of Antigua and Barbuda 2010d) and which has the mandate (PetroCaribe Energy Cooperation Agreement 2005) to examine prospects for the use of alternative energy, evaluate consumption patterns, develop a 30-year consumption forecast, and review all legislation addressing energy consumption including the Public Utilities Act (Government of Antigua and Barbuda 2010d). The Task Force is composed of stakeholders drawn from a broad cross section of agencies and disciplines, including engineers and project managers.

Major challenges in the framework include a lack of transparency and accountability among institutional actors and unclear roles and responsibilities—particularly a clearly defined chain of responsibility. The NEP seeks to outline the institutional structure appropriate for Antigua, but suffers some shortcomings. It identifies the National Energy Task Force (NETF), proposes a Sustainable Energy Unit (SEU) to replace the Energy Desk, and speaks to a proposed project for the establishment of the Eastern Caribbean Energy Regulatory Authority (ECERA).

Regarding the role identified for the NETF in the NEP, it has been significantly and substantively reduced to "examining current and anticipated energy consumption patterns in Antigua and Barbuda, technological advancements in the field of alternative energy, advancements in the field of energy conservation and other considerations, with the view towards advising the government on improvements to the National Energy Policy and the Sustainable Energy Plan."[13] Much of the mandates previously given to the NETF have been transferred to the SEU. The role of the SEU includes,

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[13] *Supra* note 9.

> *provid[ing] advice on energy-related issues and activities by, inter alia, creating a discussion forum among governmental institutions, the private sector and public stakeholders in Antigua and Barbuda; function[ing] as an observer body at the national level, in order to assist the Ministry with responsibility for Public Utilities and other national authorities in the reasonable implementation and monitoring of energy related policies and laws; propos[ing] standards for service quality and pricing systems and collaborate with APUA, the Attorney General's Chambers and relevant regional international agencies in order to review and amend the existing legal and regulatory framework; and collect[ing] relevant energy data on a regular basis, in order to support the planning and evaluation activities.*

Its responsibilities also are elaborated to include:

- Mandating and coordinating studies on energy resources, generation, transformation, and marketing in close cooperation with the responsible operating agencies;
- Promoting and monitoring power sector demand-side management programs and other programs designed to encourage the purchase and adoption of energy efficient appliances by final energy users; and
- Organizing energy-awareness campaigns and capacity-building events and disseminating appropriate information to the private and public sectors.[14]

It appears that, in some respects, the SEU should undertake some of the responsibilities of Public Utilities Commissions seen across region by "mandating and coordinating studies on energy resources, generation, transformation" and promoting and monitoring power sector demand-side management programs. This entity, however, is by no means independent; it has no authority to perform functions such as making binding decisions, setting standards, fixing tariff rates, or mediating between the utility company and the consumer. Perhaps the drafters did not intend for the SEU to be compared to an independent utilities commission, but it is quite clear that such a commission is needed. The NEP failed to make such an important provision and, despite including a role for the SEU, it appears that governance behavior regarding energy management will remain "business as usual." It further could be argued that the existence of both a Task Force and the SEU could prove unduly bureaucratic and otherwise challenging, because the NEP does not clearly identify the hierarchy of responsibility or chain of command for these institutions.

The inclusion of the ECERA in the NEP could bode well for cooperation and integration efforts among OECS member states in relation to energy management, and certainly could represent at the sub-regional level that independent body which is absent on a domestic level. Care must be taken, however, that the establishment of the ECERA does not become an excuse for inaction on key issues at the domestic level.

The policy on the transportation sector is subdivided into ground transportation, aviation transportation, and environment and transport. In this respect, the government will "take a lead in the application of efficient vehicles and cleaner fuels within its fleet. Capitalizing on the country's small size and relatively flat terrain, the Government shall explore the feasibility of introducing electric cars" (Singh 2009, p. 29). Given that, in its National Communications to the United Nations Framework Convention on Climate Change, the government indicated that the transportation section is one largest sources of

[14] *Supra* note 9.

greenhouse gas (GHG) emissions in Antigua and Barbuda, the government will honor its commitment to reduce such emissions in that sector. The NEP indicates that,

> *[L]egal frameworks have to be defined and implemented to deal with issues such as mandatory vehicle inspections, vehicular emission standards, appropriate fuel taxation schemes and import duties or tax exemptions to promote fuel efficient vehicles. In this regard, specific courses of action will include the establishment of target fuel-use standards for vehicles to be imported with high tax levels applied to vehicles which do not meet said standards. Compulsory labeling and the provision of comparative data will enable consumers to make more informed choices. (Singh 2009, p. 30)*

In addition to these provisions it is also recommended that the government impose limits on the age of imported vehicles.

3.1.16 Implementation and Monitoring

The government has mandated the creation of a Sustainable Energy Action Plan (SEAP) for short- , medium- , and long-term activities to be conducted over a 20-year period (i.e., 2010–2030). The objective of the SEAP

> *[W]ill be to enhance the implementation of the policies and goals of Antigua and Barbuda's National Energy Policy (NEP). The specific activities contained in the SEAP will foster energy conservation, energy efficiency, and diversification of energy sources, sustainable energy consumption and generation, as well as the utilization of renewable energy sources available in Antigua and Barbuda. (Singh 2009, p. 37)*

The strategies for the implementation of the NEP/SEAP are energy conservation and energy efficiency, renewable energy development, and education and awareness. Regarding the reporting and monitoring provisions, it is recommended that a standard/template reporting format should be prepared by the government, and a streamlined approach should be designed for the collection, storage, and follow up of data and reports submitted. By monitoring progress in this manner, lessons learned in Antigua and Barbuda can be leveraged by other Caribbean nations.

3.1.17 Conclusions and Recommendations

This study recommends the following action for the nation of Antigua and Barbuda.

- Examine options for unbundling and privatization of the electricity sector.
- Incorporate transparency and accountability as essential components of effective energy management/governance.
- Draw from the lessons of other countries of the region that have implemented reform measures, especially as they pertain to privatization and the establishment of an independent regulatory commission.
- Establish roles, responsibilities, and mandates, along with a clear hierarchy/chain of responsibility for the effective operation of the institutional framework.

Despite the efforts, there are no measurable benefits from current legislation and projects developed in the country to reduce the rate of oil importation and consumption during the period of analysis. Regardless of some isolated attempts, oil consumption still is increasing and internal volatility is affecting the national energy security. During the period of analysis, international agreements had no measurable impacts on fossil-fuel consumption rate.

To create a vision and framework for the nation's energy goals, the National Energy Task Force should complete its development of the NSEP, and the executive/legislative government should formally approve it. The Energy Desk should continue to engage with international expertise to actively assess the wind and solar energy resources in Antigua and Barbuda. The Energy Desk also should work with international experts to assess the potential of waste-to-energy,or biomass resources, following the lead of the ongoing wind assessment. In collaboration with APUA, the Energy Desk should establish a demand-side management plan to optimize the existing electricity supply-demand equation. It also should perform a national macro-level energy audit to identify the highest energy consumers per economic sector/activity (to verify whether desalination of seawater is considered one of the most energy-intensive activities) and to plan EE actions in such sectors/activities.

3.2 The Bahamas

Item	Value
Land Area	13,880 km² (total)
Population	310,000 (total)
Supply Diesel and Heavy Fuel Oil Natural Gas	584.8 MW 429.8 MW 155.0 MW
Price	U.S. $0.3164 per kWh

Sources: CIA 2010; Wilson 2009, pp. 27–29, 138–39.
Notes: Price for Bahamas Electricity Company only. Supply includes distributed generation.

The Commonwealth of the Bahamas consists of some 700 islands and 2,400 cays located in the Atlantic Ocean between Florida and Cuba. Only 30 islands are inhabited, primarily New Providence and Grand Bahama, with the remainder known as the Family Islands (Wilson 2009 p. 27). The latest estimate of the Commonwealth's population is 330,000 and the GDP per capita is U.S. $25,894. Tourism as an industry accounts more than 60% of the Bahamian GDP and provides jobs for about half of the national labor force.

3.2.1 Energy Sector Outlook

3.2.1.1 Electricity Market

3.2.1.1.1 Utilities

The Bahamas Electricity Company (BEC) is a government-owned electric utility covering New Providence and the Family Islands, which provides 80% of generation across the Bahamas. The BEC was established by Act in 1959, and generally sets its own tariffs (Wilson 2009, pp. 28, 32). The Grand Bahama Power is majority owned (55%) by Marubeni-TAQA, a joint venture of parties in Japan and Dubai. Canadian utility Emera also is a shareholder through the publicly traded ICD Utilities Limited of the Bahamas (Emera 2008). The utility license for Grand Bahama Power (GBP) expires in 2054, along with the regulatory agreement for the Grand Bahama Port Authority (GBPA) (Wilson 2009, p. 34).

3.2.1.1.2 Supply

The Bahamas is unique in that its electricity system is distributed among some 16 isolated island grids. Thus, expansion is incremental and generation capacity primarily is small diesel plants with a capacity of 20 MW and less (Wilson 2009, p. 31). The Bahamas Electricity Corporation (BEC) website features a map of plants on each island (BEC 2012). Despite the distributed layout of the system, the BEC charges a single rate structure for its customers (BEC 2010).

Table 4. The Bahamas Renewable Energy Potential

Technology	Value
Hydro	None indicated
Wind	58 MW (total); 15 MW (Grand Bahama); moderate potential (5% to 10% of existing capacity)
Geothermal	None indicated
Solar	58 MW; moderate potential (5% to 10% of existing capacity)
Biomass and Other	1 MW; low potential (less than 5% of existing capacity)

Sources: Wilson 2009, p. 144

Wind (total) and solar calculated from 10% of 584 MW capacity, based on Wilson.

Table 5. The Bahamas Electricity Corporation Power Plant Description and Performance

Item	Value	Notes
Plants	29	Includes one natural gas plant and 28 diesel plants
Capacity Diesel and Heavy Fuel Oil Natural gas	438 MW 283 MW 155 MW	Does not include a 48-MW diesel plant at Wilson City, Abaco Island
Peak Demand	234 MW	Peak demand for New Providence Island. Growth to 359 MW is expected by 2013
Total Electrical Sales	1,536 GWh	Growth to 2,219 GWh is expected by 2013
Unit Retail Price (U.S. $ per kilowatt-hour)	0.3164	Includes fuel surcharge of U.S. $0.1919 per kilowatt-hour

Values current for 2008.
Sources: Wilson 2009, pp. 138–39, 143; Wilson City plant: Robards 2010.

Table 6. Grand Bahama Electricity Market Summary

Item	Value	Notes
Plants	1	9 Diesel generators at Queens Highway facility
Capacity	141 MW	GBP had last capacity expansion of 13.5 MW in 2001
Peak Demand	74 MW	GBP reports record peak demand of 71 MW in 2001
Total Electrical Sales	369 GWh	Estimate for 2008 (Wilson et al.)

Values current for 2008.
Sources: Grand Bahama Power 2010; peak, sales Wilson 2009, p. 143.

Figure 8 describes the historical electricity generation in the Bahamas. During the last 30 years, the growth of electricity has been continuous and strong despite the increase of oil prices during the same period.

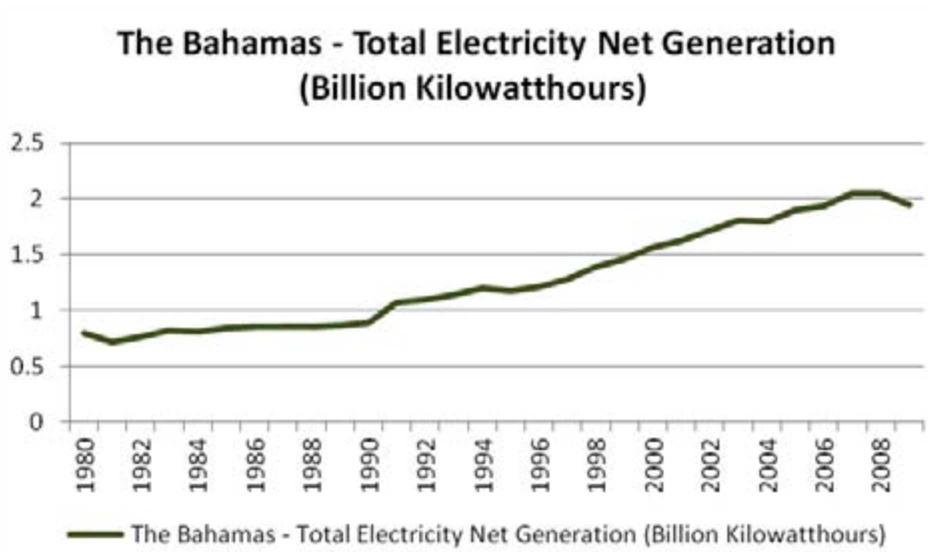

Figure 8. Electricity generation on the Bahamas

3.2.1.2 Electricity Prices

Consumers in the Bahamas incur costs consisting of a tariff and a fuel surcharge per unit of electricity. The fuel surcharge passes the cost of fuel to the consumer. Residential customers are subject to a two-tiered tariff having a minimum monthly total. Commercial customers could face a unit tariff or a combination of a unit tariff and demand charge (BEC 2010).

3.2.1.3 Electricity Demand

The Bahamas has nearly complete electrification, at about 99% overall and 100% for Grand Bahama. Electrical consumption is somewhat high for the region, averaging 5,700 kWh per capita per year in 2008 (Wilson 2009, pp. 139,143). Annual growth in electrical demand to 2013 is expected to be at least 3.1%

(Wilson 2009, p. 27), or even as much as 8% (NEPC 2008, p. 1). The service sector dominates the economy, contributing 90% of the GDP (Wilson 2009, p. 27). The hospitality and tourism industries are expected to contribute the most to future electrical demand (NEPC 2008, p. 1). Figure 9 shows the electricicty consumption over the last 30 years.

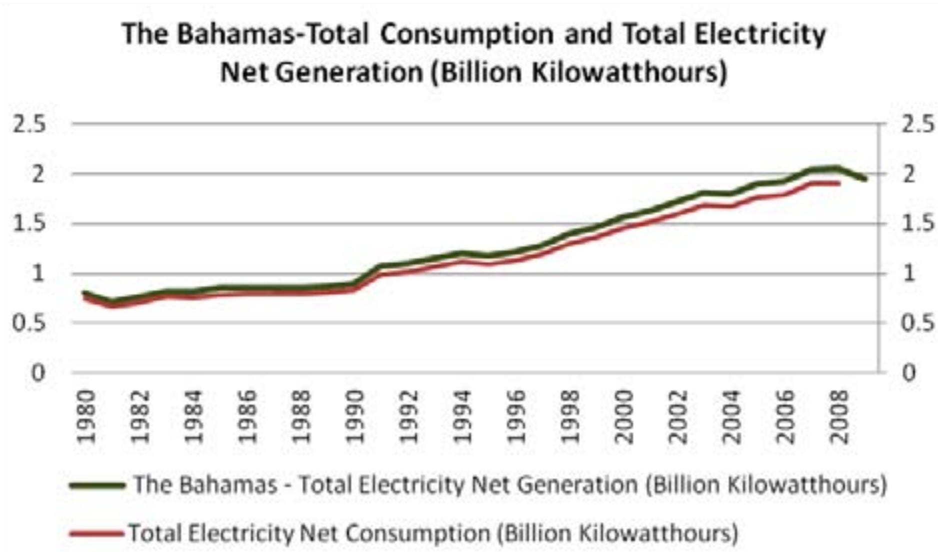

Figure 9. Consumption and generation of electricity on the Bahamas

3.2.2 Energy Efficiency

The Bahamas experienced system losses of 12.3% in 2008 (Wilson 2009, pp. 139–140). Waste of fossil fuels—via leaks and lack of inventory controls—is a particular concern for the Bahamas. The NEP calls for monitoring fossil fuel losses as a short-term goal (NEPC 2008, p. 9). Aside from a campaign to decrease use of incandescent lights, no demand-management efforts or promotions currently exist in the Bahamas. The First Report of the NEPC expresses concern that no energy efficiency assessment has been made and that, in general, no energy efficiency standards exist (NEPC 2008, p. 10).

3.2.3 Building Codes

The NEP discusses the introduction of energy-efficient building standards in the medium term. It calls for energy-efficient space cooling, water heating, lighting, windows, and equipment standards for public buildings (NEPC 2008, p. 15).

3.2.4 Energy Supply Outlook

3.2.4.1 Fossil Fuels

The Bahamas participates in PetroCaribe (Wilson 2009, p. 142). The Bahamas was not included in the *World Bank Report,* which assesses the least-cost fuel combination projected to provide a country's future energy supply.

3.2.4.2 Renewable Energy

No notable renewable energy capacity currently exists in the Bahamas. The Bahamas Electric Company considered bids for 13 candidate RE projects in 2009, and GBP has explored both wind and biomass resources (Wilson 2009, p. 31).

3.2.4.2.1 Hydro

Due to its low-lying geology, the Bahamas has no appreciable hydro resources (Wilson 2009, p. 144).

3.2.4.2.2 Wind

Wind data is being measured on Grand Bahama Island in a joint project between GBP and shareholder Emera. The assessment project involves towers at seven sites across the island, at a cost of U.S. $263,600. Following the assessment, GBP could install up to 15 MW of wind capacity by 2012 (Wilson 2009, pp. 31, 34).

3.2.4.2.3 Geothermal

Due to its lack of volcanic geology, the Bahamas has no appreciable geothermal resources (Wilson 2009, p. 144).

3.2.4.2.4 Solar

The Bahamian government implemented incentives for solar equipment in 2008 by decreasing import duties from 42% to 10%. The hospitality industry has shown some interest in solar devices, and several PV and SWH distributors have entered the market (Wilson 2009, p. 35). The Bahamas have good solar resources for flat-panel PV and solar hot water systems, with GHI averaging more than 5.3 kWh/m^2/day (*see* Figure 10). Although this is somewhat less than for other islands in the Caribbean, the high price of power means PV and SHW systems still are economically viable. The DNI resouce is far poorer, suggesting that concentrated solar would not perform well in this region.

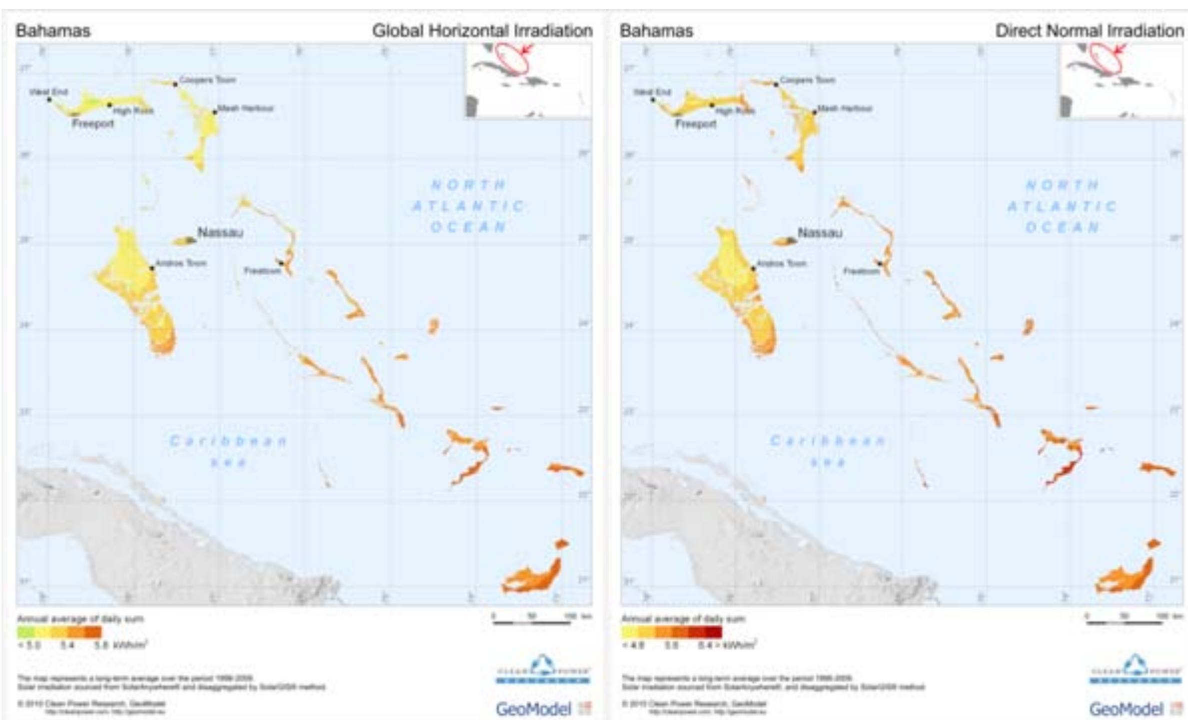

Figure 10. Solar maps of the Bahamas

3.2.4.2.5 Biomass and Other

The GBP assessed landfill gas-to-energy potential on Grand Bahama Island in 2008, finding up to 1 MW of potential capacity (Wilson 2009, p. 35). The SECCI has a specific objective to lead a waste-to-energy program for biofuels made from used cooking oil (NEPC 2008, p. 31). The Bahamas might be an ideal site for ocean-based RE technologies. Ocean thermal energy could be exploitable in the steep drop-offs of the Bahamas Bank, as could tidal wave and other sources (NEPC 2008, pp. 8–9). In November 2011, the Bahamas announced its commitment to exploring the viability of installing an ocean thermal energy conversion (OTEC) plant in its territorial waters, and signed a MoU with a developer for the assessment of building one or more OTEC plants (Sciaudone 2011).

3.2.5 Interconnections

A few local interconnections exist between islands, but their extent and locations are not reported (Wilson 2009, p. 31).

3.2.6 Energy Policy Framework

3.2.6.1 Background

The Bahamas as a CSEP project country and member of the Inter-American Development Bank (IDB) has received support from these entities in the development of a national energy policy. The IDB contracted the German consulting firm Fichtner to review the first national energy policy (NEP) of the Bahamas drafted in 2008. From the findings of this review, the Government of the Bahamas, through its National Energy Policy Committee revised its NEP. Furthermore, wind resources are being measured on Grand Bahama Island, but interest in renewable energy generally has been tepid across the nation.

3.2.6.2 Energy Sector Regulatory Framework Analysis

The Fichtner report, *Strengthening the Energy Sector in the Bahamas: Preliminary Review of the Energy Sector Framework* (2010), clearly outlines the governance framework for energy in the Bahamas. It reviews the present electricity sector framework, presents options for a new sector framework, and outlines an appropriate legal and regulatory framework.

3.2.6.3 Legal and Regulatory Framework

3.2.6.3.1 Electricity Sector Framework

The review conducted analyzes key instruments and gives an overview of the regulatory framework, including The Electricity Act (EA), Out Islands Electricity Act (OEA), and the Hawksbill Creek Agreement (HCA). See Appendix A for more details on relevant legislative, policy, and regulatory provisions. Regarding the Electricity Act (1956), it establishes the Bahamas Electricity Company (Section 3), a wholly owned government entity, and grants it exclusive power to ”purchase, generate, transmit, transform, distribute and sell energy either in bulk or to individual consumers” (Section 12(1)). The BEC’s key functions involve providing electricity at reasonable prices within its area of supply (Section 12(1)). Given the Bahamas’ geography it would prove very difficult for the BEC to supply electricity to all the inhabited islands, and so it does not. The BEC supplies electricity to only a few—the Family Islands—and for the others the minister empowered by the Out Islands Electricity Act grants licenses for the construction and operation of small power plants.

Regarding financial incentives for renewables, the CREDP *Baseline Study* indicates that, under the Third Schedule, the Act stipulates that energy technologies purchased by the BEC are tax free. The study, however, indicates that “additional legislation which allows tax-free status for renewable technology purchased by entities other than BEC could provide a meaningful fiscal incentive for the further development of renewable energy technology” (CREDP 2009).

The EA, however, contains major weaknesses. Although it does not expressly prohibit

> *third-party power generation, it hinders the process since third parties do not have direct access to the nation transmission and distribution network. Further, the provisions of the EA may not effectively facilitate the efficient and commercial operation of BEC as 'ownership, policy, regulatory functions and decision making processes and supervisory activities within BEC are so closely nested that political interventions on managerial decisions are institutionalized. (Fichtner 2010)*

In terms of the OEA, the minister may grant licenses to any person who wishes to construct an electrical system for the purposes of providing electricity to the public in any part of the Out Islands (Section 3). The Minister may grant the same powers and responsibilities to the licensee as BEC under the EA. The Hawksbill Creek Agreement, among other things, grants the Grand Bahama Port Authority the right to construct and operate utilities—including the provision of electricity on Grand Bahama—without need for further approval or license from the Government of the Bahamas. The GBPA has since granted a license to the privately owned Grand Bahama Power Company to exclusively supply electricity to Grand Bahamas. In terms of challenges, according to Fichtner, "there is no information available on the license or concession that the GBPA has entered into with the GBPC and or the way the GBPC is regulated" (Fichtner 2010).

In terms of regulatory framework, the Public Utilities Commission Act provides for the establishment of a Public Utilities Commission (PUC) and empowers the PUC to regulate all utilities, including electricity and telecommunications. When the PUC commenced its regulatory activities in 2000, however, it only was authorized to regulate the telecommunications sector. The PUC since has been replaced by the Utilities Regulatory Competition Authority (URCA), established under the Utilities Regulation and Competition Authorities Act (2009). The Act empowers the Utilities Regulation and Competition Authorities to "issue all regulatory and other measures including making determinations, issuing regulations, and imposing penalties" (URCA Act 2009, Section 4(2)). Currently, however, the URCA does not regulate the energy sector.

3.2.6.3.2 Options for a New Sector Framework

The discussion of options addresses basic principles for a new sector framework, sector roles, sector structure, clear and established regulatory regime, regulatory body, and adoption of a new governance mode. Some of the options include the following.

- Clearly allocate roles and responsibilities at the institutional level.
- Establish an independent regulatory body which has some of the following advantages: predictability in regulation for utilities and other stakeholders, including in the decision-making process; the decisions of independent bodies often are subject to appeal; create transparent tariff-setting procedures.
- Determine an appropriate market/sector structure. In this case, Fichtner presents two different market options: The Grid Access Model/Third-Party Access Model, and the Competitive Power Market/Multiple-Buyer Market. The former allows, among other things, third-party access to the grid, and the latter includes access to the network and a competitive environment for the provision of electricity services. Fichtner seems to encourage the use of a single-buyer model, a market/sector variation under the competitive power market structure. This model encourages, among other things, competitive bidding for new generation capacity, and the participation of independent power producers.

- Create a favorable regulatory regime to encourage private-sector involvement.
- Improve the "efficiency of natural monopolies," such as the BEC.
- Promote consumer interests.
- Establish an independent regulatory body having authority over the energy sector.
- Make changes in governance, which can include the privatization of the BEC, which would involve amendments to the Electricity Act and potentially could limit the Act's powers.

The regulatory framework proposed involves a complete overhaul of the current regime and, in essence, calls for the creation of a new sector framework governed by a comprehensive energy/electricity law that would perform tasks such as defining roles and functions, endowing URCA with regulatory responsibilities for the energy sector, defining the applicable market structure, and establishing third-party access to the transmission and distribution system.

3.2.6.4 Assessment of the Draft National Energy Policy

Acutely aware of its vulnerability to natural disasters and volatile fossil fuel prices, especially considering that it relies almost exclusively on imported fossil fuels for energy production, and their actual and potential impact on agriculture, commerce, and industry, the Bahamas is exploring alternative renewable energy options. This is commenced with a view to ensuring energy security and access to energy. To achieve this, the government will have to address, reduce, and eliminate barriers to the deployment of renewable energy technology; revise its legal and regulatory framework; and implement measures to ensure and encourage energy efficiency and conservation, which includes removing barriers to energy efficiency.

The main objective of the national energy policy is to "protect gross domestic product, foreign exchange and reserves while simultaneously minimizing energy consumption and increasing energy efficiency and security" (NEPC 2010). Through short- , medium- , and long-term goals, the government seeks to foster energy conservation and diversification of energy sources and energy use sectors (NEPC 2010).

The policy agenda will assist in the development of a sustainable energy matrix for the Bahamas that includes reduced electricity demand through energy efficiency at 30% by 2030, enhanced efficiency in energy production, and introducing of renewable energy technology to supply at least 40% of overall power generation. According to the NEP, "the sustainable energy matrix would achieve substantial benefits both in saved fossil fuels and a lowered environmental impact" (Singh 2009). The structure of the NEP outlines a new electricity-sector framework, policies to promote renewable energy and energy efficiency, the establishment of a Sustainable Energy Unit, policy targets and objectives, and a transport-sector policy agenda.

3.2.6.4.1 New Electricity Framework

The NEP acknowledges that the Electricity Act is "no longer suitable to deal with the challenges of the electricity sector in the Bahamas" (Singh 2009). It references recent trends and experiences in sector reform, and essentially includes all the recommendations offered by Fichtner for a complete overhaul of the sector, including the Electricity Act itself. The NEP indicates the importance of making clear distinctions between the role of the government and a regulatory authority in energy–electricity sector management to ensure sound regulatory practices and to encourage private-sector investments. The NEP then clearly delineates the roles, responsibilities, and activities of the government and the URCA. Notably, regarding sector structure, the market structure proposed is based on competition for generation capacity and private-sector participation. It grants the URCA regulatory authority over the energy–electricity sector, which includes defining rules for sector competition and supervising the competitive process; issuing, suspending, and revoking licenses; and dispute resolution. The elimination of barriers and the promotion of renewable energy programs are to be pursued as per the NEP, along with the adoption of an appropriate governance structure for BEC. In addition to the provisions under this section, it also is recommended that a clear chain of command for decision making be included to complement the roles and responsibilities elucidated to ensure transparency and accountability.

3.2.6.4.2 Promotion of Renewable Energy and Energy Efficiency

The Bahamas are leading in this area in that their NEP includes actual, specific and quantifiable targets. It provides that a share of at least 15% and 30% of RE power supply is targeted by 2020 and 2030, respectively. Whether these targets are met depends in the effectiveness of the activities used to promote power generation from renewable energy sources. The NEP outlines such promotion activities to include net metering/net billing, feed-in tariffs for energy from renewable sources, and tendering schemes for utility-scale power plants with a minimum capacity of 5 MW (Singh 2009).

Given that RETs and the development of RE are capital intensive, the NEP proposes meeting additional costs through the establishment of a Renewable Energy Fund which collects funds dedicated to renewable energy. It also identifies the sources of funds to include generic public budget allocations from the government, a particular tax, a surcharge on electricity tariffs, and income from climate change. To ensure transparency and accountability with respect to this fund, it should be formally established with clear mandates, roles and responsibilities, and monitoring and reporting requirements. Further, another source of funds could include fines imposed as a punitive measure by the courts, a regulatory authority, or another body authorized by law to so impose.

In addition to the policy initiatives listed to promote energy efficiency, the NEP also should include some of those promoted by the International Energy Agency (International Energy Agency 2008).

- Cross sectoral: Measures for increasing investment in energy efficiency, compliance monitoring, enforcement, and evaluation of energy efficiency measures, energy efficiency indicators
- Buildings: Building certification schemes
- Appliances and Equipment: Mandatory energy performance requirements or labels, energy performance test standards, and measurement protocols
- Lighting: Best-practice lighting, and phase out of incandescent light bulbs
- Industry: Collection of high-quality energy-efficiency data for industry, policy packages to promote energy efficiency in small and medium-sized enterprises
- Energy utilities: Utility end-use energy efficiency schemes

3.2.6.4.3 Sustainable Energy Unit

The NEP proposes the establishment of the Sustainable Energy Unit (SEU) to implement RE and EE promotion policies. It will form part of the ministry responsible for energy and support the implementation of the NEP. It will play an integral role in ensuring coordinating in the RE and EE activities. The NEP—in its Appendix 3a—provides great detail the public sector activities of the SEU.

The activities assigned to the SEU are quite extensive and involves engaging various government ministries and authorities. The structure of the SEU within the ministry with responsibility for energy has not been elaborated upon in the NEP, but human resources, technical resources, and other considerations are important factors in determining whether, and to what extent, the SEU is successful in executing its duties. The mandate and authority of the SEU also must be clearly established without too much overlap with the work program of other government institutions, so as to minimize domain, hierarchy, and chain-of-command challenges.

3.2.6.4.4 Policy Targets and Objectives

The NEP lists the short-term (1 to 5 years), medium-term (5 to 10 years), and long-term (10 to 20 year) targets for the Bahamas. The only major critique of this approach is that much of the targets lack specificity in terms of who is responsible for ensuring that the targets are met, and targeted timeframe for the completion of certain activities. Further, for instances in which the target is a reduction, a measurable target—in terms of percentages, dollar amount, or other quantifiable amount—should be included.

3.2.6.4.5 Transport Sector Policy Agenda

The policy targets and objects are in keeping with good sector-reform practices.

3.2.7 Key Lessons Learned

- The legal, policy, and regulatory framework periodically should be reviewed to reflect developments in energy sector reform.
- Transparency and accountability are essential components of effective energy management and governance.

3.2.8 Energy Governance Stakeholders

3.2.8.1 Government Agencies

The key government stakeholders are the Ministry of Energy & Environment, the Bahamas Environment Science & Technology, and the Public Utilities Commission. The Ministry of Energy & Environment was established in 2006 to develop a national energy policy addressing energy efficiency and adoption of renewable energy. The Public Utilities Commission currently regulates only telecommunications services, although its scope also can cover electricity, water, and gas services (Wilson 2009, pp. 28, 32).

3.2.8.2 Public-Private Partnerships

The Grand Bahama Port Authority Limited is a private corporation granted authority for municipal and economic development on the island of Grand Bahama. The GBPA regulates utilities, sets electricity tariffs, grants business licenses, and holds an exemption from import duties for capital equipment on this island alone (Wilson 2009, pp. 32–34).

3.2.8.3 Utilities and Independent Power Producers

Both the Bahamas Electricity Company and Grand Bahama Power (GBP) operate as monopolies, each with exclusive authority for electricity production, transmission, and distribution on its respective domain. Self-generation is not allowed, and IPPs are permitted only on the Family Islands (NEPC 2008, pp. 5, 9).

3.2.8.4 National Energy Policy Committee

The Bahamas National Energy Policy Committee published a draft NEP ("First Report of the NEPC") in 2008. At the time of this analysis the second draft was being reviewed by an external consultant financed by the Inter-American Development Bank. To date, the NEP has not been adopted by the government as policy. The draft NEP outlines both targets and policy objectives over the short, medium, and long term for the nation. The NEP details an implementation strategy for these goals, identifying activities for each responsible agency to pursue. Finally, the NEP identifies international sources of financing and technical expertise advantageous in achieving the policy (NEPC 2008, pp. 14–26, 28).

The short-term targets and objectives include completing a renewable energy assessment and developing energy-use metrics, starting an energy-conservation program, phasing out incandescent lights, and monitoring fossil-fuel losses. In the medium term (5 to 10 years), the plan calls for increasing building efficiency, installing RE capacity in small communities, piloting reverse thermal gradient cooling and ocean thermal energy technologies, and assessing biomass and ocean sources. Among other long-term goals, the plan calls for the Bahamas to establish funding mechanisms for energy technology innovation and a program to minimize GHG emissions. Throughout these phases, the plan also stresses the transportation sector through integrated traffic management, increased public transportation, and fuel economy standards (NEPC 2008, pp. 14–17).

The draft NEP identifies the Inter-American Development Bank as one of as the primary sources of funding for energy assessment in the Bahamas through two technical cooperation grant programs, the Sustainable Energy Climate Change Initiative (SECCI) and the Infrafund. The SECCI promotes energy and environmental programs, and aims to claim carbon credits. The Infrafund is specific to the BEC utility, supporting efficiency and RE capacity assessments. The Bahamas NEP identifies several sources of technical assistance, including the Global Environmental Facility (GEF), the CREDP, the EU Energy Initiative (EUEI) through the Caribbean Sustainable Energy Program (CSEP). The Global Environmental Facility will assist in the phase-out of incandescent lights, supply and installation of photovoltaic cells and net metering/billing, and supply and installation of solar water heaters. The CREDP will assist with the development of a comprehensive energy policy. The European Union Energy Initiative—through the Caribbean Sustainable Energy Program (CSEP)—will assist with generating legislation and policies that define electricity supply activities and promoting energy efficiency and conservation in coordination with the IDB. A public-awareness campaign and the dissemination of findings of the two IDB reports identifying and mitigating barriers to RE adoption also are planned (NEPC 2008, p. 30).

3.2.9 Conclusions and Recommendations

- Despite the efforts, there are no measurable benefits from current legislation and projects developed in the country to reduce the rate of oil importation and consumption found during the period of analysis. Oil consumption still is increasing and internal volatility is affecting national energy security. International agreements were found to have no measurable impacts on fossil-fuel consumption rate during the period of analysis. Previous studies have indicated that the Bahamas should perform the following tasks.
- Give the PUC the appropriate regulatory authority over electrical utilities. An independent regulator (such as the PUC) would provide the expertise, transparency, and accountability required to set and monitor RE targets (Wilson 2009, p. 33).
- Create incentives to encourage the development of RE technologies (Wilson 2009, p. 33).

This study recommends that the Bahamas also should complete the following tasks.

- Finalize and adopt the NEP. Work on many of the medium-term objectives can be started immediately if the proper expertise, investment, and policymaking can be coordinated.
- Assess its high per-capita electrical consumption in comparison to the overall regional consumption.
- Assess wind potential among populated islands other than Grand Bahama.

- Assess the potential for interconnections among the many distributed and isolated grids unique to the Bahamas.
- Assess and develop expertise in ocean RE technologies unique to the Bahamas.

3.3 Dominica

Item	Value
Land Area	751 km²
Population	72,800
Supply Diesel Hydro Wind	24.77 MW 17.17 MW 6.42 MW 225 kW
Price	U.S. $0.4567 per kilowatt-hour

Sources: CIA 2010; Posorski & Werner 2009, p. 61; Fadelle 2009, p. 10; DOMLEC 2008, p. 17.
Notes: Supply includes distributed generation.

Dominica is a volcanic island located between the French territories of Guadeloupe and Martinique. With diverse geology, including rainforests, coral reefs, and more than 365 rivers, Dominica is the largest and most mountainous of the Windward Islands. It is an island nation of 750 sq km, with a population of 72,660 and has a GDP per capita of U.S. $10,415. The country was close to economical crisis in 2003 and 2004, but Dominica's economy grew by 3.5% in 2005 and 4.0% in 2006. Its main activities are tourism and agriculture.

3.3.1 Energy Governance Stakeholders

3.3.1.1 Government Agencies

The Ministry of Public Utilities, Energy and Ports has several component offices to carry out its responsibilities of setting the nation's energy policy (Posorski & Werner 2009, p. 63). The Energy Unit of the ministry sets policy on electricity generation and distribution, including development of RE (Posorski & Werner 2009, p. 63). The unit has an office coordinating Dominica's Renewable Energy Programme (Fadelle 2009). Additionally, in 2010 a Project Management Unit (PMU) was established; it is in charge of the geothermal resource development. With officers appointed by the ministry, the Independent Regulatory Commission (IRC) is entrusted to regulate electrical licensees and approve electricity tariffs. The IRC was established by the Electricity Supply Act of 2006 (ESA), and became effective in mid-2007. The ministry also includes the Dominica Water and Sewage Company Ltd., a government-owned entity, and has responsibility for ports and disaster preparedness (Posorski & Werner 2009, p. 63).

3.3.1.2 Utilities and Independent Power Providers

Dominica Electricity Services Limited is the sole electrical utility on Dominica, and has a license to operate until 2015. The ESA legally opened the market to independent power producers, but unclear technical and policy details have discouraged IPPs from entering the market (Posorski & Werner 2009, p. 63; (Loy 2009, p. 8).

3.3.2 Electricity Market

3.3.2.1 Utilities

DOMLEC is majority-owned (51%) by United States–based WRB Enterprises, with 20% owned by the Dominica Social Security administration, and the remainder by local corporations and residents (Posorski & Werner 2009, p. 61). The utility's annual operating and financial statistics are available for 2003 to 2008 (DOMLEC 2007).

3.3.2.2 Electricity Supply

Table 7. Dominica Electricity Services Limited (DOMLEC) Power Plant Description and Performance

Item	Value	Notes
Plants Diesel Hydro	5 2 3	 Fond Cole and Portsmouth diesel plants. Laudat and Trafalgar hydro plants. Padu currently is offline.
Capacity Diesel Hydro	22.45 MW 16.03 MW 6.42 MW	Per Fadelle (2009), hydro has decreased since 2007 (see in-text discussion below).
Peak Demand	14.7 MW	Steady growth from 10 MW in 1996; Nexant expects annual growth of 2.7% (to 25 MW) by 2028.
Total Electricity Generated (GWh)	87.5	Nexant expects 2.5% annual growth (to 139 GWh) by 2028.
Total Electrical Sales (GWh)	73.7	Steady growth from 45 MW in 1996. Nexant expects 2.5% annual load growth (to 124.2 GWh) by 2028.
Total Diesel Fuel Used (MM imp gal)	3.915	Increased by nearly 500,000 gallons in 2007 due to changes in generation mix, resulting in U.S. $1.5 million in increased fuel costs.
Fuel Efficiency (kWh per U.S. gal)	17.1	Stable since at least 2004.
Unit Retail Price (U.S. $ per kilowatt-hour)	0.4567	Increased from U.S. $0.32 per kilowatt-hour in 2004.
Unit Generation Cost (U.S. $ per kilowatt-hour)	0.4318	Calculated for 12/2008 using: 0.18 € per kilowatt-hour generation cost (Posorski & Werner 2009, p. 62), U.S. $1.47 per € exchange rate (OANDA 2010), and U.S. $0.1672 per kilowatt-hour fuel surcharge (Fadelle 2009,

Item	Value	Notes
		p. 11). Increased from U.S. $0.21 per kilowatt-hour in 2003 (Loy & Farrell 2005, p. 11).

Values current for 2008.
Sources: Posorski & Werner 2009; Nexant 2010; Fadelle 2009; DOMLEC 2008.
Peak demand, generation, sales: Nexant 2010; Fadelle 2009.
Unit Retail Price: DOMLEC 2008, p. 17.
Unit Generation Cost: OANDA 2010.
Note: Market summary does not include contributions from distributed generation.

Figure 12 describes the historical electricity generation in Dominica, including hydro and diesel generation.

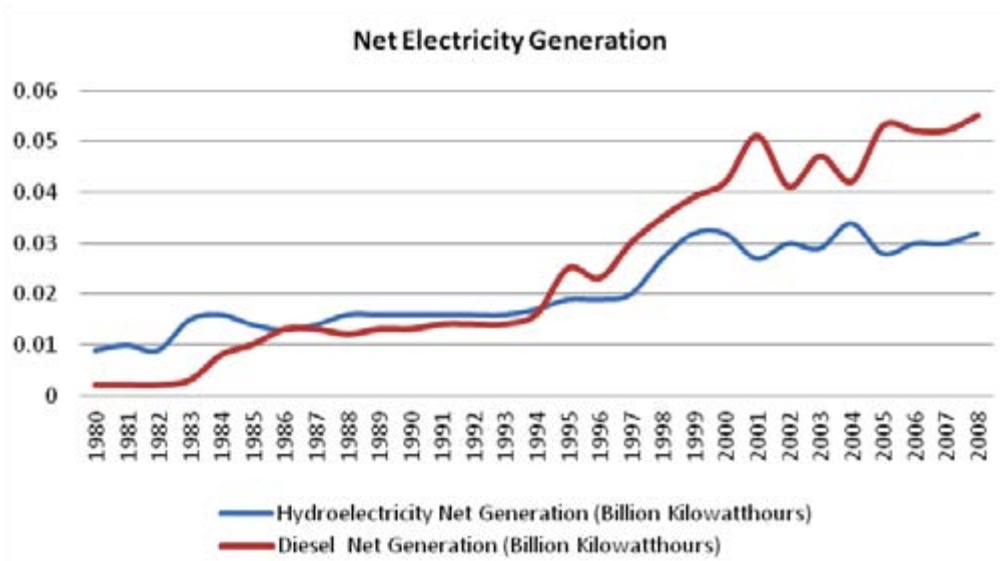

Figure 12. Hydro and diesel net electricity generation on Dominica

Figure 12 shows an interesting trend, where until 1994 the electricity generation was composed by more than 50% originating from a renewable energy source (hydropower), this showcases that investment in identifying and developing RETs is not the end goal of greening the power sector, considerable efforts are needed in Demand Side Management and Energy Efficiency improvements, and the continuous monitoring and management of the supply and demand balance.

3.3.3 Generation Mix

The proportion of available RE capacity has decreased in Dominica over time. The latest decrease was in 2007, where three new diesel generators totaling 4.2 MW were installed to replace older units at Fond Cole, resulting in a 1.28-MW net addition to the system. That same year, Hurricane Dean struck the island and damaged the Padu hydro plant—making it unavailable for production. Consequently, although the nameplate hydro capacity totals 7.6 MW (Posorski & Werner 2009, p. 61), only 6.42 MW is available (Fadelle 2009, p. 9). Nexant contends that even less is available, showing 5.0 MW (Nexant

2010, p. 5.3). DOMLEC had expected to restore the Padu plant, but there is no indication that the restoration has yet been completed (DOMLEC 2008, p. 17).

There are also differing forecasts of short-term capacity expansion for Dominica. The Energy Unit presentation indicates plans for a 7.5-MW “supplementary” plant with financial assistance from the Government of Venezuela (Fadelle 2009, p. 34), but DOMLEC does not discuss such a project (DOMLEC 2008, p. 60). In any case, Nexant forecasts that Dominica will need additional capacity starting in 2012, and assumes this would be another 5 MW of diesel (Nexant 2010, pp. 5.9, 13.2). The additional diesel capacity would be necessary to provide adequate supply if there are delays in the geothermal program.

3.3.4 Electricity Prices

Dominica has one of the highest costs of electricity in the Caribbean, peaking at an average of U.S. \$0.4567 per kilowatt-hour in 2008, with the fuel contributing nearly half of this cost (DOMLEC 2008, p. 17). Electricity consumers face costs based on a two-tiered unit tariff and a per-unit fuel surcharge. Residential customers pay approximately U.S. \$0.26 per kilowatt-hour for the first 50 kWh per month, and U.S. \$0.30 per kilowatt-hour per month thereafter. The fuel surcharge directly passes DOMLEC’s cost of fuel to the consumer, with an average of U.S. \$0.1273 per kilowatt-hour from 2004 to 2009, peaking in August 2008 at U.S. \$0.2513 per kilowatt-hour (Fadelle 2009, pp. 10–11). Residential costs also include a negligible fixed monthly fee of less than U.S. \$1 per month (Posorski & Werner 2009, p. 62), and a VAT (value-added tax) of 15% applied to the cost of use in excess of 100 kilowatt-hours per month (DOMLEC 2007).

Production costs are not available, but in their discussion of geothermal energy, Posorski and Werner use a generation cost of 0.18 € per kilowatt-hour for comparison (Posorski & Werner 2009, p. 62). Including a fuel surcharge of U.S. \$0.1672 per kilowatt-hour (Fadelle 2009, p. 11), and an exchange rate of U.S. \$1.47 per Euro (€) (OANDA 2010)—both typical for 2008—leads to an estimated production cost of U.S. \$0.4318 per kilowatt-hour from DOMLEC’s distillate plants. This represents nearly a doubling of the cost since 2003, when generation costs averaged U.S. \$0.21 per kilowatt-hour (Loy & Farrell 2005, p. 11). Given that oil prices peaked in 2008, current generation costs are expected to fall somewhere between these two extremes.

3.3.5 Electricity Demand

Dominica has nearly 100% electrification, thanks to past rural electrification programs funded by the Caribbean Development Bank (CDB), USAID, and OAS (Loy & Farrell 2005, p. 12). Electrical demand for the nation has slowed since the mid 2000s as a result of high oil prices, and is expected to grow modestly by 2.7% annually in the future (Nexant 2010, p. 6.3). Figure 13 shows the electricity consumption over the past 30 years.

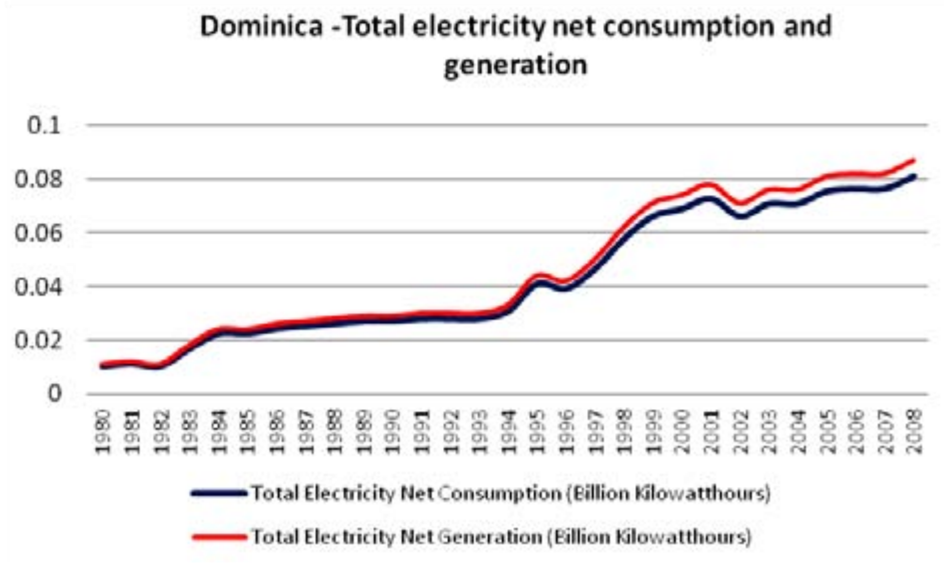

Figure 13. Net consumption and generation of electricity on Dominica

Table 8 Electricity End Uses in Dominica

	Customers	Consumption (MWh)	Consumption per Customer (MWh)
Domestic Households	28,000	34,000	1.21
Commercial	4,000	30,300	7.58
Industrial	30	6,000	200.00
Hotels	429	2,000	4.65
Street Lighting	# N/A	1,330	# N/A
Own Use	# N/A	3,200	3.77% of net generation
Losses	# N/A	10,600	12.5% of net generation
Source DOMLEC 2008, p. 60. Consumption per customer calculated, except losses.			

Table 8 serves as an initial guideline in prioritizing energy auditing efforts, highlighting the highest energy consumers, industries, commerce and hotels in order of consumption rate per costumer.

3.3.6 Energy Efficiency

DOMLEC experienced 12.5% losses on net generation in 2008. Although this is the lowest in company history, it nevertheless is high for the region (DOMLEC 2008, p. 4).

3.3.7 Demand Management

The utility in Dominica has a new demand response-management platform and is analyzing automated metering infrastructure in a pilot project. DOMLEC promotes energy conservation to the public through energy savings tips on its website. DOMLEC has implemented the JUICE demand response management platform, marketing it as a “Pay As You Go” (PAUG) customer interface, replacing an earlier system in place since 2003 (DOMLEC 2010). JUICE is a demand response management platform for smart metering (Utilisol). The AMI pilot project began in 2008, and the utility reports encouraging results, with benefits to both customers and its own operations (DOMLEC 2008, p. 20).

3.3.8 Building Codes

The Physical Planning Division administers building codes for Dominica, and it is reported that these codes generally are followed by local architects (Baptiste 2010). The building codes in Dominica were drafted in 2001 and are based on OECS model building code (Wilson 2001). The Physical Planning Act of 2002 discusses building codes but does not specifically adopt or address the OECS code (Commonwealth of Dominica 2002, pp. 180–183). In response to the 2010 Haitian earthquake, the Dominican Ministry for Immigration, National Security, and Labour recently ordered a review of Dominican seismic codes, stressing that the current codes are directed at addressing hurricane hazards (Dominica News Online 2010).

3.3.9 Energy Supply Outlook

3.3.9.1 Fossil Fuels

Dominica participates in PetroCaribe (Burke 2009, p. 5). To provide future supply, the *World Bank Report* projects that, if geothermal cannot be developed, the least-cost fuel combination is 5 MW of additional diesel capacity for peak, mid-range, and base-load duties (Nexant 2010, pp. 1.8, 8.46, 8.48). The cost of fossil-fuel energy for Dominica could be reduced with the expansion of the regional petroleum facilities in St. Lucia (Nexant 2010, p. 7.22).

Electrical utilities typically back up renewable capacity from dispatchable sources. The existing diesel generators initially would serve this purpose, but fossil-fuel capacity eventually would have to expand to meet reserve and spinning capacity requirements (Nexant 2010, p. 8.49).

3.3.9.2 Renewable Energy

Table 9. Dominica Renewable Energy Potential

Technology	Value
Hydro	17 MW
Wind	30 MW
Geothermal	300 MW
Solar	45 MW
Biomass and Other	Unknown

Sources: Hydro, Loy 2007, p. 9.4; wind, geothermal, Loy & Farrell 2005, p. 13); solar, Nexant 2010, p. 8.36.

Screening curve comparisons indicate that renewable energy is the most cost-effective source for Dominica, using current costs and available technology. Geothermal and wind both compare favorably with diesel—the cheapest fossil fuel available for Dominica—for capacity factors greater than 20% (Nexant 2010, pp. 8.46–8.48).

3.3.9.2.1 Hydro

During the 1960s, hydro supplied nearly 90% of Dominica's electrical power. As the population and load grew, however, the use of diesel fuel increased, particularly due to the seasonal availability of hydro resources. Currently, water shortages during the dry season decrease the available capacity to 3.6 MW (Loy 2007, p. 9.4). The age of the hydro plants also is a concern; plants currently operating were built between 1965 and 1988. In 2005, CREDP/GTZ studied feasibility of upgrades and expansion at Trafalgar and Padu. Some overhauls began at Padu prior to the damage from Hurricane Dean in 2007 (Loy 2007, pp. 9.4, 9.12). In 2008, DOMLEC received U.S. $1.4 million in funding—to repair Padu—from insurance claims on the plant. Repair has taken longer than expected due to the timing of insurance settlement, and because the manufacturer is out of specific electromechanical components (DOMLEC 2008, pp. 15, 20).

Dominica has potential to expand its hydro capacity for both utility and distributed generation. Since 2003, the CREDP/GTZ has consulted in identifying additional hydro sites and in river gauging (Loy 2009, p. 11), which DOMLEC has continued (DOMLEC 2008, p. 21). There is interest in self-generation from several industrial enterprises and at least one resort, and there exists a number of potential IPPs. Particularly, the CREDP has assisted the Dominica Water and Sewerage Company in the Newtown project, for which utilizing an existing conduit could provide 150 kW of commercial output (Loy 2009, p. 11; Loy 2007, p. 9.4).

3.3.9.2.2 Wind

The Rosalie Bay Resort installed a 225-kW wind turbine for self-generation in 2008; the first mid-scale wind development in Dominica. It is expected to produce 596 MWh annually, and surplus generation can be sold back to the grid (Posorski & Werner 2009, p. 64). Since 2003, the CREDP/GTZ has consulted with DOMLEC in wind development, reviewing historical wind studies and identifying potential sites on the island (Loy 2009, p. 10). Crompton Point is identified as having 10 MW potential, contributing to a total of 30 MW along the east coast of Dominica (Loy & Farrell 2005, p. 13). DOMLEC has continued this initiative but has had difficulty in acquiring the necessary land (due to the area's small land parcels and unclear land ownership), and in facing the geographic and transportation challenges. Wind data was collected at the Pointe Mulâtre site from 2004 to 2006, and the utility has ordered two new measurement towers (DOMLEC 2008, p. 21). DOMLEC is developing seven of nine wind sites identified (Nexant 2010, p. 8.44).

3.3.9.2.3 Geothermal

Geothermal has been explored in Dominica since 1977 (Loy & Farrell 2005, p. 14). Although some extremely optimistic studies have indicated the potential for as much as 1,390 MW (Joseph 2008), the geothermal potential for Dominica more often is cited as being a fraction of this estimate, ranging from 100 MW (Nexant 2010, p. 8.36) to 300 MW (Loy & Farrell 2005, p. 14).

As discussed above, the development of the Wotten Waven site at the southern part of the island is the current priority of Dominica's energy program (Fadelle 2009, p. 22). This site alone has been assessed as containing potential for up to 120 MW, through the use of up to 40 production and reinjection wells (Posorski & Werner 2009, p. 62). The government's Energy Development Programme intends to produce at least 20 MW, reducing the cost of electricity to U.S. $0.06 per kilowatt-hour (excluding fuel costs) (Fadelle 2009, p. 27). The latest developments include the performance of more detailed planning and studying of the feasibility of exporting electricity generated from geothermal resources on Dominica to neighbouring island Martinique and Guadeloupe (European Investment Bank, 2012).

Furthermore to carry out exploration and development efforts in another potential geothermal site, the government issued a license to West Indies Power (Dominica) Limited (WIP) in 2008. WIP is a regional geothermal IPP that currently is installing a plant in Nevis (West Indies Power 2009; Caribbean Net News 2010). The company performed geochemical, geophysical, and geological assessments for the site in 2008 (Fadelle 2009, p. 22), and was to begin drilling exploration wells in 2009 (Nexant 2010, p. 8.45). Note that the activities by WIP are not occurring at Wotten Waven, but at another site in Soufriere.

DOMLEC expects the first plant at the site to be 10 MW to 15 MW (Nexant 2010, p. 8.45), and the utility reports that it is in "constructive engagement" with WIP and other potential IPPs (DOMLEC 2008, p. 21), but no power purchase agreement was found at present.

3.3.9.2.4 Solar

The solar resource in Dominica varies greatly from the windward side to the leeward side (Figure 14). The western side of the island has good solar resources for flat-panel PV and solar hot water systems with GHI averaging more than 5.6 kWh/m^2/day. The eastern half of the island has poor resources. The DNI resouce on both sides of the island is far worse, suggesting that concentrated solar would not perform well in this region. See Http://www.ecpamericas.org/initiatives/default.aspx?id=31 for full-page copies of the GHI and DNI solar maps.

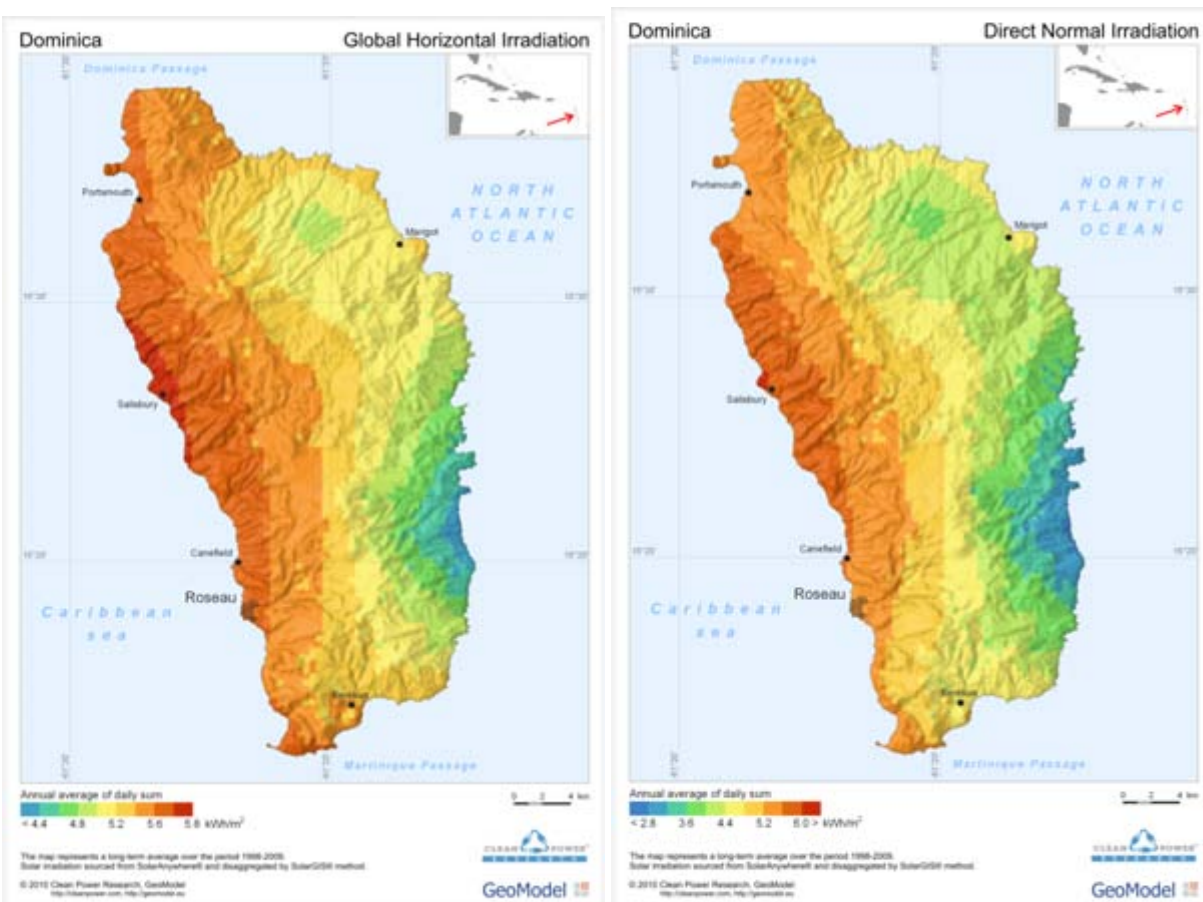

Figure 14. Solar maps of Dominica

There are a few solar water heaters (SWH) installations in Dominica (Loy & Farrell 2005, p. 12), although the hospitality sector has substantial latent demand for SWH, according to a CREDP/GTZ market study conducted on Dominica, St. Lucia, and St. Vincent (Loy 2007 p. 140). The Energy Development Programme intends to further audit this market, and encourage SWH use in both the residential and hospitality sectors (Fadelle 2009, pp. 34, 36). The ECPA Caribbean Initiative has in 2011 engaged with the Ministry of Public Utilities, Energy and Ports in preparing a national solar water heater awareness campaign to facilitate the increase in investments and use of SWH.

DOMLEC does not have any demonstration or utility-scale PV plants, but there is distributed generation from both the government and hospitality sectors in isolated locations, including a small-scale PV system at Morne Diablotin National Park (Loy 2007, p. 9.25). The Rosalie Forest / 3 Rivers Eco Lodge has several isolated systems with SWH, micro hydro, PV, wind, and battery storage (Winston 2009).

3.3.9.2.5 Biomass and Other

Dominica could possess viable biomass resources available from its forests and agriculture (Loy & Farrell 2005, p. 15). Domestic heating and cooking use a great amount of biomass in traditional roles; however no studies have been done to quantify this information or show potential for modern energy developments in this area (Posorski & Werner 2009, p. 61).

3.3.10 Interconnections

Dominica has so much geothermal potential that interconnections with the neighboring French islands of Martinique and Guadeloupe are considered to be an essential part of Dominica's energy future (Loy 2009, p. 14). Indeed, much of the funding for RE assessment has come from Europe due to these interests, and this is expected to continue as financing for development of the resource (Fadelle 2009, p. 19). Sponsors of these past studies include EU's Interreg IIIB program and ADEME (the French Environment and Energy Management Agency) (Posorski & Werner 2009, p. 62). The Dominican government intends to build interconnections capable of exporting at least 40 MW each to Guadeloupe and Martinique (Fadelle 2009, p. 27). As an active player in the operation, West Indies Power also considers this power interconnection to be a critical component of development in Dominica (McDonald 2009).

3.3.11 Energy Sector Regulatory Framework Analysis

In 2004, the CREDP/GTZ prepared country studies on "The Status of Energy Policy in Selected Caribbean Countries." The status of energy policy in Dominica was assessed but, although a few things have remained unchanged, there has been significant development on the policy front.

3.3.12 Legal and Regulatory Framework

- A draft sustainable energy plan (SEP) was completed with assistance from GSEII/OAS. This plan was updated in October 2009.
- Specific targets for the electricity sector until 2008 were set: stabilizing peak demand and increasing the renewable energy standard share of installed capacity to almost 50%; and any such accomplishment would be dependent on approval of the SEP. To date, these targets have not been met. In fact, the recently updated SEP, which has not yet been finally approved, indicates in Action 7 that a renewable energy portfolio standard (REPS) for Dominica will be established and that the REPS will "impose that at least 50% percent of installed capacity shall be renewables-based by 2020" (Government of the Commonwealth of Dominica 2010a, p. 18).
- A long-term goal was established by the government to provide 65% to 70% of electricity from hydropower by 2015. Currently, only 4% of hydropower is contributed to the energy mix (Government of the Commonwealth of Dominica 2010b, pp. 14).
- Previously, 50% of DOMLEC was owned by a private company (WRB Enterprise) and the rest owned by the Dominica Social Security Scheme and the Government of Dominica. DOMLEC now is a majority privately owned utility company. The Dominica Private Power Ltd, a company registered in the Turks and Caicos, owns 52% of DOMLEC's shares, Dominica Social Security holds 21%, and the remaining 27% are held by members of the public.

- Under the Electricity Supply Act, DOMLEC had exclusive rights to generate, transmit, distribute, and sell electricity in Dominica until December 2025, with an option to renew (Section 3, Section 21(1)). Further, although self-generation was permitted, it required a license from DOMLEC. With assistance of the World Bank, the Electricity Supply Act (ESA) was revised in 2006, thereby ushering in regulatory and sectoral reform. Among the changes is the shortening of DOMLEC's exclusive license period from 2025 to 2015. Further, private entities can receive a license for self-generation and to feed into the grid.
- Renewable energy systems continue to be exempted from import taxes.
- The energy sector had no discernible regulatory structure. The revised ESA (2006) provides for the establishment of an Independent Regulatory Commission, with a mandate to regulate all electricity entities and all related licenses (Section 19).

3.3.13 Assessment of the Draft National Energy Policy

The volatility of energy prices, acute dependency on fossil fuels, and climatic/weather events, are among the key challenges facing Dominica's energy sector. There also is tremendous potential for the exploitation of—and even trade in—renewable energies such as geothermal power. The NEP represents the government's strategy for the development and use of sustainable energy which is a key component toward Dominica's overall sustainable development. The core objectives of the NEP include greater energy security, increased energy independence, greater environmental sustainability; and the reduction of energy costs and tariffs (Government of the Commonwealth of Dominica 2010b, p. 7). Moreover, the guiding principles of the NEP are gleaned from the *Saint George's Declaration of Principles for Sustainability in the OECS,* which provides that "the promotion of energy conservation through the use of energy efficient technologies and systems will be a high priority for everyone in the region. However, the people of the region will expand their use of renewable energy sources such as solar and wind power" (OCES Principle 16).

In terms of policy expression, the NEP establishes goals and policies for the following categories: Institutional issues, non-renewable energy resources, renewable energy resources, renewable energy technologies, energy efficiency, and conservation; and for the transport, power, agriculture, hotel and tourism, industry, and domestic sectors.

3.3.13.1 Institutional Issues

In this respect, the goal of the government is to develop new energy policies supported by action plans which define measurable targets and timeframes. The actions in pursuance of the goal, however, must be further developed. The overall institutional framework makes no mention of the Independent Regulatory Commission. Although it does establish a National Sustainable Energy Office within the Ministry of Public Works, Energy and Ports, it does not include sufficient provisions for effective inter-institutional cooperation, including clear mandates, roles and responsibilities of various government agents in the energy sector, and a chain of command and responsibility.

3.3.13.2 Non-Renewable Energy Resources

The goal of the government is to "provide a safe, reliable, and affordable petroleum supply and promote their clean management and use, in an effort to foster efficiency and cost saving" (Fichtner 2010). It would seem that, given volatile energy prices and high consumption of fossil fuels, part of the goal also should include reducing fossil-fuel use and imports. Moreover, in terms of the activities to be executed for the goal's accomplishment, the provision of subsidies to enable access to energy by "marginalized groups in society" should be exercised with caution lest they lead to increased and inefficient energy use. Additionally, monitoring and evaluation; setting reporting standards; and data reporting to the appropriate domestic agency on the use, achievement in goals/objectives, and targets of non-renewable energy resources also should be included in this section.

3.3.13.3 Transportation Sector

The policy statements are quite benign and devoid of specifics. One policy, for example, is that the government will "encourage the importation of fuel efficient vehicle." This policy statement does not indicate how it will be done. Another example is that the government will "discourage the importation of vehicles that are more than five years old." This raises the question as to the form and nature of such discouragement. Further, for this sector it might be important to include provisions in terms of fuel use–fuel mix in public transportation vehicles, and for mechanisms to promote the use of public transportation. Additionally, the review and possible amendment of traffic and transportation management plans are critical to ensuring energy efficiency in transportation sector.

3.3.13.4 Power Sector

There should be included a policy requirement that the power sector utilize renewable sources of energy in the provision of energy services. Provisions on net-metering/net-billing and feed-in tariffs also are notably absent.

3.3.13.5 Hotel and Tourist Sector

Energy audits for the energy sector should not only be encouraged but be required, especially considering the high rate of energy consumption in this services sector. Energy use/efficiency standards also should be established for this sector.

3.3.13.6 Industrial Sector

Energy audits/data reporting also should be required of this sector.

3.3.14 Sustainable Energy Plan

The current plan of action for the government of Dominica centers on a 3-year study of geothermal development on the island, funded by approximately U.S. $7 million from the European Union and AFD (*Agence Française de Développement*). The study is to technically prove the resources at the Wotten Waven site, by further drilling and geological characterization. It also will recommend domestic utility policy and analyze power interconnections to Guadeloupe and Martinique (Fadelle 2009, pp. 19–27). In the short term, the government also intends to address the weaknesses in its current energy policy. It will refine the 2006 ESA to clarify regulations for IPPs, and adopt renewable energy legislation and regulations, per World Bank recommendations (Fadelle 2009, p. 28).

Secondary to these goals, the Dominica Energy Development Programme also calls for studies of additional hydropower and geothermal sites, energy audits of government facilities, and incentives to encourage use of solar hot water systems in homes and hospitality sectors (Fadelle 2009, p. 34). Lastly, the Energy Unit intends to draft a SEP which will detail the strategy to achieve the NEP through opportunities for local labor and foreign investment (Fadelle 2009, pp. 31–33).

3.3.15 Conclusions and Recommendations

Previous studies have made the following recommendations for Dominica.

- The island experiences the highest prices for electricity in the region, while it possesses huge geothermal resources, as well as wind, solar, hydro, and landfill gas—giving Dominica the potential to be an RE showcase nation. It has enough geothermal energy to become a net exporter of electricity to neighboring islands. Dominica has three legacy hydro plants, and installed its first wind turbine in 2008 (Posorski & Werner 2009, p. 53). Dominica should focus on developing these resources.
- Dominica's experience in energy-sector reform, particularly unbundling and privatizing the sector, could serve as example for other SIDS.
- Despite the hydroelectricity generation and the current efforts made by the government, no measurable benefits from current legislation and projects developed in the country to reduce the rate of oil importation and consumption were demonstrated during the analysis period. Regardless the hydropower currently used—which has been surpassed by fossil-fuel use—the oil consumption still is increasing and internal volatility is affecting the national energy security.
- The government should adopt a national energy policy to determine its energy policy goals and long-term supply strategy. This will reduce risk of "deterioration of the electricity sector" due to policy uncertainty, and will encourage long-term investment (Posorski & Werner 2009, p. 63; (Loy 2009, pp. 8–9).
- Within the auspices of the NEP, the government should adopt a sustainable energy plan, as it has a unique opportunity to become the first country to rely completely on sustainable energy, and become a showcase nation (Loy & Farrell 2005, p. 12).
- The government should address the policy deficiencies that have prevented IPPs from investing in RE and self-generation (Posorski & Werner 2009, p. 63; Loy 2009, pp. 8–9).

- Policies specific to IPP's should include:
    - Policy for IRC to determine excess, backup, and reserve power tariffs;
    - Policy for licensing and guidelines for operation of IPPs; and
    - Guidelines for power purchase agreements (Loy 2009, p. 12).
- The government should address the lack of RE and self-generation policy, including:
    - Technical rules for grid connection of self-generators and small-scale RE installations; and
    - Rules for net metering (Loy 2009, p. 12).
- The government of Dominica should address energy efficiency as follows.
    - Conduct energy audits in government, commercial, and public buildings. Table 8 can serve as a guideline to prioritize energy efficiency improvement efforts, starting with high energy consumers as the industry and hotel sectors;
    - Work with other islands to develop building codes that address energy efficiency
    - Ban incandescent light bulbs, and compel the standards agency to set standards for energy-consuming appliances (Loy 2009, p. 12)
- The government should mandate the use of solar water heaters for new construction (Loy 2009, p. 12). The government should prioritize incentives for solar water heaters prior to considering whether to make them mandatory (per Loy 2009, p. 12).

- The government and international agencies should undertake detailed study of biomass energy, including incentives for dryers and biodigesters, and biofuels from sustainable sources, to evaluate the effect of these measures on the sustainability of the agricultural sector.

3.4 Grenada

Item	Value
Land Area	344 km²
Population	107,800
Supply Diesel Wind Solar	52 MW 51 MW 80 kW 74 kW
Price	U.S. $0.3234 per kilowatt-hour

Sources: CIA 2010; Posorski & Werner 2009; Hosten 2009.
Note that supply includes distributed generation.

Grenada consists of a mountainous main island and the southern Grenadines—including the inhabited islands of Carriacou and Petit Martinique. Venezuela, Trinidad and Tobago lie to the south, and St. Vincent and the Grenadines are just to the north. Grenada is 344 km^2 (133 sq mi.), with an estimated population of 110,000. Its capital is St. George's. Grenada's annual generation is approximately 190 GWh/year. It is one of the largest consumers of energy in the Eastern Caribbean, relying almost 100% on imported fossil-fuel products. The major energy commodity consumed is diesel (58%), followed by gasoline (29%), jet aviation fuel (8%), and LPG (4%), plus limited quantities of kerosene and other fuel derivates. The electricity sector consumes nearly 50% of imported fuels followed by the transport sector (43% from road, sea, and air travel). The GDP per capita is U.S. $10,657. Tourism is Grenada's main economic force and exporting and producing several different spices. It's the second-largest producer of nutmeg, after Indonesia.

3.4.1 Energy Sector Outlook

3.4.1.1 Energy Stakeholders

3.4.1.1.1 Government Agencies

The Division of Energy and Sustainable Development is in charge of drafting Grenada's NEP (Burke 2009). The Ministry of Finance, Economic Development, Energy and Foreign Trade has responsibility for implementing energy policy, and is the designated national authority for the Kyoto Protocol (Posorski & Werner 2009, pp. 67–68). The Ministry of Works is responsible for enforcement of building codes and provides engineering support to government and statutory bodies (Government of Grenada 2010).

3.4.1.1.2 Utilities and Independent Power Producers

Grenada Electricity Services Limited has the exclusive license to generate, transmit, distribute, and sell electricity in Grenada until 2073 (Posorski & Werner 2009, p. 67). Independent power providers are allowed by sublicense from the utility, which also allows self-generation with net-metering of up to 10 kW (Loy 2007, p. 136).

3.4.2 Electricity Market

3.4.2.1 Utilities

GRENLEC is publicly traded, with 50% of shares held by United States–based WRB Enterprises, 21% by the Government and the National Insurance Scheme of Grenada, 4.5% by employees, and 16.5% by Grenadian and Caribbean nationals (GRENLEC 2010).

3.4.3 Electricity Supply

Table 10. Grenada Electricity Market Summary

Item	Value	Notes
Plants	3	All diesel generators
Capacity (MW)	50.9	48.5 MW in Queen's Park, Grenada; 1.92 MW in Carriacou, 480 kW in Petite Martinique
Peak Demand (MW)	29.8	0.5 MW on Carriacou (Loy & Farrell 2005, p. 22); GRENLEC expects national annual growth of 4.1%; Nexant expects annual growth of 5.4% (to 84 MW) by 2028
Total Electricity Generated (GWh)	197	Experienced 7% annual growth since 2003; Nexant expects 5.3% annual growth (to 530 GWh) by 2028
Total Electrical Sales (GWh)	189	
Total Diesel Fuel Used (MM imp. gal)	8.9	Calculated from 80.91% of diesel consumption by electricity sector, out of 11 million imp gal total (Lambrides 2009, p. 5)
Fuel Efficiency (kWh per U.S. gal)	16.27	Increased from 13.5% in 2000, and stable since 2005 (GRENLEC 2009, p. 23)
Unit Retail Price (U.S. $ per kWh)	0.3234	Calculated from 0.22 € per kilowatt-hour at end of 2008 (Posorski & Werner 2009), and average annual exchange rate of U.S. $1.47 per € for 2008 (OANDA 2010)

Values current for 2008.
Sources: Posorski & Werner 2009; Nexant 2010; GRENLEC 2010.
Note: Market capacity does not include contributions from distributed generation.

Figure 16 describes the historical electricity generation in Grenada. A steady growth of the electricity generation is observed during the past 30 years, despite the increase of oil prices and volatility.

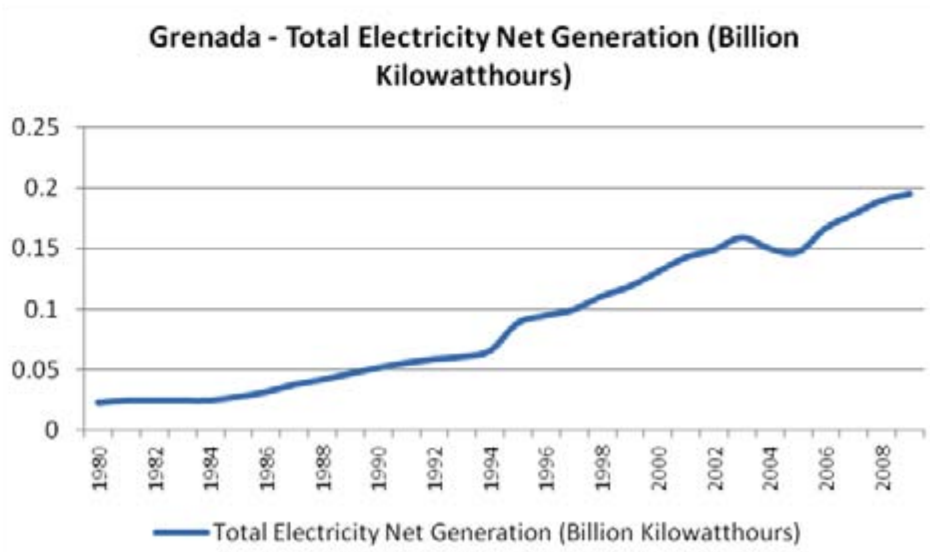

Figure 16. Electricity generation in Grenada

3.4.4 Electricity Demand

Grenada has nearly complete electrification at 99.5% (Loy 2007, p. 135). Electrical demand for the nation is expected to grow by 4.2% annually. Among economic sectors, commercial and industrial sales both are expected to grow by 4.8% annually, and residential by 4.4% (Posorski & Werner 2009, p. 67). Based on this growth, Grenada will require added new capacity by 2013 (Nexant 2010, p. 13.3).

Table 11. Grenada Electricity End Uses

	Customers	Consumption (MWh)	Consumption per Customer (MWh)
Domestic Households	35,000	66,232	1.89
Commercial	5,330	96,600	18.12
Industrial	36	5,628	156.33
Street Lighting	#N/A	4,041	#N/A
Own Use	#N/A	7,133	3.77% of net generation
Losses	#N/A	10,191	5.39% of net generation

Source: Posorski & Werner 2009, p. 66. Losses and Consumption per customer calculated.

Figure 17 shows electricity consumption and generation during the last 30 years; the trend describes a sustained growth. The current trend will be difficult to sustain in the long term with an electricity matrix based on fossil fuels.

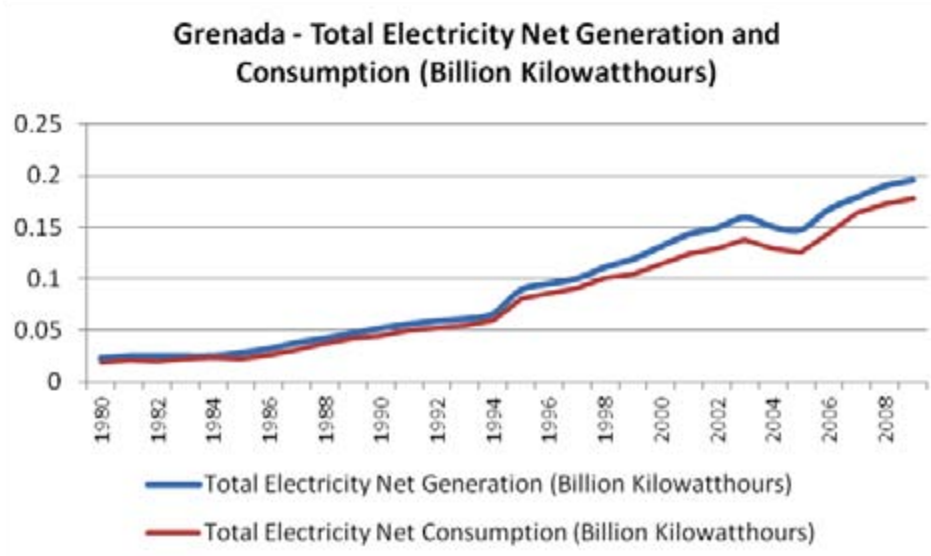

Figure 17. Generation and consumption of electricity on Grenada

3.4.5 Energy Efficiency

GRENLEC experienced system losses of 9.1% in 2008 (Nexant 2010, p. 6.6), and 9.2% in 2009 (GRENLEC 2009) and based on latest available data, GRENLEC's losses were at 8.2% in 2010 (GRENLEC 2010).

3.4.6 Demand Management

Both GRENLEC and the National Ozone Unit (NOU) promote energy conservation to the public. GRENLEC provides conservation tips on its website. The NOU broadcasts energy conservation public service announcements on its website, the radio, and television. It also has sponsored workshop visits to schools and social groups, and held an Ozone Day Celebration in 2009, distributing promotional materials (e.g., posters, shirts, caps, notebooks) (NOU 2009).

3.4.7 Building Codes

The National Ozone Unit is a program promoting ozone-friendly air conditioning, coolants, and other building equipment. The NOU is run by the Ministry of Finance to enact Grenada's compliance with the Montreal Protocol. The NOU sets policy on ozone-depleting substances, trains refrigeration and HVAC technicians, and conducts public awareness initiatives (NOU 2010). The NOU receives financial support from the Multilateral Fund Secretariat of the Montreal Protocol, the United Nations Environment Programme Regional Office for Latin America and the Caribbean (UNEP/ROLAC), and the UNEP Department of Technology, Industry and Energy (DTIE) (NOU 2010).

The Ministry of Works is responsible for enforcement of building codes. Its responsibility also includes maintenance of government buildings, engineering support to government and statutory bodies, and management of electrical inspections and examination of electricians (Government of Grenada 2010). The Physical Planning and Development Control Act (2002) contains the framework for enforcing sustainable use and improving standards of building construction (Government of Grenada 2002). A draft version of Grenada's building code, based on the OECS model code, is available. This code was developed with assistance from the Caribbean Disaster Mitigation Project of the OAS. The code has not been adopted as the official building code, and might be out of date (OAS 2001).

3.4.8 Energy Supply Outlook

Grenada participates in PetroCaribe (Burke 2009, p. 5). To provide future supply, the *World Bank Report* projects that the least-cost fuel combination is 10 MW of diesel capacity for peak and mid-range duty, and 10 MW of coal-fueled circulating fluidized bed capacity for base load (Nexant 2010, p. 1.8). The cost of fossil fuel energy for Grenada could be reduced with the expansion of the regional petroleum facilities in St. Lucia (Nexant 2010, p. 7.22).

3.4.9 Renewable Energy

Screening curve comparisons performed by Nexant indicate that renewable sources (particularly wind) are favorable as compared to fossil-fuel sources (including coal, oil, and natural gas) at certain capacity factors (Nexant 2010, pp. 11.6, 11.22–11.23). Scenario analysis shows that development of wind capacity would benefit Grenada regardless of future fossil-fuel development (Nexant 2010, p. 14.3).

Table 12. Grenada Renewable Energy Potential

Technology	Value
Hydro	500 kW
Wind	20 MW
Geothermal	Unknown
Solar	Unknown
Biomass and Other	Unknown

Source: Loy & Farrell 2005, pp. 23, 56.

3.4.9.1 Hydro

There is only moderate potential for hydropower in Grenada, and its use would compete with potable water and irrigation uses (Loy & Farrell 2005, p. 23).

3.4.9.2 Wind

The Paradise Bay Resort installed an 80-kW wind turbine for self-generation in 2007, the first utility-grade turbine at a resort in the region. Its expected annual production is 180,000 kWh, and GRENLEC allows surplus generation to be sold back to the grid (Posorski & Werner 2009, p. 69). The utility itself has assessed wind resources on five sites in Grenada and two sites in Carriacou, with a goal of installing 1 MW (Hosten 2009, pp. 19-20). Although it has technology partners, GRENLEC prefers in-house operation of wind farms to IPPs. It is negotiating leases on two of the sites in Grenada, where average wind speed is approximately 7.6 m/s, and expects to install 3 MW capacity overall. On Carriacou GRENLEC is seeking to install 1 MW on a government site. It expects to eventually reach a similar capacity in Petite Martinique (Loy & Farrell 2005, p. 22; Posorski & Werner 2009, pp. 68–69).

3.4.9.3 Geothermal

GRENLEC studied geothermal feasibility in 2009 (Hosten 2009, pp. 18–20). GRENLEC and the Government of Grenada concluded in 2010 that the geothermal resource development potential was between 20-50 MW and was worthwhile pursuing (CARICOM Energy Programme Quarterly Newsletter 2010, pp. 12). New exploration with sound technology, however, is necessary to assess quality of the geothermal fluid and temperature of the geothermal fields. Direct use for heating the water supply is available (Loy & Farrell 2005, p. 22). In 2010 the Government of Grenada established a Geothermal Energy Committee (GEC) composed of representatives of relevant ministries and GRENLEC to provide advice and guidance to the Government regarding geothermal development potential in Grenada and requested assistance from the ECPA Caribbean Initiative (Geothermal Energy Weekly 2011, pp. 7). In 2011 ECPA Caribbean Initiative and the Grenada Geothermal Energy Committee secured the assistance of Castalia Strategic Consultants in preparing the Geothermal Resource Development Bill and Environmental Regulations (Spicegrenada, 2011). As of December 2011, both documents were in a final draft version to be submitted to Cabinet for review. The geothermal project has become a high ranked priority to the Government of Grenada and GRENLEC particular attention placed during the 2012 Budget Proposal (Grenada Ministry of Finance, 2010).

3.4.9.4 Solar

With GHI averaging more than 5.7 kWh/m^2/day, the Grenadines and the lower-lying parts of Grenada have good solar resources for flat-panel PV and solar hot water systems. The DNI resouce is far poorer, suggesting that concentrated solar would not perform well in this region (*see* Figure 18). See Http://www.ecpamericas.org/initiatives/default.aspx?id=31 or full-page copies of the GHI and DNI solar maps.

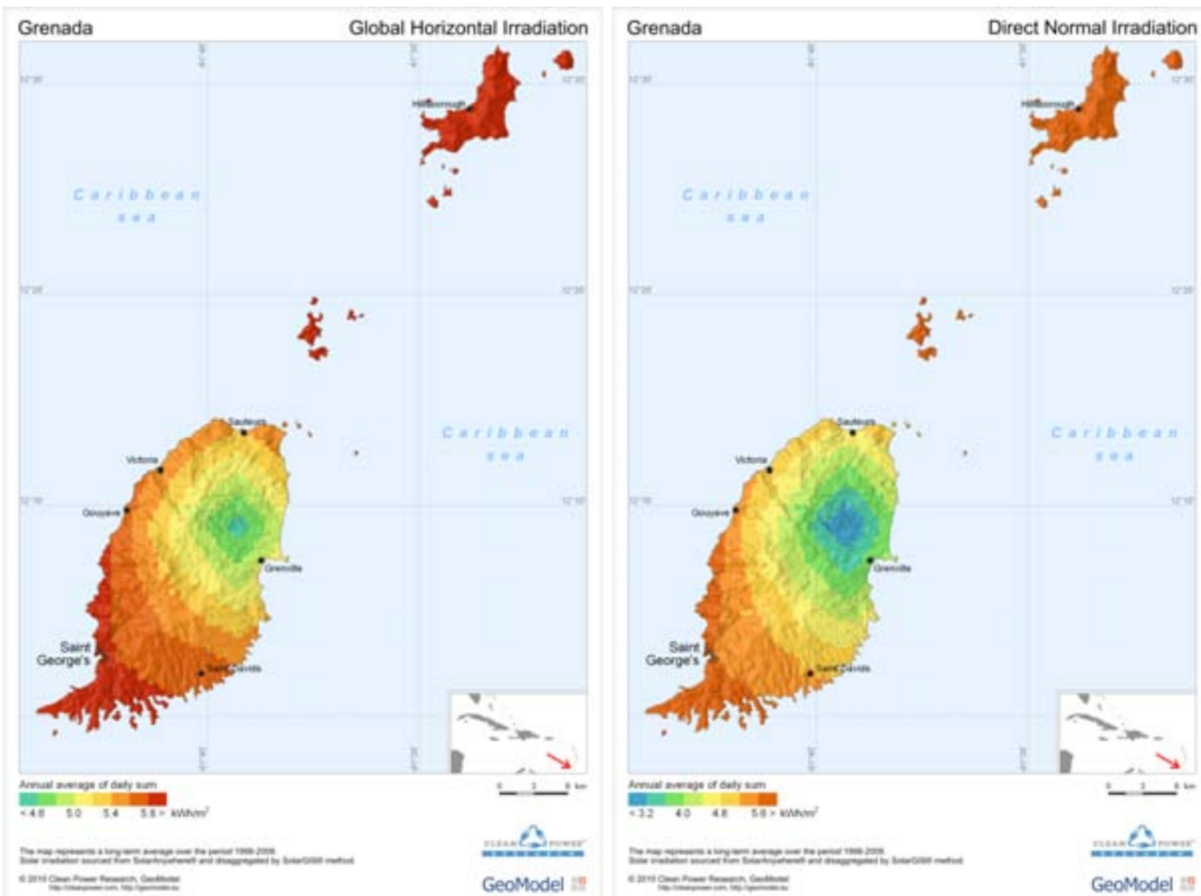

Figure 18. Solar maps of Grenada

Solar water heating is “already common” in the hospitality sector of Grenada, and SWH-ready plumbing is typical for modern residential construction. SWH equipment usually is sourced from Barbados and Dominica (Loy & Farrell 2005, p. 22). A market is developing for distributed solar PV, led by Grenada

Solar Power Ltd. (GRENSOL). The company distributes, installs, and monitors both grid-tied and standalone self-generation systems (GRENSOL 2010). At least 21 PV installations of less than 10 kW were active by 2008 (Posorski & Werner 2009, p. 67), and distributed PV capacity reached 74 kW by 2009 (Hosten 2009, p. 6). The development of GRENLEC's interconnection policy and standards for private solar installations were motivated primarily by GRENSOL's entry into the distributed PV market (Hosten 2009, p. 18). GRENLEC had intentions to pilot utility-scale solar PV and solar-thermal technology by 2011 but as of December 2011 there were no records of their implementation. Furthermore GRENLEC is considering a 200-kW wind/PV demonstration system (Hosten 2009, pp. 16, 20).

3.4.9.5 Biomass and Other

Unlike many small islands in the region, Grenada's agricultural industry has remained active despite the hurricanes in the 2000s, through its export of nutmeg and mace (CIA 2010). Loy and Farrell report an opportunity for biogas production from nutmeg shells, but there do not appear to be any developments in this area (Loy & Farrell 2005, p. 23). The government also is considering incentives to promote solar dryers and biodigesters for the agricultural sector (Burke 2009). There have been reports of a desire to pursue waste-to-energy (WTE) technologies. WTE was a recommended alternative to the long term solid waste reduction, treatment and disposal in Grenada (Hydroplan, 2010), The Government through the Grenada Solid Waste Management Authority (GSWMA) has an invitation for Expression of Interest.running where it intends to select a suitable Waste-to-Energy partner by the third quarter of 2012 (GSWMA, 2012).

3.4.10 Interconnections

Although Grenada is relatively close to Trinidad and Tobago, it is unlikely that the nation would be connected to the Eastern Caribbean Gas Pipeline due to tectonic issues (Nexant 2010, p. 7.7). Further, there does not appear to be interest in local interconnections between Grenada to Carriacou, Petit Martinique and the other Grenadines, likely due to their small markets.

3.4.11 Energy Sector Regulatory Framework Analysis

Although the government of Grenada still must finalize its energy policies, the private sector has assumed leadership in RE progress in Grenada. Paradise Bay is the first resort in the region to install its own wind turbine; GRENSOL has created a market for solar PV self-generation; and the utility GRENLEC has initiated a comprehensive interconnection policy for distributed generation tie-in to the electrical grid. The National Ozone Unit program can serve as a model outreach program for other low-carbon and sustainability initiatives.

3.4.12 Legal and Regulatory Framework

With regard to the institutional framework, the Ministry of Finance, Planning, Economy, Energy and Cooperatives is the institution tasked with executing Grenada's energy portfolio through its Department of Energy and Sustainable Development. The role of the department, among other things, is to

> *ensure adequate, reliable and economical energy services to sustain economic development, while satisfying the current and projected demands; encourage and promote the use of renewable energy technologies and energy efficiency alternatives; promote energy efficiency and energy conservation at all levels of the economy, in order to achieve optimum economic use of renewable and non-renewable sources of energy; and promote, encourage and facilitate petroleum exploration and development in environmentally friendly (sustainable) manner (Government of Grenada 2009).*

The Ministry, with the support of the OAS-CSEP, in 2010 finalized the final draft National Energy Policy and its corresponding action plan. The NEP is assessed in more detail below. The main challenges in the institutional framework are the finalization of the NEP.

The legal, policy, and regulatory framework, the Grenada Electricity Services Limited Act (1990) established GRENLEC, and the Electricity Supply Act (1994) granted GRENLEC exclusive rights to generate, transmit, distribute, and sell electricity in Grenada, Carriacou, and Petit Martinique until 2073 (Section 3). Section 4 empowers GRENLEC to issue sub-licenses for the generation, transmission, and distribution of electricity; and Section 5 permits a person to "generate electricity for his own consumption and use (a) on any premises used exclusively for private residential purposes; (b) solely during periods of interruption of supply by GRENLEC; (c) and located in an area not supplied with electricity by GRENLEC."

Section 13 provides for tax exemptions of all plant, machinery, equipment, and vehicles imported by GRENLEC. Section 14 provides income-tax concessions for any losses suffered by GRENLEC. Section 30 exempts GRENLEC from paying stamp duties. Section 13 could be deemed to also apply to RET. Also applicable to renewable energy is Section 25, which permits GRENLEC to harness water or wind power, without charge, for the purpose of providing the public with electricity. Section 26 provides that the "Government shall, whenever requested by GRENLEC, acquire under the provisions of the Land Acquisition Act . . . any land reasonably required by GRENLEC for the purpose of its business of generating, transmitting, distributing, or supplying electricity in Grenada. . . ." This provision also seems to apply to the establishment of wind farms.

In 2008, an Interconnection Policy was drafted in Grenada to allow customers to install renewable energy generation plants (<5 MW) to GRENLEC's distribution network. This policy seeks to attract dissemination of renewables at a small scale. A fast-track interconnection process is given to installations of less than 10 kW. Moreover, the policy delineates necessary compliance requirements of interconnection to avoid damage to customers or GRENLEC's distribution network. Details of the terms, conditions, and application process also are described. A net-metering system is applied for installations of less than 10 kW at retail electricity prices. For systems larger than 10 kW, a payment rate for electricity fed into the grid has to be negotiated with GRENLEC. The policy also applies to photovoltaic, wind, fuel cells, micro wind turbines (less than 250 kW), biogas, and landfill-gas technologies.

Grenada has been providing duty-free concessions for solar water heaters to the hotel sector since 2009. The concessions were revised in February 2010. The duty-free concessions have allowed a moderate spread of such systems in the tourism sector. Given the 2-year lifetime of the policy, it could be too soon to evaluate its effectiveness. The policy currently is one of a kind in the Eastern Caribbean, and it is recommendable that Grenada build on its experience with it, ensure its effectiveness, and amend it if necessary to encourage a broader and faster triggering of renewable energy applications.

The main challenges in Grenada's legal, policy, and regulatory framework are discussed below.

- Given GRENLEC's monopoly structure, there should be an overarching body for effectively regulating the energy sector. The ESA should be revised to address this issue.
- The ESA also should be revised to address some of its very stringent provisions on self-generation. Unduly tight regulation discourages investment in distributed energy.

- Regarding the interconnection policy, unfortunately there has been no differentiation between technologies used or an assessment of their estimated cost to adequately remunerate customers and make investments more attractive. Also, there is no time commitment in the interconnection procedures, creating uncertainty among project developers.
- The net-metering configuration as presently established does not provide security to the investor, because there is no long-term guarantee of the electricity exchange. The interconnection policy should be revisited and to evaluate the policy's effectiveness in promoting the increased installation of small-scale renewable energy production systems, by particularly addressing the issue of feed-in-tariff structure and guaranteed duration.

Unfortunately, there is limited available public information on the effectiveness of the duty-free concession for SWHs to be able to draw solid conclusions. A challenge in analyzing the effectiveness of fiscal incentives for SWHs is that such systems offset the use of electricity for heating water, which requires a multiple set of parameters, continuous monitoring, and relative complicated energy conversion methods to produce results. Thus, a separate policy analysis of fiscal incentives in place to promote the import and use of SWHs should be conducted.

3.4.13 Assessment of the National Energy Policy

With the support of CSEP and through an extensive consultation process with a wide cross-section of stakeholders, in 2010 a national energy policy was created for Grenada. The Government of Grenada recognizes that "energy is a significant driver of development . . . and requires policy priority" (Government of Grenada 2010, p. 2),[15] and that the ultimate objective of the NEP is to "ensure and provide affordable, equitable, reliable, clean and sustainable energy sources and services to drive and secure national development, and improve the quality of life for all of its citizens" (Government of Grenada 2010, p. 10).

The national energy policy is guided by the principles of: energy security, energy independence, energy efficiency, energy conservation, environmental sustainability, avoiding the unsustainable exploitation of energy resources, lower energy prices, and energy equity and solidarity. In terms of policy expression, the NEP establishes goals and policies for the following categories, institutional issues, legal and regulatory framework, hydrocarbons, renewable energy, energy efficiency, and conservation; and for the following sectors, transport, power, agriculture, hotel and commercial, manufacturing, and household.

3.4.13.1 Institutional Issues

The government recognizes that a new institutional framework is required to ensure good governance of the energy sector. Thus, the goal is to "build and establish the adequate human capacity and institutional regime to guarantee the appropriate allocation and management of resources to achieve energy policy goals" (Government of Grenada 2010, p. 15). The policies as listed are very vague and lack specifics. One policy, for example, involves the establishment of a National Sustainable Energy Office (NSEO) and, although it outlines the NSEO's organizational structure in Appendix IV of the NEP, it does not indicate whether the NSEO is an independent and autonomous body, and doesn't include its proposed functions. It also is unclear what the relationship will be with the existing institutional structure, which includes the ministry and department having energy-related responsibilities. The NEP must include clear roles and responsibilities, and a defined hierarchy or chain of command, and should

[15] Hon. Nazim Burke M.P. Grenada Minister of Finance, Planning, Economy, Energy and Cooperatives.

facilitate effective inter- and intra-institutional cooperation. An appropriate institutional structure also should be established for the receipt, processing, and management of data.

3.4.13.2 Legal and Regulatory Framework

The goal is to establish an enabling legal and regulatory framework to achieve the government's policy objectives. The policies listed, however, still leave gaps that must be filled. The policy does not indicate whether the ESA will be revisited to, among other things, revise the market structure for energy generation and distribution, and to amend unduly restrictive provisions on self-generation. The policy also does not indicate whether the regulatory body to be established will be independent and autonomous. Additionally, there are no policy provisions regarding establishing standards; ensuring that all energy-related laws, regulations, and policies developed are compatible or in harmony with other environment-related initiatives/instruments including land-use policies; or describing the development of incentive mechanisms, monitoring, evaluation and enforcement, and mandatory data collection/reporting requirements from high energy consumption sectors.

3.4.13.3 Energy Efficiency and Conservation

The goal of reducing the rate of national energy consumption and increasing economic growth by adopting best practices in energy efficiency and conservation should be supported by a policy on monitoring and evaluation (including reporting requirements) of high energy consuming sectors.

3.4.13.4 Transport Sector

The goals of establishing an affordable and reliable public transport sector, increasing the use of more efficient vehicles, and expanding transport alternatives to reduce energy consumption, could be furthered through the inclusion of specific policies. Such policies could include imposing limits on the age of imported vehicles; conducting a review of vehicle life cycle (imports, use, disposal)[16]; implementing digitalized vehicle registration, facilitating data collection, monitoring and sharing; and mandating emission testing. For this sector, it also might be important to include provisions in terms of fuel use and fuel mix for public transportation vehicles, and for mechanisms to promote the use of public transportation. Additionally, the review and possible amendment of traffic and transportation management plans are critical to ensuring energy efficiency in transportation sector.

3.4.13.5 Agricultural Sector

Providing training and capacity building in new technologies and energy efficiency practices also should form part of the government's policy in this sector.

3.4.13.6 Hotel and Commercial Sector

Conducting of energy audits in this sector should be a policy requirement, in addition to establishment of standards, and the monitoring and evaluation of energy efficiency practices.

3.4.13.7 Manufacturing Sector

Energy audits and other reporting requirements, along with the monitoring and evaluation of energy efficiency practices, also should be included in the policy.

3.4.14 Conclusions and Recommendations

Previous studies have made the following recommendations for Grenada.

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[16] This was recommended by John Auguste, Senior Energy Officer in the Ministry of Finance Energy Division, in a consultation meeting with the OAS-CSEP team on August 17, 2010.

- The policy and regulatory framework should be approved soon to improve the main legal framework for a massive deployment of RETs, and the policy and regulations should be reviewed periodically to improve the policy in the issues described above and to introduce latest developments in energy-sector reform.
- The government should adopt a national energy policy to drive future economic development of Grenada (Burke 2009).
- Despite the efforts, there are no measurable benefits apparent from current legislation and projects developed in the country to reduce the rate of oil importation and consumption during the period of analysis. Regardless of some isolated attempts, oil consumption still is increasing, and internal volatility is affecting the national energy security.
- Within the auspices of the NEP, the government should adopt a sustainable energy plan to help achieve sustainable development in Grenada (CIPORE 2009).
- The government should provide incentives to promote energy efficiency, including building codes and design standards, appliance standards, phasing-out incandescent bulbs, and setting fuel-efficiency standards for vehicles (Burke 2009).
- In addition to the 5% import tax waiver on solar panels, the government could assess whether there is benefit in providing further financial support to the newly developing PV market on island.
- To continue supporting distributed solar installations, the utility might find it useful to revisit its capacity limit on the net-metering policy.
- The utility should consider developing expertise in energy efficiency consulting, and should offer energy-auditing services (Hosten 2009).

This report also recommends the following for Grenada.

- The government should evaluate potential for solar water heater incentives among the measures proposed in the ongoing NEP efforts.
- The government and international efforts should undertake detailed study of biomass energy—including incentives for dryers, biodigesters, and biofuels created from nutmeg—to evaluate the effect of these measures on the sustainability of the agricultural sector.
- The government and international efforts can use the NOU program to serve as a model for outreach efforts in energy-efficient lighting, building codes, appliance standards, and other low-carbon and sustainability initiatives to be enacted as part of the NEP/SEP.

3.5 St. Kitts and Nevis

Item	Value
Land Area	261 km² (total) 168 km² (St. Kitts) 93 km² (Nevis)
Population	50,000 (total) 39,000 (St. Kitts) 11,000 (Nevis)
Supply Diesel Wind	52.4 MW 50.8 MW 1.6 MW
Price	U.S. $0.21 per kilowatt-hour

Sources: CIA 2010; SKN Vibes News 2010; West Indies Power 2008.
Notes: Price of electricity in Nevis. Supply includes distributed generation.

The Federation of St. Kitts and Nevis consists of two volcanic mountainous islands located in the Leeward Islands of the Caribbean. To the north and northwest are Saba and Statia (Dutch Overseas Territories), to the south is Montserrat, and to the east is the nation of Antigua and Barbuda (Wilson 2009, p. 94). Economy relies on tourism and agriculture. Additoinally, during the last few decades, offshore banking activity has assumed a larger role in the financial and economical sector. The latest available estimate of its population is about 51,300, and the GDP per capita is U.S. $8,200.

3.5.1 Energy Sector Outlook

3.5.1.1 Energy Governance Stakeholders

3.5.1.1.1 Government Agencies

The Ministry of Public Works, Housing, Energy and Utilities is the government agency responsible for energy planning for the nation (Government of St. Kitts and Nevis 2010). In Nevis, the Geothermal Resources Advisory Committee, chaired by the Minister of Natural Resources, coordinates renewable energy policy, according to the Nevis Geothermal Resources Development Ordinance (2008) drafted with the assistance of GSEII (Wilson 2009, p. 100). In St. Kitts, the utility, St. Kitts Electricity Department (SKED), was until 2011 a department of the government (Wilson 2009, p. 95). The St. Kitts Electricity Company (SKELEC) was incorporated as a statutory body of the federal government on August 1st 2011 and will be managed by the Caribbean Utilities Management Company until 2014 (St. Kitts and Nevis Observer, 2011).

3.5.1.1.2 Utilities and Independent Power Producers

Both St. Kitts Electricity Company Ltd. (SKELEC) and the Nevis Electricity Company Ltd. (NEVLEC) operate as monopolies. Each has exclusive authority for production, transmission, and distribution on its respective island. Self-generation from wind and PV sources is allowed by the Electricity Ordinance (1998) in Nevis. Independent power producers are allowed on either island by license (Wilson 2009, p. 100).

3.5.2 Electricity Market

Both SKELEC and NEVLEC operate as monopolies. Up until August 2011 the former St. Kitts Electricity Department was unique as a government agency; it had no corporate structure, and therefore no financial performance measures, nor was there separate accounting for electricity versus tax revenues to the government. At an operational level, government facilities are not metered, therefore electrical consumption and system losses are unknown (Wilson 2009, pp. 95–96). The NEVLEC is a government-owned subsidiary but has been operating since 2000 as a separate corporate entity. Historically, it has been unable to operate profitably because the electricity tariff was set below cost of production. The NEVLEC does not hedge on its fuel supply, and its fuel surcharges generally have been inadequate to cover costs. The company, however, continually has invested in the expansion and improvement of its generation, transmission, distribution, and administrative facilities (Wilson 2009, pp. 96–98).

3.5.3 Electricity Supply

Table 13. St. Kitts Electricity Market Summary

Item	Value	Notes
Plants	1	All diesel generators.
Capacity (MW)	37.4	Expects to develop 10 MW wind, and import 30MW geothermal from Nevis.
Peak Demand (MW)	30	Wilson, et al. expect growth to 41.2 MW by 2015.
Total Electricity Generated (GWh)	150	Based on estimates by Nexant and Wilson, et al.
Total Electrical Sales (GWh)	123.8	Estimated by Wilson, et al.
Fuel Efficiency	40%	
Unit Generation Cost (U.S. $ per kilowatt-hour)	0.17	

Values current for 2008, except unit generation cost (2007).
Sources: Wilson 2009; Nexant 2010; efficiency: Lambrides, de Cuba & Rivera 2006; unit generation cost: de Cuba & Rivera-Ramirez 2007, pp. 16–17.
Note: Market capacity does not include contributions from distributed generation.

Table 14. Nevis Electricity Market Summary

Item	Value	Notes
Plants	1 1	7 Diesel generators at Prospect Power Station (NEVLEC). 8 275kW-Vergnet Wind Turbines at Maddens (WindWatt).
Capacity (MW) Diesel (MW) Wind (MW)	15.6 13.4 2.2	NEVLEC's last expansion was 2.7MW in 2002. WIP developing 10MW geothermal by 2011 for local use. WIP expects 30 MW additional for export to St. Kitts.
Peak Demand (MW)	9.0	Wilson, et al. expect growth to 15.9 MW by 2015.
Total Electricity Generated (GWh)	56.1	Recorded by NEVLEC.
Total Electrical Sales (GWh)	44.7	Experienced 4.6% annual growth during 2006–08; overall revenues similarly had 5.1% annual growth during 2004–08.
Efficiency (%)	35%	
Unit Retail Price (U.S. $ per kilowatt-hour)	0.22	Averaged U.S. $0.21 per kilowatt-hour during 2006–08. Peaked close to U.S. $0.40 per kilowatt-hour (without fuel subsidy) in 2008.
Values current for 2008. Sources: Wilson 2009, Nexant 2010; plants and expansion: NEVLEC 2010, West Indies Power 2010.		

Figure 20 describes the historical electricity generation in St. Kitts and Nevis. During the last 30 years, the growth of electricity generation has been exponential.

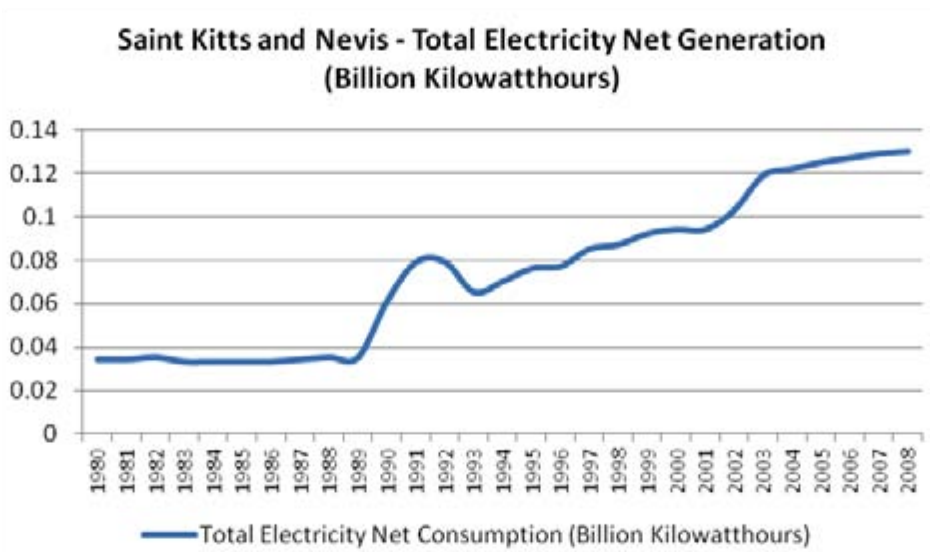


Figure 20. Electricity generation on St. Kitts and Nevis

3.5.4 Electricity Demand

Electricity demand for the nation is expected to grow steadily in the future, at 5.6% annually into 2015 (Wilson 2009, pp. 98–99). Among the economic sectors, more energy is expected to be demanded by the hospitality sector in the future. In St. Kitts, the economy is in transition, as the government closed the sugar industry in 2005 (CIA 2010).

In Nevis, the Four Seasons Hotel typically demands about 30% of all energy on the island (Wilson 2009, pp. 98–99). The resort had been closed since 2008, however, due to Hurricane Omar; it reopened at the end of 2010 (Four Seasons 2010). Consequently, annual load growth in Nevis is expected to increase at a rate of 11.2% until 2012, tapering afterwards to an average of 5.9% growth until 2028 (Nexant 2010). Figure 21 shows the electricity consumption trend during the last 30 years.

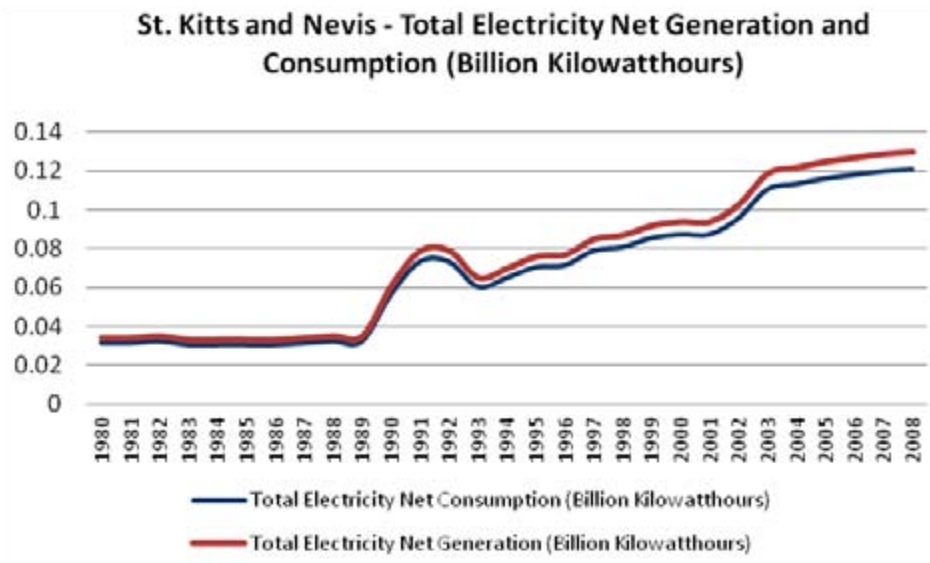


Figure 21. Consumption and generation of electricity on St. Kitts and Nevis

3.5.5 Energy Efficiency

Inefficiency of electrical supply appears to be a problem for both islands. On St. Kitts, supply efficiency is not measurable due to the lack of metering. On Nevis, NEVLEC experienced system losses of 20.3% in 2008. Although these inefficiencies are attributed to both technical and non-technical factors, it was concluded that a majority of losses are non-technical (Wilson 2009, p. 99).

3.5.6 Demand Management

Although the SEP calls for St. Kitts and Nevis to launch a national residential DSM initiative, with the goal of reducing consumption and peak demand in the residential sector 20% by 2010, it is unclear whether any DSM efforts have been made so far. The SEP also indicates that the government is to begin commercial and industrial DSM initiatives, set efficiency standards for new construction and industrial operations, and make concessions for commercial and industrial retrofitting with energy efficient equipment (Wilson 2009, p. 106).

3.5.7 Building Codes

St. Kitts and Nevis has adopted OECS model building codes (SKN Vibes News 2004). Additionally, the SEP indicates that the government will produce standards to guide energy efficiency practices in its buildings (Wilson 2009, p. 106). It is unclear, however, whether any efforts have been made in this area.

3.5.8 Energy Supply Outlook

3.5.8.1 Fossil Fuels

The Federation of St. Kitts and Nevis participates in PetroCaribe (Wilson 2009, p. 142). To provide future supply, the *World Bank Report* projects that the least-cost fuel combination is to continue to use distillates as a power source (Nexant 2010, p. 1.8). The cost of fossil-fuel energy for St. Kitts and Nevis could be reduced by expanding the regional petroleum facilities in Antigua (Nexant 2010, p. 7.22).

3.5.8.2 Renewable Energy

Table 15. St. Kitts and Nevis Renewable Energy Potential

Technology	Value
Hydro	None indicated
Wind	5 MW, Moderate potential (5% to 10% of existing capacity)
Geothermal	300 MW (Nexant 2010, p. 8.36) 50 MW (Joseph 2008) High potential (>25% of existing capacity)
Solar	16 MW (PV), Moderate potential (5 – 10% of existing capacity)
Biomass and Other	10 MW, High potential (>25% of existing capacity)
Sources: Quantitative estimate, Nexant 2010, p. 8.36; qualitative and proportion of existing capacity, Wilson 2009, p. 144; geothermal, Joseph 2008; biomass, de Cuba & Rivera-Ramirez 2007.	

The implementation of wind and geothermal projects on St. Kitts and Nevis marks a major step forward in the nation's energy outlook. If these sources can be completed as planned, the federation would exceed its renewable energy target of 20% before 2015.

3.5.8.2.1 Hydro

St. Kitts and Nevis have no appreciable hydro resources (Wilson 2009, p. 144).

3.5.8.2.2 Wind

Wind resources across St. Kitts and Nevis were mapped in 2007 by GTZ (GSEII 2009). Findings indicated average wind speeds of 6.18 m/s on St. Kitts and 7.89 m/s on Nevis (Wilson 2009, p. 108). St. Kitts plans to develop 10 MW of wind energy by 2012. In 2009, the government agreed to further assessments at several sites on the northern side of St. Kitts (Wilson 2009, pp. 100,108). In the interim, a 2.2-MW Maddens Wind Farm currently is operational in Nevis. The nameplate capacity of Maddens Wind Farm represents 20% of peak demand (SKN Vibes News 2010). The farm is a U.S. $3.7 million investment made by Canadian firm WindWatt. It's development started in 2008, when a power purchase agreement (PPA) was signed (GSEII 2009). The PPA for the Maddens Wind Farm, commissioned in 2010 represents "the first of its kind in the English-speaking Caribbean," and was completed with help of OAS/GSEII (St. Kitts Daily News 2010).

3.5.8.2.3 Geothermal

Geothermal energy has been considered at five sites on Nevis since at least 1998, whereas St. Kitts has been less explored (Huttrer 2005). Regional geothermal IPP West Indies Power has been exploring geothermal power in Nevis since 2007, and began exploratory drilling in 2008 (West Indies Power 2008). It signed a power purchase agreement with NEVLEC in 2009 (Wilson 2009, p. 99). As of 2010, WIP was to start constructing a 10-MW plant in Nevis, including drilling new production and injection wells. The plant was to be financed by the Bank of Nova Scotia (Scotiabank), with a guarantee from the Export Import Bank of the United States (EXIM), for approximately U.S. $30 million, and was expected to come on line during the first half of 2011 (Caribbean Net News 2010). On April 2011 the Nevis Island Administration approved the Environmental Impact Assessment for the construction of a 8.5MW single flash geothermal plant at Spring Hill (GreenIsland Inc 2011). The second phase for WIP calls for an additional 30-MW plant in Spring Hill Nevis, with a subsea cable interconnection to St. Kitts. Scotiabank has arranged financing for this project as well, pending the completion of power purchase agreements with St. Kitts (West Indies Power 2010). As of December 2011 no further updates of the Nevis geothermal phase I are recorded.

3.5.8.2.4 Solar

With GHI averaging more than 5.7 kWh/m^2/day, the low-lying parts of St. Kitts and Nevis have good solar resources for flat-panel PV and solar hot water systems (*see* Figure 22). The DNI resouce is significantly less, suggesting that concentrated solar would perform poorly in this region. See Http://www.ecpamericas.org/initiatives/default.aspx?id=31 for full-page copies of the GHI and DNI solar maps.

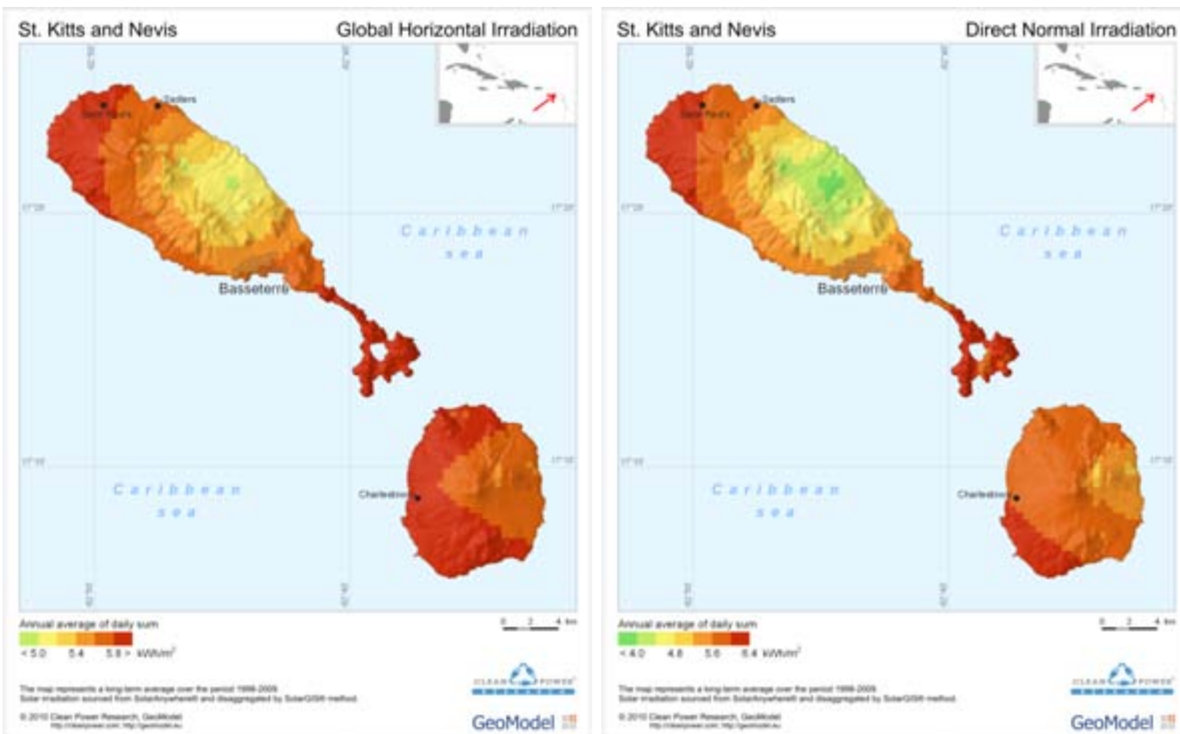


Figure 22. Solar Maps of St. Kitts and Nevis

The SEP calls for St. Kitts and Nevis to launch solar hot water heating and distributed solar PV initiatives. The SWH initiatives will promote commercial and residential use, grant concessions to SWH businesses, and remove import duties on equipment for SWH manufacturing (Wilson 2009, p. 105). It is unclear, however, whether any of these efforts have been made thus far.

3.5.8.2.5 Biomass and Other

Sugarcane farming and processing had been a nationalized industry in St. Kitts until the government closed production in 2005 due to long-term financial losses. Use of sugarcane as an energy source would be meaningful to the economy and history of the island. This interest led the GSEII to investigate the potential for sugarcane biomass to ethanol or electricity on St. Kitts and Nevis in 2007. They found ethanol production to be economically unfeasible, because the nation would have to process more sugar than it could consume, and high costs prohibit exporting the excess. Conversely, sugarcane biomass to electricity was found to be economically feasible, with production costs in St. Kitts of U.S. $0.05 to U.S. $0.17 per kilowatt-hour, a range lower than the estimated current cost of production. The GSEII report projected that a 10-MW biomass plant could be used for base-load capacity during 4 months of the year (de Cuba & Rivera-Ramirez 2007). This led to the incorporation of St. Kitts and Nevis in the US-Brazil Biofuels Initiative, where with assistance of the Fundacao Getulio Vargas (FGV) detailed suitability maps were prepared for biofuels crops in St. Kitts and Nevis (April, 2008). By mid 2008 due to land use competition for the services sector and other sectors, the Government of St. Kitts and Nevis decided not to pursue biomass-to-energy (de Cuba, 2011).

In the meanwhile the solid waste disposal is becoming a critical challenge to St. Kitts and Nevis where the existing landfills on each respective islands have reached their maximum capacity and where siting of a new landfill is complicated and necesitates a complete review and adjustment of the waste management in the Federation (de Cuba 2011).

3.5.9 Interconnections

West Indies Power is planning a subsea cable interconnection to distribute geothermal power from Nevis to St. Kitts. This connection presumably would serve several large resorts on St. Kitts, and is planned to use three-mile long high-voltage alternating-current (HV-AC) technology (Nexant 2010, p. 8.45). Scotiabank has arranged financing for this project as well, pending the completion of power purchase agreements with St. Kitts (West Indies Power 2010). Furthermore, in November 2011 the ECPA Caribbean Initiative secured the assistance of a specialized international firm, KEMA to perform a prefeasibility study of the electrical interconnection potential between the Federation of St. Kitts and Nevis and Puerto Rico for the potential export of geothermal power (ECPA Caribbean Initiative, 2011).

3.5.10 Energy Policy Framework

On St. Kitts and Nevis, the power generation sector is the largest consumer of imported energy, followed by the transportation sector. As a two-island state, there are two independent operating utilities, the St. Kitts Electricity Company (SKELEC) and the Nevis Electricity Company (NEVLEC). The installed capacity at SKELEC amounts to 37.5 MW using eight diesel generators. NEVLEC produces and distributes electricity on Nevis with diesel-fueled generation units equaling an installed capacity of 13.4 MW. These plants work independently of each other and are not interconnected. The country primarily is dependent on fossil fuels for electricity generation and transportation which ensures its vulnerability to volatile energy prices.

The sector has experienced some setbacks in recent times, including the loss of generators (SKELEC) due to fire, and it has been challenging for Nevis to meet peak demand (Government of St. Kitts and Nevis 2010). The systems on both islands are quite susceptible to damaging weather events such as hurricanes. In 2008, system capacity on Nevis fell to 43% due to the impact of Hurricane Omar (Singh 2009, p. 98).

Regarding renewable energy, there are several sources that can be exploited by the country, including solar, wind, geothermal, and biomass. Several renewable energy feasibility studies have been conducted and wind and geothermal seem to have more medium- to long-term potential (Library of Congress November 1987, p. 20). The government energy policy still is incomplete; however, the nation recently has made strides by forming public-private partnerships to develop RE capacity. Current renewable energy projects a 8.5-MW geothermal plant in Nevis (West Indies Power, July 2011) and a 5.4MW wind farm on St. Kitts (Recharge, October 2011).

3.5.11 Energy Sector Regulatory Framework Analysis

The institutional framework governing the energy sector, apart from SKELEC and NEVLEC, includes the Ministry of Public Works, Housing, Energy and Utilities which is responsible for the country's energy portfolio. With support from CSEP, it recently began developing the Federal Energy Department. It is envisioned that the department will be in charge of gathering data, information, and expertise that can be used to provide technical assistance and make recommendations to the government about what actions (and their socio-economic and environmental implications) the government can pursue with respect to energy-related activities. Such activities include projects, pricing, energy policy, and drafting a sustainable energy program. Due to its recent launch, the department's staff is limited and its proposed activities and role inside the ministry are to be confirmed. In Nevis, the Ministry of Communications, Utilities, Posts, Planning, Natural Resources and Environment in the Nevis Island Administration (NIA), which forms part of the government of St. Kitts and Nevis, shares the responsible for the energy portfolio.

3.5.12 Legal and Regulatory Framework

Regarding the legal, regulatory, and policy framework, the Electricity Supply Act (2011) requires a license for the supply of electricity. The minister, in granting the license, could require that the plant is powered only by wind or photovoltaic power, and be used for self-generation on their own premises (Section 3(2)). Although a license granted by the minster can give exclusive rights to generate, transmit, and distribute electricity for any public or private purpose, Section 5 provides that such a license may not exceed 25 years in duration.

The Act also provides, under Section 15(1), that the Public Utilities Commission, established under the Public Utilities Commission Act, "shall have the power to regulate and oversee generally the overall use and supply of electricity in Saint Christopher [St. Kitts]." The responsibilities of the PUC as provided under Section 15(2) are to:

- Promote and encourage the effective and efficient development and administration of the electricity supply, having regard to the development well-being and security of the country;
- Oversee the generation, distribution, supply, and sale of energy for public and private purposes;
- Promote the interests of consumers of electricity supplied by persons licensed to supply electricity in terms of (i) the prices charged and other terms of supply; (ii) continuity of supply; and (iii) the quality of the electricity supply services provided;
- Encourage the operation and development of a safe, efficient, and economic electricity sector in Saint Christopher [St. Kitts]; and
- Ensure the security and efficiency of the supply of electricity in Saint Christopher [St. Kitts] through the conduct of an efficient long-term supply planning process with due regard for future potential generation sources such as renewable energy and wind energy.

In Nevis, the Electricity Ordinance (1998) stipulates that the electric utility designated under the Electricity License, in this case NEVLEC, is the only entity entitled to transmit and distribute power in Nevis. Section 3(2)(a)(b) provides for self-generation without the need for a license.

In 2008, a draft power purchase agreement template was prepared with the assistance of GSEII, followed by a wind energy–specific tailored PPA that was negotiated between a wind developer and the Nevis Island Administration. The PPA contains the technical schedules and the terms and conditions applicable for a predetermined period, normally 25 years. A PPA next to guaranteeing clarity and payment on delivery of power also allows the developer to secure finance for the construction of the wind farm which, for RETs, is the most capital-intensive phase of such projects. Although there is limited information publicly available on the nature and characteristics of such PPAs, it is a widely used policy instrument to promote RET development and deployment.

The Nevis Geothermal Ordinance ("The Ordinance") is another notable renewable energy–related instrument. It provides the definition and ownership of the geothermal resources and establishes corresponding regulations for the development of the resource. The Ordinance provides that IPPs with licenses to develop geothermal resources are allowed to transmit and distribute only to clients beyond the borders of SKN, based on clear prerequisites and guidelines including those related to royalties. Moreover, it ensures the adequate development of geothermal resources that foster the economic growth and welfare of Nevis and decreases dependency on fossil fuels. The Ordinance mandates the creation of a Geothermal Resources Advisory Committee to serve as an advisory group for developing adequate policy and providing advice to the ministry with responsibility for natural resources.

3.5.13 Assessment of the National Energy Policy and Action Plan

The government's vision for St. Kitts and Nevis in relation to energy is that it becomes "an island nation with a sustainable energy sector where reliable, renewable, clean and affordable energy services are provided to all its citizens."[17] The strategy planned to accomplish this vision is to increase diversification, utilization, and generation of indigenous or renewable energy resources; and to promote smarter, efficient, and innovative approaches. To support the implementation of the NEP, the action plan proposes short-term (1 to 5 years), medium-term (5 to 10 years), and long-term (10 to 20 years) tasks. In terms of policy expression, the national energy policy and action plan address issues including energy-sector management, diversification of energy supply, electricity generation, transportation, and energy use.

3.5.13.1 Energy-Sector Management

The policy objective for the management of the energy sector is "efficient and well-coordinated planning and management activities to ensure sustainable supply, generation, distribution and use of energy."[18] The policy statements in this section are sound. Additional statements on reporting requirements for high-consumption sectors; and the development of mechanisms to ensure inter- and intra-institutional cooperation should be included.

Action Plan (AP): There seems to be some confusion regarding the establishment of a National Energy Committee under institutional requirements, as it is first listed as a "committee" then as a "commission." Moreover, the AP indicates that the entity will function as a regulatory body, which raises the question as to how this comports with the role of the "Commission" identified in the revised Electricity Supply Act. This issue also arises in Section 2.1.3: Future Energy Structure, Market and Integration. It includes a mandate to "institute an independent and permanent Energy Regulatory Board for controlling energy market specifics like energy pricing for consumers. . . ." It is unclear why an

[17] *Supra* note 1, at 23.
[18] *Supra* note 16, at 24.

additional regulatory body is necessary to conduct activities already within the purview of another institution. The AP also does not clarify how inter- and intra-institutional cooperation will be ensured, and does not include in the framework a chain of responsibility or command to support transparency, efficiency, and accountability.

These issues must be addressed to prevent fragmentation, unnecessary bureaucracy, and discord in and among relevant institutions, especially considering the limited resources available to make even one institution sustainable. Moreover, the AP does not include specific, measurable targets, and the language is benign in some respects. An example is "embrace sustainable energy powered vehicles for both private and public transportation." The role of the AP is to identify concrete, specific activities with measurable targets for the implementation of the policy. The government should be guided by indicators and develop an effective action plan.

3.5.13.2 Diversification of Energy Supply

The goal here is "safe, reliable and affordable supplies of petroleum products and their efficient and clean handling while in parallel significantly increasing the deployment and utilization of renewable energy technologies in the Federation of St. Kitts and Nevis." The policy statements are sound.

Action Plan: The provisions here seem to be more policy statements than specific targets or courses of action to be taken to support the implementation of the NEP. The government should be guided by indicators and develop an effective action plan.

3.5.13.3 Electricity Generation

The goal for electricity generation is "safe, efficient, reliable, affordable, and environmentally friendly electricity generation and supply for all parts of St. Kitts and Nevis." Although the policy statements are sound, they also should include conducting the monitoring and evaluation of energy generation facilities, both public and private.

Action Plan: The provisions here seem to be more policy statements than specific targets or courses of action to be followed to support the implementation of the NEP. The government should be guided by indicators and develop an effective action plan.

3.5.13.4 Transportation

The policy goal is "efficient, environmentally clean and cost-effective transportation." The establishment of adequate standards and regulations for accomplishing this goal should be included.

Action Plan: Although there are attempts to introduce specific targets, for example "execute by the last quarter of 2011 an assessment of the infrastructure . . ." they are not sufficiently specific or measureable. The government should be guided by indicators and develop an effective action plan.

3.5.13.5 Energy Use

The objective is "minimized energy input and lowest possible energy intensity of economic services in all sectors of the society." The provisions are sound.

Action Plan: There are no specific or measurable reductions of consumption, use, or increase in efficiency targets. The government should be guided by indicators and develop an effective action plan.

3.5.14 Conclusions and Recommendations

Previous studies have made the following recommendations for the Federation of St. Kitts and Nevis.

- Institutional frameworks should include mechanisms for clear inter- and intra-institutional cooperation, and efforts should be made to prevent fragmentation, unnecessary bureaucracy, and discord in and among relevant institutions, especially considering the limited resources available to make even one institution sustainable.
- Action plans require concrete, specific, measurable targets.
- The government should be guided by indicators and develop an effective action plan.
- The government should adopt an NEP to create a framework for the achievement of the sustainable energy plan (Wilson 2009, p. 103).
- The government should reach an agreement with WIP for a 30-MW geothermal plant and a subsea cable interconnection to St. Kitts, because financing already exists (West Indies Power 2010).

This study recommends that the Federation of St. Kitts and Nevis also should complete the following.

- Act on the energy efficiency and SWH strategies outlined in the sustainable energy plan.
- Start metering government electricity consumption.
- Focus on minimizig both technical and non-technical losses to achieve efficient transmission and distribution of electricity.
- Leverage the human capital being built by geothermal and wind projects to make St. Kitts and Nevis a center of renewable energy for the region.

3.6 St. Lucia

Item	Value
Land Area	616 km²
Population	160,922
Supply Diesel Solar	76.1 MW 76.0 MW 0.1 MW
Price	U.S. $0.28 per kilowatt-hour

Sources: CIA 2010; LUCELEC 2009; Nexant 2010, p. 8.40).
Notes: Price based on tariff sales.
Supply includes distributed generation.

St. Lucia is a mountainous, volcanic island located in the Lesser Antilles between Martinique, St. Vincent, and Barbados. St. Lucia covers a land area of 238 square miles and has an estimated population of 173,765. The GDP per capita is U.S. $5,671. Of the GDP, the industry sector represents 20%, agriculture sector 7%, and tourism/services 73%. In 2006, the government closed the sugar industry after decades of annual losses of from 3% to 4% of total GDP. To balance the employment losses, the government embarked on a program to diversify the agricultural sector and to stimulate other sectors of the economy, such as tourism, export-oriented manufacturing, and offshore banking.

For a more detailed financial and economical analysis of the country, please refer to the IMF document, International Monetary Fund, "Eastern Caribbean Currency Union: 2010 Discussion on Common Policies of Members Countries—Staff Report; Informational Appendix," and the "Public Information Notice on the Executive Board Discussion, January 2011," available at http://www.imf.org/external/pubs/ft/scr/2011/cr1130.pdf (accessed February 9, 2012).

3.6.1 Energy Sector Outlook

3.6.1.1 Energy Governance Stakeholders

3.6.1.1.1 Government Agencies

The Ministry of Physical Development and the Environment drafted the island's recent national energy policy (Ministry of Physical Development and the Environment 2010), which was approved in June 2010 (CREDP-GTZ 2010). The NEP calls for establishing an Energy Policy Advisory Committee and an Independent Regulatory Commission. The Energy Policy Advisory Committee is to engage private and public stakeholders in energy-policy discussions, and advise the government on policy instruments and strategies. The Independent Regulatory Commission has responsibility to issue licenses for the generation, transmission, and distribution of electricity; to set tariffs and rates; and to tender power investments (Posorski & Werner 2009, p. 73).

3.6.1.1.2 Utilities and Independent Power Producers

St. Lucia Electricity Services Limited (LUCELEC) holds a universal license for generating, transmitting, distributing, and selling electricity until 2045, according to the 1964 Power Supply Act. Self-generation is allowed by the 1994 Electricity Supply Act (Posorski & Werner 2009 p. 72). Independent power producers with prices that are less than avoided costs are permitted by agreement with LUCELEC (Loy & Farrell 2005, p. 38). Solar St. Lucia Limited is an IPP operating several distributed PV demonstration systems (LUCELEC 2010). United States–based IPP Qualibou Energy Inc. recently announced an agreement with the government of St. Lucia to develop geothermal projects on the island (Kessler 2010).

3.6.2 Electricity Market

LUCELEC is publicly owned, with 20% of shares owned by Emera, a Canadian utility holdings company (Emera 2008), 20% by Trinidad-based First Citizens Bank Limited, 16% by the National Insurance Corporation of St. Lucia, 16% by the Castries City Council (capital of St. Lucia), and 12% by the Government of St. Lucia. LUCELEC's annual financial and operations statistics are available from 1999 to March 2010 (LUCELEC 2010).

The Electricity Supply Act of 1994 guarantees the utility a fixed return on its investment, and allows it to pass on the cost of fuel through surcharges (Loy & Farrell 2005, p. 37); this is termed a "cost of service" utility (Emera 2008). Because of this structure, the company is not exposed to market risks (i.e., fuel-price volatility), and therefore has little incentive to take internal risks (i.e., RE investments). Regarding geothermal production, for example, LUCELEC said it "does not intend to go into this risky explorative undertaking itself, in order to protect consumers from such ventures that may negatively affect its tariff." During the early 2000s, however, it maintained a policy of being receptive to integrating RE sources into the grid

> *at a medium run cost that is competitive with alternative feasible options that are available to the Company from its own generation and/or from other parties. In other words, the Company will purchase this source of power from any third party at a price that is equal to or lower than the cost at which the Company can generate power (LUCELEC 2007, p. 8).*

3.6.3 Electricity Supply

Table 16. St. Lucia Electricity Market Summary

Item	Value	Notes
Plants	1	9 diesel generators at Cul de Sac Power Station, adjacent to Hess oil terminal. As of December 2011 a 10MW Wartsila engine has been ordered to be commissioned in December 2012 (LUCELEC, 2011) to increase installed capacity to 86MW
Capacity (MW)	76	Increased from 66.5 MW in 2000.
Peak Demand (MW)	55.9	Increased from 43.3 MW in 2000; LUCELEC expects growth of 13.4% (to 63.1 MW) by 2019.
Total Electricity Generated (MWh)	362	Increased from 276 MWh in 2000; losses down to 9.3% in 2009, maximum since 2000 is 12%.
Total Electrical Sales (MWh)	315	Increased from 234MWh in 2000; LUCELEC expects 2.3% annual growth through 2014.
Total Diesel Fuel Used (MM imp gal)	18.26	Increased from 14 million gallons in 2000.
Fuel Efficiency (kWh/gal)	19.75	Specific fuel consumption increasing slightly; won efficiency awards from diesel turbine manufacturer.
Unit Retail Price (U.S. $ per kilowatt-hour)	0.280	Steady during 2000–2005, averaging 0.152; higher since 2006, averaging 0.279; peaked at $0.30 in 2008.
Unit Generation Cost (U.S. $ per kilowatt-hour)	0.229	Averaged 0.266 during 2000s; peaked at $0.40 in 2008.

Source: LUCELEC 2009, except efficiency award.
Note: Unit retail price = tariff sales; unit generation cost includes operating and fuel costs. Market supply does not include contributions from distributed generation.

Figure 24 describes the historical electricity trend generation for St. Lucia. During the last 30 years the growth has been continued and steady.

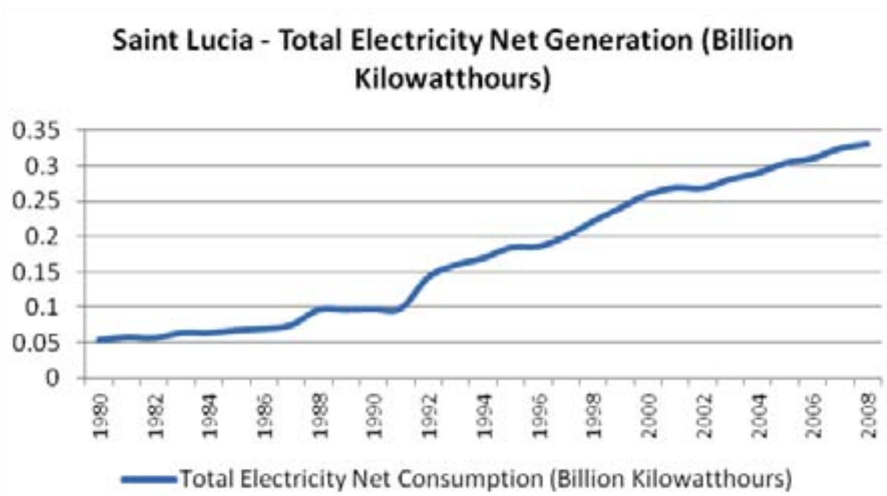


Figure 24. Electricity generation on St. Lucia

3.6.4 Electricity Demand

St. Lucia, at about 98%, has nearly complete electrification. Demand for electricity grew steadily over the last decade, including disproportionate growth in the commercial sector—with consumption increasing by 4.6% from 2002 to 2007 (Loy 2007, p. 20). LUCELEC expects slowing demand growth in the future, stating,

> *The domestic, commercial and hotel sectors are expected to grow, on average, by 1.52%, 1.63% and 0.85% respectively over the next 10 years. The growth rates in these three major sectors indicate that a plateau has been reached in terms of the continued growth in sales and mirrors the state of the economy. This growth is predicated on an average GDP growth of 1.50% for the next 10 years. Peak demand is forecasted to grow by 13.4% during this same period (LUCELEC 2009, p. 16).*

Table 17. St. Lucia Electricity End Uses

	Customers	Consumption (MW)	Consumption per Customer
Domestic Residences	52,986	107,820	2,035
Commercial (Including Hotels)	6,479	178,518	27,553
Industrial	100	19,002	190,024
Street Lighting	7	9,741	#N/A
LUCELEC Own Use	#N/A	14,312	#N/A
Losses	#N/A	33,597	9.25% of gross generation

Source: LUCELEC 2009, p. 92.
Note: End uses do not include contributions from distributed generation.

Figure 25 shows the electricity consumption on St. Lucia during the last 30 years. The trend shows a persistant increase of the local demand.

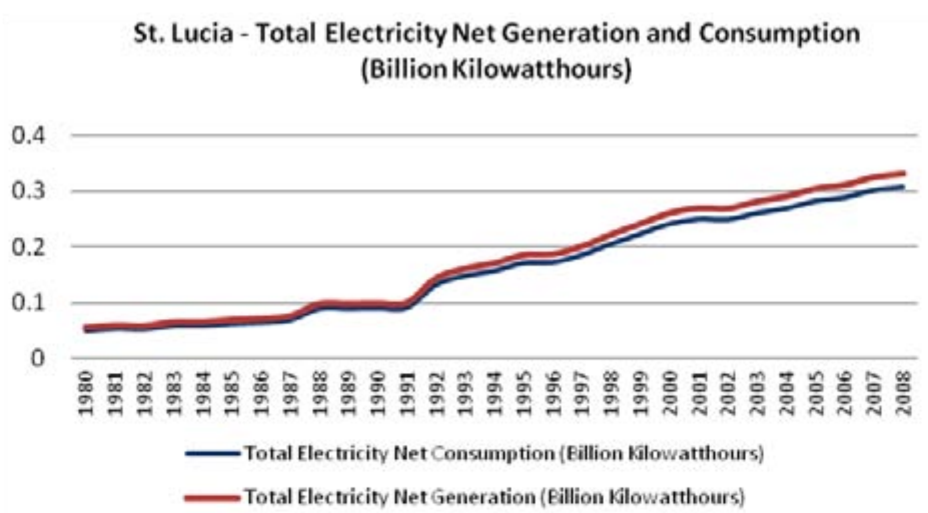


Figure 25. Consumption and generation of electricity on St. Lucia

3.6.5 Energy Efficiency

LUCELEC makes efficient use of existing capacity through system reliability, transmission losses, and fuel efficiency (LUCELEC 2009, p. 13). In 2003 the company was honored for its consistent maintenance of its power plants by Wärtsilä, the diesel turbine manufacturer (LUCELEC). In 2010 LUCELEC's generation losses were at 9.5% (LUCELEC Annual Report 2010).

In August of 2010 the LCCC project partners hosted in collaboration with CARILEC and CSEP a regional energy-auditing workshop in St. Lucia with focus on providing fundamental knowledge to strengthen the capacity to carry out energy audits and recommend efficiency measures for public, commercial, and hotel buildings (LCCC 2010).

3.6.6 Demand Management

LUCELEC recently began implementing an automated metering infrastructure (AMI), with 11,500 smart meters (equal to 20% of its customer base) installed at the end of 2009, and approximately 9,000 more were installed in 2010. The "AMI was one of the most significant contributing factors to a reduction in system losses—an indication that our meter population was relatively old" (LUCELEC 2009, p. 17).

3.6.7 Building Codes

St. Lucia adopted the model OECS building code in 2001, and in 2009 established a National Technical Sub-Committee to develop the Caribbean regional building standards (RBS). During the 1990s, the government of St. Lucia led the region in developing the model OECS building code. Although the OECS code was a regional effort, the model document appears to be specific to St. Lucia, and thus some reviews of the code refer to the OECS code and St. Lucia's interchangeably (Chin 2001). The code was implemented as part of a 2001 Physical Planning Bill, which includes laws on infrastructure and electricity. This bill gives responsibility for building code development, enforcement, and training to the Development Control Authority, and the Ministry of Physical Development, Environment and Housing (Government of St. Lucia 2001). An unofficial version of the code is available at http://foshlaninc.com/knowledgebase/
slu_building-codes/codepreface.htm (Foshlan 2005).

The National Technical Sub-Committee was formed by St. Lucia Bureau of Standards (SLBS) in 2009 to coordinate input from St. Lucia to the Caribbean Regional Building Standards model code. The committee is composed of various stakeholders from the nation, including professional organizations of engineers, architects, and contractors, the Development Control Authority, the Ministry of Housing, and the Ministry of Communications, Works, Transport and Public Utilities (St. Lucia Bureau of Standards 2009).

3.6.8 Electrical and Lighting Codes

The SLBS publishes a list of standards, including international standards that the nation has adopted concerning electrical equipment, power systems, and lighting. The SLBS makes the standards available at cost. Although some standards are marked as "mandatory St. Lucia National Standards," whether these standards are enforced or to what degree they are utilized is unknown (St. Lucia Bureau of Standards 2010, pp. 3–4).

Table 18. St. Lucia Electrical and Lighting Standards

Code	Title	Mandatory
SLNS/BSI 7671:2008	Requirements for electrical installations. "IEE Wiring Regulations. Seventeenth Edition"	Yes
SLNS/BS EN 60335-1: 2002	Household and Similar Electrical Appliances—General Requirements	Yes
SLNS/BS EN 60335-2-35: 2002	Household and Similar Electrical Appliances—Particular Requirements for Instantaneous Water Heaters	Yes
SLNS/BS EN 60335-2-80: 2003	Household and Similar Electrical Appliances—Particular Requirements for Fans	Yes
SLNS/BS EN 60598-1: 2008	Luminaries part 1—General requirements	No
SLNS/BS EN 60598-2-5: 2005	Luminaries part 2—requirements section 2.20 Lighting chains	No
SLNS/BS EN 61558-1: 2005	Safety of power transformers, power supply units and similar—part 1: General requirements (mandatory)	No

Source: St. Lucia Bureau of Standards 2010, p. 3.

3.6.9 Energy Supply Outlook

St. Lucia participates in PetroCaribe, and Hess Oil owns a 9-million-barrel petroleum transshipment terminal at Cul de Sac (Nexant 2010). Although Hess has a long-standing option to build a refinery at the site, it recently announced that it has no plans to do so (Haddadin & Driver 2008). To provide future supply, the *World Bank Report* projects that the least-cost fuel combination for St. Lucia is a 20-MW gas turbine capacity for peaking duty, and a 20-MW low-speed diesel capacity for mid-range and base-load duty (Nexant 2010, p. 1.8). The cost of fossil-fuel energy for St. Lucia could be reduced if it is connected to the ECGPC (Nexant 2010, pp. 7.8–7.9), or if the petroleum-storage capacity was expanded to serve other islands (Nexant 2010, pp. 7.22–7.23).

LUCELEC itself has three weeks of fuel storage at the Cul de Sac power plant (Nexant 2010, p. 7.21), and began hedging fuel prices in 2009. The utility is considering conversion of existing light fuel oil (LFO) or diesel generators to heavy fuel oil (HFO) (LUCELEC 2009, pp. 14–15). It also is considering gas turbines or coal–pet coke circulating fluidized bed reactors (LUCELEC 2008). As per December 2011, LUCELEC finalized a contract for the delivery and installation of a new 10 MW engine for Cul De Sac Power Station. The new engine will be provided by Wärtsilä of Finland and will bring the number of generators installed at Cul De Sac to 10. It is expected to be commissioned in December, 2012 (LUCELEC 2011).

3.6.10 Renewable Energy

Table 19. St. Lucia Renewable Potential

Technology	Value
Hydro	150 kW
Wind	40 MW
Geothermal	170 MW
Solar	36 MW (PV)
Biomass and Other	unknown

Sources: Hydro, wind, Loy 2007, pp. 139,156; geothermal, solar, Nexant 2010, p. 8.36.

Both geothermal and wind are being developed commercially. Additionally, although SWH and distributed PV installations also exist, their market adoption has been slow. In terms of policy, there has been limited success in implementation of the SEP. The government has waived import duties and consumption taxes on renewable energy equipment since May 1999 (Loy & Farrell 2005, p. 39), and added incentives for solar water heaters in 2001. In 2004, it held an energy awareness week, promoting efficient lighting and including an energy-auditing workshop for the hospitality sector (GSEII 2009). The major goal of building commercial and distributed RE capacity, however, has not yet been achieved (Loy 2007, p. 156).

3.6.10.1 Hydro

St. Lucia has the potential for about 150 kW of hydro power at the Roseau Reservoir, which could be used for water delivery (Loy 2007, p. 139). Its use, however, would require excess flow of water, and the island has experienced significant droughts twice in the last decade (2001 and 2010) (Bishop 2010).

3.6.10.2 Wind

Wind power has been considered commercially since at least 1995, when a foreign partnership proposed a 13.5-MW wind farm (Loy & Farrell 2005, p. 38). With the St. Lucian government, LUCELEC also considered a 4.25-MW wind farm at Point de Caille in 2004. In the second case, the utility was unable to secure the site from its hospitality-industry owners (GSEII 2009). Finally, in 2007, LUCELEC began its current development of a 12.6-MW Sugar Mill wind farm at the Rouane Estate, where wind speeds average more than 7 m/s. CREDP/GTZ estimated that, at this average speed, the generation costs would be below fuel costs alone at U.S. $.08 per kilowatt-hour (Loy & Farrell 2005, p. 38), with a potential capacity of 40 MW at this site (Loy 2007, p. 156). In 2009 the organization agreed to provide LUCELEC with financial and technical assistance in the project (LUCELEC 2009, p. 15). As per December 2011, no further development is reported due to problems in acquiring the land for the wind farm site.

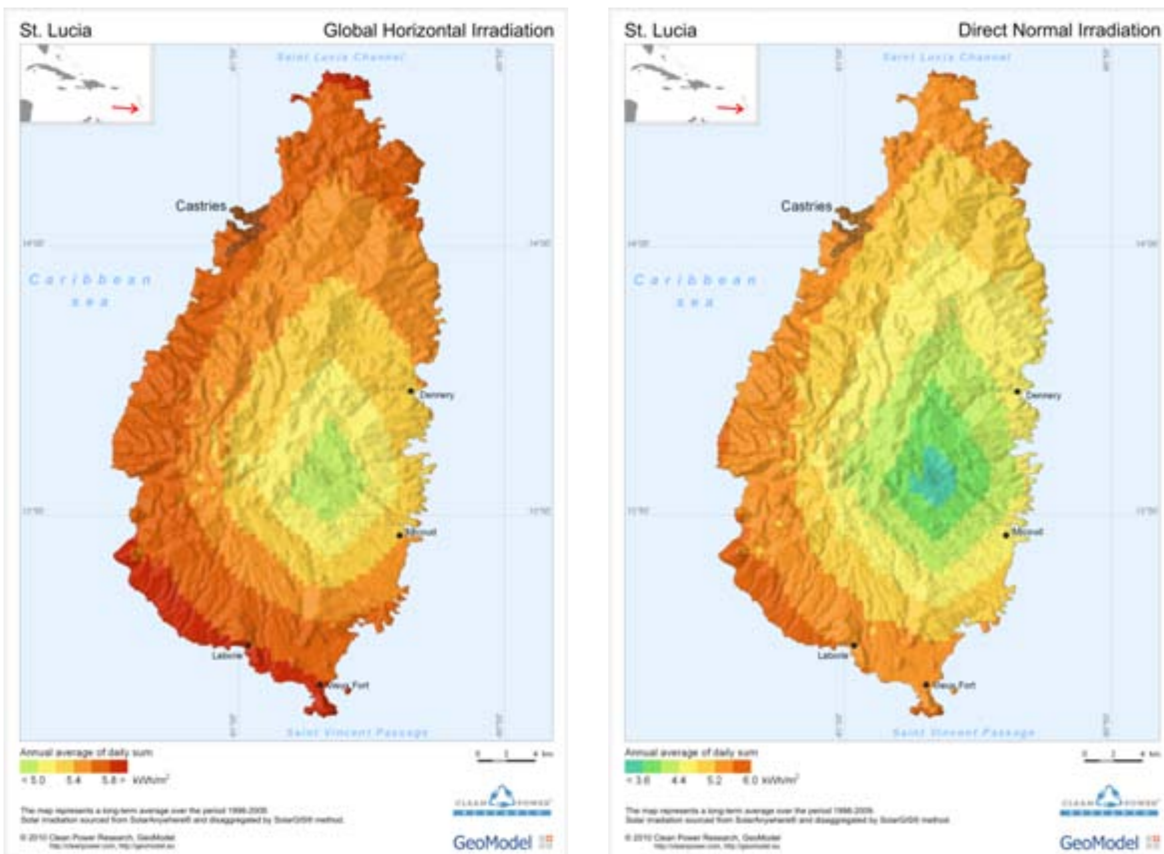
3.6.10.3 Geothermal

There have been numerous studies of geothermal potential in the region (Coles 2004, pp. 7–9). Loy and Farrell provide a summary of these studies, conducted from the 1960s until 2004 (Loy & Farrell 2005, pp. 40–41). Objective estimates of St. Lucia's geothermal potential are in the range of 25 MW, but only geophysics and geological surface techniques could show the real geothermal potential available (Nexant 2010, p. 8.36). In 2004, however, a Canadian group called the Unified Network of the Eastern Caribbean (UNEC) signed an agreement to partner with the government to develop resources in the Soufriere (Sulphur Springs) region (Loy 2007, p. 141). This company has since evolved into the United States–based Qualibou Energy Inc. (Qualibou Energy 2008). Qualibou recently announced an updated agreement with the government, including a 30-year contract, but its financial details and whether the contract includes exclusive rights to the region or the entire island were not disclosed. LUCELEC has agreed to buy the geothermal power from Qualibou (McFadden 2010).

Qualibou plans to eventually generate some 120 MW in the Soufriere region, claiming 30 MW of proven reserves and an additional 140 MW of probable reserves (Kessler 2010). The government agreement is contingent on drilling by 2012 (McFadden 2010), and the company intends to develop 12 MW by 2012, with a goal of 100 MW by 2015 (Qualibou Energy 2008). Qualibou also is considering exporting electricity to Martinique (McFadden 2010). As of March 2011, Qualibou reported that previously announced due diligence has concluded and it has entered into an interim agreement to fund its St. Lucia geothermal power project with a private energy company headquartered in Vancouver, Canada (Qualibou Energy, Inc. 2011). As of December 2011 no further developments were recorded regarding drilling activities for geothermal exploration in St. Lucia.

3.6.10.4 Solar

With GHI averaging more than 5.7 kWh/m^2/day, the low-lying parts of St. Lucia have good solar resources for flat-panel PV and solar hot water systems (*see* Figure 26). The DNI resouce is far poorer,



suggesting that concentrated solar would not perform well in this region. See Http://www.ecpamericas.org/initiatives/default.aspx?id=31 for full-page copies of the GHI and DNI solar maps.

Figure 26. Solar maps of St. Lucia

Distributed, grid-tied residential and governmental solar PV systems up to 10 kW are allowed in a pilot project between LUCELEC and Solar St. Lucia Limited. In aggregate, this totals about 0.1 MW of distributed, grid-tied solar capacity (Nexant 2010, p. 8.40). Included among these are at least three government sites, The St. Lucia Banana Industry Trust, the Castries Market, and a school in Vieux Fort (LUCELEC 2010, p. 3; Posorski & Werner 2009, p. 72). The country already enjoys a relatively high usage rate for solar water heaters (Loy & Farrell 2005, p. 39), although the hospitality sector has substantial latent demand for SWH, according to a CREDP/GTZ market study conducted on Dominica, St. Lucia, and St. Vincent (Loy 2007, p. 140).

3.6.10.5 Biomass and Other

The potential for generation from landfill gas has been studied at the Ciceron site (Loy & Farrell 2005), and LUCELEC is currently studying the Deglos site (LUCELEC 2009). A poultry litter study by GSEII proved not to be economical (GSEII 2009). In August 2011 the Ministry of Public Utilities approved a 15MW Waste-to-Energy (WTE) Project (Waste Management World 2011). As of December 2011 no updates were recorded.

3.6.11 Interconnections

St. Lucia could be connected to the ECGPC to achieve a lower cost of natural gas fuel (Nexant 2010, pp. 7.8–7.9). Based on whether development of geothermal resources is successful, Qualibou is considering an undersea transmission line to export electricity to Martinique (McFadden 2010).

3.6.12 Energy Policy Framework

St. Lucia is a net importer of fossil fuels, and like other members of the OECS, is vulnerable to volatility in energy market prices and the impact on the country's trade balance. The electricity and transportation sectors are the greatest consumers of fossil-fuel energy. Regarding renewable energy, there are several sources that could be exploited by the country including solar, wind, geothermal, and waste to energy, but their actual potential for usage—particularly in the short term—has not been fully determined. Pre-feasibility studies, however, are ongoing. Although St. Lucia set itself on an ambitious path toward RE and sustainability more than a decade ago, it has been unable to implement much of its program due to an incomplete energy policy and technological and financing issues at promising geothermal sites. The government recently approved a national energy policy, however, and currently is drafting an updated sustainable energy plan. St. Lucia has abundant geothermal resources as well as moderate wind and solar resources. Currently, one IPP is demonstrating distributed PV systems, the utility is developing a wind farm, and another IPP is planning 120 MW of geothermal projects.

3.6.13 Energy Sector Regulatory Framework Analysis

With regard to the institutional framework governing energy management, the Ministry of Economic Affairs, Economic Planning, National Development and the Public Service through its Sustainable Development and Environment Section is responsible for developing St. Lucia's energy policy, conducting energy planning, and the dissemination of information concerning RETs (Renewable Energy & Energy Efficiency Partnership 2010a). The Department of Public Utilities in the Ministry of Communications, Works, Transport and Public Utilities is responsible for regulating the electricity sector. The electricity sector's sole provider until 2045 is the publicly traded St. Lucia Electricity Services Limited. The Government of St. Lucia owns 45% of the shares in LUCELEC and the Commonwealth Development Corporation (United Kingdom) owns 49%. LUCELEC owns one generating plant facility with an installed capacity of 76 MW.[19] The main challenges in the institutional framework are that the nature of accountability and responsibility, supported by the identification of clear roles and responsibility including a hierarchy or chain of command or responsibility, is not readily discernible.

3.6.14 Legal and Regulatory Framework

In terms of the legal, policy, and regulatory framework, the Power Supply Regulation (1964) established the St. Lucia Electricity Services Limited Act and granted it the exclusive right to generate, transmit, distribute, and sell electricity in St. Lucia. This right was retained until 2045 under the Electricity Supply Act (1994), which repealed/superseded the regulation. LUCELEC is empowered to grant—and the Cabinet may revoke—sub-licenses to generate, transmit, distribute, and sell electricity under certain conditions and within a specified area (*see* Section 4 and Section 5, respectively).

LUCELEC is permitted the duty-free importation of all plant machinery, equipment, and vehicles for the purposes of its business; income tax concessions for any losses incurred by LUCELEC (Section 9); and exemptions from the payment of stamp duty (Section 10). These benefits under the legislation also could be deemed to apply to the importation of renewable energy technologies. Further, under Section 10 the government may acquire land, upon LUCELEC's request, that is reasonably required to generate, transmit, distribute, and supply electricity. This provision also seems to apply to the establishment of wind farms and other renewable energy–related initiatives. Other renewable energy–related provisions are Section 19, which permits LUCELEC—whether on Crown or private land—to harness water or wind power without charge for the purpose of providing the public with electricity. Section 21(2) permits LUCELEC or another corporation, with LUCELEC having the right of first refusal, to generate electricity utilizing fumaroles at Soufriere. Another notable provision in the ESA relates to self-generation. Section 21(1) permits self generation for one's own consumption and use, but under certain terms and conditions which are not specified in the Act, and within a specified area. In terms of any form of regulatory oversight provisions in the ESA, Section 34 provides for the establishment of a Review Board which is responsible for reviewing basic energy rates (Section 31).

Although the ESA is the main legislative instrument relating to the energy sector, there is other legislation that could touch upon and concern the sector and which must be considered, including the Land Acquisition Act, Montreal Protocol (Substances that Deplete the Ozone Layer) Act, Physical Planning and Development Act, Motor Vehicles and Road Traffic Act, Public Utilities Restriction on Shareholding (St. Lucia Electricity Services Limited) Act, Waste Management Act, and the Water and Sewerage Act.

Regarding policy statements, in 1999 the government passed Cabinet Conclusion No. 646, eliminating all import duties and consumption taxes on renewable energy equipment and materials. In 2001, solar water heaters were made tax deductible. Details on other policy and regulatory instruments are not readily available in the public domain, except the national energy policy which is discussed below. The main challenges in the legal, policy, and regulatory framework are the following (Government of St. Lucia 2010, p. 3).

- LUCELEC's monopoly over the energy sector bucks current developments in energy-sector reform which involve revising the market structure to encourage competition. The ESA should be revised to address this issue.

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[19] *See* http://www.lucelec.com/site/discover/operations.php. Accessed August 10, 2011.

- Given the monopoly structure, there is no overarching independent commission or body to effectively regulate the energy sector. The ESA should be revised to address this issue.
- The policy provisions noted above have been deemed insufficient for addressing significant challenges in energy efficiency and reducing reliance on fossil fuels.

3.6.15 Assessment of the National Energy Policy

The Government of St. Lucia seeks to develop its energy policy and strategy within the context of the National Vision Plan and the Medium-Term Strategy (Government of St. Lucia 2010, p. 4). The government's objective is to "ensure the development, and/or exploitation, of new and renewable energy sources . . . in its efforts to establish St. Lucia and a Sustainable Development Energy Country" (Government of St. Lucia 2010, p. 4). The national energy policy is guided by the following principles.

> *[P]rocurement of energy supplies at the least cost through liberalization of the energy sector and broad private sector participation; energy security and reliability; diversification of the energy base; exploitation of indigenous renewable energy resources; higher efficiency in energy production, conversion, and use with the overall objective of reducing energy intensity; reduction of adverse environmental impacts and pollution by rehabilitating existing energy sector facilities and introducing new standards for energy related products as well as mandating environmental impact assessments for new projects; implementation of appropriate pricing policies to ensure adequate energy supplies are efficiently delivered to all economic sectors and fostering an environment to facilitate an improved and sustained energy supply network with sufficient incentives to encourage private sector investments; and establishment of an appropriate regulatory framework to set clear guidelines for investors and protect the interests of consumers (Government of Grenada 2009).*

In terms of policy expression, the NEP addresses institutional arrangements, energy subsectors, energy-efficiency measures across subsectors, and environmental aspects.

3.6.15.1 Institutional Arrangements

This section outlines the responsibilities of the ministry in charge of energy planning and the ministry in charge of public utilities. Further, it provides that the government will establish an Energy Advisory Policy Committee co-chaired by the two ministries, to provide advice on energy-related issues and activities including "creating a discussion forum open to state institutions and the private sector; and advise on adequate and strategies with a view to supporting reform in the energy sector." The committee will be composed of senior experts from various ministries, private-sector organizations, and civil society groups. Moreover, the NEP provides for the establishment of an independent regulatory body to:

- Recommend to the minister with responsibility for public utilities the terms and conditions for the issuance of licenses for LUCELEC to generate, transmit, and distribute electricity to consumers;
- Recommend to the minister with responsibility for public utilities the terms and conditions for the issuance of licenses to independent power producers;
- Undertake economic regulation;
- Establish and monitor tendering procedures for any major investments in the electricity generation sector;
- Set and monitor quality standards and reliability criteria for all licensees; and

- Act as arbitrator in all cases of dispute between electric utilities and consumers, or between any other parties engaged in the electricity sector.

Although these policy provisions seek to provide a clearer structure for energy governance and clearer roles and responsibilities, there are a few shortcomings. There is a potential for overlap in jurisdiction between the ministries in charge of planning and public utilities which could hinder effective institutional management. A clear hierarchy or chain of responsibility must be elucidated to prevent institutional inefficiencies. Further, all of these institutions could create unnecessary layers of bureaucracy, especially for consumers. Both the ministry in charge of public utilities and the proposed regulatory commission would have responsibility for addressing consumer concerns. For a more streamlined, transparent process, only one entity should be charged with that purpose. Recent developments in energy-sector reform have tasked independent regulatory bodies with responsibility for addressing consumer concerns. Also, although an energy policy advisory committee is good way to engage all relevant stakeholders in a meaningful way, such committees, without the clear and proper structure and mandate established by law or cabinet order, often suffer the fate of being reduced to ad hoc gatherings and "talk shops."

3.6.15.2 Energy Subsectors

This section addresses three main subsectors, petroleum, gas, and electricity. In terms of the petroleum subsector, the policy provisions cover the security of energy supply, pricing and taxation, safety and standards, and national oil refinery. Under pricing and taxation the Ministry of Finance is responsible for establishing and maintaining a mechanism to monitor the pricing scheme to ensure, for example, that prices are not "being marked up with excessive transportation, loss and insurance costs." It is recommended that the Ministry of Finance either conduct this activity in consultation or collaboration with the proposed independent regulatory commission—given its proposed mandate to approve tariff structure and rates for all consumers and undertake economic regulation of the sector—or, as is done in other jurisdictions, empower the independent regulatory commission to set prices in consultation with the Ministry of Finance. In terms of standard setting, given the proposed role of the independent regulatory commission to set and monitor quality of service standards for all licensees, and the interest of other institutions such as the ministry with responsibility for energy and public utilities, all standards instituted including with the Bureau of Standards should be in consultation with these entities.

3.6.15.3 Electricity Subsectors

This section addresses power expansion planning, private-sector engagement, regulatory arrangements, co-generation, indigenous renewable energy sources, quality-of-service standards, and economic regulation and tariff design. Regarding co-generation, the policy provisions indicate that the ESA will be revised to allow commercial entities such as hotels and hospitals to co-generate electricity (with a maximum plant capacity of 500 kW), ad equipment should be located on the site of consumption. These co-generators will be connected to the grid and feed-in tariff measures will be developed. These provisions are good improvements in keeping with development in energy-sector reform. Further, in terms of renewable resources, there now is a policy provision for self-supply with a maximum peak capacity of 10 kW. Intended self-suppliers, however, would need approval from LUCELEC even though a license is not required. It is recommended that, to ensure greater transparency, the proposed independent regulatory commission be empowered to grant such approvals or deny requests after consultations with LUCELEC. To ensure the quality-of-service standards, monitoring and evaluation of power facilities must form part of the policy.

3.6.15.4 Energy Efficiency Measures

This section addresses energy efficiency in the electricity, building, and transport sectors. Regarding the transport sector, limits on the age of imported vehicles also should be imposed.

3.6.15.5 Environmental Aspects

All energy- and environment-related legislation should be periodically reviewed to avoid conflicts and inconsistencies.

3.6.16 Conclusions and Recommendations

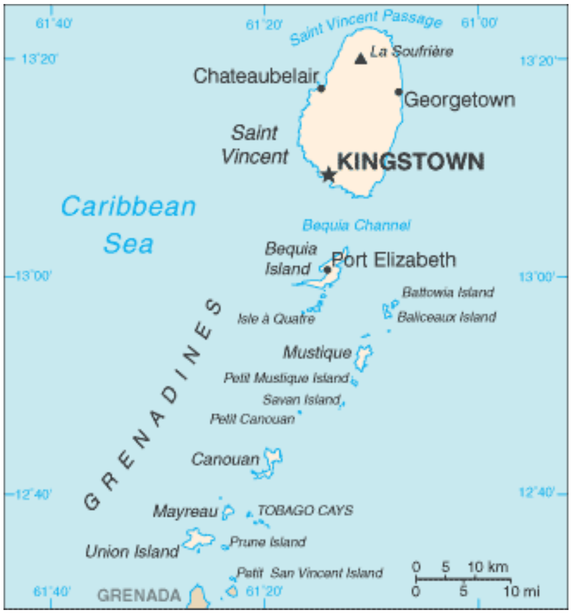
The institutional framework must be reviewed to ensure inter- and intra-institutional cooperation. Clear mandates and roles, along with a clearly defined hierarchy or chain of responsibilities, must be established to enhance the effectiveness of energy governance in St. Lucia. Overlaps in jurisdiction should be avoided along with unduly bureaucratic processes.

Despite the efforts made, no measurable benefits from current legislation and projects developed in the country to reduce the rate of oil importation/consumption were found during the period of analysis. Regardless of some isolated attempts to change course, oil consumption still is increasing and internal volatility is affecting national energy security. International agreements had no measurable impacts over the fossil-fuel consumption rate during the period of analysis.

Previous studies have made recommendations for St. Lucia, including that St. Lucia should complete its work to draft and adopt an updated sustainable energy plan (Posorski & Werner 2009, p. 73). The present study makes the following recommendations for St. Lucia.

- International initiatives should pursue studies to further quantify solar water heating adoption, and work with the government to enact effective incentives to increase adoption.
- International initiatives should pursue studies to further quantify biomass and landfill resources.
- International initiatives should pursue studies to objectively assess the economic, technical, and political implications of developing electricity interconnections for the export of geothermal power.
- The government and LUCELEC should publicly disclose pending and existing agreements and report their ongoing progress on wind-power projects.
- The government, Qualibou, and LUCELEC should publicly disclose pending and existing agreements and report their ongoing progress in geothermal projects.

3.7 St. Vincent and the Grenadines



Item	Value
Land Area St. Vincent Grenadines	150 km² (total) 133 km² 17 km²
Population	104,200
Supply Diesel Hydro	49 MW 43.3 MW 5.2 MW
Price	U.S. $0.3236 per kilowatt-hour

Sources: CIA 2010; Posorski & Werner 2009; Government of St. Vincent and the Grenadines 2010, p. 21.
Note: Supply includes distributed generation.

St. Vincent and the Grenadines (SVG) is a nation composed of a mountainous main island and the northern Grenadines, including several small inhabited islands. St. Lucia lies to the north, Barbados to the east, and Grenada is just to the south.

3.7.1 Energy Sector Outlook

3.7.1.1 Energy Governance Stakeholders

3.7.1.1.1 Government Agencies

The Office of the Prime Minister sets energy policy for the nation through several government offices. The National Energy Committee is composed of stakeholders from various government ministries and state institutions, and serves to advise the government on energy situations and policy, including drafting the national energy policy. The Energy Unit is mandated to implement energy policy, especially for the development of renewable energy and energy efficiency (Posorski & Werner 2009, p. 79).

3.7.1.2 Utilities and Independent Power Producers

St. Vincent Electricity Services Limited (VINLEC) has the exclusive license to provide the public with electricity until 2033, per the 1973 Electricity Supply Act. This Act also stipulates that VINLEC must issue a license to any other parties that wish to generate, transmit, and distribute electricity, including for both IPP's and self-generation (Posorski & Werner 2009, p. 78). Of the inhabited islands of the nation, only the private islands of Palm and Mustique have independent power production as part of their respective resorts (Loy 2007, p. 158).

3.7.2 Electricity Market

VINLEC is owned by the government of St. Vincent and the Grenadines, and is the only provider of electricity generation, transmission, and distribution to the islands of St. Vincent, Bequia, Canouan, Union Island, and Mayreau. It operates as a corporation, with financial statements available for the period from 2003 to 2008 (VINLEC 2006).

3.7.3 Electricity Supply

Table 20. St. Vincent and the Grenadines Electricity Market Summary

Item	Value	Notes
Plants Diesel Hydro	9 6 3	Diesel plants at Cane Hall and Lowman's Bay in St. Vincent; and islands of Bequia, Canouan, Union Island, and Mayreau. Hydro plants at South Rivers, Cumberland, and Richmond in St. Vincent.
Capacity (MW) Diesel Hydro	68.82 63.52 5.2	Last diesel expansion was 9 MW in 2006 and 8.4 MW in 2011[20] at Lowman's Bay; Last hydro expansion was 3.7 MW at Cumberland 1988.
Peak Demand (MW)	24.8	Peak demand in St. Vincent. Nexant expects annual growth of 6.9% (to 94.4 MW) by 2028.
Total Electricity Generated (GWh)	139.1	16% of generation from hydro. Nexant expects 6.9% annual growth (to 554.9 GWh) by 2028.
Total Electrical Sales (GWh)	122.9	Nexant expects 6.9% annual growth (to 510.3 GWh) by 2028.
Total Diesel Fuel Used (MM imp gal)	unknown	
Fuel Efficiency (kWh per U.S. gal)	unknown	
Unit Retail Price (U.S. $ per kilowatt-hour)	$0.3236	Minimum residential rate, calculated from U.S. $0.157 per kilowatt-hour tariff, and fuel surcharge (November 2008) of U.S. $0.166 per kilowatt-hour.
Unit Generation Cost (U.S. $ per kilowatt-hour)	$0.3581	Calculated from U.S. $44 million in operating expenses.

Values current for 2008.
Sources: VINLEC 2008, pp. 45–46; Posorski & Werner 2009, pp. 77–78; Nexant 2010, pp. 5.8, 5.13, 6.12; capacity expansion: Government of St. Vincent and the Grenadines 2010, pp. 15, 21.
Note: Market summary does not include contributions from distributed generation.

[20] http://i-witness-news.com/2011/11/27/vinlec-officially-opens-lowman-bay-power-plant/ (Nov 2011)

Figure 28 describes the historical electricity generation in St. Vincent and the Grenadines. During the last 30 years, the growth of electricity generation has been continuous and strong despite the increase of oil prices in the same period.

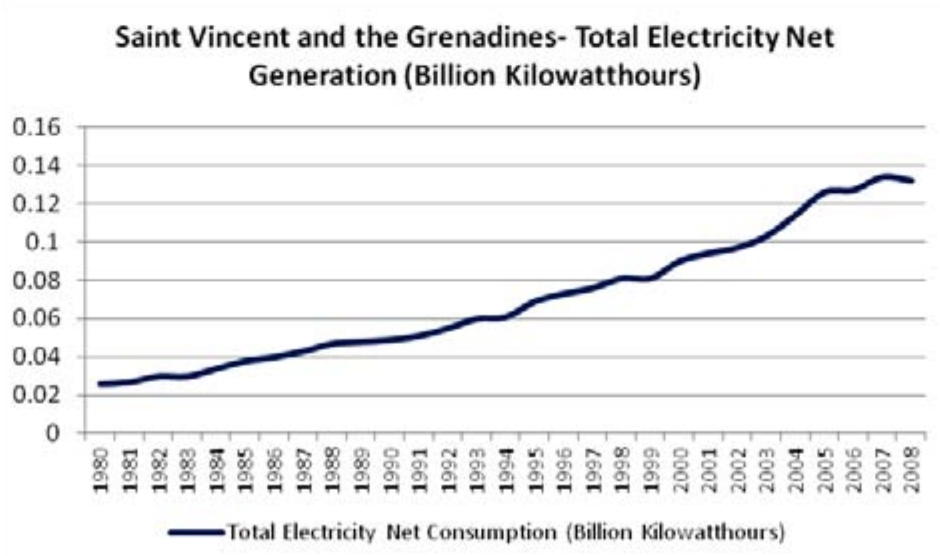


Figure 28. Electricity generation on St. Vincent and the Grenadines

3.7.4 Electricity Prices

Electricity consumers face costs based on a two-tiered unit tariff and a per-unit fuel surcharge. Residential customers are charged a tariff (fixed since 1989) of U.S. $0.157 per kilowatt-hour for the first 50 kWh per month, and U.S. $0.185 per kilowatt-hour per month thereafter (VINLEC 2006). Although the fuel surcharge began to increase dramatically in 2004 and peaked in 2008 (Government of St. Vincent and the Grenadines 2010, p. 12), it has since remained high—the fuel surcharge in November 2008 was U.S. $0.166 per kilowatt-hour (VINLEC 2008), but in May 2010 it still was U.S. $0.140 per kilowatt-hour (Vincyview.com 2010). For a residential consumption falling within the lower tier costs at the end of 2008, this represents a *minimum* electricity cost of U.S. $0.3236 per kilowatt-hour. Note that this is not the mean price for the entire SVG economy; VINLEC consistently has recorded a profit during the 2000s, despite the oil-price spike (VINLEC 2008, p. 45).

3.7.5 Electricity Demand

St. Vincent and the Grenadines have 99% electrification (Loy 2007 p. 135). Among the SVG economy, the commercial sector has contributed the most to growth in demand since 2003 (Government of St. Vincent and the Grenadines 2010, p. 17). In 2008, commercial uses totaled approximately 47% of all electricity, and residential use was 45% (Posorski & Werner 2009, p. 8). Electrical demand for the nation is expected to grow robustly by 6.9% annually, meaning that SVG must add new capacity by 2017 (Nexant 2010, pp. 6.12, 13.3).

Table 21. St. Vincent and Grenadines Electricity End Uses

	Customers	Consumption (MWh)	Consumption per Customer (MWh)
Domestic Households	34,500	55,500	1.61
Commercial	4,200	58,280	13.88
Industrial	27	6,180	228.89
Street Lighting	48	2,930	61.04
Own Use	#N/A	5,000	3.73% of net generation
Losses	#N/A	11,200	8.35% of net generation

Source: VINLEC 2008, pp. 45–46.
Consumption per customer calculated.

Figure 29 shows the electricity consumption during the last 30 years. It is observed as a continuous increase in consumption.

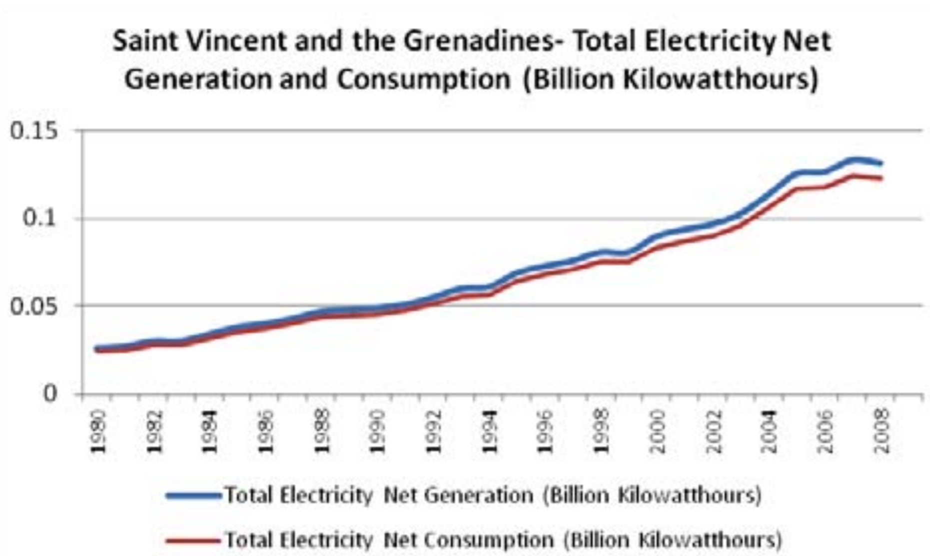


Figure 29. Consumption and generation of electricity on St. Vincent and the Grenadines

3.7.6 Energy Efficiency

VINLEC experienced system transmission and distribution losses of 8.7% during 2007 and 2008, and Nexant expects this efficiency to remain constant (Nexant 2010, p. 6.12). The NEP calls for improving the efficiency of power production, transmission, and distribution (Government of St. Vincent and the Grenadines 2009, p. 10). Additionally, although the EAP mentions that most of VINLEC's diesel generators are old and inefficient, it does not initiate any specific actions toward furthering this policy (Government of St. Vincent and the Grenadines 2010, pp. 5, 15).

3.7.7 Demand Management

Action 32 of the sustainable energy plan EAP calls for studying opportunities for demand management in the short term. The Ministry of Energy is to coordinate with consultants and stakeholders to analyze energy consumption and potential for improvements in efficiency. Specifically, VINLEC will analyze the consumption patterns of electrical customers (Government of St. Vincent and the Grenadines 2010, p. 42).

Action 40 directs the Ministry of Energy to lead public awareness campaigns to promote energy conservation. In 2010, the Government of St. Vincent and the Grenadines—using funding under the European Union's Special Framework of Assistance (SFA) 2006—implemented a 10-month energy efficiency study, aiming to identify areas for possible energy savings and implementing energy efficiency measures in 75 highest energy consuming government-owned buildings. As part of the project, an Energy Conservation Education and Awareness Programme was developed to raise awareness and promote energy-efficient behaviors among government employees in the workplace. Additionally, the SEP notes that a 2010 study of energy efficiency in government buildings (financed by the European Development Fund Special Framework of Assistance) includes a public awareness program in its scope (Government of St. Vincent and the Grenadines 2010, p. 46).

A final stakeholder workshop on energy efficiency was held on November 4, 2010. It was lead by the Energy Unit of the Prime Minister's Office in collaboration with Egis Bceom International Consultancy. The objective of the workshop was to present the main findings and results achieved from the energy audits, and discuss the tools for further implementation of the energy-efficiency measures. It was agreed that the CSEP/OAS will provide assistance and expertise in an effort to give continuity to the work initiated by Egis Bceom International Consultancy, both in the areas of energy efficiency and energy awareness. No further specific updates are available regarding these initiatives (SVG Energy Unit 2011).

3.7.8 Building Codes

The SEP addresses energy efficiency in buildings in the areas of design, lighting, and appliances, as well as regarding use of solar hot water. To encourage both market compliance and continued government action, all these measures call for the assigned agencies to work with other nations in the Caribbean region or toward leading international standards.

3.7.9 Building Design

Action 34 of the SEP calls for the government and the Bureau of Standards to encourage energy-efficient building technologies. Specifically, the Bureau of Standards is to collaborate with similar institutions in the Caribbean to develop standards on materials and components for new and existing buildings. The Bureau then disseminates this information to architects, civil engineers, construction companies, and the public. It also will present guidelines for energy-efficient building design, including:

- Reducing cooling loads,
- Improving day lighting,
- Insulating to avoid overheating and cooling losses,
- Use of natural ventilation, and
- Use of efficient air-conditioning systems (Government of St. Vincent and the Grenadines 2010, p. 43).

3.7.10 Lighting

A 100% excise tax and 15% value added tax are currently are in place for incandescent lights, but compact fluorescent lamps (CFLs) are exempted from both of these taxes. By Action 35 of the SEP, the Ministry of Energy and the Bureau of Standards are to consider further fiscal incentives and embark on public awareness campaigns toward energy-efficient lighting (Government of St. Vincent and the Grenadines 2010, pp. 29, 44).

3.7.11 Appliances

In Action 37, the SEP energy action plan charges the Ministry of Energy and the Bureau of Standards to set energy performance standards for importing and sales of major domestic appliances. Appliances will require energy labeling that conforms to the rules of the European Appliance Label or U.S. Energy Star programs. The agencies can suggest legislation such as import bans or taxes to achieve compliance (Government of St. Vincent and the Grenadines 2010, p. 45).

3.7.12 Energy Supply Outlook

The nation of St. Vincent and the Grenadines participates in PetroCaribe, but traditionally imports most of its oil from Trinidad. To provide local security of supply, VINLEC recently built 440,000 imperial gallons of fuel storage at Lowman's Bay, St. Vincent. Action 25 of the EAP calls for the government of SVG to strengthen its relationships with energy supplying nations, and to support any new refining capacity (Government of St. Vincent and the Grenadines 2010, p. 39).

To provide future supply, the *World Bank Report* projects that the least-cost fuel combination is 10 MW of diesel capacity for peak and mid-range duty, and 10 MW of coal-fueled circulating fluidized bed capacity for base load (Nexant 2010, p. 1.8). The cost of fossil-fuel energy for SVG could be reduced by expanding the regional petroleum facilities in St. Lucia (Nexant 2010, p. 7.22).

3.7.13 Renewable Energy

Table 22. St. Vincent and the Grenadines Renewable Energy Potential

Technology	Value
Hydro	10 MW
Wind	8 MW
Geothermal	100 MW
Solar	23 MW (PV)
Biomass and Other	4 MW

Sources: Hydro, wind: Posorski & Werner 2009, pp. 53, 78, 80
Geothermal: Deane 2009, p. 16
Solar: Nexant 2010, p. 8.36
Biomass: Government of St. Vincent and the Grenadines 2010, p. 36.

Screening curve comparisons by Nexant indicate that renewable sources (particularly wind) are favorable as compared to fossil-fuel sources (including coal, oil, and natural gas) at certain capacity factors (Nexant 2010 pp. 11.6, 11.22–11.23). Scenario analysis shows that development of wind capacity would benefit SVG, regardless of future fossil-fuel development (Nexant 2010, p. 14.4).

3.7.13.1 Hydro

Only the island of St. Vincent has rivers and rainfall substantial enough for hydro power. Hydro has been utilized there since the 1950s. Although the nameplate capacity is 5.6 MW, about 5.2 MW actually is available; only 2 MW is available during the dry season (Government of St. Vincent and the Grenadines 2010, pp. 21, 34).

A 2009 feasibility study considered both rehabilitating older hydro plants and developing new sites along existing rivers. Commissioned by VINLEC and funded by CRETAF (a CREDP feasibility study fund), the study found several projects to be technically and economically feasible. The existing Richmond and South Rivers hydro plants could add output of 13% and 10%, respectively, by replacing electromechanical equipment, at a cost of U.S. $8.5 million. A new 1.19-MW plant also planned. Tendering for all three projects was planned for 2010 (Government of St. Vincent and the Grenadines 2010, pp. 33–34). As of December 2011 no further updates were recorded.

For the undeveloped Wallibou and Buccament rivers, previous studies by CREDP/GTZ have suggested potential of up to 10 MW. Currently, the National Water Resource Management program is comprehensively assessing water resources for drinking, irrigation, and hydro power. The management program is supported by the European Development Fund (EDF) in collaboration with the Central Water and Sewerage Authority and VINLEC. This effort has installed the measurement equipment needed to assess potential new sites (Government of St. Vincent and the Grenadines 2010, pp. 21, 33–34). As of December 2011 no further updates were recorded.

3.7.13.2 Wind

Wind resources have been studied throughout SVG since 2005. Among the Grenadines, the islands of Bequia, Canouan, Mayreau, and Union all have potential for wind generation, with estimated annual mean wind speeds of up to 8 m/s on eastward-facing ridges. On St. Vincent, Brighton (a landfill site) and nearby Ribishi Point were identified as the most promising, with average wind speeds of 7.8 m/s at 10 m and an 8.4 m/s at 55 m, respectively (Government of St. Vincent and the Grenadines 2010, pp. 22, 35; Posorski & Werner 2009, p. 80). At Ribishi Point, an 8-MW wind farm with generation cost of U.S. $0.074 per kilowatt-hour was estimated as a U.S. $7.2-million investment in 2008 (Posorski & Werner 2009, p. 80). VINLEC has tendered bids for an IPP to provide 5 MW at this site, with a decision that was expected during 2010 (Government of St. Vincent and the Grenadines 2010, pp. 22, 35). During the proposals evaluation VINLEC pulled out of the bid procedure (CAWEI 2011, pp. 57). Unlike other islands in the region, Ribishi Point is located near a landfill site where land use competition is limited while offering excellent wind resources (CAWEI 2011, pp. 57). As of December 2011 no further updates were recorded.

Desalination by wind power also is being studied under a project financed by the Global Environment Facility. On the island of Bequia, wind turbines could be used to power reverse-osmosis desalination (Government of St. Vincent and the Grenadines 2010, p. 35). This application has potential, because both wind generation and freshwater demand are variable quantities.

3.7.13.3 Geothermal

Geothermal resources have been considered on St. Vincent since a 1996 study performed by the Idaho National Laboratory (Joseph 2008, pp. 14–15). No exploratory drilling has been done, therefore potential estimates were drawn from a 1999 government study, and range from about 100 MW (Deane 2009, p. 16) to as much as 890 MW (per Huttrer) (Joseph 2008, p. 14).

The government granted exploration rights to the developer CGE Ltd, a private geothermal firm, through a geothermal exploration and exploitation agreement (GEA) signed January 15, 2010. The GEA grants the developer the exclusive right to investigate and develop the resources within the Soufriere region and to operate as an IPP (Government of St. Vincent and the Grenadines 2010, pp. 22, 32). The developer failed to commence the initial geo-scientific survey within six months of the effective date of the agreement. As a result, on August 13, 2010, the government issued a notice of termination which became effective in December 2010 if no corrective action was taken by CGE Ltd. Furthermore CSEP launched a Request for Proposals to secure legal specialist to assist the Government of St. Vincent and the Grenadines with the preparation of a draft Geothermal Resource Development Bill (CREDP/GIZ 2011). As of December 2011 no further update is publically available.

3.7.13.4 Solar

St. Vincent and the Grenadines have GHI averaging more than 5.8 kWh/m^2/day, therefore the low-lying areas have good solar resources for flat-panel PV and solar hot water systems.

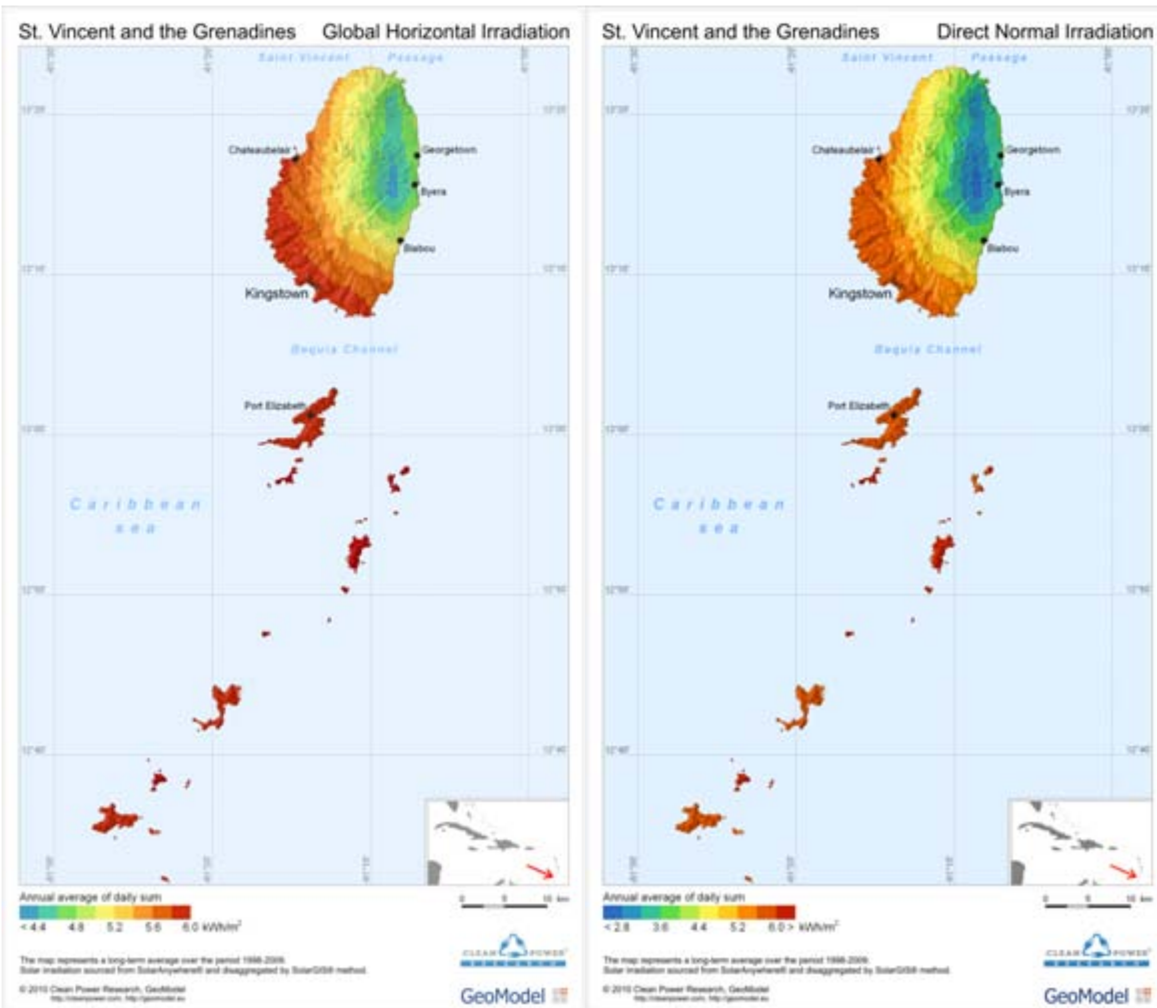


Figure 30. Solar maps of St. Vincent and the Grenadines

Adoption of solar water heating equipment in St. Vincent and the Grenadines is only marginal (Loy & Farrell 2005, p. 47), and few solar PV systems exist in the nation, partly due to the laws against self-generation. In Action 20 of the EAP, the Ministry of Energy is to collaborate with VINLEC to analyze market potential of both SWH and PV in all sectors (Government of St. Vincent and the Grenadines 2010, pp. 36–37).

The SWH installations that do exist in SVG are found only in large residential buildings, and typically are imported from Barbados (Government of St. Vincent and the Grenadines 2010, p. 21). A market study conducted by CREDP/GTZ on Dominica, St. Lucia, and St. Vincent revealed substantial latent demand in the hospitality sector (Loy 2007, p. 140). The EAP calls for increasing the use of SWH in hotels, restaurants, and hospitals as well as in residences, to eventually replace all water heating currently handled by electricity. Action 36 calls for the Ministry of Energy to recommend and enforce policies exempting SWH components from import duties, to provide low-interest loans for SWH installation, and enforce mandatory installation of SWH in new residences and service buildings (Government of St. Vincent and the Grenadines 2010, p. 21).

To promote solar electric adoption, the EAP calls for more PV demonstration systems, guidelines for distributed PV grid connections, and analysis of PV opportunities in the smaller Grenadine islands. Specifically, Action 20 calls for the installation of PV demonstration systems on government buildings and at VINLEC facilities. It also requests that VINLEC establish technical guidelines for the interconnection of distributed PV systems. Action 21 calls the Ministry of Energy to collaborate with international expertise in analyzing PV potential in the small grids of the Grenadines, and Action 22 seeks a similar study for isolated systems in general, such as for street lighting (Government of St. Vincent and the Grenadines 2010, pp. 36–37). As a response to the EAP, in 2011 the SVG Energy Unit with the assistance of the ECPA Caribbean Initiative started the preparation of a Solar PV demonstration project at the main administrative building of the Government (ECPA 2011).

3.7.13.5 Biomass and Other

St. Vincent and the Grenadines might have viable biomass resources. In the past, the government of SVG has explored the possibility of cooperating with Guyana in a venture to raise, process, and market *jatropha curcas* (Barbados nut) as a biofuel (Loy 2007, p. 140). In 2009, GFA Envest GmbH and Caribbean Bio-Energy Technology Ltd. conducted a feasibility study on the use of *jatropha curcas*, banana trees, and municipal waste, among other sources, for biogas electricity production in SVG. The study concluded that, although *jatropha curcas* are not of sufficient quality for biogas, other feedstocks might be; and that there is potential for up to 4 MW from such a plant (Government of St. Vincent and the Grenadines 2010, pp. 22, 36). Caribbean Bio-Energy Technology Ltd is a SVG-based vendor of biogas fermentors (Caribbean Bio-Energy Technology 2010).

3.7.14 Interconnections

St. Vincent and the Grenadines has opportunities for both domestic connections among the Grenadines and regional interconnections with neighboring nations. VINLEC studied connecting the small grids among the Grenadine islands in early 2009, but found that it was not cost effective. Interconnections for energy exports could follow the materialization of geothermal development. Per Action 6 of the EAP, the Ministry of Energy is to continue to investigate opportunities for electrical interconnections over the long term (Government of St. Vincent and the Grenadines 2010, p. 28).

3.7.15 Energy Policy Framework

St. Vincent and the Grenadines are significantly dependent on fossil fuels for energy needs, particularly in the areas of electricity generation, transportation, and cooking. It has a total installed capacity of 49 MW (2009), 11.5% of which is provided by hydropower (Government of St. Vincent and the Grenadines

2010, p. 13).[21] The transport sector is the biggest consumer of energy, accounting for more than 66% of total energy consumption; the domestic and commercial sectors account for 30% consumption from electricity generation. The rest of the energy matrix consists of kerosene and LPG consumption for residential cooking and some industrial activities.

3.7.16 Energy Sector Regulatory Framework Analysis

The energy sector is heavily dependent on fossil fuels; however, renewable energy has great potential in SVG. There is potential for wind, solar, and hydropower. Preliminary studies have been conducted (CREDP/GIZ) to ascertain hydropower potential and identify wind sites for development of wind parks, but very little RE has been exploited. Further, current law discourages both IPPs and self-generation, and fails to promote adoption of solar water heating. Additionally, SVG has approved a national energy policy and an energy action plan. The nation is poised to improve its energy situation dramatically if it can act on these policies.

3.7.17 Legal and Regulatory Framework

In terms of the legal and regulatory framework, the Electricity Supply Act (1973) is the guiding instrument. It grants VINCLEC exclusive rights to generate, transmit, distribute, and sell electricity in St. Vincent for a period of 60 years (Section 3). This license expires in 2033. VINCLEC, with the minister's approval, also may grant sub-licenses to generate, transmit, distribute, and sell under certain terms and conditions and within a specified area (Section 4). This provision largely benefits inhabitants of the many islands in the Grenadines. Further, self-generation is permitted for one's own consumption and use under Section 5 of the ESA. All plant, equipment, and machinery imported by VINLEC for the purpose of conducting its business is exempt from customs and all other import duties (Section 12) and stamp duties (Section 32). Moreover, VINCLEC has the right to harness water power—whether on Crown or private land—without a requirement to pay. Currently, there is no clear regulator to exercise oversight over VINCLEC or the energy sector in general.

Although there is not much information on the use of tax rebates and other such incentives for RETs, the following are some examples.

- Tax rebate to solar collectors, solar electricity-generating equipment (PV panels, converters, batteries), and other renewable-energy technologies equipment on a case-by-case basis.
- Case-by-case tax exemptions are given for PV panels, batteries, and inverters. There has been a very slow diffusion of PV on the islands.

Note also that an excise tax of 60% and a 15 % value added tax was introduced in May 2007 for incandescent light bulbs and only the 15% VAT was applicable for compact fluorescent lights. In June 2008, the excise tax was increased from 60% to 100% on incandescent light bulbs and the VAT remains at 15%; CFLs are completely exempted from both excise tax and VAT. Unfortunately, there is not sufficient data on the amount and frequency of the importing of light bulbs. The revenue generated by this tax also is unknown, as is where this money is invested. This highlights the critical need to establish proper data collection and monitoring systems to allow the government to evaluate the effectiveness of

[21] These figures appear inconsistent as compared to other sources. In 2009, the national energy policy indicated that the energy mix was 96% petroleum based and 3% hydropower. One possible explanation could be varying precipitation levels throughout the year, noting especially the impact of the dry season and sometimes drought. However, this only makes the case for proper and accurate data collection.

this policy instrument. Addressing the statistical needs is highly recommended to enable the Energy Unit to monitor the use of incandescent versus CFLs in the nation.

The main challenges in the legal, policy, regulatory, and institutional framework are the following.

- No clear institutional framework for energy governance exists for St. Vincent and the Grenadines.
- No discernible regulatory oversight is being conducted nor is any entity dedicated to that purpose.
- The ESA is outdated.
- Limited data is available on the energy sector, and data collection, monitoring, and evaluation are limited.

3.7.18 Institutional Framework

The institutional framework governing the energy sector includes the St. Vincent Electricity Services Limited which is government owned and has exclusive rights to provide electricity. Additionally, VINLEC is responsible for maintaining generation equipment and transmission and distribution systems. VINLEC also is a department in the Office of the Prime Minister. The infrastructure governed by VINLEC, including its generators, have been characterized as "old, inefficient, and in need of replacement" (Government of St. Vincent and the Grenadines 2010, p. 15). New facilities and equipment, however, are forthcoming.

3.7.19 Assessment of the National Energy Policy and Energy Action Plan

In March 2009, St. Vincent and the Grenadines became the first Eastern Caribbean nation to formally receive Cabinet approval for its national energy policy. The government has recognized the significant role energy diversification plays in the country's economy and in poverty reduction (International Monetary Fund 2011) and is guided by the following principles (International Monetary Fund 2011) in the preparation of the national energy plan.

- Guarantee a clean, reliable, and affordable energy supply to customers.
- Strengthen the national economy by reducing the dependence on import of fossil fuels.
- Stabilize and possibly reduce the energy consumption per capita in the medium- and long-term.
- Reduce the dependence on import of energy through continued and expanded exploitation of indigenous resources and improvement of energy efficiency and conservation of energy.
- Liberalize the energy market by encouraging and accommodating private-sector participation in energy development and energy services, thereby enhancing competitiveness and engendering lower prices.
- Take advantage of renewable, local energy resources, wherever this is possible from the aspects of availability (potential), energy demand, technical and social implications, economic feasibility, ecological harmony, and sustainability.
- To always encourage and stimulate the efficient use of all energy resources, keeping in mind that all types of energy either are scarce or need significant amounts of capital to be tapped into or transposed into applicable forms of energy use.
- In all its decision making with respect to energy services development, the government will strongly promote the active participation of the energy sector, the general public, and NGOs.
- In delivering energy services, the government will minimize subsidies to consumers and set prices and tariffs in such in way that they timely reflect full cost but take into account ways to relieve the price burden on the lowest-income households.

- Take advantage of national expertise and know-how as far as possible for the development and delivery of energy services. Where importation of resources is required, provide incentives for the use of the most readily available technology.
- Ensure that the measures taken in pursuing this energy policy are in line with the requirements and legal implications of the Caribbean Single Market Economy (CSME).

In terms of policy expression, the national energy policy and action plan address planning and management, power sector, renewable energy, petroleum sector, transportation, and energy efficiency.

3.7.19.1 Planning and Management

The policy objective is "[e]fficient and well-coordinated planning and management activities to achieve sustainable supply and use of energy Government of St. Vincent and the Grenadines 2009)." The policy provisions could be further strengthened by ensuring the research, development, and exploitation of new and renewable energy resources and energy conservation measures leading to increasingly efficient and sustainable energy services and a more competitive economy (Government of St. Vincent and the Grenadines 2010, p. 25); instituting reporting requirements for high-consuming sectors; and developing mechanisms to ensure inter- and intra-institutional cooperation.

Action Plan: The government also should clearly indicate the roles, responsibilities, and mandates of those entities it has identified as being responsible for energy issues, and should institute mechanisms to ensure a defined chain or hierarchy of responsibility, and inter- and intra-agency cooperation. The establishment of an independent regulatory commission to exercise regulatory authority over the energy sector also must be included. Further, in addition to the requirements of the Office of Statistics, reporting requirements from energy audits also should be included.

The AP, unfortunately, does not offer specific, measurable targets and has a few weaknesses. Under Action 3, for example, the Ministry of Education is required to "propose a strategy for the implementation of capacity building activities at all levels . . . it will provide financial support for advanced professional training. . . ." Although the timeframe indicated is "short"(i.e., 1–5 years), it doesn't provide a proposed time frame for when the proposal should be completed, or a proposed time for approval and the commencement of implementation.

3.7.19.2 Power Sector

The policy goal here is "safe, efficient, reliable, affordable and environmentally friendly electricity generation and supply for all parts of St. Vincent and the Grenadines (Government of St. Vincent and the Grenadines 2009)." Although the policy statements are sound, it also should include conducting monitoring and evaluation of energy-generation facilities, public and private; and "establishing mechanisms that in tandem allow for small scale decentralized electricity generation and fair access to the transmission/distribution system" Government of St. Vincent and the Grenadines (2009).

Action Plan: The goal of the AP is to reduce projected increase in peak demand by 5% by 2015 and 10% by 2020, and to strive to reduce power losses to a total of 7% by 2015 and 5% by 2020. Here, the target is specific and measurable. Another example of specific measurable targets is Action 11, which provides that "every 2 years," VINLEC will design and review a 10-year planning prospect for the electricity sector.

3.7.19.3 Renewable Energy

The policy goal is to "increase the utilisation of renewable energy technologies on all islands of St. Vincent and the Grenadines (Government of St. Vincent and the Grenadines 2009)." The policy statements are sound.

Action Plan: The goal of the action plan is to deliver 30% of projected total electricity output from renewable energy sources by 2015 and by 2020. Here, the target is specific and measurable. Whether it is feasible requires further examination.

3.7.19.4 Petroleum Sector

The policy goal for the sector is "[s]afe, reliable and affordable supplies of petroleum products and its efficient and clean handling and use (Government of St. Vincent and the Grenadines 2009)." The policy also should include reporting, and monitoring and evaluation provisions for and of petroleum storage and handling facilities.

Action Plan: The goal of increasing energy security and diversification of the energy portfolio, specific actions for facilitating self-generation and feeding in to the grid, and incentives to promote energy diversification also should be included.

3.7.19.5 Transport Sector

The policy goal for transportation is "efficient, environmentally clean, and cost-effective transportation (Government of St. Vincent and the Grenadines 2009)." The policy provisions are sound.

Action Plan: The goal is to reduce projected consumption of fossil fuels in the transport sector by 10% by 2015 and 15% by 2020. Here, the target is specific and measurable. Whether it is feasible requires further examination.

3.7.19.6 Energy Efficiency

The policy goal is "minimized energy input and lowest possible energy intensity for all energy-related services (Government of St. Vincent and the Grenadines 2009)." The policy provisions are sound.

Action Plan: The goal is to reduce projected electricity generation by 5% by 2015 and 15% by 2020. Here, the target is specific and measurable. Whether it is feasible requires further examination.

3.7.20 Conclusions and Recommendations

- Appropriate incentives must be developed to encourage the use of RET and the development of renewable energy standard.
- Despite the efforts, no measurable benefits from current legislation and projects developed in the country to reduce the rate of oil importation and consumption emerged during the period of analysis. Regardless of some isolated attempts, the oil consumption still is increasing and internal volatility is affecting national energy security.

Based on the sources for this report, the NEP and especially the EAP embody many of the relevant recommendations indicated in previous studies. Among the short-term actions in the EAP, the following represent opportunities for immediate implementation.

- **Biomass:** Per Action 19, analyze the energy potential from the agricultural, forestry, and food processing sectors, of organic waste material and of dedicated energy plants.

- **Solar:** Per Action 20, analyze market potentials for the (extended) application of solar thermal and solar electric systems in all consumption sectors. Install a pilot photovoltaic plant and publish technical guidelines for the interconnection of small grid-connected RE systems. This is being pursued by the SVG Energy Unit with the assistance of the ECPA Caribbean Initiative.

3.7.20.1 Distributed Generation

Per Action 21, investigate opportunities to tap wind and solar potentials cost efficiently for electricity generation in the Grenadines. Provide support of private power operators on initiatives to replace diesel fuel with alternative energy sources. Per Action 22, investigate opportunities for the installation of standalone PV and wind-power systems.

3.7.20.2 Building Efficiency

Per Action 34, draft guidelines for the construction of energy-efficient and well-insulated building design, including daylighting. Per Action 38, identify those government buildings with the greatest energy cost-reduction opportunities and evaluate options to supply the energy needs by efficiency and RE technology.

Although many policy documents and agencies currently are in draft or nascent stages, there are some tangible results from resource characterization, net metering, alternative energy investment, and power purchase agreements within the region that can serve as a rich pool of experience and inspiration and can provide insight into important considerations for other islands currently developing energy policies.

An updated national energy policy and energy action plan should consider formalizing energy policies by drafting these documents. Organizations such as CREDP/GTZ and OAS/CSEP should be leveraged for the development of these plans, as they have expertise in policy development and considerable experience in the Caribbean. Additionally, the support organizations should strive to better communicate and coordinate with each other to facilitate a clear understanding of energy policy concepts as applied to Caribbean and to learn from the experience of island nations.

Those nations that are developing or revising energy policy can look to specific attributes of other NEPs and EAPs used in the Caribbean region as examples. A number of lessons can be noted. Policy developers should ensure that the following actions are part of the development of or are included in any policy changes.

- Clearly define energy mix targets with time frames. There also should be intermediate goals and associated time frames and clarification of the baseline and other issues (e.g., installed/sold, whether efficiency gains count towards meeting targets).
- Encourage an iterative and cyclical integrated resource-planning process. Regardless of whether there is specification of the methodology, it is important that the utility company be expected to demonstrate consideration of fuel sources and electricity production technologies on long-term cost and benefit analysis.
- Outline compliance monitoring and penalty charges for meeting energy mix standards and for the planning process or designate authority to develop such to a specific independent authority. There are examples of island power sectors where utility regulators have approved and excised penalty charges for non-compliance with RPS, under the stipulation that such charges cannot be included in the rate cases and thus be passed on to consumers. Along with monitoring regimes, the potential for penalties adds into cost considerations for companies, which can affect capacity expansion decision making and analysis.

- Designate responsibility to some portfolio—government or independent—to conduct preliminary resource assessments. This will help to reduce the load on utility companies directly and might play a role in eventually encouraging commercial investment.
- Identify funding sources and the general fiscal programs and mechanisms that are intended for development in both the short term and long term. Financial incentives and programs should be considered carefully before committing public funds to their development, especially in small, developing island economies. This task can be delegated to a government portfolio.
- Address the issue of interconnections and grid access. It should be clear how open the grid is intended to be and at what level competition is assumed to be most favorable. Despite a number of similarities, individual island power sectors have evolved differently and even though in larger, more diverse systems competition at the wholesale level could be useful, for other smaller and perhaps more sensitive island systems competition is better served when limited to the retail level. This issue of power-sector disintegration should be considered carefully from both commercial and technical grid integrity standpoints and decisions with regard to the level and maximum capacity of grid access should be strategic over the long term.

Identify bodies or government portfolios that will be responsible for the implementation of the various policy components. As highlighted above, give the often-rudimentary nature of island power sectors, without regulators and legislation it is vital that policy directives be clearly assigned to some existing body or the mandate for the formation of such should be made. Further, it is important to highlight the supporting regulatory and legislative developments that would be necessary to enable the policy as prescribed. It is crucial to understand the islands are at various levels of legislative sophistication and certain policies could be implementable in some contexts and be completely unsupported in others without the requisite attention to these areas.

4 Conclusions

The Caribbean islands possess a great potential for power generation from renewable energy sources and improvements in energy efficiency. Many of the islands in the eastern Caribbean have excellent geothermal prospects, and all boast tropical climates presenting consistent wind and solar resource availability. Although the measurable impact on carbon emissions might be small as compared to the world as a whole, these islands present opportunities to demonstrate renewable energy, energy efficiency, and low-carbon energy practices and technologies that could scale-up to make a significant impact on the rest of the world. Apart from the environmental benefits, another major opportunity is the reduction of dependence on imported fossil fuels for power generation and use as transport fuel. The high cost of this foreign-sourced power has been a drain on island economies for decades.

As has been shown, a number of regional policy groups, such as the CARICOM Energy Programme, CREDP/GIZ, the OAS/GSEII, OAS/CSEP, and UN agencies (UN-ECLAC, UNEP, UNIDO and UNDP among other), have in recent years intensified efforts to assist Caribbean SIDS in developing regional policy documents and projects. A number of the region's island governments also developed national energy policies or sustainability plans that call for a re-evaluation of the current utility-generation capacity mix and the current utility mode of operation. For some of these islands, there are in fact renewable energy projects that have been deployed, adding to the local pool of experience and expertise.

Programmatic approaches in a regional context, such as the CSEP program are, extremely necessary for the Caribbean countries. The wide range of activities covered by CSEP, however, is a double-edged sword in terms of effectiveness. Conversely, a good reception from countries helps CSEP in the finalization and implementation of the activities. Further, due to time scale it presently is impossible to evaluate the overall impact of programs like CSEP on the energy sector. In the next decades, an evaluation of the impacts more likely will be initiated. Currently, based on an objective methodology, the impact of CSEP and CREDP/GIZ are not measurable for the energy sector. The following information, however, is known.

- Development of energy policies are often borne out of a crisis.
- It is urgent that oil reductions measures are prioritized so they can be acted upon in an ordered manner.
- The priorities and approach of countries and donors often differ, making it difficult to get any significant regional energy initiative or program off the ground.
- The success of any well-intended initiative can be derailed by a lack of resource mobilization to support implementation.
- Beneficiary countries under any energy resource supply agreement with net-oil exporting entities are vulnerable to volatilities induced by the social, economic, and political challenges of the net-exporting country.
- Cooperation agreements and arrangements with net-exporters external to the sub-region can create challenges for sub-regional integration cooperation efforts.
- The absence of a sustainable financing mechanism could delay the effective implementation of critical programs.
- Despite the accomplishments of key regional initiatives in sustainable energy development, actual adoption and implementation at the domestic level are not guaranteed, even when local stakeholders are integrally involved or extensively engaged in the preparation and drafting stages.

Numerous recommendations for both the local and regional policy developers have arisen from this work. A significant point to note is that not only must overarching NEPs and SEPs be published to direct national energy focus, but the supporting capacities necessary to ensure implementation also must be developed. Many islands lack direct government oversight of utility operation; there often is little regulation or legislation that binds the utility to a certain standard of operation or planning ethic. There also often are few binding industry codes (building codes, efficiency codes, interconnection standards) to govern growth. Without addressing such potential deficiencies, any other national and regional energy policy will be stalled.

Thus, activities that policy developers should either embark upon or delegate to sub-agencies are the exploring of:

- The extent to which regulation could be helpful;
- Legislative needs for influencing utility capacity decision making;
- The need for competition and its placement in the energy sector;
- Short-term and long-term cost and feasibility assessment for indigenous resources; and
- The state of markets and the fiscal incentives that might be necessary to support and encourage their rapid expansion.

This will help to streamline policy, highlight areas for energy sector development, and eventually attract interest and investment to the region and its islands.

Caribbean islands have the potential to lead the world to a new energy future, but this will not happen without implementing consistent, thoughtful policies and plans. For each nation, a statement of energy policy, complemented with a plan of action, have become key to making progress toward fulfilling a nation's energy potential. Those nations which do not have both an updated national energy policy and energy action plan should consider drafting and approving such policies.

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Appendix A. Organizations in the Caribbean Working on Energy Efficiency / Renewable Energy Development

Much work has been done on energy development in the Caribbean since the middle of the twentieth century, when many of the islands were transitioning toward independence. Most of the energy systems were designed during a period when cheap oil and efficiency was not emphasized as it is today. Since the 1990s, various regional and international political, technical, and market-based organizations have intensified efforts to study, recommend policy for, and provide financial assistance in the development of the energy sector in the Caribbean, with a focus on diversifying the energy matrix. The following is a partial list of such organizations.

Multilateral Agencies
Caribbean Community (CARICOM) is a supranational organization of Caribbean islands focused on economic development and market unification (CARICOM 2009). Please visit http://www.caricom.org/.

CARICOM Region - Energy and Climate Change Project Portfolio (2010–2011)

- Caribbean Regional Energy Development Programme (CREDP) is an initiative of the Energy Ministers of the Caribbean Community (CARICOM) that focuses on renewable energy (CARICOM 2009). Please visit http://www.credp-gtz.org/.
- Caribbean Renewable Energy Technical Assistance Facility (CRETAF) is a program to secure grant financing for renewable energy projects under CREDP. It is funded by the Global Environmental Facility (CRETAF 2009). Please visit http://www.caricom.org/jsp/projects/cretaf.jsp?menu=projects.
- Caribbean Sustainable Energy Program (CSEP) is a project managed by the Organization of American States (OAS) with finance from the European Commission via the European Union Energy Initiative to address and improve energy-sector management and governance on seven Caribbean islands. Please visit http://www.sepa-americas.net/proyectos_detalle.php?ID=6.
- Energy and Climate Change Partnership of the Americas (ECPA) created a Caribbean Initiative (ECPA Caribbean Initiative) project with funding from the U.S. Permanent Mission to the Organization of American States (US-OAS) to provide short-term and medium-term technical, legal, and financial assistance for the commercialization of small and medium-sized renewable energy or energy efficiency projects in the Caribbean. One of the authors of this report (Kammen) serves as the ECPA Energy Envoy for the U.S. Department of State. Please visit http://www.usoas.usmission.gov/ and http://www.ecpamericas.org/.
- Global Sustainable Energy Islands Initiative (GSEII) is an initiative that aims to assist SIDS in developing and implementing national sustainable energy plans, building local capacity for—and reducing obstacles to—clean energy and energy efficiency projects, and moving towards energy independence, reduced greenhouse gas emissions, and socio-economic development. Please visit http://www.gseii.org/
- Low-Carbon Communities in the Caribbean Project (LCCC) is to implement actions and strategies geared toward increasing the sustainability of islands energy supplies and reducing carbon emissions from the energy sector through the development and use of renewable energy and energy efficiency systems. The project seeks to develop the local workforce to conduct energy-efficiency audits and to deploy energy-efficiency technologies, and also aims to strengthen the capacity to review and evaluate resource assessments related to renewable-energy resources. Please visit http://www.ecpamericas.org/initiatives/default.aspx?id=31.

- Organization of Eastern Caribbean States (OECS) is a supranational organization of nine islands in the eastern Caribbean that share a single currency and court system (OECS 2009). Please visit http://www.oecs.org/.
- Organization of American States (OAS) is a western-hemispheric multilateral institution that, via its Department of Sustainable Development Energy and Climate Change Mitigation Section, collaborates with the industry, academia, and NGOs, and assists OAS member states in advancing sustainable energy in the Americas. Please visit http://www.oas.org/en/sedi/dsd.
- Renewable Energy & Energy Efficiency Partnership (REEEP) is a nonprofit organization focused on emerging markets (REEEP 2010). The OAS is the REEEP Regional Secretariat for Latin America and the Caribbean. Please visit http://www.reeep.org/.

Previous programs include the Eastern Caribbean Geothermal Development Project, Geo-Caraïbes; and Renewable Energy in the Americas (REIA).

United Nations[22]

The United Nations (UN) was established to foster global peace, prosperity, and justice. Over the last 60 years, however, the UN's mission and membership have been broadened dramatically. The UN now is asked to tackle the world's most intractable problems—global-scale challenges that transcend borders but directly or indirectly affect us all. Such challenges include health, the environment, human rights and justice, peace and security, population, hunger, and peacekeeping. The UN has a proud record of accomplishment in helping address key global challenges. In today's interconnected world, governments working through the United Nations cannot face such challenges alone. A worldwide partnership between the public and private sectors is needed—involving individuals, non-governmental organizations, corporations, and foundations. The UN Secretary-General, Ban Ki-Moon, and the UN Office of Partnerships work to connect people, ideas, and resources with the United Nations to solve the great global challenges of the twenty-first century.

The main agencies/branches/funds and programs working on and related to energy, environment, and climate change in the Caribbean Basin are listed below.

- United Nations Development Program (UNDP)
- United Nations–Economic Commission for Latin America and the Caribbean (UN ECLAC)
- United Nations Environment Program (UNEP)
- United Nations Environment Program, Department of Technology, Industry and Energy (DTIE)
- United Nations Industrial Development Organization (UNIDO)
- United Nations Regional Office for Latin America and the Caribbean (United Nations Environmental Program (UNEP) / ROLAC)

To learn more about the UN agencies/branches/funds and programs activities and programs in the Caribbean please visit http://www.unfoundation.org/what-we-do/issues/united-nations/about-the-un.html.

International Cooperation and Development Agencies Covering the Caribbean Basin (2010 – 2011)

- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) is a German government organization for international cooperation on sustainable development, and has done much of the

[22] The information of this section is based exclusively on information from the UN website. http://www.unfoundation.org/what-we-do/working-with-the-un/. Accessed November 14, 2011.

technical work for CARICOM, particularly the CREDP studies and projects (GTZ 2010). To learn more about the GIZ programs in the Caribbean, please visit http://www.giz.de/en/.

- Agence Française de Développement (AFD) is a French government institution for financing international development. To learn more about the AFD programs in the Caribbean please visit http://www.afd.fr/home.
- Agence de l'Environnement et de la Maitrise de l'Energie (AEME) is a French Environment and Energy Management Agency. To learn more about the AEME programs in the Caribbean please visit http://www2.ademe.fr/servlet/getDoc?id=38480&m=3&cid=96.
- United Kingdom Department for International Development (DFID) is the international cooperation and development agency of the United Kingdom. To learn more about the DFID programs in the Caribbean please visit http://www.dfid.gov.uk/.
- The United States' Department of State via its Bureau of Western Hemispheric Affairs (DOS/WHA) provides support for one of its four priority themes, Clean Energy development, via the Energy and Climate Partnership of the Americas to the Caribbean region, please visit http://www.state.gov/p/wha/rt/climate/index.htm

Energy and Climate Change-Related Organizations

The list below includes international treaties or advocacy groups representing interests in a specific energy-related market.

- Caribbean Electric Utility Service Corporation (CARILEC): An association of electric utilities within CARICOM, providing training, technical studies, and policy for its members (CARILEC). Please visit http://www.carilec.com/.
- Caribbean Community (CARICOM) Regional Organization for Standards and Quality (CROSQ): A regional body for standards and technical regulations, with a focus on efficiency and environmental protection (CARICOM, 2001). To learn more about the CROSQ programs in the Caribbean please visit: http://www.caribbeanclimate.bz/
- Caribbean Community Climate Change Center (CCCCC): A body that coordinates the Caribbean region's response to climate change. To learn more about the CCCCC programs in the Caribbean please visit: http://www.caribbeanclimate.bz/
- Latin American Organization of Energy (OLADE): A regional body supporting the development of energy resources and their efficient and rational use, attempting to contribute in the economic and social development of Latin America and the Caribbean. To learn more about the OLADE programs in the Caribbean please visit: http://www.olade.org/
- Caribbean Energy Information Center (CEIS): A regional body set up to provide a regional energy information service through a network of Caribbean countries in support of planning and decision making. To learn more about the CEIS programs in the Caribbean please visit: http://www.ceis-caribenergy.org/.

Sources of Financing

The organizations listed below have a mission of securing financing or which are themselves sources of financing or guarantees, with interests related to energy development, and which have been identified as providing assistance to Caribbean nations in this report.

- Caribbean Development Bank (CDB) a source of financial assistance to nations in the Caribbean. To learn more about the CDB programs in the Caribbean please visit: http://www.caribank.org/

European Union (EU) has several active funds and initiatives in the region, including the following.

- European Union Energy Initiative (EUEI): An EU program focused on giving priority to the role of energy in poverty alleviation (EUEI 2010). To learn more about the EUEI programs in the Caribbean please visit: http://www.euei.net/.
- European Development Fund (EDF): An EU fund that grants technical and financial assistance to developing nations in Africa, the Caribbean, the Pacific region, and overseas European territories (EDF 2009). To learn more about the EDF programs in the Caribbean please visit: http://ec.europa.eu/europeaid/how/finance/edf_en.htm.

For general information about EU programs in the Caribbean please visit http://europa.eu/index_en.htm.

- Export Import Bank of the United States is a U.S. federal agency focused on financing the export of U.S. goods and services to international markets. It also provides working capital guarantees, insurance, and direct loans (Ex-Im 2010). It is financing a geothermal plant in Nevis for approximately U.S. $ 30 million (Caribbean Net News 2010). To learn more about the EXIM programs in the Caribbean please visit http://www.exim.gov/index.cfm.
- Overseas Private Investment Corporation (OPIC) is a U.S. Government's development finance institution with portfolio in the Caribbean with interest in renewable energy projects. In October 2011 it approved a US$16M for a Wind Farm in St. Kitts and Nevis. Please visit http://www.opic.gov/.
- Inter-American Development Bank (IDB) is a development bank for Latin America and the Caribbean which provides loans, grants, technical assistance, and research. The IDB focuses on climate change, renewable energy, environmental sustainability, and regional integration (IDB 2010). Please visit http://www.iadb.org/
- Sustainable Energy Climate Change Initiative (SECCI) and Infrafund technical cooperation programs, produce studies on RE development and utility efficiency in the Bahamas (NEPC 2008, p. 30). Please visit http://www.iadb.org/en/topics/climate-change/secci,1449.html.

To learn more about the IDB programs in the Caribbean please visit: http://www.iadb.org/en/inter-american-development-bank,2837.html.

- World Bank (WB) is a source of financial and technical assistance to developing countries around the world.
- Global Environmental Facility (GEF) is an independent financial organization that provides grants to developing economies for projects related to issues including climate change, the ozone layer, and pollutants (Global Environment Facility 2008). Please visit http://www.thegef.org/gef/.
- The Low-Carbon Development Initiative (2010, ongoing) works with client nations to develop integrated low-carbon growth plans, using the marginal abatement curve methodology a the starting point. These efforts have been implemented at the national to local levels (Casillas and Kammen 2010).

To learn more about the WB programs in the Caribbean please visit http://www.worldbank.org/.

Energy and Climate Change Relevant Treaties

Key energy and climate change–relevant treaties and alliances to which some nations in the Caribbean adhere are listed below.

- Kyoto Protocol: The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), aimed at fighting global warming. Please visit http://unfccc.int/2860.php
- PetroCaribe: A market alliance between Caribbean states and PDVSA, the Venezuelan state oil company, for purchasing oil on conditions of preferential payment (PDVSA 2009). Please visit http://www.petrocaribe.org/index.php?tpl=interface.en/design/union/readmenuprinc_acerca.tpl.html&newsid_temas=4

Participation in Energy-Related Organizations and Treaties							
	Political Organizations				**Energy-Related Treaties**		
Island State	**CARICOM**	**OECS**	**OAS**	**ACS**	**CARILEC, CROSQ**	**Kyoto Protocol**	**Petrocaribe**
Antigua and Barbuda	X	X	X	X	X	X	X
Bahamas	X		X	X	X	X	X
Dominica	X	X	X	X	X	X	X
Grenada	X	X	X	X	X	X	X
St. Kitts and Nevis	X	X	X	X	X	X	X
St. Lucia	X	X	X	X	X	X	X
St. Vincent and the Grenadines	X	X	X	X	X	X	X
Other islands (for Reference)							
European Territories	X*	X		X*		X	
Barbados	X		X	X	X	X	
Jamaica	X		X	X	X	X	X
Puerto Rico			X				
Trinidad and Tobago	X		X	X	X	X	
**European territories include British overseas territories (e.g., BVI), Aruba, Curacao, Saint Martin and the Dutch Overseas Departments (Bonaire, Saba and Saint Eustasius), and French Overseas Departments (Guadeloupe, Martinique and French Guyana). In CARICOM, Montserrat: full member; BVI: associate. In ACS, BVI: observer, France, Netherlands: associates.*							

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