CARICOM Countries
Renewable Energy/Energy Efficiency
Data Collection Survey
Final Report

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Japan International Cooperation Agency (JICA)

Shikoku Electric Power Co., Inc. (YONDEN)

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Table of Contents

Annex

Table of Figures and Tables

Abbreviation

ABB	Asea Brown Boveri
AFD	Agence Française de Developpement
AMI	Automatic Metering Infrastructure
CCCCC	Caribbean Community Climate Change Centre
CFL	Compact Fluorescent Lamp
CORE	Co-financing for Renewable Energy and Energy Efficiency
EU	European Union
FIT	Feed-in Tariff
GEF	Global Environment Facility
GIZ	Gesellschaft für Internationale Zusammenarbeit
ICDF	International Cooperation and Development Fund
IDB	Inter-American Development Bank
IRENA	International Renewable Energy Agency
LED	Light Emitting Diode
LS	Labeling System
NM	Net Metering
NB	Net Billing
OAS	Organization of American States
OTEC	Ocean Thermal Energy Conversion
SCADA	Supervisory Control And Data Acquisition
SEEC	Sustainable Energy for Eastern Caribbean
TOU	Time of Use
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USDOE	U.S. Department of Energy
WB	World Bank

Chapter 1 Background and Purpose of the Survey

(1) Background

A critical problem facing most Caribbean Community (CARICOM) countries is their dependence on imported fossil fuels for power generation. Most CARICOM countries have no domestic fossil fuel sources and since electricity tariffs are correlated to global petroleum markets electricity consumption creates balance of payments pressures.

Adoption of renewable energy has been limited for reasons including: high initial costs, grid stability issues and an insufficient understanding of clean energy resources. However, interest in renewable energy has been growing recently, due to concerns such as energy supply security, energy price stability, and climate change.

In light of these circumstances, in March 2012 JICA signed an agreement with the Inter-American Development Bank (IDB) for the Co-financing for Renewable Energy and Energy Efficiency (CORE Scheme). IDB is an important donor to the region, and facilities the co-financing of infrastructure projects in Central America and the Caribbean. In March, 2014, JICA and IDB revised the CORE framework to include the Caribbean Development Bank (CDB), included the Eastern Caribbean countries as potential recipients and added the potential utilization of Japanese Yen-denominated loans (e.g. in Panama, Costa Rica and Suriname). Additionally, JICA is considering forming a relationship with Sustainable Energy for Eastern Caribbean (SEEC), an initiative overseen by the IDB.

JICA has clear intentions to become a more active supporter of clean energy development in the CARICOM region. However, JICA recognized that it does not yet have sufficient experience in providing energy-related assistance to CARICOM countries, nor does it have detailed information on CARICOM energy policies or clean energy potential. Accordingly, it was necessary to collect and analyze information from the CARICOM countries pertaining to their present situation, policy framework and other issues related to renewable energy and energy efficiency.

(2) Purpose

This survey is conducted to collect the data needed to identify potential opportunities for renewable energy and energy efficiency projects, and begin to build the basis for further cooperation and assistance. The “survey countries” included the CARICOM member nations: Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Christopher and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago. Additionally, the survey conducted a JICA-sponsored invitation program in Japan, comprised of seminars and site visits regarding the utilization of Japanese technologies to assist and support the survey countries.

Based on the results of the above activities, the survey will also consider the future possibility of a Japan ODA loan under the co-financing scheme of CORE with the IDB.

(3) Survey Countries

The survey countries included twelve CARICOM members that are primarily English–speaking: Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Christopher and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

(4) Survey Team and Schedule

As Table 1 shows, the survey had two teams that conducted separate site visits. Both teams included members with expertise in renewable energy, energy efficiency and economic analysis. Additionally, Team B included experts in ocean thermal energy conversion (OTEC) and geothermal energy, due to expected potential for this technology. The OTEC expert joined the site survey in St. Lucia, St. Vincent and Barbados and the geothermal expert joined in St. Christopher and Nevis, Dominica and St. Lucia. The schedule is shown in Table 2.

Table 1 Survey Team Members

Name		Assignment
Team A	Mr. Kenichi Kuwahara	Leader/Renewable Energy
	Mr. Hiroshi Omori	Energy Efficiency
	Mr. James Logerfo	Economic Analysis
Team B	Mr. Yoshitetsu Fujisawa	Vice Leader/Energy Efficiency
	Mr. Toshio Aki	Renewable Energy
	Mr. Kohei Kawaguchi	Economic Analysis
	Mr. Kazuhisa Ota	Ocean Thermal Energy Conversion (OTEC)
	Mr. Paul Moya	Geothermal

Source： Survey Team

Table 2 Team Schedules for the Site Survey

Group A
4+1 countries

No.	Date	Day	Stay	Departure	Time	Arrival	Time	Flight No.
1	31-Aug	Sun		Tokyo/Narita	15:55	Los Angels	10:00	AA170
		Sun		Los Angels	12:00	New York/ JFK	20:40	AA004
2	1-Sep	Mon	1	New York/ JFK	0:50	Port of Spain	5:45	BW425
3	2-Sep	Tue	2	Trinidad and Tobago 5				
4	3-Sep	Wed	3					
5	4-Sep	Thu	4					
6	5-Sep	Fri	5					
7	6-Sep	Sat						
8	7-Sep	Sun		Port of Spain	7:15	Gergetown	8:25	BW425
9	8-Sep	Mon	1	Guyana 5				
10	9-Sep	Tue	2					
11	10-Sep	Wed	3					
12	11-Sep	Thu	4					
13	12-Sep	Fri	5					
14	13-Sep	Sat						
15	14-Sep	Sun		Gergetown	9:35	Port of Spain	10:45	BW662
16	15-Sep	Mon	1	Port of Spain	22:40	Paramaribo	1:10	BW883
17	16-Sep	Tue	2	Surimane 5				
18	17-Sep	Wed	3					
19	18-Sep	Thu	4					
20	19-Sep	Fri	5					
21	20-Sep	Sat		Paramaribo	6:10	Port of Spain	6:45	BW884
				Port of Spain	8:00	Kingston	12:50	BW456
22	21-Sep	Sun						
23	22-Sep	Mon	1	Jamaica 5				
24	23-Sep	Tue	2					
25	24-Sep	Wed	3					
26	25-Sep	Thu	4					
27	26-Sep	Fri	5					
28	27-Sep	Sat						
29	28-Sep	Sun		Kingston	6:35	Fort Lauderdale	9:15	BW031
				Miami	12:20	Belize City	12:29	AA2476
30	29-Sep	Mon	1	Belize 5				
31	30-Sep	Tue	2					
32	1-Oct	Wed	3					
33	2-Oct	Thu	4					
34	3-Oct	Fri	5					
35	4-Oct	Sat						
36	5-Oct	Sun		Belize City	13:37	Miami	17:45	AA1419
37	6-Oct	Mon		Miami	17:05	Santo Domingo	19:26	AA1306
38	7-Oct	Tue		Dominican Republic 1				
39	8-Oct	Wed		Santo Domingo	8:32	Miami	10:55	AA1145
				Miami	13:45	Dallas/Fort Worth	15:50	AA1605
40	9-Oct	Thu		Dallas/Fort Worth	10:31			AA175
41	10-Oct	Fri				Narita	13:55	
	11-Oct	Sat						

Group B
6+1 countries

No.	Date	Day	Stay	Departure	Time	Arrival	Time	Flight No.
1	31-Aug	Sun		Tokyo/Narita	15:55	Los Angels	10:00	AA170
		Sun		Los Angels	21:55			AA2260
2	1-Sep	Mon				Miami	5:51	
		Mon		Miami	10:54	St. Kitts and Nevis	13:55	AA318
3	2-Sep	Tue	1	St. Kitts and Nevis 4				
4	3-Sep	Wed	2					
5	4-Sep	Thu	3					
6	5-Sep	Fri	4					
7	6-Sep	Sat		St. Kitts and Nevis	11:50	Antigua	12:20	LI541
8	7-Sep	Sun		Antigua 4				
9	8-Sep	Mon	1					
10	9-Sep	Tue	2					
11	10-Sep	Wed	3					
12	11-Sep	Thu	4	Antigua	17:10	Dominica	17:50	LI523
13	12-Sep	Fri	1	Dominica 4				
14	13-Sep	Sat	2					
15	14-Sep	Sun						
16	15-Sep	Mon	3					
17	16-Sep	Tue	4					
18	17-Sep	Wed		Dominica	16:30	St. Lucia	17:10	LI565
19	18-Sep	Thu	1	St Lucia 4				
20	19-Sep	Fri	2					
21	20-Sep	Sat						
22	21-Sep	Sun						
23	22-Sep	Mon	3					
24	23-Sep	Tue	4					
25	24-Sep	Wed	1	St. Lucia	7:00	St. Vincent	9:20	LI771
26	25-Sep	Thu	2	St. Vincent 4				
27	26-Sep	Fri	3					
28	27-Sep	Sat						
29	28-Sep	Sun						
30	29-Sep	Mon	4					
31	30-Sep	Tue		St. Vincent	12:00	Barbados	12:40	LI760
32	1-Oct	Wed	1	Barbados 4				
33	2-Oct	Thu	2					
34	3-Oct	Fri	3					
35	4-Oct	Sat	4					
36	5-Oct	Sun		Barbados	9:40	Grenada	10:45	LI361
37	6-Oct	Mon	1	Grenada 4				
38	7-Oct	Tue	2					
39	8-Oct	Wed	3					
40	9-Oct	Thu	4					
41	10-Oct	Fri		Grenada	8:49	Miami	12:25	AA1021
				Miami	17:20	Dallas/Fort Worth	19:38	AA1391
42	11-Oct	Sat		Dallas/Fort Worth	10:31			AA175
43	12-Oct	Sun				Tokyo/Narita	13:55	

Source： Survey Team

Team A

Team B

Source： Survey Team

Figure 1 Travel Route of the Site Survey

Chapter 2 Renewable Energy (RE) and Energy Efficiency (EE) in the CARICOM Power Sector

(1) Policies

The twelve countries surveyed in this study already have established policies which promote renewable energy (RE) and energy efficiency (EE), although details differ by country. Antigua and Barbuda, Dominica, Grenada, St. Christopher and Nevis, St. Lucia and St. Vincent and the Grenadies were assisted by the Organization of American States (OAS) to establish a National Energy Policy (NEP). The NEPs in several countries have numerical targets for the introduction of RE/EE based on their impact on the energy situation. The target for RE in the Eastern Caribbean countries and Jamaica is around 15% - 35% of projected total electricity output by 2020. This is more ambitious than the 10% - 20% targets set by Pacific island countries and Maldives, where conditions are comparable to those of the Eastern Caribbean countries. Observing how each country advances towards its respective targets provides a way to understand the future of its energy industry.

Table 3 RE/EE policy by country

Country	Renewable Energy	Energy Efficiency
Antigua & Barbuda	Reformed market framework and mandated targets to achieve 15% renewable energy in the electricity supply by 2030	Targeted efficiency and conservation measures designed to reduce the overall energy intensity of the economy by 10% below a 2010 baseline within 10 years
Barbados	Output from Renewable Energy in total produced electricity output is 30% by 2029	Reduction in final energy consumption is 20% by 2029
Belize	No overall strategic plan and No specific numerical goal Government wishes to reduce the dependency from Mexican Power import by 2020	No overall strategic plan and No specific numerical goal
Dominica	It is the Government's policy to foster a safe, efficient, affordable, and low-carbon national electricity supply that meet international quality standards by promoting the efficient use of imported fossils and of Dominica's domestic renewable energy resources	It is the Government's policy to reduce the country's energy intensity while increasing its economic growth by adopting best practices in energy efficiency and conservation
Grenada	20% of all domestic energy usage (electricity & transportation) will originate from renewable energy sources by 2020	Reduce the national rate of energy consumption while increasing the economic growth (decoupling), by adopting best practices in energy efficiency and conservation
Guyana	No overall strategic plan Hinterland Electrification Program (HEP) to accelerating power supply in the remote area.	Strategic Loss Reduction Plan (SLRP) Target 27.9% in 2018 (31.4% in 2013)
Jamaica	National Energy Policy, 20% of the country's energy from renewable by 2030 9% in 2013 (of which Solar Energy's contribution is only 1%)	target of Energy intensity index as follows, Baseline (2007) : 15,392BTU/kWh 2015: 12,700BTU/kWh 2030: 6,000BTU/kWh
St. Kitts & Nevis	Safe, reliable and affordable supplies of fuels and their efficient and clean handling while in parallel significantly increasing the deployment, access and utilization of renewable energy in the Federation of St. Kitts and Nevis	Minimize energy input and achieve lowest possible energy intensity of economic services in all sectors of the society
St. Lucia	As a first target, quotas will be set in such a way that at least 5% of the electricity generated in 2013, and at least 15% in 2015, will originate from renewable energy sources. The quota should reach at least 35% by 2020	In National Energy Policy, specific numerical target is not mentioned. Based on the interview with Ministry of Sustainable Development, Energy, Science and Technology, the target is to reduce 20% energy consumption by 2020
St. Vincent	Deliver 30% of projected total electricity output from Renewable Energy by 2015 and 60% by 2020	Reduce projected electricity generation by 5% by 2015 and 15% by 2020
Suriname	No overall strategic plan and No specific numerical goal The strategic objectives are to incorporate in the power sector framework and institutions the use of RE and EE technologies in interior land	No overall strategic plan and No specific numerical goal
Trinidad & Tobago	Setting a target of 60 MW of generation by RE by 2020(5% of the present peak demand)	No overall strategic plan Replacement of light bulbs with efficient compact fluorescent models

(2) Promotion Systems

a. Incentive System

Incentives for RE can be classified in four categories: Feed-in Tariffs, Net Metering, Net Billing and Tax Reduction/Exemption. Incentives for EE also can be classified in two categories: Labeling Systems and Tax Reductions/Exemptions. Table 4 below summarizes RE/EE incentives across the CARICOM region.

On RE incentives, Barbados is fairly aggressive, having already established a Feed-in Tariff of USD 0.32/kWh (as of October, 2014). This FIT is somewhat lower than Japan's; however it is suitably high to promote RE in Barbados. Other countries have not introduced a FIT. Regarding Net Metering/Net Billing, half of the countries in the survey have introduced one or the other and no country in the survey has tax-based incentives.

Regarding EE incentives, Labeling Systems to promote home electrical appliances have been implemented in several countries and they are under consideration in all survey countries. In addition, all countries have implemented tax-based incentives for energy efficiency.

In short, all countries save for Guyana, Suriname and Trinidad and Tobago, are researching suitable incentives for RE/EE.

Table 4 Incentive System for RE/EE by country

Country	Renewable Energy				Energy Efficiency	
	Feed-in Tariff (FIT)	Net Metering (NM)	Net Billing (NB)	Tax Reduction /Exemption	Labeling System (LS)	Tax Reduction /Exemption
Antigua & Barbuda	Not Existing	Existing	Not Existing	Existing	Not Existing (Under Construction)	Existing
Barbados	Existing	Not Existing	Not Existing	Existing	Existing	Existing
Belize	Not Existing	Not Existing	Not Existing	Not Existing	Not Existing (Under Consideration)	Not Existing
Dominica	Not Existing	Existing	Not Existing	Existing	Not Existing (Under Construction)	Existing
Grenada	Not Existing	Not Existing	Existing	Existing	Existing	Existing
Guyana	Not Existing	Not Existing (Under Consideration)	Not Existing (Under Consideration)	Not Existing	Not Existing (Under Consideration)	Existing
Jamaica	Not Existing	Existing	Not Existing (Under Consideration)	Existing	Not Existing (Under Consideration)	Existing
St. Kitts & Nevis	Not Existing	Existing	Not Existing	Existing	Not Existing (Under Construction)	Existing
St. Lucia	Not Existing	Existing	Not Existing (change from NM in future)	Existing	Not Existing (Under Construction)	Existing
St. Vincent	Not Existing (will be established soon)	Existing	Not Existing	Existing	Not Existing (Under Construction)	Existing
Suriname	Not Existing	Not Existing (Under Consideration)	Not Existing (Under Consideration)	Not Existing (Under Consideration)	Not Existing	Not Existing
Trinidad & Tobago	Not Existing (Under Consideration)	Not Existing	Not Existing	Not Existing	Not Existing (Under Consideration)	Existing

Source： Survey Team

b. Electricity Tariff

Except in Trinidad and Tobago and Suriname, the high cost of diesel fuel and heavy fuel oil is reflected in high electricity tariffs of approximately 30-40 Japanese yen per kWh - twice as high as average rates in Japan. Countries generally use a tiered tariff structure, with higher consumption resulting in a higher unit price. Not all countries have adopted a tariff structure for demand charges and only a few use Time of Use pricing (TOU), which could contribute to load leveling. Accordingly, reducing fossil fuel consumption through RE/EE should help cut peak demand.

Table 5 Outline of Electricity Tariff in each country

Country	Average Tariff (US$/kWh)	TOU	Demand Charge	Energy Charge
Antigua & Barbuda	0.35	×	○	○
Barbados	0.25	○	○	○
Belize	0.19	×	○	○
Dominica	0.43	×	○	○
Grenada	0.37	×	○	○
Guyana	0.27	×	×	○
Jamaica	0.33	○	○	○
St. Kitts & Nevis	0.30	×	○	○
St. Lucia	0.32	×	×	○
St. Vincent	0.36	×	×	○
Suriname*	0.04	○	○	○
Trinidad & Tobago	0.05	×	○	○

Source： Survey Team

(3) Relevant Organizations

Electric power companies in CARICOM countries serve the public sector as a function of the government. But in the Eastern Caribbean countries they are now shifting to privatization in pursuit of management efficiency. Progress is being made according to the level of financial and technical maturity of each company. For example, 80% of the shares of the electric power company in Jamaica are held by Marubeni and Korean enterprises.

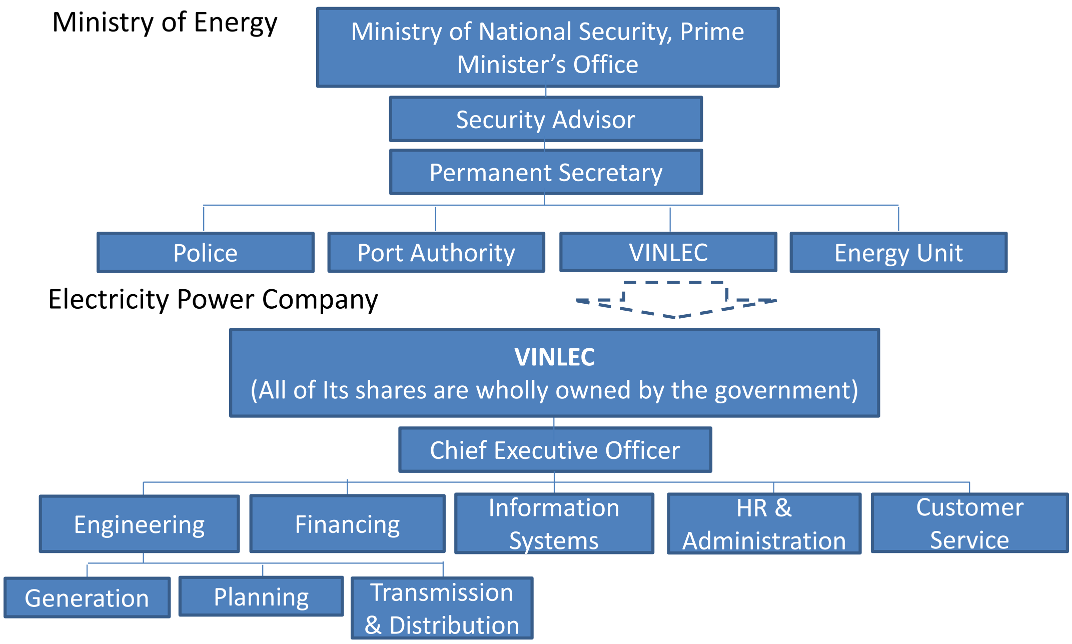
Electric power companies, supervised by their governments (see Table 6), work closely to design and execute policy for Renewable Energy and Energy Efficiency. These are appropriate counterparts to be surveyed to obtain data and gain an understanding of the current situation and goals for Renewable Energy and Energy Efficiency. This is applicable to both policy and technical issues.

Table 6 Relevant Organizations by country

Note: "Regulator" for Jamaica needs to be changed

Country	Regulator	Electric Power Company
Antigua & Barbuda	Office of the Prime Minister	Antigua Public Utilities Authority (APUA)
Barbados	Division of Energy and Telecommunications, Prime Minister's Office	Barbados Light and Power Company (BLPC)
Belize	Ministry of Energy, Science & Technology, and Public Utilities	Belize Electricity Limited
Dominica	Ministry of Public Works, Energy & Ports	Dominica Electricity Services (DOMLEC)
Grenada	Ministry of Finance and Energy	Grenada Electricity Services Limited (GRENLEC)
Guyana	Office of the Prime Minister (OPM)	Guyana Power and Light Inc.
Jamaica	Trinidad and Tobago Electricity Commission	Jamaica Public Service Company Limited
St. Kitts & Nevis	Ministry of Housing, Public Works, Energy & Public Utilities	St. Kitts electricity Company Limited (SKELEC)
St. Lucia	Ministry of Sustainable Development, Energy, Science and Technology	St. Lucia Electricity Services Limited (LUCELEC)
St. Vincent	Ministry of Natural Security, Prime Minister's Office	St. Vincent Electricity Services Limited (VINLEC)
Suriname	Ministry of Natural Resources	Energie Bedrijven Suriname (Coastal Area) Dienst Electrificatievoorziening (Interior Area)
Trinidad & Tobago	Ministry of Energy and Energy Affair	Trinidad and Tobago Electricity Commission

Source： Survey Team



Source： Survey Team

Figure 2 Energy-related Organization (example of St. Vincent)

(4) Power Sector Development: Meeting Future Needs

a. Continental Countries, Jamaica and Trinidad and Tobago

Although electric demand in Trinidad and Tobago is volatile due to fluctuating industrial demand, electric demand in all the other countries has steady increased at a rate of several percent per year, creating the need for power development planning. Urgent issues in Guyana, Suriname and Belize include an annual shortage of power in the dry season (from November to March) due to a dependence on hydro power. Belize can avoid this through importing power from Mexico, however Guyana and Suriname do not have international grid connections. As such, they plan to construct biomass power utilizing bagasse from sugar cane factories in the dry season.

Guyana and Suriname have plans to construct large hydro power plants and long distance transmission lines in their country's interior (Hinterland) and several studies and preparation is being made by private companies. In addition, Belize plans to construct additional hydro power plants and large wind farms in the southern mountainous region that contains three existing hydro plants.

Jamaica has plans to construct coal-fired, gas-fired and hydro power plants. However, construction may be delayed due to Jamaica's poor credit situation and inability to borrow from traditional sources.

b. The Eastern Caribbean Countries

Power demand in the eastern Caribbean countries follow two power demand peaks (daytime and evening) with residential load a high proportion of total power demand. Daytime peak demand occurs due to commercial and air-conditioning loads and peak demand in the evening occurs due to residential load. Future power demand in the eastern Caribbean countries is estimated to remain flat or increase slightly. Since future demand is unlikely to increase substantially, new diesel power stations will likely not be constructed.

Although hydro power plants supply electricity in Dominica and St. Vincent and the Grenadines, almost all countries in the eastern Caribbean depend on diesel power. However, renewable energy is planned to increase to reduce the consumption of fossil fuel. No new diesel power plants are planned.

⑸ Activities of Other Donors and Private Companies

a. Continental Countries, Jamaica and Trinidad and Tobago

Guyana, Suriname and Belize have low electrification rates[1], therefore rural electrification is an important national policy goal. The addition of small, renewable resources with the support of IDB, EU, WB are in progress. Additionally, Guyana having high distribution losses, is conducting distribution line improvement projects to reduce distribution losses.

Jamaica has received attention from GIZ, IDB, UNDP and WB due to the strong potential for renewable energy and energy efficiency. Historically, Guyana has many investments in the power sector from private companies from India and China, etc.

b. The Eastern Caribbean Countries

For the Eastern Caribbean Countries surveyed by Group B, the following three organizations are the main donors and tend to support EE over RE:

・Organization of American States (OAS）: Support for Establishment of National Energy Policy

・Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH (GIZ) : Support for Establishment of Labeling System for Home Electrical Appliances.

・Chinese Government : Support for Installation of High Efficiency Street Lighting and Construction of a new Cricket Stadium

[1] Antigua and Barbuda: 100%,Barbados: 100%, Belize: 85%,Dominica: 100%, Grenada: 99.5%, Guyana: 81%, Jamaica: 90%, St. Christopher and Nevis: 95%, St. Lucia: 98%, St. Vincent and the Grenadies: 99%, Suriname: 85%,,Trinidad and Tobago: 97% (Source: Interview in countries)

Table 7　Activities of Other Donors and Private Companies by country

Country	Activities of Donor & Private Company	
Antigua & Barbuda	OAS	- Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP) - Review of Building Code
	Chinese Gov.	- Installation of Sir. Vivian Richard Stadium & Street Lump around the stadium by Grant
	GIZ	- Establishment of Energy Management System - Establishment of EE Labeling System
Barbados	IDB	- Frame work 1&2 in Sustainable Energy Framework for Barbados（SEFB） - Smart energy fund
	IDB and EU	- Public sector smart energy
	Japan	- School PV, Grassroots
	Korea	- Biofuel vehicle (2cars) - LED (400units)
	GEF	- RE/EE project 1&2
Belize	CCCCC	energy efficiency policy options and initiatives in the building sector
	Government of Germany	renewable energy pilot project in rural communities
	IDB	energy efficiency baseline study
	WB	planning and policy for implementation of energy resilient action
Dominica	OAS	- Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP)
	AFD,WB, CDB, CIF	- Development of Geothermal
	GIZ	- Study on Hydro Power Generation - EE Labeling System - Establishment of Energy Management System
	Chinese Gov.	- Establishment of Cricket Stadium - Installation of PV Street Light (2,500units) (Grant)
Grenada	OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
	GIZ	- EE Labeling System
	Chinese Gov.	- LED light and inverter AC installation by grant - Establishment of Cricket stadium by grant
Guyana	GEF, IDB, EU	Hinterland Electrification Program, including household solar power systems with battery storage, small hydro projects for community power
	IDB, EU	Upgrade the electricity distribution network and reduce distribution losses using AMI
	China	Upgrade three substations, and construct a 69kV transmission line
	India	Biomass energy resource assessment study, survey of power factors of electricity distribution lines
	EU, UNDP, World Bank	clean energy development
Jamaica	GIZ	Energy Road Map, solar PV system for Jamaica Education Center
	IDB	EE and conservation strategies within the SMEs sector, Public Sector Energy Efficiency & Technical Assistance, Wind Resource Assessment
	UNDP	Wind Power for Domestic and Community Use
	WB	Smart Grid Roadmap for Jamaica, Hydro Power Feasibility Study
St. Kitts & Nevis	OAS	- Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP)
	TAIWAN ICDF	- Renewable Energy Policy Consultant-Dispatching Project ➢ 750kW PV system at the airport ➢ Street LED Light (Total approx. 250 units) & Public Buildings ➢ ECO Park
	GIZ	- EE Labeling System
St. Lucia	OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
	GIZ	- EE Labeling System
	Chinese Gov.	- Establishment of Cricket Stadium
	Private	- Study on 3MW Solar Farm
St. Vincent	OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
	WB and OAS	- Gov. plans to install LED light (by Gov.), Inverter AC (by WB) and SHS (by OAS) into 70 places such as other ministries, hospital and school and so on.
	EU	- BEMS will be installed into the Ministry of National Security in 2015.
	GIZ	- EE Labeling System - Approx. 90 LED street lights already have been installed with VINLEC
	Private	- VINLEC and EMRE are being conducting FS study on Geothermal.
Suriname	IDB, EU	Introduction of Sustainable Business Models in Suriname Rural Electrification
		Support for the Preparation of the Sustainable Energy Framework
		Support to the Institutional and Operational Strengthening of the Energy Sector
Trinidad & Tobago	UNEP	development Feed in Tariffs
	IDB	Energy Audits for 8 selected Government buildings
	USDOE	Establishment of a Regional RE Research Center
	IRENA	capacity building, technical and policy support

Source：　Survey Team

Chapter 3 Overview on the level of investment Renewable Energy and Energy Efficiency in CARICOM Countries

The site survey included the assessment of national energy policy, technical potential and the status of market entry of Japanese companies in CARICOM. This research, along with an assessment of institutional RE and EE systems and technology, was used to determine the suitability for candidate countries for future JICA projects. The results of RE/EE are as follows (with further detail is referred to in Chapter 4):

(1) Present Situation of Renewable Energy

The present situation on renewable energy is assessed from two aspects: institutional systems and technical issues. The specific contents are as follows:

- Institutional systems: Policy, Incentive Systems
- Technical issues: Solar, Wind, Small Hydro, Geothermal, Biomass, OTEC

The result of the site survey on renewable energy is shown below.

a. Continental Countries, Jamaica and Trinidad and Tobago

Continental countries, such as Guyana, Suriname and Belize have strong hydro power potential due to their specific geographic formations. However, load is concentrated in coastal areas and therefore, large-scale hydro power and transmission systems that have advantage of scale are being developed only in Suriname. The above-mentioned three countries each have at least 10% of its population lacking access to electricity and expect to utilize renewables such as wind, small hydro and biomass for rural electrification.

Each has a national policy stressing rural electrification and donors have stepped forward to offer assistance. Nonetheless, many small rural electrification projects focused on solar energy were halted due to a variety of issues related to operation and maintenance.

Jamaica has large incentives for renewable energy to offset their high electricity tariffs. There is, in addition, a national policy to increase the amount of renewable energy from 9% at present, to 20% by 2030. Accordingly, private companies, such as Jamaica Oil Company, are investing aggressively (government organizations are excluded). Jamaica has the potential to introduce medium to large utility-scale renewable energy farms (i.e. solar, wind). Presently, efforts are being made to reduce high electricity tariffs through household load reduction. However, net-metering is expected if institutional frameworks and policy are more clearly defined.

Trinidad and Tobago has an extremely low electricity tariff and therefore has little incentive to introduce renewable energy. The government of Trinidad and Tobago has a goal to install 60MW by 2020. However investments from private companies may be difficult due to the lack of data on renewable energies such as solar and wind.

b. The Eastern Caribbean Countries

The Eastern Caribbean Countries have few options for hydropower due to the geology of the region. Also, there is little potential for biomass energy due to the limited collection of waste from small populations.

On the other hand, there is the potential for both solar power and wind power. Currently, the introduction of solar power is more advanced than wind due to the relative ease of installation. Rooftop solar is the most common form due to the lack of suitable land.

Wind power is hindered from environmental concerns and the difficulty of securing land, although wind power would be suitable in the east-coast (windward) areas of these countries. In addition, the development of renewable energy is destabilizing to the small grids in the region. Grid stability control systems would be helpful in easing the addition of renewables in the Eastern Caribbean Countries.

The potential for geothermal power is moderate and found in some countries. Where there is potential, plans to develop geothermal for baseload power to reduce dependence on diesel fuel are being given. However, these countries have not yet commenced with the construction of geothermal plants due to the high initial construction costs, limits of introduction from small overall load and the necessity of a legal framework for development rights, etc.

There is also the potential for OTEC in the Eastern Caribbean Countries because their geological conditions are suitable for easy access to the deep water required for OTEC technology. Even though OTEC technology has not reached commercial success, several countries already have plans to implement feasibility studies to consider future utilization.

⑵ Present Situation of Energy Efficiency

EE is assessed from two aspects: Institutional Systems and Technology and the specific contents are as follows:

- Institutional Systems: Energy Management System, Building Code, Labeling System, Subsidy
- Technology：High Efficiency Light, Inverter Air Conditioner, Amorphous Transformer, Smart Meter

Additionally, the outline of the results of the site survey shows different trends in Group A and Group B and is described by each Group as follows (refer to Chapter 4 for details)

a. Continental Countries, Jamaica and Trinidad and Tobago

Each country recognizes energy efficiency policy as important, though progress varies by country. Institutional policies, such as building codes, energy management systems and labeling systems are not yet common. However, views on this topic differ between those countries that are net energy producers/exporters versus energy consumers/importers. Lower electricity tariffs in the countries producing energy is one of the reasons.

Labelling systems are effective in promoting high-efficiency electric appliances. However, each country depends on imported appliances and has difficulty in managing such programs independently. Therefore, CARICOM countries utilize outside energy efficiency standards, testing methods and economic performance, etc.

No country in the study actively utilizes energy management systems. Additionally, the energy data needed to analyse energy consumption and future growth is insufficient. Regarding technology, each country has promoted high-efficiency lamps (CFL/LED) aggressively. Dissemination in the market varies by country, although they can generally be purchased in retail markets. The reason for slow dissemination is caused mainly by a lack of awareness of the benefits of energy efficiency by the customer. Also, there has also been some impact due to poor quality and high prices.

Inverter-based air conditioners are widely available, however, their performance has not overcome the initial cost. Appliance shops do not provide overall product life cost calculations and rarely explain the benefits of energy efficiency to customers. Labelling systems and consumer education at the retail-level would be useful. In Jamaica, there is a policy focused on energy efficiency based on a labelling system, however the policy does not include the promotion of inverter-based air conditioners. Accordingly, Jamaica is a candidate for assistance from JICA in the future. Smart meters are being introduced step by step in each country, though ITRON Corpl. (USA) currently dominates their market.

Amorphous transformers have not been widely disseminated due to a lack of understanding of the product. However, utilities and industrial customer are likely to adopt the technology in the future. From the view of a manufacturer, the region’s markets are small and transportation costs are high due to weight, causing barriers to market entry.

Jamaica is concerned with various energy problems, including losses in their water and sewage pump systems. These systems consume great volumes energy and are in need of upgrades.

b. The Eastern Caribbean Countries

Necessary and comprehensive institutional systems are being arranged in each country through the support of donors as well as the independent efforts of each country.

High efficiency lighting and smart meters are being introduced in each country with the support of donors and the independent efforts of each country. Inverter-based air conditioners and amorphous transformers have not been installed yet. However, inverter-based air conditioners would have potential where consumers were better informed, potentially through a labeling program. Labeling programs are about to be established in several countries through the support of GIZ. It seems that customers are more likely to purchase a high-efficiency air conditioner when educated on the benefits by appliance shop staff.

Although amorphous transformers are not standard in most countries, there is strong interest in the technology and its potential benefits. Amorphous transformers could contribute positively in the countries having large power losses, including St. Christopher & Nevis (power loss: approx. 30%) and Antigua & Barbuda (power loss: approx. 17-20%).

(3) Current Situations at Potential Sites

a. Rural Electrification Site in Inland in Guyana

Guyana believes that rural electrification in inland areas (Hinterland) is an important issue. The survey team conducted a site visit to the Tumatumari area by request of the local government. The site was reached by airplane, as the road to Tumatumari (150km) from the capital city, Georgetown, is poor. Tumatumari is one of Guyana's many remote areas with a significant Amerindian minority population.

● **Tumatumari Small Hydro Power Station**

- Run-of-river small hydro power plant (1.5MW) constructed in 1957 with support of the United Kingdom
- Distribution lines constructed to supply power to mine and neighborhood villages. Was stopped in 1980 due to technical issues.
- Local company (Dynamic Engineering) started repairs in 2012; however it is not presently operating.
- The survey team understands that repairs would be difficult due to the age of the equipment.

● **Mahdia Power & Light (MPL)**

- Diesel power generators (350kW x 3 units) supply power from midnight to 6:00 A.M. to an Amerindian community (1,000 people) in Mahdia and Campbell town
- Fuel is sent by truck on unimproved roads from Georgetown. Refueling cannot be conducted during the rainy season and blackouts occur due to a lack of fuel
- No electricity is available for people living in villages far from the main cities

b. Diesel power plants in the Eastern Caribbean Countries

Electric power supplies in the Eastern Caribbean Countries depend heavily on diesel fuel. Therefore, the site survey focused on the status of the diesel power plants in each country. All electric power supplied in each country comes from one or two diesel power plants. The diesel power generation units are monitored and controlled from a control room at the diesel power plant. Output of the generators is adjusted according to instructions from the control center. Grid frequency and voltage can be kept balanced by governors and voltage regulators of the diesel generator units. Control centers are equipped with a SCADA systems for frequency and voltage control and to operate remote switchgear in transmission lines and substations.

Figure 3 Diesel power plant (St. Lucia)

c. Solar Farm and Wind Farm (St. Christopher and Nevis)

St. Christopher & Nevis has a 750kW solar farm and a 2.2MW wind farm. The two facilities do not have duty staff and are monitored from the utility's office via an internet connection. In case of a malfunction, the generating systems can be disconnected from the power grid automatically by protective relays and an alert automatically sent to the electric power utility's office.

Figure 4 750kW Solar farm (St. Christopher and Nevis)

d. Geothermal Power Potential Site in the Eastern Caribbean Countries (Dominica, St. Lucia and St. Christopher and Nevis)

Drilling surveys for production wells and reinjection wells at a potential site in Dominica is being implemented to collect data needed for the design of geothermal plants. Early-stage drilling surveys are also under way in St. Lucia and St. Christopher and Nevis.

Figure 5 Geothermal potential site (Dominica)

e. Potential Sites for OTEC (St. Lucia, St. Vincent and Barbados)

In St. Lucia, St. Vincent and the Grenadines and Barbados, reconnaissance for potential sites selected in a desk study were implemented. OTEC plants should be developed together with other industries such as the fishing industry or agricultural industry in order to improve the economic efficiencies of OTEC plants. This is due to overall installed capacities being limited due to power demand in these countries. Fishing and agriculture are found in proximity to potential OTEC sites.

Figure 6 Discussion on OTEC（St. Lucia）

f. Market Situation of Inverter Air Conditioner (twelve countries)

The survey visited electric appliance shops, including those with inverter-based air conditioners, to understand the market. Based on this research, the survey understood that most all of the twelve countries visited have inverter air conditioners for sale. However most products originate from U.S.A., China, etc. and not from Japan.

Figure 7 Inverter Air Conditioner in St. Vincent
(Made by MASTERTECH (USA) Approx. USD 1,220)

g. High Efficiency Light Bulbs (CFL/LED) (twelve countries)

The survey conducted visits to electric appliance shops to understand the market for high- efficiency lamps. Most of the twelve countries visited market lamps such as CFL/LED, etc. Buildings including ministry offices and hotels, etc. already have such technology installed.

CFL(Barbados)

LED(St. Vincent)

Figure 8 Example High Efficiency Bulbs

h. Pole Transformer (twelve countries)

The survey conducted a site survey to understand the present situation regarding pole-mounted transformers in order to evaluate the potential for amorphous transformers. Almost all pole-mounted transformers are American products. Although some countries already have high-efficiency pole transformers installed to reduce power losses, amorphous transformers are not well understood. St. Christopher and Nevis and Antigua and Barbuda have good potential for amorphous transformers due to their strong interest in reducing power losses.

Figure 9 Pole Transformer (Dominica: ABB Production (USA))

i. Electricity Meter (twelve countries)

The survey conducted site surveys to understand the present situation regarding electricity meters to evaluate the potential for smart meters. The survey understands that the continental countries- Jamaica and Trinidad and Tobago already have installed Automatic Metering Infrastructure (AMI) and several countries in the Eastern Caribbean countries have installed smart meters.

Figure 10 Smart Meter (St. Christopher and Nevis: Landis+Gyr Production)

Chapter 4　Results by country

(1)　Overall methodology

The potential of renewable energy and energy efficiency for each country was assessed based on the information gathered during the survey. The evaluation was completed according to the procedures outlined below.

The results of the survey are organized so as to explain: (1) survey methodology, (2) analysis of each country's conditions and (3) dialogue with related persons from the invitation program.

(2)　The evaluation for Japanese cooperation potential

Through this organization structure, the potential for renewable energy and energy efficiency in each country was evaluated according to two indexes as outlined below.

1)　Whether any potential exists
2)　Consistency with energy policy

The results of the evaluations are signified as follows:

No potential - 「×」
Has potential but inconsistent with energy policy - 「△」
Has potential and consistent with energy policy - 「○」

Among projects scored as "○", further evaluation is used to select more feasible projects according to the two indexes below. The projects that satisfy these indexes are scored as "◎".

Possibility for the application of technologies found in Japanese companies
Current and future situation on donors of other countries

Table 8　Criteria of evaluation

Potential	High / Low	× Low	○ High	○ High	○ High	○ High	○ High	○ High	○ High	○ High
Clear Policy	Existence / Non-Existence	—	× Non-Existence	× Non-Existence	× Non-Existence	× Non-Existence	○ Existence	○ Existence	○ Existence	○ Existence
Potential use of Japanese Technology	High / Low	—	× Low	× Low	○ High	○ High	× Low	× Low	○ High	○ High
Donor	Impact of Japanese Support High / Low	—	× Low	○ High	× Low	○ High	× Low	○ High	× Low	○ High
Comprehensive Evaluation		×	△				○			◎

・In "Potential", both sides of technology & economic are considered.
・In "Donor", in case that other donors already have conducted their activities and impact of Japanese support is low, evaluation is ×.

Table 9 Evaluation Summary of the Survey (Renewable Energy)

	Introducing technology												Institutional System			
	Solar power		Wind power		Small hydropower		Geothermal power		Biomass power		OTEC		Policy		Incentive system	
	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.
Antigua & Barbuda	PV systems are installed by private sector. Government studies allowable capacity of renewable energy.	◎	Potential of wind power is estimated to be 18 to 20MW. Some wind power projects are being studied.	◎	No hydro power is installed. Potential of hydropower isn't found.	×	Potential of geothermal power isn't found	×	Potential of biomass power is being studied by government.	△	There are NO large potential sites.	△	Targeted value of renewable energy is being studied.	○	Tax exemption is applied for renewable energy equipment. FIT or Net billing will be introduced in the near future.	○
Barbados	5MW PV systems were installed at private buildings. Government will expand installed capacity of PV system up to 30MW.	◎	Government will expand installed capacity of wind power plants up to 10MW.	△	No hydro power is installed. Potential of hydropower isn't found.	×	Potential of geothermal power isn't found.	×	Government will expand installed capacity of waste power generation and biomass co-generation up to 15-20MW and 20MW respectively.	△	Candidate Site for land base OTEC is considered to exist in the east coast area. Government and BLPC intend to implement F/S respectively.	○	Targeted value of renewable energy is 30% of generated power by 2029.	○	Tax exemption is applied for renewable energy equipment. Net billing is applied as purchase system.	○
Belize	PV is useful in off grid island But need to measure the potential	△	Many wind plans are listed, but National Wind Map has not developed yet.	◎	Additional development are no longer possible because its potential output is not feasible.	×	There are no potential sites.	×	Waste wood from timber product is estimated enough to generate the power	△	There are no potential sites.	×	- there are no numerical target data. - Plan to measure the actual data for wind, Biomass	◎	- No plan for the incentives	△
Dominica	Government has intention to introduce roof-top type PV systems in private and public buildings.	◎	225kW wind power is installed by a private company. Potential of wind power is estimated to exist in the east coast area.	△	Potential of hydropower is estimated to exist, but no plan is developed.	△	One potential site has been surveyed in detail. Potential of geothermal power is estimated to be more than 100MW.	○	Potential of biomass power is studied, but it is estimated to be small.	△	There are NO large potential sites.	△	Targeted value of renewable energy is being studied.	○	Tax exemption is applied for renewable energy equipment. Purchase system will be shifted from Net metering to FIT or Net billing.	○
Grenada	GRENLEC installed 32kW ground-mounted PV system in Petite Martinique and will extend installed capacity up to 100kW.	○	Potential of wind power is considered to exist along the east coast. GRENLEC has a plan to install 2MW wind power plants.	○	No hydro power is installed. Potential of hydropower isn't found.	×	Potential of geothermal power is estimated to exist around Mt. St.Catherine. Government intends to develop it as a base load power source.	◎	Potential of waste power generation is estimated to be so small, but Government continues to study its potential.	△	There are NO large potential sites.	△	Targeted value of renewable energy is 20% of generated power by 2020.	○	Tax exemption is applied for renewable energy equipment. Net billing is applied as purchase system.	○
Guyana	-1MW PV plan in the University of Guyana	○	- 10-25MW wind farm at Hope Beach are waiting the finance - No wind speed data	△	- 18 suitable sites will be assessed for the piloting. - But there are many problems of sustainabilities.	○	There are no potential sites.	×	-Guyana Univ. optimal introducing small gasification plant for hinder land.	○	There are no potential sites.	×	- Only plan for rural electrification	○	- No plan to introduce	△
Jamaica	For self-consumption solar power have enough feasible to reduce power consumption	◎	- Wind conditions are good - 10 medium-sized wind farms are planned	◎	-Small hydro potential can be developed in 11 sites	○	There are no potential sites.	×	-The excess power from power plant could not be sold to the grid	△	According to the related documents, there are some possibilities.	×	Targeted value of renewable energy is 20% of generated power by 2030.	△	High cost of electric power gives big incentives to introduce RE	○
St. Kitts & Nevis	750KW PV system is installed 750kW roof-top type PV systems are planned	○	2.2MW wind power is installed. Potential of wind power is estimated to be 11MW.	◎	No hydro power is installed. Potential of hydropower isn't found.	×	Potential of geothermal power is estimated to exist. F/S is being implemented in Nevis.	○	Potential of biomass power is being studied, but specific amount hasn't been estimated.	△	There are NO large potential sites.	△	Targeted value of renewable energy introduction isn't decided.	○	Tax exemption is applied for renewable energy equipment. FIT or Net billing isn't introduced.	○
St. Lucia	Potential of solar power is estimated to be 18-20 MW.3MW PV system is planned to be installed.	○	Government has a plan to install 12-15MW wind power plant, but its detail isn't determined.	△	Government has no plan to develop hydropower because of social and environmental impact.	×	Large potential of geothermal power is estimated. It is planned to be developed as a base load power source.	○	According to the study by Government, scale of biomass power is estimated to be small.	△	Candidate Site for land base OTEC is considered to exist in the west coast area, especially in Soufriere.	○	Targeted value of renewable energy is 35% of generated power by 2020.	○	Tax exemption is applied for renewable energy equipment. Purchase system will be shifted from Net metering to FIT or Net billing.	○
St. Vincent & the Grenadines	300kW PV system is installed. Government will expand installed capacity of PV systems to 800-900kW.	◎	Potential of wind power is considered to exist at the south-east coast area. Additionally, F/S is implemented in central area.	△	Government intends to replace the old hydropower plant and study possibility of small hydropower systems.	△	F/S is started in north area. Government intends to develop geothermal plant as a base load power source.	◎	In pre-feasibility studies, potential of biomass power is estimated to be small.	△	Candidate Site for land base OTEC is considered to exist in the west coast area, especially near Kingstown. Government intends to implement F/S.	○	Targeted value of renewable energy is 60% of generated power by 2020.	○	Tax exemption is applied for renewable energy equipment. FIT will be introduced in the near future.	○
Suriname	-SHS have potential for the rural. -MW PV planed in the costal area.	△	- The east coast of reservoir is the good site	△	-Several mini /micro hydro are planned in rural area and waiting for developments	△	There are no potential sites.	×	-There are 3 potential sites to have F/S - Still need to survey for the biomass material	△	There are no potential sites.	×	- Plan is mostly to develop the big power plant - There is plan for rural electrification	△	- No incentives to introduce	△
Trinidad Tobago	-Mega class PV are planned, but land acquisition is the barrier	△	- Wind farm are planned, but land acquisition is the barrier - There are NO wind map.	△	There are no potential sites.	×	There are no potential sites.	×	- Not enough agri_waste - Waste segregation are planning now.	△	According to the related documents, there are some possibilities in Tobago island.	△	Targeted value of renewable energy is 5% of generated power by 2020.	△	- already introduced some incentive program	△

Table 10 Evaluation Summary of the Survey (Energy Efficiency)

	Institutional System								Technology							
	Energy Management System		Building Code		Labeling System		Subsidy		CFL/HID/LED		Inverter AC		Amorphous TR /Water System (WS)		Smart Meter(SM)	
	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.	Potential	Eval.
Antigua & Barbuda	Expert is being educated supported by GIZ	△	Reviewing with support of OAS by including EE	△	Under consideration with GIZ	△	Tax exemption for equipment of RE&EE	△	･Many kinds of products already has been sold. ･Street Lights are not changed to EE type and no future plan.	△	Promoted by Labeling in the future	△	No installation T/D Loss is 17-20% No problem in WS	◎	･Under Demonstration 30 units will be installed by Gov. budget. ･Future plan is under consideration.	○
Barbados	SEFB covers to educate auditor and establish audit scheme	△	Now under review by considering of EE by Gov.	△	Already has been established by Gov.	△	Tax exemption for equipment of RE&EE	△	SEFB covers to install into public buildings.	△	SEFB covers to install into public buildings.	△	Has strong interest to reduce power loss, (T/D loss is 6-7%.) No problem in WS	×	BLPC is planning to install AMI.	△
Belize	Planning	△	Existing To be implemented	○	Under consideration by GIZ	×	Not Implemented No intention by Gov.	△	Demonstration started of LED	×	To be studied	△	T/D Loss is 12%	△	Planning of Introduction of AMI	△
Dominica	Under consideration with GIZ	△	Just start to review by Dominica Gov.	○	Under consideration with GIZ	△	Tax exemption for equipment of RE&EE	△	･ PV Street Light (2500units) will be installed by China grant. ･Gov. installed PV Street Light. (16units)	△	Promoted by Labeling in the future	△	already has power loss improvement including TR No problem in WS	△	DOMLEC has the plan to install	△
Grenada	Gov. assigned some person to being trained as energy auditor.	△	Now under Review by considering of EE by Gov.	△	Already has been established with GIZ	△	Tax exemption for equipment of RE&EE	△	･LED was installed into Gov. Bldgs by Chinese Grand. ･Gov. requested donors to install high efficiency SL.	△	Installed into Gov. Bldgs and hospital, etc. by Chinese Grand.	△	considering to change to amorphous TR at the replacing time. No problem in WS	△	･AMI was installed into 1/3 customers. ･SM is planned to install other customers.	×
Guyana	To be established already	△	To be established already	△	Encouraging introduction of energy star rating	○	Not Implemented No intention by Gov.	△	CFL Commonly used already Small potential LED	△	Available in the Market Effective with Labeling	○	1st Priority in Rural Electrification T/D Loss is 31% Strategic Loss Reduction Plan (SLRP)	○	Already introducing AMI	×
Jamaica	To be established	△	Initial Energy Efficiency Building Code (EEBC) in 1994.	○	Once introduced Refrigeration Label, not disseminated	×	Not Implemented No intention by Gov.	△	Available in the Market To be continued	△	Emphasizing on EE, High potential of EE Especially in schools and Public offices	◎	T/D loss is 22% Amorphous is studies by Utilities High efficiency Pump/Motor in Water System	○ ◎	Already introducing AMI in some part of area	△
St. Kitts & Nevis	Is planning to be adopted in near future	△	No plant which will be revised by focusing on EE	○	Under consideration with GIZ	△	Tax exemption for equipment of RE&EE	△	TAIWAN Gov support ･change Street Lights ･plan to install LED to public buildings	△	Targets could be almost same as the LED plan	△	No installation ･T/D Loss is 30% ･Total 400 units ･No problem in WS	◎	SM will be installed to all customers in 2 years by Gov. budget	△
St. Lucia	Under consideration with GIZ	△	Review already has been done by St. Lucia Gov.	△	Under consideration with GIZ	△	Tax exemption for equipment of RE&EE	△	･ Gov. installed in 2 Gov. bldg. and will install in others. ･Gov. installed 50 LED SL and will exchange others by ESCOs.	△	Promoted by Labeling in the future	△	T/D loss is 8.8% No problem in WS	△	LUCELEC already has installed 35,000 units.	×
St. Vincent & the Grenadines	no plan to educate energy audit person at present	○	Need to Review, but no Plan	○	Under consideration with GIZ	△	Tax exemption for equipment of RE&EE(PV panel & LED, not AC)	△	･Gov. conducted EE project in one Ministry and will install to other 70 public bldgs with WB. ･VINLEC installed 90 LED SL with GIZ and will exchange others.	△	Promoted by Labeling in the future	△	VINLEC has not installed Amorphous TR. (T/D loss is 7.0%) No problem in WS	△	VINLEC does not have idea to install in terms of cost-benefit performance.	△
Suriname	To be established already	△	No Activity	△	No Activity	△	Not Implemented No intention by Gov.	△	Easy EE Measure	○	To be studies after Establishing Institutional System	△	1st Priority in Rural Electrification T/D Loss is 10%	×	To be studies after Establishing Institutional System	×
Trinidad Tobago	To be established already	△	Under consideration by MEEA	△	Under consideration by MEEA with CARICOM Collaboration	○	Not Implemented No incentives	△	Available in the Market Potential to introduce	○	Available in the Market Effective with Labeling	○	T/D Loss is 8%	×	Already introducing AMI	×

Antigua and Barbuda

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Ministry of Foreign Affairs
- Antigua Public Utilities Authority (APUA)

b. Analysis of Current Situation

The results of the survey are as follows.

- "Solar" has good potential and is already moving ahead in the private sector. In addition, "Wind" potential is also high with an opportunity estimated at 20MW. Very little has yet to be installed.
- Regarding energy efficiency, there is strong potential for "Amorphous Transformers". This transformer technology has not yet been introduced in Antigua and Barbuda, where transmission and distribution losses are in the 17-20% range.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ Small scale roof-top PV have been installed by the private sector. ✓ Currently, the government has no plans to subsidize PV systems other than tax exemptions for renewable energy equipment.	✓ The government has no specific plans to install large-scale ground mounted PV systems. ✓ In conjunction with IRENA, the government is researching maximum allowable renewable capacity (*1).	◎
Wind	✓ Currently, there are no wind turbines installed in Antigua or Barbuda.	✓ The government estimates wind power potential to be approximately 18 to 20MW. ✓ Wind power has been studies somewhat. After determining maximum renewable capacity limits, a plan will be discussed to develop wind facilities.	◎

	Current Situation	Potential/Plan	Evaluation
Hydro	✓ No hydro power is installed.	✓ Potential of hydro has not been found.	×
Biomass	✓ No biomass power is installed.	✓ Potential for biomass power is under review by government.	△
Geothermal	✓ Geothermal has yet to be exploited.	✓ It is assumed that there is no potential to develop geothermal.	×

Remarks

*1) Grid stability issues related to Solar PV have not yet occurred. However, the Antigua government is studying the upper limits for renewable energy interconnection to while maintaining stability and a constant frequency/voltage. This study is being executed in cooperation with IRENA.

2) Energy Efficiency

<table>
<tr><th></th><th>Type</th><th>Current Situation</th><th>Potential/Plan</th><th>Evaluation</th></tr>
<tr><td rowspan="4">Institutional System</td><td>Energy Management System</td><td colspan="2">-Education is being provided with the support of GIZ (Target: Government Facilities)</td><td>△</td></tr>
<tr><td>Building Code (BC)</td><td>-Exists</td><td>-Reviewing with support of OAS -including EE</td><td>△</td></tr>
<tr><td>Labeling System</td><td colspan="2">-Under consideration with GIZ</td><td>△</td></tr>
<tr><td>Subsidy</td><td colspan="2">-Tax exemption for RE and EE technologies</td><td>△</td></tr>
<tr><td rowspan="2">Technology</td><td>CFL/HID/LED</td><td colspan="2">-Tax exemption only. Success will depend on market forces.
-Many kinds of products are available to the consumer.
-Street lights have not been upgraded and there are no current plans to do so.</td><td>△</td></tr>
<tr><td>Inverter AC</td><td>-No dissemination</td><td>-Promoted through a labeling program</td><td>△</td></tr>
</table>

	Type	Current Situation	Potential/Plan	Evaluation
	Amorphous TR	-No dissemination	-High power losses	◎
	Smart Meter	-A demonstration will install 30 units due to government budget limitations. Next steps are under consideration.		○

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. Andre Matthias (Antigua Public Utilities Authority) Mr. Luther Lee (Antigua Public Utilities Authority)
Dialogue Result	➢ It is understood that soft loans or grants are unlikely due to the country's high income. ➢ Grid-connected "Solar" and "Wind" of 100－200kW capacity is expected to expand in the future. The members requested information on how to operate economically.

d. Preliminary Conclusion

- "Solar" could be a candidate for ODA, because roof-top systems are being installed by the private sector and the introduction of a FIT is under consideration. However, maximum capacity of "Solar" has not been determined. There are concerns of the effects to grid stability and so the government has not created a specific plan to introduce "Solar".
- "Wind" could also be a candidate, however the government has no specific development plans due to concerns of grid stability. Therefore, wind power development is currently not advancing compare than Solar.
- Considering the above, grid stability concerns related to the installation of "Solar" and "Wind" is one of the main issues to be resolved. Therefore, Japanese support of grid stability through technical transfer could have a large positive impact on the promotion of these technologies.
- "Amorphous Transformers" provide a strong opportunity for ODA, due to the high transmission and distribution losses (17-20%). Antigua and Barbuda is interested in this technology, however it would be important to provide more information early in the process to increase their understanding of the technology.

Barbados

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Division of Energy and Telecommunications, Prime Minister's Office
- The Barbados Light & Power Company Limited (BLPC)

b. Analysis of Current Situation

The results of the survey are as follows.

- "Solar" has potential in that only 5MW of the 30MW planned has been installed.
- Energy efficiency is more complicated. Institutional systems and technologies that are supported from Japanese are already being worked on with the support of other donors, such as SEFB, etc.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ 5MW of roof-top PV exists on privately-owned buildings. ✓ Large scale ground-mounted PV systems have not been constructed due to land limitations.	✓ The government plans up to 10MW of PV. In the plan, PV generating systems are installed by the private sector. ✓ Barbados Lighting and Power Company (BLPC) will invite tenders for up to 8MW of PV from the private sector. ✓ Solar heating systems are quite popular in Barbados, and 40% of households have such systems to reduce their consumption of fossil fuel.	◎
Wind	✓ A few small scale wind power systems were installed by the private sector. These wind power systems are not connected to the grid, and generated power is consumed only in the buildings.	✓ The power utility (BLPC) expects to expand the capacity of wind farms by up to 10MW. Little progress has been made due to a lack of suitable land.	△

	Current Situation	Potential/Plan	Evaluation
	✓ BLPC doesn't have wind power plants.		
Geothermal	✓ No geothermal power plants exist.	✓ The potential for geothermal power is not considered to exist.	×
Hydro	✓ No hydro plants are installed.	✓ The potential for hydropower is not considered to exist.	×
Biomass	✓ The government started a feasibility study for biomass cogeneration and WTE with support from IDB. ✓ Based on the results of the feasibility study, foreign private companies (USA, Canada, etc.) are making plans for biomass co-generation plants and WTE plants. ✓ In addition to biomass, the government started a feasibility study for biofuel to reduce the consumption of fossil fuels in the transportation sector.	✓ The government wants to expand the capacity of WTE and biomass cogeneration to 15-20MW and 20MW respectively. In prefeasibility studies, the potential of biomass is estimated to be small. Therefore, plans to develop biomass are not progressing.	△
OTEC	✓ The government and BLPC implemented a feasibility study for OTEC as follows: ✓ The Division of Energy and Telecommunications is looking to begin a feasibility study with support from IDB. ✓ SIDS-DOCK in Japan, in cooperation with Ministry of Agriculture, began a pre-feasibility study. ✓ BLPC wants to do a feasibility study	✓ Potential of OTEC is considered to exist on the east coast. ✓ The government and BLPC consider OTEC to be a useful technology, adding to renewable energy and reducing the consumption of fossil fuel.	○

	Current Situation	Potential/Plan	Evaluation
	in cooperation with a private company in France (DCNS).		

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	- SEFB endeavors to educate auditors and establish an audit scheme		△
	Building Code (BC)	- Exists, but does not includes EE	- Now under review – government considering of EE	△
	Labeling System	- Already established by the government		△
	Subsidy	- Several Tax exemptions for RE and EE technology		△
Technology	CFL/HID/LED	- CFL is on the market	SEFB plans to install LEDs in public buildings.	△
	Inverter AC	-No dissemination	- SEFB plans to install in public buildings.	△
	Amorphous TR	-No dissemination	- BLPC has not installed Amorphous TR, but has interest in EE technology to reduce power losses that are approx. 6-7%.	×
	Smart Meter	- Electrical-mechanicals meters will be replaced with AMI.		△

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. HINDS William Alexander L.(Government of Barbados)
Dialogue Result	➢ For “Waste Biomass Generation”, there are few companies with experience, though many bid for their projects. They have strong interest in Japanese technologies seen through this invitation program.

d. Preliminary Conclusion

- "Solar" could be a candidate for ODA. Development plans for "Solar" include up to 30MW were established based on the leadership of the government, though grid stability issues need to be solved. Japanese support of grid stability could be very supportive of the government's "Solar" plans.

Belize

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team performed site surveys in and around Belize's islands and shared opinions on the potential to received support from JICA.

(Organizations Visited)

- Ministry of Energy, Science & Technology and Public Utilities
- Belize Electricity Limited (BEL)
- Public Utilities Commission (PUC)

b. Analysis of Current Situation

The results of the survey are as follows.

- Power supply is insufficient for part of the year during the dry season, requiring imports from Mexico. Renewable energy would be useful to fill this gap.
- Belize has many places suitable for "Wind" in the coastal region.
- Biomass generation utilizing agricultural resources and wood waste, etc. is being planned.
- Belmopan and Belize City has issues with interconnecting renewables to their grid.
- Institutional purchase programs, etc. have been delayed. For a purchase price, the evaluation of economic performance is of great value.
- Utility-based energy efficiency is limited as line losses are relatively small.
- Residential energy efficiency is also limited as homes are small. Energy efficiency for street lighting is worth considering because energy efficiency measures have not been introduced widely.

1) Renewable energy

	Current situation	Potential/Plan	Evaluation
Solar	✓ Belize's solar energy resources are strong, as about 65% of Belize's land area receives 5.0 to 5.5 KWh/m2/day. ✓ The only large scale solar project originated from a JICA grant at the University of Belize in Belmopan	✓ PV is useful for off-grid applications such as island, but suitable land is scarce. ✓ The generating cost per kWh will compete with cost to import from CFE, Mexico.	△
Wind	✓ According to NREL, wind energy potential in Belize in offshore areas is moderate-to-excellent, with wind resources averaging 5-6m/second	✓ There are many plans to install wind in Belize, but a National Wind Map has not been created. The government wants to survey the	◎

	Current situation	Potential/Plan	Evaluation
	✓ Most of this windy terrain is located in the Maya Mountain Range and the northern cayes.	country's wind speeds. ✓ There is a need to find a feasible location in proximity to transmission lines	
Hydro	✓ Just over 50 MW of hydropower has been developed in the Cayo District on the Macal River cascade	✓ Additional development is no longer possible.	×
Biomass	✓ Sugarcane bagasse is currently the main source of biomass fuel in Belize. ✓ Output could be been doubled if the bagasse was used in a high-pressure steam turbine.	✓ Bagasse is available only 180 days in a year. ✓ Need for studies into alternative resources such as agricultural and forestry residues and Municipal Solid Waste（MSW). ✓ Waste wood volumes from logging and wood product may be a useful feedstock for power generation.	△

2) Energy efficiency

	Type	Current situation	Potential/Plan	Evaluation
Institutional System	National Energy Policy	No formal energy strategy or comprehensive National Energy Policy (NEP)	Ministry of Energy, Science & Tech. and Public Utilities (MESTP) has plan to establish strategy	×
	Education and Awareness	Not implemented	Education in schools, local communities and government sectors using various methods should be considered	○
Technology	CFL	Not implemented	✓ MESTP is active in promoting these measures ✓ BEL and MOF should be involved in these activities	×
	LED	Not implemented		×
	Street Light	Not implemented ✓ Owned by Financial Ministry		×
	Inverter AC	Not implemented	MESTP evaluated this technology	△

	Type	Current situation	Potential/Plan	Evaluation
			highly and will promote it with a labeling system	

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. COBB Ryan Michael-Lee (Ministry of Energy, Science & Technology and Public Utilities) Mr. USHER Mark Anthony Fitzgerald (Public Utilities Commission) Mr. PERALTA Ahnivar Ancelmo (5C)
Dialogue Result	➢ At present, all bagasse produced is burned to run steam turbines (23MWx2Units). Purchasing contracts for 13.5MW are in place and is being supplied to grid. ➢ Inverter air conditioners have been sold commercially. ➢ It is important to provide the public with an education on energy efficiency, including raising awareness, establishment of a labeling system and standards for energy efficiency.

d. Preliminary Conclusion

- Power supplies are insufficient for part of the year during the dry season. Renewable energy would be useful to compensate for seasonal supply fluctuations.
- Since bagasse from sugarcane had already used to produce steam for generation, agricultural waste resources other than bagasse, such as oranges and bananas, are could have potential as they are well understood.
- Island resorts are powered by diesel generators for only some hours of the day. The Belize government plans to run a submarine cable from the continent to these island resorts to steady power supplies, though it has not yet been implemented.
- Development of "Wind Turbine" in coastal areas should be considered. EIA and wind condition studies, etc., will advance development.

Dominica

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Ministry of Public Works, Energy and Ports
- Dominica Electricity Services Limited (DOMLEC)

b. Analysis of Current Situation

The results of the survey are as follows.

- "Solar" could potentially be supported due to the fact that roof-top solar has already been installed. This has occurred mainly at industrial facilities. Roof-top solar installations for government facilities is planned as part of the country's energy policy.
- Energy efficiency is more complicated. Institutional systems and technologies that are supported from Japanese are already being worked on with the support of other donors, such as GIZ, etc.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ Small scale roof-top PV generating systems were installed by the private sector.	✓ The government intends to introduce roof-top PV generating systems in private buildings as well as public buildings. However, specific plans haven't been determined. ✓ For large scale PV systems, there is little government support. They feel that it will not effectively lower the overall cost of generation.	◎
Geothermal	✓ A potential site for a geothermal plant has been surveyed in detail. ✓ The design of a geothermal plant is moving ahead.	✓ Potential of geothermal is estimated to be more than 100MW. ✓ The first project would likely be a 7.5MW geothermal plant targeted to go online in 2016(*1). ✓ Subsequent to this, plants of up to 100MW may be developed with surplus electric energy exported to	○

	Current Situation	Potential/Plan	Evaluation
		Martinique and Guadeloupe via subsea cables.	
Wind	✓ A 225kW wind plant was installed by a private company.	✓ Potential of wind power is likely to exist in the east-coast of Dominica. ✓ The government has no plans to install wind power.	△
Hydro	✓ 3 hydropower plants have been in operation since 1957, and account for 27% of generation. ✓ These hydropower plants are owned by DOMLEC.	✓ Potential for additional hydropower is assumed to exist. ✓ The government has no plans to install new hydropower plants currently. ✓ The government is reviewing roof-top PV and small hydropower systems that are applied to water supply pipes in cooperation with GIZ.	△
Biomass	✓ No biomass power exists.	✓ Potential of biomass has been studied. ✓ The study results were that a small plant would be uneconomic and so there are no plans to introduce this technology.	△

Remarks

*1) The government has a plan to operate a 7.5MW geothermal plant as a base load power station. However, accurate capacity of the geothermal plant hasn't been decided yet.

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	-Under consideration with support from GIZ		△
	Building Code (BC)	-Exists	- Dominica Government begging to review	△

	Type	Current Situation	Potential/Plan	Evaluation
	Labeling System	-Under consideration with GIZ		△
	Subsidy	-Tax exemption for RE and EE technology		△
Technology	CFL/HID/LED	-PV street lights (2,500 units) will begin to be installed in one-to-two months with funding from a Chinese grant. -PV street lights (16 units) were installed with funding from the government -The government plants to retrofit public buildings to LED Two buildings have already been converted. -The national stadium was built with Chinese government funding in 2007. However, LED lighting has not yet been installed.		△
	Inverter AC	-No dissemination	-Promoted through a labeling program	△
	Amorphous TR	-No dissemination	-DOMELC has conducted a power loss improvement program. High efficiency TR is already in place.	△
	Smart Meter	-DOMLEC has plans to install		△

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. Carrette Samuel (Ministry of Finance)
Dialogue Result	➢ "Solar" and "Wind" energy potential is concentrated in the western area of the country. ➢ The concept created by PANASONIC caught Dominica's attention, in particular the concepts looking at the future and electric vehicles. ➢ OTEC has strong potential. Several incremental studies would be needed to better understand the opportunity.

d. Preliminary Conclusion

- "Solar" could be a candidates for ODA, because policy will implement to the installation of roof-top solar for governmental facilities in the future. Japanese support of these installations could be impactful where Japanese products, including panels and grid control systems, can be provided.
- "Geothermal" is moving forward quickly and many donors already have become involved.

Grenada

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Ministry of Finance and Energy
- Grenada Electricity Services Limited (GRENLEC)

b. Analysis of Current Situation

The results of the survey are as follows.

- A "Geothermal" geochemical study in surrounding the candidate site has been completed and feasibility study will be conducted soon. Possibilities here are good.
- Energy efficiency is more complicated. Institutional systems and technologies that are supported from Japanese are already being worked on with the support of other donors, such as GIZ, etc.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ Small scale roof-top PV has been installed on public as well as private buildings. ✓ Currently, electric power generated by PV is 370KW and accounts for approximate 2% of total generated electricity. ✓ GRENLEC installed 32kW of ground-mounted PV on Petite Martinique Island, and will expand capacity up to 100kW.	✓ PV will be led by the private sector. ✓ The government is going to establish incentive schemes for renewable energy, including tax exemptions for renewable energy technology. ✓ Solar heating systems are quite popular in Grenada to reduce the consumption of fossil fuel.	○
Wind	✓ Several small scale wind power systems were installed on private buildings. ✓ The government and GRENLEC have not developed any wind farms.	✓ Wind has potential on the east coast, but there are no specific plans due to the difficulty of obtaining suitable land. ✓ Wind power will be led by the private sector. ✓ GRENLEC plans to build a 2MW	○

	Current Situation	Potential/Plan	Evaluation
		hybrid wind-diesel system on Carriacau Island.	
Hydro	✓ Hydropower plants had not been installed.	✓ No potential is assumed for hydro.	×
Biomass	✓ A private company (Solid Management Company) did a feasibility study for WTE generation and biofuel production.	✓ There are no plans for WTE due to the small size and economic inefficiency.	△
Geothermal	✓ GRENLEC did a feasibility study for geothermal power.	✓ Geothermal resources may exist around Mt. St. Catherine. ✓ The government intends to develop geothermal power as a base load power source. ✓ Development has stopped currently due to questions related to financing.	◎

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	- NEP suggested they would establish EMS. The government assigned staff for energy auditor training.		△
	Building Code (BC)	- Exists, but does not includes EE	- Now under review – the government is considering EE	△
	Labeling System	- Established with support from GIZ.		△
	Subsidy	- Several Tax exemptions for RE and EE technology		△
Technology	CFL/HID/LED	- LED was installed in various government buildings by Chinese Grand. At present, Petro Caribbean continues doing installations. - The government requested some donors to support the installation of LED street lighting.		△

	Type	Current Situation	Potential/Plan	Evaluation
	Inverter AC	-No dissemination	- Installed in government buildings, a hospital, etc. by Chinese Grand.	△
	Amorphous TR	-No dissemination	-GRENLEC is considering to change to amorphous TR when current transformers need replacement.	△
	Smart Meter	- AMI already has been installed with 1/3 of customers. Discussion is ongoing about whether to continue.		×

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. Christopher Joseph (Ministry of Finance & Energy) Mr. Carl John (T. A. Marryshow Community College)
Dialogue Result	➢ For renewable energy, profitability is most important and the establishment of legal system has not been completed. In addition, human resource development is scheduled to begin soon. ➢ For "Geothermal", financial support is also expected.

d. Preliminary Conclusion

➢ "Geothermal" could be a candidate for ODA, beginning with a feasibility study. However, a bill related to "Geothermal" failed in Congress and delays in developing clear legal rules is a concern.

Guyana

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. Site surveys were made at electric power supply facilities on the coast and in the interior to share opinions on loss reduction in distribution lines and methods to supply power to the interior, Hinterland.

(Organizations visited)

- Guyana Energy Agency (GEA)
- Guyana Government Office of the Prime minister
- Guyana Power and Light, Inc. (GP&L)

b. Analysis of Current Situation

The results of the survey are as follows.

- Currently, the government is developing an energy policy. The availability of renewable energy such as solar, wind and biomass has not yet been determined.
- A large scale hydropower plant is being planned that, if constructed, would settle any capacity issues.
- Distribution facilities are installed in the coastal areas, but large distribution losses exist due to theft. It has become a serious issue.
- The government created the Hinterland Electrification Program (HEP) as part of its energy policy. Renewable energy will be introduced to the region and though many donors are participating in the program, numerous energy policy and technical issues remain to be settled.

1) Renewable energy

	Current situation	Potential/Plan	Evaluation
Solar	✓ 8kW grid-tied system in GEA's office. ✓ Roof-top PV totaling 1MW installed (*1).	✓ Roof-top PV has potential in developing rural electrification. ✓ 1MW PV plan at the University of Guyana	○
Wind	✓ Studies have indicated that no wind potential exists in the hinterland ✓ There is sufficient wind in coastal areas	✓ 10-25MW wind farm at Hope Beach awaiting financing	△
Hydro	✓ Extensive potential for hydropower ✓ Accelerating small-scale hydro power for Hinterland electrification	✓ 18 sites in 2013 and 2014. Suitable sites will be assessed for a pilot.	○

	Current situation	Potential/Plan	Evaluation
Biomass	✓ Bagasse are already utilized in sugarcane factories ✓ Rice husk potential map completed with some potential reported ✓ Waste wood can be utilized to produce power ✓ The Indian organization will start a F/S with University of Guyana	✓ GEA will seek to establish a 20 to 30kW demonstration unit. ✓ Guyana Univ. researching installing small gasification plants in the Hinterland. ✓ A biomass resource map will be completed in the near future.	○

2) Energy efficiency

	Type	Current situation	Potential/Plan	Evaluation
Institutional System	Energy Audit	-Conducted in 49 buildings in 2012/13	-Relatively few buildings exist in Guyana	△
	Labeling System	- Does not exist	-Encouraging introduction of energy star rating	○
	Education and Awareness	-Brochure publication -Education of customers -Education of school children	-Continuous implementation	△
Technology	CFL	- Commonly used	- Market mechanism	△
	LED	-Demonstration project (2 units)	- No plans	△
	Street Light	-Demonstration project (80 units)	- No plan	△
	Inverter AC	-Available in the Market	-A new labeling system should help establish this technology	○
	Amorphous TR	- No dissemination		○
	Smart Meter	-Planning introduction of AMI		×

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40-17:00
Attendants	Mr. PYLE Trevlon Alexander (Office of the Prime Minister) Mr. CHETRAM Nigel Anthony (Guyana Power & Light Inc.)
Dialogue Result	➢ Ground mount and rooftop "Solar" is planned for both rural and urban areas. ➢ Renewable energy with the greatest potential is both large and small-scale "Hydro". ➢ The capital city has a refuse crisis, making the introduction of a biomass plant an urgent

	issue. ➢ Demonstration projects are being conducted with smart meters and AMI technology to reduce transmission and distribution losses from the current 31%. ➢ Energy efficiency labeling in retail appliance in shops is thought to be of value. ➢ "Amorphous Transformers" are still costly, however a demonstration project to reduce transmission and distribution loss should be considered

d. Preliminary Conclusion

- Many donors are offering support for rural electrification in the forms of renewable energy and energy efficiency. It required coordinating with other donors' actions would help prevent conflict and duplication of efforts.
- Electricity supplies vary greatly between coastal and interior regions. Distribution losses on the coast are improving due to the addition of advanced electric meters. Additionally, amorphous transformers should be considered due to their high efficiency. The Japan invitation program was very useful and a good opportunity to introduce amorphous transformer technology.
- Abundant water resources allows for large-scale hydropower plants to be developed. The hydropower would reduce current high electricity tariffs. There are many small non-electrified villages in the Hinterland due to its distance from the power grid. As such, distributed renewable energy can be done more economically, though some institutional and technical issues remain to be solved.
- Power generation from Waste to Energy (WTE) in the capital is expected. The amount of waste and number of waste gathering systems is yet to be determined. The study of the solid fuel stock and its transportation would be required before looking to introduce WTE to Guyana.
- Small-scale biomass generation from wood or agricultural waste would be efficient in the country's interior regions.

Jamaica

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team performed site surveys at electric power supply facilities, potential renewable energy sites and shared opinions on the potential to received support from JICA.

(Organizations Visited)

- Ministry of Science, Technology, Energy and Mining
- Petroleum Corporation of Jamaica

b. Analysis of Current Situation

The results of the survey are as follows.

- The survey team confirmed that there is strong potential for mid-scale solar power and wind power facilities, in additional to the need for inverter-based air-conditioners with high-efficiency motors.
- Renewable energy is being developed in the private sector because electricity tariffs are high. ODA is can be utilized for technical support for energy efficiency in public buildings and the development of roof-top solar power.
- ODA projects could have a greater impact in Jamaica because electricity demand in Jamaica is larger than that of other CARICOM countries.

1) Renewable energy

	Current situation	Potential/Plan	Evaluation
Solar	✓ Average horizontal irradiance from 5 to 7 kwh/m2/day throughout most of the country ✓ Jamaica completed its largest solar project at 600 kW in 2013. ✓ JPS and UTech set up a solar renewable energy facility of 100kW.	✓ There are some 1MW and larger solar projects. ✓ Not clear due to poor institutional grid connecting rules and the sales price. ✓ For self-consumption, solar power can be applied	○ Mega PV ◎ Medium size (100-500KW)
Wind	✓ Several locations in Jamaica have extremely strong wind energy potential. ✓ 3MW Munro Wind Farm ✓ Wigton Wind Farm	✓ 10 medium-sized wind farms (60 megawatts each) are being planned and studied.	◎

	Current situation	Potential/Plan	Evaluation
Hydro	✓ The new hydro project will expand the existing hydroelectricity to 21MW in Maggotty. ✓ JPS hydropower plants are very old and cannot efficiently produce power.	✓ Developing small hydropower at Jamaica's remaining viable sites, (11 sites) ✓ Still not clear due to poor institutional grid connecting rules and price of electricity.	○
Biomass	✓ Sugarcane bagasse is currently the main source of biomass fuel in Jamaica. ✓ Two waste to energy projects were studied at PCJ. ✓ Includes an open damping garbage station near Kingston.	✓ Excess power cam not be sold to the grid. ✓ The sugarcane harvest season in Jamaica is about 185 days. Other bio resources would be needed during the off-season	△

2) Energy efficiency

	Type	Current situation	Potential/Plan	Evaluation
Institutional System	Energy Audit	UNDP & GOJ conducted energy audit in schools and hospitals. Audits have not continued.	Capable auditors are needed. Energy management systems should be included in a national policy.	○
	Labeling System	Most imported appliances are not energy efficient	High potential for EE. Difficulty in implement with imported appliances. Collaboration with CARICOM countries is indispensable	×
	Education and Awareness	Government and JPC is aggressive to promote EE.	High potential EE awareness in schools and individuals are effective tools	○
Technology	CFL	Cuba distributed low-quality CFL to Jamaica households,	GOJ plans to continue distribution.	×
	LED	Not prevalent	To be adopted instead of CFL	△
	Street Light	Inefficient	To be replaced by high efficiency lighting The property is private	○
	Inverter AC	Not prevalent	High potential of EE Especially in schools and Public offices	◎

	Type	Current situation	Potential/Plan	Evaluation
	Amorphous TR	Not prevalent	Utility company should study the technology	○
	Pump & Motor	Water systems of NWC are inefficient and consume large amounts of electricity.	Replacement with high-efficiency pump and motors is possible.	◎
	Smart Meter	GOJ started rollout	Effective as a means to reduce non-technical losses	△

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40-17:00
Attendants	Ms. EDWARDS, Yvonne Barretts (Ministry of Science, Technology, Energy and Mining) Mr. GALLIMORE, Kevin (Petroleum Corporation Of Jamaica)
Dialogue Result	➢ Energy efficiency projects in public buildings were performed by the Petroleum Corporation of Jamaica, including: energy efficient air-conditioners and lighting. They plan to install renewable energy in fifteen schools. Additionally, energy efficient water pumps are need and could be a useful project with the Irrigation division and Water Supply division. ➢ Electricity supply from combined solar and wind power could be effective in bringing electricity to new regions. ➢ Policies on renewable energy do not include either wheeling or FIT. These incentives should be considered and introduced in order to promote development of renewable energy.

d. Preliminary Conclusion

- Energy efficiency at water supply facilities and educational facilities has been effective and had a positive impact on energy efficiency awareness, as these facilities consume large amount of electricity. The Ministry of Education is keen to promote energy efficiency at educational facilities. The Petroleum Corporation of Jamaica (PCJ) has specified appropriate organizations and is now formulating an EE demonstration for Kingston.
- The study team discussed the needs of educational organizations. These organizations were adamant that high power prices make it difficult to afford its utility bills. We concluded that an illustration of the benefits of energy efficiency through a demonstration project would be appropriate. This could include the installation of energy efficiency equipment and solar generation.
- The existing inefficiencies of the water works and irrigation facilities waste large amounts of power. This is mainly due to a lack of proper maintenance caused by a both a lack of knowledge and funding. Improving energy efficiency at these facilities should be done in conjunction with plans to repair old,

inefficient facilities and infrastructure.

- The government and electric power company already have substantial knowledge of renewable energy and energy efficiency policy. As a next step, the development of specific projects is expected by the ministry. Technical Assistance should focus on more practical human resource development in the electric sector through seminars and training utilizing real demonstration facilities.

St. Christopher and Nevis

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Ministry of Housing, Public Works, Energy & Public Utilities
- St. Kitts Electricity Company Limited (SKELEC)
- Nevis Electricity Company Limited (NEVLEC)

b. Analysis of Current Situation

The results of the survey are as follows.

- "Wind" potential is high with estimates of 11MW. Current capacity is approximately 2.2MW.
- Interest in "Amorphous Transformers" is high. The technology is new to the islands and losses in the St. Christopher and Nevis and transmission and distribution system is 30%.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ 750kW PV plant was installed at the airport in October, 2013. (*1) ✓ Roof-top PV with a total capacity of 250kW is planned.	✓ An additional 750kW of roof-top PV is planned by the end of 2014. ✓ In addition, a 1MW PV system is being considered.	○
Wind	✓ 2.2MW wind power system was installed in 2010 at Nevis(*1).	✓ Potential for wind power is estimated to be 11MW. ✓ The opportunity is limited due to the lack of load in Nevis (*2).	◎
Geothermal	✓ No geothermal has been developed.	✓ It is assumed that geothermal has some potential. ✓ Limited load in Nevis limits geothermal power opportunities (*2,3).	○
Hydro	✓ No hydro power is installed.	✓ Potential for hydro has not been identified.	×

	Current Situation	Potential/Plan	Evaluation
Biomass	✓ No biomass power is installed.	✓ The potential of biomass is under investigation and data is not yet available.	△

Remarks

*1) Problems with grid instability due to renewables has not yet been experienced.

*2) St. Kitts and Nevis are not interconnected. Therefore, renewables are limited by the load present on the grid on each island.

*3) The development of geothermal power would require an undersea cable to connect the two islands.

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	-Plans exist to begin installation of EMS		△
	Building Code (BC)	-Exists	-No plans for EE are in place	○
	Labeling System	-Under consideration by GIZ		△
	Subsidy	-Tax exemptions for RE and EE technology		△
Technology	CFL/HID/LED	-Street lights from the airport were upgraded with support from the Taiwanese Government -A plan to install LEDs in public buildings is based on support from the Taiwanese Government.		△
	Inverter AC	-No dissemination	-Targets may be similar to the above LED plan.	△
	Amorphous TR	-No dissemination	-Ave. load factor is 60% -Total 400 units	◎
	Smart Meter	-The goal is to roll out meters to all customers within 2 years		△

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. MATTHEW Leoan Pentonville (St. Christopher Air and Sea Port Authority)
Dialogue	➢ Residential solar is “behind the meter” and battery-connected.

Result	➢ Geothermal has potential in the Island of Nevis. The development of geothermal has started but was postponed due to issues with the developer. ➢ SKELEC has interest in amorphous transformers, as its transmission and distribution loss reach 30%.

d. Preliminary Conclusion

- "Wind" potential is high, based on the results of the study, but has not gone forward due to a vulnerable power grid. Therefore, power grid enhancement would be an important first step. Technical transfer related to strengthening the power grid is also recommended.
- "Amorphous Transformer" could be a candidate for ODA due high transmission and distribution losses (30%). There is strong interest in St. Christopher and Nevis for this technology; however it is not yet well understood and a good first step would be to provide information.

St. Lucia

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency. Additionally, the survey team conducted interviews with GIZ to gathering information donor activity in the region. GIZ has an office in St. Lucia and is supporting numerous RE and EE projects.

(Organizations Visited)

- Ministry of Sustainable Development, Energy, Science and Technology
- St. Lucia Electricity Services Limited (LUCELEC)
- Deutsche Gesellschaft fur internationale Zusammenarbeit (GIZ)

b. Analysis of Current Situation

The results of the survey are as follows.

- For renewable energy, including “Solar”, “Wind”, “Geothermal” and “OTEC”, all have strong potential. “Solar”, since projects greater than 1MW is moving ahead in the private sector, it is less desirable as a candidate for Japanese support. For “Wind”, plans to develop farms is under consideration by government leadership. It is not clear what will ultimately be decided and so wind would also be difficult to support. “Geothermal” and “OTEC” could be more easily supported. While government development plans are unclear, research and feasibility studies would be useful.
- Energy efficiency is more complicated. Institutional systems and technologies that are supported from Japanese are already being worked on with the support of other donors, such as GIZ, etc.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ The government installed twenty-two (22) roof-top PV generating systems on public buildings to verify its business model for PV. ✓ Additionally, small-scale rooftop PV systems have been installed on private buildings.	✓ Potential of solar power is estimated to be approximately 18-20 MW. ✓ The government has plans to install 3MW of PV and was proposed an NGO (Carbon War Room). ✓ In addition to the above, the government is installing 75kW of roof-top PV systems on public buildings. ✓ The power utility (LUCELEC) has a plan to install 5MW of PV systems	○

	Current Situation	Potential/Plan	Evaluation
		(solar farms) in the south of the island.	
Wind	✓ No wind power plants are installed.	✓ The government has plans to install 12-15MW of wind power plant, though this has not been finalized. ✓ The land with the most promise for wind power is also the most costly.	△
Geothermal	✓ One potential site for a geothermal plant has been surveyed. ✓ The government hasn't evaluated whether this potential site is suitable for construction of a commercial geothermal plant.	✓ Potential of geothermal power is estimated to be approximately 30MW. ✓ The government intends to develop geothermal to supply baseload power.	○
Hydro	✓ No hydropower plants are installed currently.	✓ The government has no plans to develop hydropower due to their aversion to dams ✓ The government will consider micro-hydro power installed in irrigation canals, but specific plans have not been established.	×
Biomass	✓ No biomass power plants are installed.	✓ According to a government study, any potential biomass plant would be too small to be economically viable.	△
OTEC	✓ The government is not considering OTEC technology currently.	✓ Potential for OTEC is considered to be best on the west coast, particularly in Soufriere. ✓ Secondary support of through sales of energy to industries focused on agriculture or marine culture would be required to improve an OTEC plant's economic efficiency.	○

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	- Under consideration with support of GIZ		△
	Building Code (BC)	- Exists	- Review completed by the St. Lucia Government	△
	Labeling System	- Under consideration with GIZ		△
	Subsidy	- Tax exemption for RE and EE technology		△
Technology	CFL/HID/LED	- Government has already installed high efficiency lights in 2 Government buildings internally funded and plans to install them in other Government buildings over time. - 50 LED street lights have already been installed by the government. They plan to exchange other street lights by through ESCOs.		△
	Inverter AC	-No dissemination	-Promoted through a labeling program	△
	Amorphous TR	-No dissemination	-LUCELEC already has conducted a power loss improvement program (Power loss: approx. 8.8%). High efficiency TR already has been installed.	△
	Smart Meter	-LUCELEC has already installed 35,000 units.		×

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. HAYNES Carryl Omar (LUCELEC)
Dialogue Result	➢ 5MW of "Solar" is planned for Vieux Fort (Sothern part of Island) by LUCELEC. ➢ Potential for "Geothermal" was estimated at 30MW from a study 15 – 20 years ago. ➢ High efficiency transformers have already has been introduced. Transmission and distribution losses stand at 8.8%.

d. Preliminary Conclusion

- "Geothermal" and "OTEC" evaluate "good potential", due to the high estimated potential and the government's strong interest to support future development. However, geothermal is not considered a strong candidate for Japanese support at present due to unclear government development and scheduling plans.

St. Vincent and the Grenades

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team visited local power facilities and development sites related to renewable energy and energy efficiency.

(Organizations Visited)

- Ministry of National Security, Prime Minister's Office
- St. Vincent Electricity Services Limited (VINLEC)

b. Analysis of Current Situation

The results of the survey are as follows.

- Approximately 500kW of "Solar" capacity is installed. An opportunity exists in that a total of 800-900kW is planned by the government. In addition, "Geothermal" could also be supported by Japan in that VINLEC is conducting a feasibility study with a private U.S. company. The government will introduce a renewable energy target, (60% of generation supplied by renewables by 2020). This goal would be difficult to achieve without "Geothermal".
- Energy efficiency is more complicated. Institutional systems and technologies that are supported from Japanese are already being worked on with the support of other donors, such as GIZ, etc.

1) Renewable Energy

	Current Situation	Potential/Plan	Evaluation
Solar	✓ The government installed 190kW of roof-top PV generating systems on public buildings and is installing a 300kW ground-mounted system at a VINLEC diesel power station. ✓ Some small-scale roof-top PV systems have been installed by private entities.	✓ The government is planning a 260kW ground-mounted PV installation at a VINLEC power station. This is in addition to the 300kW PV system. ✓ The government plans to expand installed capacity of PV to 800-900kW in combined public and private sector projects. ✓ Based on current load, PV would be limited to 2 - 3MW.	◎
Wind	✓ No wind turbines are installed. ✓ The government's plan to install two wind farms on the south-east coast was cancelled due to the proximity to the international airport.	✓ The south-east coast has strong wind resources. Land in the area is owned by the private sector, making real estate costly. ✓ The government executed a	△

	Current Situation	Potential/Plan	Evaluation
		feasibility study for the central mountain area.	
Geothermal	✓ Potential of geothermal power is considered to exist in the north mountainous area. ✓ Private companies in Canada (EMRE) and Iceland implement feasibility study in this area in cooperation with VINLEC.	✓ The government intends to develop geothermal plants for baseload power and expand its installed capacity. ✓ A PPA is being discussed among participating entities, including the government and VINLEC.	◎
Hydro	✓ Three hydropower plants are installed, but one was damaged by flood in December 2013 and is offline. ✓ There are no plans by the government to develop new hydro plants due to the social and environmental impact.	✓ The government intends to finish rehabilitation of the damaged hydropower plant by the first quarter of 2015. ✓ The government intends to replace old hydropower plants and the study possibility of small hydropower systems installed in irrigation canals.	△
Biomass	✓ No biomass power is installed.	✓ In pre-feasibility studies, the potential of biomass is thought to be small. There are no current plans to develop biomass.	△
OTEC	✓ The government does not have plans to develop OTEC.	✓ It is assumed that there is potential for OTEC on the west coast, especially near Kingstown. The government will perform a feasibility study on OTEC. ✓ Small load limits OTEC. Supplying energy to the agriculture and marine industries would improve economic efficiency.	○

2) Energy Efficiency

	Type	Current Situation	Potential/Plan	Evaluation
Institutional System	Energy Management System	- There are no plans to educate an energy auditor at present		○
	Building Code (BC)	- Exists, but does not includes EE	- Need to Review, but no Plan	○
	Labeling System	- Under consideration with GIZ, but CARICOM countries do not have test facilities.		△
	Subsidy	- Tax exemption for RE and EE technology, including PV panels and LED, but not air conditioners		△
Technology	CFL/HID/LED	- Government has already conducted an EE project with WB. High-efficiency lighting, air conditioning and SHS systems have been installed in the Ministry of National Security Building as a showcase. 70 public buildings (e.g. Ministries, Hospitals, Schools) are expected to join the WB project. - Approx. 90 LED street lights were installed by VINLEC with support from GIZ. VINLEC plans to exchange other street lights to LED.		△
	Inverter AC	-No dissemination	-Promoted through a labeling program	△
	Amorphous TR	-No dissemination	-VINLEC has not installed Amorphous TR. Power losses are approx. 7.0%.	△
	Smart Meter	- Not installed. However, VINLEC has not considered the cost-benefit performance.		△

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40 – 17:00
Attendants	Mr. Thornley O. A. O. Myers (St. Vincent Electricity Services Limited (VINLEC))
Dialogue Result	➢ "Solar" is planned at approximately per install. ➢ For "Geothermal", VINLEC is conducting a feasibility study with a private company. There are other potential site with potential of10MW or more. ➢ "Geothermal" is the key renewable resource and financing from Japan could be interesting. In addition, "geothermal" experience in the government is lacking and a collaborative relationship with Japan could be developed.

d. Preliminary Conclusion

- “Solar” is a good candidate for ODA as the overall target is up to 800-900kW and Japan is well situated to support in this area. Japanese grid stability technology could be applied to support the expansion of “Solar” capacity.
- “Geothermal” is also a good candidate for Japanese ODA because the experience and technology available from Japan could contribute to its development. “Geothermal” is indispensable in meeting renewable energy goals (60% of generated energy from renewables by 2020).

Suriname

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team performed site surveys at electric power supply facilities on the coast and shared opinions on reducing losses in distribution lines as well as methods of supplying power to the country's interior.

(Organizations visited)

- Energie Bedrijven Suriname (NV EBS)
- Ministry of Natural Resources and Energy

b. Analysis of Current Situation

The results of the survey are as follows.

- The government is giving priority to large-scale hydropower development. Renewable energy is considered most effective for rural electrification in the interior.
- Distribution facilities are installed along the coast. Although distribution losses are approximately 10%, countermeasures have not been attempted due to the low cost of electricity.
- Low electricity tariffs decrease incentives for customers to conserve energy. Energy efficiency for road lighting is feasible.
- Many donors' countries, such as the Netherlands, are carrying out projects. Therefore, ODA from Japan should be arranged with care.

1) Renewable energy

	Current situation	Potential/Plan	Evaluation
Solar	✓ Irradiation is in Suriname is high at approximately 5 kWh/m2day ✓ The University of Adek is measuring the solar intensity in the interior areas. ✓ Mostly financed by the Dutch Government.	✓ SHS PV has potential for the rural Electrification. ✓ 1MW and greater PV is planned along the coastline. ✓ Rural electrification has been unsuccessful due to poor maintenance.	△
Wind	✓ Wind speed measurement are installed by CREDEP ✓ Wind measurements have been limited.	✓ The east coast of the Brokopondo Reservoir is the good site to install small type of wind turbines	△

	Current situation	Potential/Plan	Evaluation
Hydro	✓ a mini hydro plant (700-kW) is being constructed ✓ 40-kW hydro plant was built but went offline in 4 years due to inadequate maintenance.	✓ Several mini/micro hydro projects are planned and waiting for development. ✓ Rural electrification using RE has been generally unsuccessful	△
Biomass	✓ Bagasse is utilized in sugarcane factories ✓ Rice husks and waste wood potential is relatively good	✓ There are three potential locations for F/S in Suriname. 1_ Rice husk mill generator of 4MW in Nickerie 2_Sugarcane power plant at several MW in the coastal area 3_Bio waste power plant of 10MW in the coastal area 4_rural electrification in interior regions	△

2) Energy efficiency

	Type	Current situation	Potential/Plan	Evaluation
Institutional System	Law and Regulation Education and Awareness Official agency responsible for EE	No standards, regulations or laws for efficient energy use in exist in Suriname.	For the time being, awareness of the importance for EE is low.	△
Technology	CFL	Not implemented	Easy EE Measure	○
	LED		After CFL introduction	○
	Street Light		To be studied after institutional systems are established	○
	Inverter AC			△
	Amorphous TR			×
	Smart Meter			×

c. Dialogue with Invitation Program Members

Date	November 5th,2014 (Tuesday) 13:40-17:00
Attendants	Mr. TAUS Mohamed Idries (Ministry of Natural Resources and Energy) Mr. WONGSOREDJO Guilliano Soedie (NV EBS)
Dialogue	➢ Suriname has a dry season and a rainy season each lasting six months.

Result	➢ Many telecommunication companies are promoting distributed energy systems combining solar PV and batteries in remote villages. ➢ Low electricity tariffs are caused by government subsidy, making it difficult to promote energy efficiency.

d. Preliminary Conclusion

- Many donors are offering support for rural electrification through renewable energy and energy efficiency. It required coordinating with other donors' activities and information to prevent the conflict of the duplications.
- The development of solar power and wind power is planned for the coast but feasibility studies have not been conducted by both public and private organizations. New policies on renewable energy are expected by the government and the electric power company to develop them and to give them the incentives to expand their investment for renewable energy.

Trinidad and Tobago

a. Survey Methodology

The survey team interviewed the organizations listed below to obtain information on energy conditions, policy on renewable energy and energy efficiency and the possibility of ODA from Japan. The survey team performed site surveys at electric power supply facilities and shared its opinions with the visit organizations on loss reduction in distribution lines, SCADA and methods for supplying power to Tobago Island.

(Organizations Visited)

- Ministry of Energy and Energy Affair
- Trinidad and Tobago Electricity Commission

b. Analysis of Current Situation

The results of the survey are as follows.

- Currently, the government energy policy is being created with the thought to investigate the apparent abundance of renewable energy such as solar, wind and biomass. Such a study has not yet been executed. However, renewable energy would be unlikely to be developed without the addition of a FIT policy. This is due to the low electricity tariff in Trinidad and available land for the development of renewable energy such as solar and wind is limited.
- Energy efficiency is expected to be supported by the government in the future because the electric sector sufficiently experience to manage energy efficiency projects. Regarding industrial energy efficiency, companies have already begun to introduce energy efficiency and the consumer sector will possibly introduce inverter-based air-conditioners, LED lighting and heat insulation for buildings.

3) Renewable energy

	Current situation	Potential/Plan	Evaluation
Solar	✓ Only PV for small scale applications are installed ✓ There exists only backup power for some systems, e.g. security lighting and emergency radio systems.	✓ Large PV farms are planned, but land acquisition is a barrier ✓ Economic incentives are lacking due to low electricity tariffs.	△
Wind	✓ F/S to examine the potential for local wind resources to demonstrate large scale wind power generation.	✓ Wind conditions are insufficient for wind farms ✓ Land acquisition and environmental assessments are not finished	△
Biomass	✓ R&D is conducting waste to energy technologies	✓ It would require a program for waste segregation to be a viable option.	△

4) Energy efficiency

	Type	Current situation	Potential/Plan	Evaluation
Institutional Systems	Building Codes (Green Building)	-Under consideration by MEEA	Establish new energy efficient design standards	△
	Labeling System		-Adoption of Energy Star (USA)	○
	Energy Audit	-Conducted in 8 government building	-Completed in main government building. Further work is not expected	×
Technology	CFL/LED	- Planning	-Phasing out the use and import of incandescent lighting	○
	Inverter AC	-Available in the market	-May expand in market with the introduction of a new labeling system	○
	Amorphous TR	-No dissemination	-Losses are at 8%	×
	Smart Meter	-Started Introduction of Automatic Metering Infrastructure (AMI)		×

c. Dialogue with Invitation Program Members

Date	November 5th, 2014 (Tuesday) 13:40-17:00
Attendants	Mr. MAURICE, Randy (Ministry of Energy and Energy Affairs) Mr. CLARKE, Allen (Trinidad and Tobago Electricity Commission)
Discussion Results	➢ For "Solar", introduction of projects above 1 MW is not planned. ➢ For "Wind", detailed studies have not yet been conducted. ➢ For "Building Code", An NGO is preparing its introduction will look for approval from the government. ➢ For "Labeling System", this exists but is not mandatory. ➢ For "CFL", import taxes were abolished.

d. Preliminary Conclusion

- The government has plans to incentivize renewable energy and energy efficiency. However, low electricity tariffs will mean large incentives would be needed.
- Electric facilities are well maintained – there are no clear outstanding issues to be solved.
- Energy efficiency is well understood by the private sector and though the public sector is considering moving ahead with plans, concrete measures are still undecided. The Ministry of Energy and Energy Affair is expected to lead the local energy sectors in encouraging EE incentives to organizations.

- Although Waste to Energy (WTE) power generation is thought to be effective, it might not be developed on a large scale due to the limited amount of waste which can be gathered. To introduce WTE efficiently, it would be necessary to study the nature of the waste material, collection system and PPA options to sell to the utility.

Chapter 5 Japan Invitation Program

A total of 21 people from 12 CARICOM countries were invited to this Japan invitation program. Through site visits and opinion exchange with the relevant persons in the program, they deepened their understanding of Japanese technology and know-how of renewable energy and energy efficiency which can be utilized and applied in the CARICOM countries.
The evaluation result of the program is attached in Annex 5-1.

Table 11 Results of Japan invitation program

Schedule (Day of Week)	Time	Items	Venues
28th October (Tuesday)		Visit to Japan	
29th October (Wednesday)	9:00～10:00	Orientation	➢ JICA Headquarter ➢ Foreign Ministry ➢ Ministry of Economics and Industry
	10:00～12:00	➢ Courtesy visit to JICA Senior General Officer in charge of Central & South America ➢ Courtesy visit to Foreign Ministry ➢ Courtesy visit to Ministry of Economics and Industry	
	13:30～17:00	Technology Introduction of RE/EE	JICA Tokyo
30th October (Thursday)	9:30～12:00	Visiting EE Products	Panasonic Center Tokyo
31st October (Friday)	Biomass Group (Fukuoka Prefecture)		
	13:30～15:30	Garbage Power Plant	Kougou Saki Factory in Kitakyushu City
	Geothermal Group (Kagoshima Prefecture)		
	9:00～10:30	Lecture on Geothermal Power Generation	Kagoshima chamber of commerce and industry
	13:30～15:00	Visit to Geothermal Power Station	Ogiri Geothermal Power Station
1st November (Saturday)		Travelling	
2nd November (Sunday)	9:00～11:30	Visiting OTEC (Ocean Thermal Energy Conversion) facilities	Ocean Deep Water Research Center in Okinawa Prefecture
3rd November (Monday)		Travelling	
4th November (Tuesday)	9:00～11:30	Visiting Smart Community	Miyako Kurima-Jima
	13:30～15:00	Visiting Mega-Solar	Demonstration Site of Miyako-Jima
5th November (Wednesday)	13:30～17:00	Prior Meeting for Seminar Individual Hearing to 12 countries	JICA Headquarter
6th November (Thursday)	9:30～12:30	Japan – Caribou Exchange Seminar	JICA Headquarter
	15:00～16:30	Introduction of RE/EE examples	JICA Global Square

Schedule (Day of Week)	Time	Items	Venues
7th November (Friday)		Leaving Japan	

Chapter 6 Following the Japan Invitation Program

On November 15, 2014, Foreign Minister Kishida co-chaired the Fourth Japan-CARICOM Ministerial-Level Conference with foreign ministers and other officials from CARICOM member states, which comprise 14 countries in the Caribbean region.

The participating countries held discussions in line with the three pillars of Japan's CARICOM policies announced by Prime Minister Shinzo Abe at the first Japan-CARICOM Summit Meeting in July 2014.

This survey was mentioned in the official statement, and it concluded that this survey has contributed to the mutual relationship of Japan - CARICOM.

<< Extract from the Ministerial Joint Statement between Japan and CARICOM >>

The Fourth Japan-CARICOM Ministerial-Level Conference November 16, 2014
http://www.mofa.go.jp/la_c/crb/page22e_000626.html

Evaluation

CARICOM member states highly appreciated the three pillars of Japan's CARICOM policies ((1) Cooperation towards sustainable development, including overcoming the vulnerabilities particular to small island states; (2) Deeping and expanding fraternal bonds of cooperation and friendship; and (3) Cooperation in addressing challenges of the international community), which were announced by Prime Minister Abe at the First Japan-CARICOM Summit Meeting in July, and it was confirmed that relations will be strengthened going forward, based on these pillars.

Minister Kishida demonstrated that the issues raised at the first Summit Meeting are being followed up steadily. Surveys are currently being carried out in the renewable energy and energy conservation fields, which are essential to overcoming the vulnerabilities particular to small island developing states. This was highly appreciated by the CARICOM side.

（Omission）

First Pillar: "Cooperation towards sustainable development, including overcoming the vulnerabilities particular to Small Island Developing States"

- Minister Kishida stated that as a result of considering the importance of assistance not based solely on GDP per capita, a point in which the CARICOM side expressed strong interest at the past Ministerial-Level Conference in September, Prime Minister Abe announced at the Japan-CARICOM Summit Meeting in July this year that Japan would conduct field surveys on future cooperation. Minister Kishida explained that as a result, surveys have been carried out in the areas of renewable energy and energy conservation since the end of August this year, and that a survey in the field of disaster risk reduction is also scheduled to be carried out soon. Minister Kishida also mentioned that Japan will consider concrete cooperation based on the results of these surveys.

- In response, the CARICOM member states expressed their appreciation for the strengthening of the relationship between Japan and CARICOM, and the broad array of assistance being extended by Japan, along with stating that this Ministerial-Level Conference is an expression of both sides' strong interest in strengthening cooperation. They also expressed gratitude and expectations over Japan's serious consideration of CARICOM's long-standing concerns and the concrete progress that is being made in this regard.

（The rest is omitted.）

Full text is attached in "Annex 6「Ministerial Joint Statement between Japan and CARICOM」"

12 Countries' Report

Antigua and Barbuda

1. General

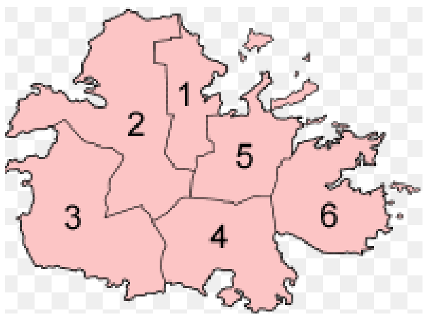
Flag and coat of arms	 		
Official languages	English		
Capital city	Saint John's		
Largest city	Saint John's		
Government	Monarch	Elizabeth II	
	Governor-General	Rodney Williams	
	Prime minister	Gaston Browne	
Area	Total (km2)	443	
	Water (%)	Negligible	
Population	2014 estimate	91,295	
	Density (/ km2)	186	
GDP	PPP 2012 estimate	Total	$1.579 billion
		Per capita	$18,026
	Nominal 2012 estimate	Total	$1.176 billion
		Per capita	$13,428
Independence	From the United Kingdom on 1 November 1981		
Currency	East Caribbean dollar		
Politics	The politics of Antigua and Barbuda takes place in a framework of a unitary parliamentary representative democratic monarchy, wherein the Sovereign of Antigua and Barbuda is the head of state, appointing a Governor-General to act as vice-regal representative in the nation. A Prime Minister is appointed by the Governor-General as the head of government, and of a multi-party system; the Prime Minister advises the Governor-General on the appointment of a Council of Ministers. Executive power is exercised by the government. Legislative power		

<table>
<tr><td></td><td colspan="2">is vested in both the government and the 2 chambers of the Parliament.

○Executive branch
As the head of state, Queen Elizabeth II is represented in Antigua and Barbuda by a governor general who acts on the advice of the prime minister and the cabinet.

○Legislative branch
Antigua and Barbuda elects a legislature at the national level. Parliament has 2 chambers. The House of Representatives has 19 members; 17 members elected for a 5-year term in single-seat constituencies, 1 ex-officio member and 1 Speaker. The Senate has 17 appointed members. The prime minister is the leader of the majority party in the House and conducts affairs of state with the cabinet. The prime minister and the cabinet are responsible to the Parliament. Elections must be held at least every 5 years but may be called by the prime minister at any time.
There are special legislative provisions to account for Barbuda's low population relative to that of Antigua. Barbuda is guaranteed 1 member of the House of Representatives and 2 members of the Senate. In addition, there is a Barbuda Council to govern the internal affairs of the island.

○Political parties
Antigua and Barbuda has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for anybody to achieve electoral success under the banner of any other party. The major parties are the Antigua Labor Party and the United Progressive Party.</td></tr>
<tr><td>Administrative divisions</td><td>Antigua and Barbuda is divided into six parishes and two dependencies:

Parishes
1.Saint George
2.Saint John
3.Saint Mary
4.Saint Paul
5.Saint Peter</td><td>
</td></tr>
</table>

	6.Saint Philip Dependencies 1.Barbuda 2.Redonda	

2. Energy Profile in Antigua and Barbuda

2.1 Energy

Economic growth and final energy consumption	The electricity demand in the country is expected to increase by 3.3% per year during next 20 years. This will lead to the doubling of current demand by 2030. According to the professional perspective of a technician at APUA, the relatively gradual increase in peak demand is due to the economic challenges currently being experienced, resulting in a decline in investment into the country.
Energy supply by source and energy imports	Antigua and Barbuda relies almost exclusively on fossil fuels for electricity generation, transportation and cooking. There are no sources of fossil fuels in Antigua and Barbuda. The country imports a number of refined petroleum products including gasoline, jet kerosene, diesel, heavy fuel oil (HFO) and LPG.
Energy supply and sectoral use	The structure of the Antigua & Barbuda economy is heavily reliant on air travel for tourism purposes. Also, there is a high level of private vehicle penetration. As a result energy intensity is relatively high. In terms of electricity, the main energy consumption sectors are the Commercial, Domestic and Government/Public sector. In 2011, these three sectors accounted for 94% of electricity consumed on the country. The actual portion of electricity consumption sectors in 2010 was the Commercial (45%), Domestic (38%) and Government/Public sector (11%).

Energy balance	There are eight operating thermal power plants which provide an estimated total net electrical installed capacity of about 83 MW. The average base load is about 42 MW whereas the peak load in 2009 was about 50MW. The net electricity generation fed into the grid in 2009 was about 326,383 MWh. Besides fossil fuel generation plants, since the end of 2009, there is a small photovoltaic grid-connected pilot project of 3kW installed in Antigua. This small renewable energy facility in the full year of 2010 supplied to the grid 4.8MWh of electricity.
Domestic energy resources	Antigua & Barbuda relies almost exclusively on imported fossil fuels for electricity generation, transportation and cooking. This imposes a very big financial burden on the economy.

2.2 Electric Power Industry

General feature of power industry	Antigua	Most of electricity generating capacity in Antigua is thermal-based, using diesel fuel. In addition, small scale roof-top type solar power generating systems are installed. Three electric power companies provide electric power service in Antigua. Two of them are private companies which are Black Pine and APC (Antigua Power Company). One of them is owned by Antigua Public Utilities Authority (APUA) owned by the government. APUA has one diesel power station named as Wadadliu. It has 6 diesel generator units with total capacity of 30MW. Three (3) diesel power stations including private companies' power station are connected to Crabbs substation adjacent to APUA's diesel power station by 11kV underground cables. Seven (7) 69kV substations exist in Antigua. These substations are connected by 69kV transmission lines to form closed loop grid. (Refer to Attachment-1) Electricity is supplied from these substations to customers by 11kV and 400V distribution lines. The power grid in Antigua and that in Barbuda aren't connected to each other.

<table>
<tr><td rowspan="2"></td><td></td><td>APUA owns all of transmission lines, substations and distribution facilities, and control and maintain these facilities.
Substation equipment can be controlled by APUA's control center, and APUA has responsibility to control frequency and voltage of the power grid.

Antigua Generator Summary

<table>
<tr><th>Description</th><th>MW</th><th>Number</th><th>Engine Model</th></tr>
<tr><td>11MW_on APC busbar</td><td>11.4</td><td>3</td><td>12VW46</td></tr>
<tr><td>17MW_on APC busbar</td><td>17.1</td><td>1</td><td>18VW46</td></tr>
<tr><td>6MW Blackpine</td><td>6.35</td><td>2</td><td>18WV32</td></tr>
<tr><td>7.5MW Blackpine</td><td>7.84</td><td>2</td><td>18VW32</td></tr>
<tr><td>5MW Wadadli (CHINESE)</td><td>5</td><td>6</td><td>SXD-MAN 12V32/40</td></tr>
<tr><td>6.5MW MIRELESS</td><td>6.35</td><td>2</td><td></td></tr>
</table></td></tr>
<tr><td>Barbuda</td><td>All of electricity generating capacity in Nevis is thermal-based, using diesel fuel.
APUA has one diesel power station which has three diesel generator units.
Other private companies don't provide electric power service in Barbuda.

Barbuda Generator Summary

<table>
<tr><th>Description</th><th>MW</th><th>Number</th><th>Engine Model</th></tr>
<tr><td>Caterpillar</td><td>0.6</td><td>1</td><td>3508 B</td></tr>
<tr><td>Caterpillar</td><td>0.7</td><td>1</td><td>C27 ACERT</td></tr>
<tr><td>Caterpillar</td><td>0.5</td><td>1</td><td>3412</td></tr>
<tr><td>Detroit Diesel</td><td>0.5</td><td>1</td><td></td></tr>
</table></td></tr>
<tr><td>Electricity tariff</td><td colspan="2">For residents the energy tariff of EC$0.38-0.40 is charged for every kWh consumed and for industrial and commercial users that of EC$0.38-0.45 is charged for kWh</td></tr>
</table>

consumed.

Domestic	Minimum Charge	EC$25
	Consumption Charge	
	Up to 300kWh	EC$0.40/kWh
	Over 300kWh	EC$0.38/kWh
Commercial	Minimum Charge	EC$45
	Monthly Demand Charge	EC$8/kVA
	Consumption Charge	
	100kWh of demand	EC$0.45/kWh
	250kWh of demand	EC$0.42/kWh
	All remaining kWh	EC$0.38/kWh

*Except for Fuel Surcharge

*Industrial has same tariff with Commercial but it does not have Monthly Demand Charge.

The government has plan to adopt Net billing and a FIT by 2015.

Electricity demand

Electricity demand and power system loss in Antigua is summarized as follows.

Year	Total Energy Generated (kWh)	Total Energy Distributed (kWh)	Total Units Billed (kWh)	Total System Losses %	Peak Demand (MW)
2011	346,842,452	327,671,252	271,911,430	17	51
2012	350,766,910	329,079,342	269,749,155	18	50
2013	338,091,852	319,913,920	257,318,504	20	50

Electricity demand and power system loss in Barbuda is summarized as follows.

Year	Total Energy Generated (kWh)	Total Energy Distributed (kWh)	Total Units Billed (kWh)	Total System Losses %	Peak Demand (MW)
2013	3,134,940	2,947,290	2,344,037	20	0.49

<table>
<tr><td rowspan="2">Current issues</td><td>[Power system loss]
As mentioned above, the power system loss in Antigua and Barbuda is 17-20%. However, APUA cannot determine the exact proportions of technical losses versus non-technical losses. APUA is planning to implement demonstration test of smart meters in order to reduce the power system loss and to improve customers' services.</td></tr>
<tr><td>Load Factor in Distribution Transformer: Approx. 70%
 </td></tr>
</table>

2.3 Renewable Energy

<table>
<tr><td>Photo Voltaic</td><td>Current situation
Small scale roof-top type PV generating systems have been installed by private sector.
The government has no plan to promote introduction of PV generating systems except for import tax exemption for renewable energy equipment.
Currently, the installed base of PV systems has not caused any grid stability problems.

Potential/Future plan
The government has no specific plan to install large scale ground mounted PV generating systems.
Currently, the government has plan to introduce renewable energy such as PV generating and wind power up to 20% of generated energy. However, the government is studying how much renewable energy can be connected to the existing power grid from the viewpoint of ensuring stability; that is, keeping voltage and frequency of the grid constantly, based on current operation</td></tr>
</table>

	method of the power grid. This study is executed in cooperation with International Renewable Energy Agency (IRENA).
Wind Power	Current situation Currently, no wind power systems are installed in Antigua or Barbuda. Potential/Future plan The government estimates potential of wind power to be approximately 18 to 20MW. Some wind power projects are under consideration. As mentioned above, the government studies with IRENA the allowable capacity of renewable energy such as PV generating and wind power. After allowable capacity of installed renewable energy is decided, specific plan to install wind power will be studied.
Small Hydro Power	Current situation No hydro power is installed. Potential/Future plan Potential of hydro power isn't found.
Geothermal Power	Current situation No geothermal power has been developed. Potential/Future plan Potential of geothermal power isn't found.
Biomass Power	Current situation No biomass power is installed. Potential/Future plan Potential of biomass power is under study by government.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in Antigua and Barbuda Antigua Public Utilities Authority (APUA) Smart meter demonstration project, which will introduce 30 units based on government budget. Governmental activities As for Smart Meter, the demonstration which will introduce only 30 units based on government budget (US$34,000) exists. However, the future plan after the demonstration is under consideration. Tax exemption is conducted for imported equipment of EE Energy Management Expert is being educated based on the support of GIZ (Target: Government Facilities) Building Code is be reviewed by considering of EE based on the support of OAS EE Labeling System is under consideration based on the support of GIZ

2.5 Governmental Policy

Comprehensive Target	By 2030 Antigua & Barbuda will meet the need of the present generation while safeguarding the environment and enabling future generations to meet their own energy needs. All citizens and residents will have access to affordable efficient, socially responsible and reliable forms of energy.
Renewable Energy	Reformed market framework and mandated targets to achieve 15% renewable energy in the electricity supply by 2030.
Energy Efficiency	Targeted efficiency and conservation measures designed to reduce the overall energy intensity of the economy by 10% below a 2010 baseline within 10 years.

2.6 Related Organization

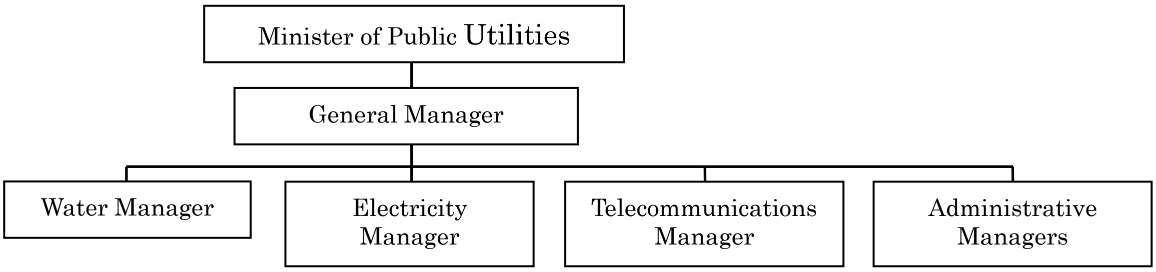
[Antigua Public Utilities Authority (APUA)]

As a statutory body, Antigua Public Utilities Authority (APUA) is given oversight by the Minister Responsible for Public Utilities (Minister of Public Utilities, Civil Aviation & Transportation).

The Authority is run under the direct oversight of the Management Team:

- Electricity Manager
- Human Resource Manager
- Planning Standards & Customer Service (PSCS) Manager
- General Manager
- Telecommunications Manager
- Water Manager
- Financial Controller

The Public Utilities has all shares of APUA which has three businesses, water, electricity and telecom. The total number of staff is approximately 800 and water department has 200, electricity 170 and telecom 150 and the rest of the number belong to administrative department.



2.7 Donor Activities

OAS(Organization of American States)	- Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP) - Review of Building Code
Chinese Government	- Installation of Sir. Vivian Richard Stadium & Street Lump around the stadium by Grant
GIZ	- Establishment of Energy Management System - Establishment of EE Labeling System

Barbados

1. General

<table>
<tr><td>Flag and coat of arms</td><td colspan="3"> </td></tr>
<tr><td>Official languages</td><td colspan="3">English</td></tr>
<tr><td>Capital city</td><td colspan="3">Bridgetown</td></tr>
<tr><td>Largest city</td><td colspan="3">Bridgetown</td></tr>
<tr><td rowspan="3">Government</td><td>Monarch</td><td colspan="2">Elizabeth II</td></tr>
<tr><td>Governor-General</td><td colspan="2">Elliott Belgrave</td></tr>
<tr><td>Prime minister</td><td colspan="2">Freundel Stuart</td></tr>
<tr><td rowspan="2">Area</td><td>Total (km2)</td><td colspan="2">431</td></tr>
<tr><td>Water (%)</td><td colspan="2">Negligible</td></tr>
<tr><td rowspan="2">Population</td><td>2010 census</td><td colspan="2">277,821</td></tr>
<tr><td>Density (/ km2)</td><td colspan="2">660</td></tr>
<tr><td rowspan="4">GDP</td><td rowspan="2">PPP
2013 estimate</td><td>Total</td><td>$7.053 billion</td></tr>
<tr><td>Per capita</td><td>$25,100</td></tr>
<tr><td rowspan="2">Nominal
2012 estimate</td><td>Total</td><td>$4.490 billion</td></tr>
<tr><td>Per capita</td><td>$16,151</td></tr>
<tr><td>Independence</td><td colspan="3">From the United Kingdom on 30 November 1966</td></tr>
<tr><td>Currency</td><td colspan="3">Barbadian dollar</td></tr>
<tr><td>Politics</td><td colspan="3">The politics of Barbados function within a framework of constitutional monarchy and a parliamentary government with strong democratic traditions. Executive power is vested in the Barbadian monarch, and is exercised by his or her vice-regal representative, on the advice of the Prime Minister and Cabinet, who, together, form the government. Legislative power is vested in both the government and the 2 chambers of the Parliament.</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">○Executive branch
The Prime Minister and Cabinet are formed by the political party which gains a simple majority in the general elections held in Barbados. These elections constitutionally must be held no longer than every 5 years apart, however elections can be called whenever the Government so chooses to seek a new mandate or loses a vote of no confidence in Parliament.

○Political parties
Barbados has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for anybody to achieve electoral success under the banner of any other party. The major parties are the Barbados Labor Party and the Democratic Labor Party.</td></tr>
<tr><td>Administrative divisions</td><td>Barbados is divided into 11 parishes:
Christ Church
Saint Andrew
Saint George
Saint James
Saint John
Saint Joseph
Saint Lucy
Saint Michael
Saint Peter
Saint Philip
Saint Thomas</td><td>
</td></tr>
</table>

2. Energy Profile in Barbados

2.1 Energy

Economic situation	The international economic crisis, which is having a severe impact in the Caribbean and in particular on the Barbadian economy, has added urgency to the foregoing commitment announced by the Prime Minister. According to estimates announced by the Central Bank of Barbados (CBB), the GDP contracted by 5.3% in 2009 as global demand slowed down and the tourist industry contracted by 8.7%. These negative shocks have resulted in rising unemployment, which jumped from a rate of 8.6% in June 2008 to over 10.1% at present. Lower economic growth has depressed fiscal revenues, increased pressures on expenditures and increased the Government's fiscal needs. The Government has pursued anti-cyclical measures, both monetary and fiscal, to attempt to ameliorate somewhat the effects of the global economic crisis on the domestic economy. This has pushed up the fiscal deficit to some 8% of GDP for FY 2009/10 and the debt to GDP ratio to some 115%. The Government is well aware of the dangers of this situation and has published a Medium Term Fiscal Strategy with a program to limit fiscal deficits starting in 2011/12 and to bring the debt to GDP ratio down. The Barbadian authorities have a good track record of pursuing these types of commitments when the situation dictates.
Energy supply by source	The country's electricity installed capacity of 239.1-megawatts (MW) is 100% fossil-fuel based: 82% of generation plants use heavy fuel oil, of which 19% goes to steam plants and 63% to low speed diesel plants; and 18% use diesel fuel.
Energy balance	There are three power plants, Spring Garden (150MW), Fairly Valley (73MW), and Garrison Hill (15MW) and those plants meet 83-86% of total generation capacity. Fuels for those plants are diesel, bunker C and gas. The peak demand used to be 167MW; however, it is now around 145-150MW due to energy efficiency measures and installation of more solar panels.

Energy sectoral use and energy imports	Power generation represents the main use of fuels in the country (50%), followed by transportation (33%). Barbados has some oil production, but domestic demand, approximately 10,000-barrels of oil per day (bbl/d) greatly exceeds local supply (approximately 1,000-bbl/d). This results in imports in excess of 9,000-bbl/d, which represents a significant expenditure and drain on Barbados' foreign reserves, particularly considering the usual high degree of volatility in international oil markets.
Domestic energy resources	As shown in figure 1, the RE potential for wind utility scale (10-MW or more), biomass cogeneration (20-MW), Waste to Energy (WE) (13.5-MW), and solar water heaters, is both economically and commercially viable; therefore, these technologies are all recommended and may operate below the avoided cost of fossil fuel. Solar Photovoltaic (PV) panels are also being recommended given the annually decreasing costs of PV. The overall RE potential is estimated in 28.9% of the total installed capacity of electricity (in terms of MW).

2.2 Electric Power Industry

General feature of power industry	Most of electricity generating capacity in Barbados is thermal-based, using diesel fuel, heavy oil and gas. In addition, small scale roof-top type solar power generating systems and small scale wind power generating system are installed at public buildings and households. The wind power generating systems in households are not connected to the grid because their installed capacities are quite small and generated power is consumed only in the households. Barbados Lighting and Power Company (BLPC), a private company, supplies electricity to the whole of Barbados and it is only the electric power utility in Barbados. BLPC has 3 power stations with total installed capacity of 240MW. The installed capacity is categorized as follows.

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>Category</td><td>Installed capacity (MW)</td></tr>
<tr><td>Steam turbine (Bunker C)</td><td>40</td></tr>
<tr><td>Diesel generator</td><td>114</td></tr>
<tr><td>Gas turbine</td><td>86</td></tr>
<tr><td>Total</td><td>240</td></tr>
</table>

These power stations and substations are connected by 69kV or 24kV transmission lines to form the national grid. BLPC owns 3 power stations and all of the substations, transmission lines and distribution facilities.
The transmission lines in the capital area (Bridgetown), near the international airport and some residential area are underground cables from the viewpoint of taking measures against hurricanes and ensuring security.
The power gird is controlled by the grid control center owned by BLPC. The frequency and voltage of the grid is kept constant by adjusting output from the steam turbine units.
BLPC has a plan to install a new power plant in St. Lucy district. This power plant would consist of steam turbines (Bunker C) and gas turbines.
Total loss including generation and transmission is approximate 6-7%.
</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>For residents the energy tariff of BB$0.15-0.224 is charged for every kWh consumed and for industrial users who are categorized as Lgarge Power that of BB$0.117 is charged for every kWh consumed.</td>
</tr>
</table>

Domestic	Customer Charge *Customer's 30-day average kWh consumption over the previous 12 months	0-150kWh	BB$6/month	Base Energy Charge	First 150kWh	BB$0.15/kWh
		151-500kWh	BB$10/month		Next 350kWh	BB$0.176/kWh
		Over 500kWh	BB$14/month		Next 1,000kWh	BB$0.2/kWh
					Over 1,500kWh	BB$0.224/kWh
General	Customer Charge *Customer's 30-day average kWh consumption over the previous 12 months	0-100kWh	BB$8/month	Base Energy Charge	First 100kWh	BB$0.184/kWh
		101-500kWh	BB$11/month		Next 400kWh	BB$0.217/kWh
		Over 500kWh	BB$14/month		Next 1,000kWh	BB$0.259/kWh
					Over 1,500kWh	BB$0.29/kWh
Large Power	Customer Charge	BB$300/month	Demand Charge	BB$22/kVA	Base Energy Charge	BB$0.117/kWh

Electricity demand	Peak power demand was 160MW in 2010, but it is now approximately 145-150MW because of progress in energy efficiency and energy conservation, as well as economic recession. Additionally, introduction of PV generating systems is reducing peak power demand. Similarly, electricity consumption decreased from 960GWh in 2010 to 910GWh in 2013. Household electricity consumption accounts for 30% of total demand, and the commercial and public sectors account for 65%.

Current issues	Regarding National Energy Policy, the draft already has been completed however it is under consideration with several stakeholders.
	Power Loss: Approx. Approx. 6 - 7%
	Load Factor in Distribution Transformer (3000 units): Approx. 74% 

2.3 Renewable Energy

Photo Voltaic	Current situation 5MW roof-top type PV generating systems were installed at private buildings. Large scale ground-mounted type PV generating systems have not been installed because the large amount of land needed for PV generating systems is difficult to acquire. Potential/Future plan The government has a plan to expand the installed capacity of PV generating system up to 10MW. In the plan, PV generating systems would install by private sector. Barbados Lighting and Power Company (BLPC) will invite tenders for PV generating systems up to 8MW from private sector. Solar heating systems are quite popular in Barbados, and 40% households have solar heating systems to reduce consumption of fossil fuel.

Wind Power	Current situation A few small scale wind power systems were installed at private buildings. These wind power systems are not connected to the grid, and their output is consumed onsite. BLPC does not currently have wind power plants. Potential/Future plan BLPC has a plan to expand the installed capacity of wind power plants to 10MW. Little progress has been made because the necessary land is difficult to acquire, and the social and environmental impacts may be significant.
Small Hydro Power	Current situation No hydropower plants are installed. Potential/Future plan Potential for hydropower is not considered to exist.
Geothermal Power	Current situation No geothermal power plants are installed. Potential/Future plan Potential for geothermal power is not considered to exist.
Biomass Power	Current situation The government implements feasibility study for biomass co-generation and waste power generation with support from IDB. Based on the result of the feasible study, foreign private companies (USA, Canada, etc.) are implementing study for making plans for biomass co-generation plants and waste to energy generation plants. In addition to biomass power generation, the government implements feasibility study for bio-fuel to reduce consumption of fossil fuel in the transportation sector. Potential/Future plan The government has a plan to expand the installed capacity of waste to

	energy generation and biomass co-generation up to 15-20MW and 20MW respectively. In pre-feasibility studies, potential of biomass power is estimated to be small. There are no current plans to develop biomass power.
OTEC (Oscan Thermal Energy Conversion)	Current situation The government and BLPC implement feasibility study for OTEC as follows. Division of Energy and Telecommunications has a plan to implement feasibility study with support from IDB. SIDS-DOCK in Japan in cooperation with Ministry of Agriculture implemented pre-feasibility study. BLPC has a plan to implement feasibility study in cooperation with a private company in France (DCNS). Currently, BLPC and this private company are preparing the contract for the feasibility study. Potential/Future plan Potential of OTEC is considered to exist in the east coast area. The government and BLPC consider that OTEC is useful technology to enhance introduction of renewable energy and reduce consumption of fossil fuel. OTEC is considered to be used as a base load power source.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in St.Vincent and the Grenadies

The Barbados Light & Power Company Limited (BLPC)

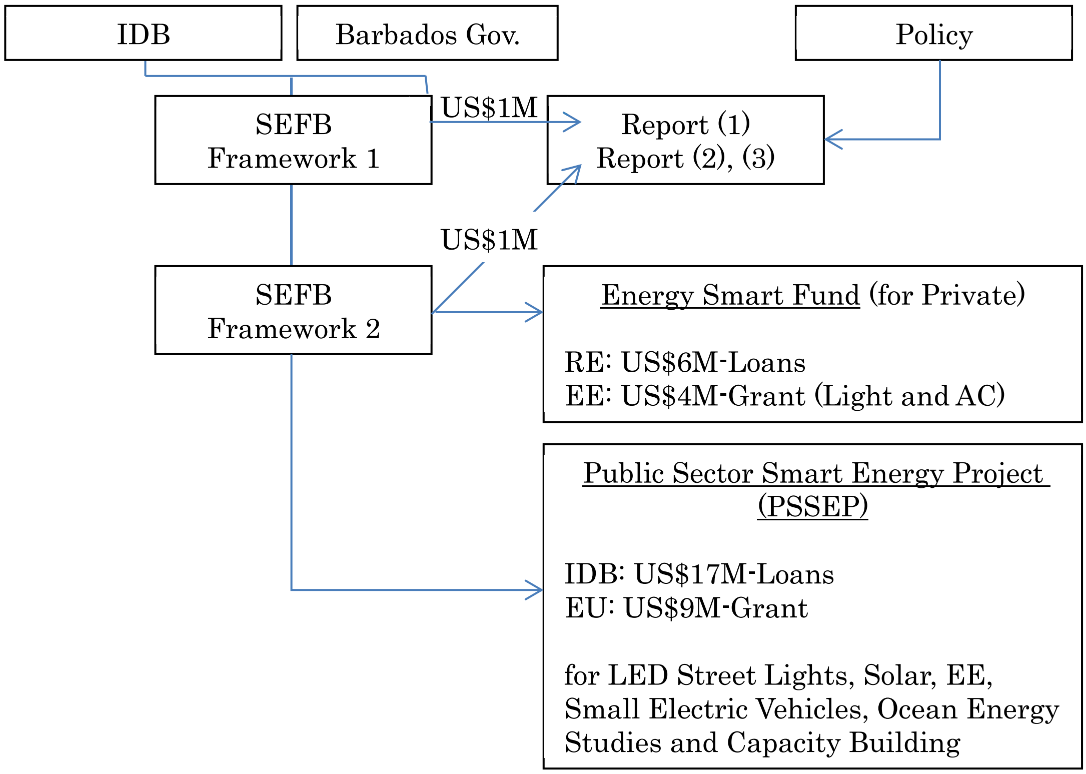
BLPC has committed to a plan to change all meters to AMI (Advanced Metering Infrastructure) in 5-7 years.

Governmental activities

Gov. already has established the labeling system by themselves.

Gov. is reviewing the building code from an EE perspective.

With IDB, Gov. is conducting several activities as the figure below shows.



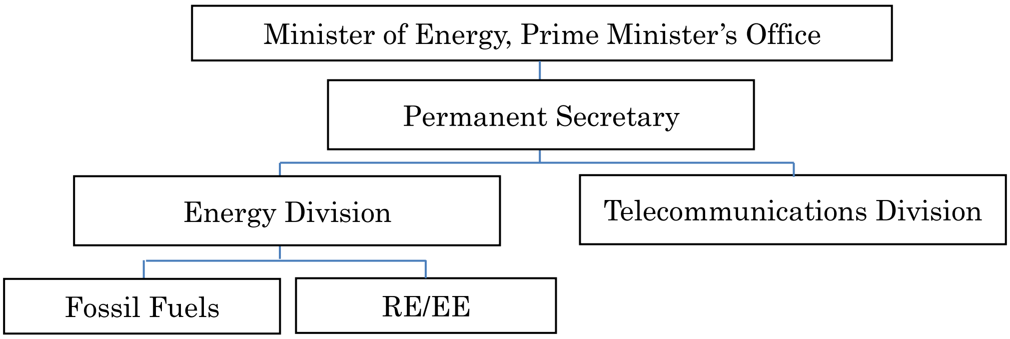
2.5 Governmental Policy

National Energy Policy	Draft already has been completed. It is now under consideration by several stakeholders.
Renewable Energy	Renewable Energy will contribute 30% of total electricity production by 2029.
Energy Efficiency	Reduction in final energy consumption is 20% by 2029.

2.6 Related Organization

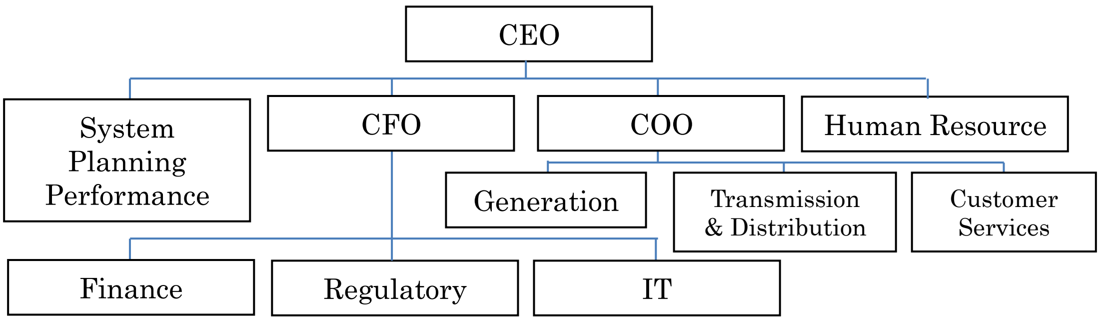
[Division of Energy and Telecommunications, Prime Minister's Office]

Division of Energy and Telecommunications, Prime Minister's Office has Minister whom Prime Minister is concurrently in charge of and Permanent Secretary. Under Permanent Secretary, there are two divisions, Energy, which has Fossil Fuels and RE/EE sections, and Telecommunication.



[The Barbados Light & Power Company Limited (BLPC)]

The Barbados Light & Power Company Limited (BLPC) has CEO at the top of organization and it has two officers, Chief Financial Officer and Chief Operating Officer, and two departments, System Planning Performance and Human Resource. CFO supervises three divisions, Finance, Regulatory and IT, and COO supervises three divisions, Generation, Transmission and Distribution and Customer Services. The number of total employee is approximately 450.



2.7 Donor Activities

IDB	-Framework 1&2 in Sustainable Energy Framework for Barbados (SEFB) -Smart energy fund
IDB and EU	-Public sector smart energy
Japan	-School PV, Grassroots
Korea	-Biofuel vehicle (2 cars) -LED (400 units)
GEF	-RE/EE project 1&2

Belize

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Belmopan		
Largest city	Belize City		
Government	Monarch	Queen Elizabeth II	
	President	Colville Young	
	Prime minister	Dean Barrow	
Area	Total (km2)	22,966	
	Water (%)	0.7	
Population	2014 estimate	340,844	
	Density (/ km2)	14.0	
GDP	PPP 2012 estimate	Total	$2.999 billion
		Per capita	$8,753
	Nominal 2012 estimate	Total	$1.554 billion
		Per capita	$4,535
Independence	From the United Kingdom on 21 September 1981		
Currency	Belize dollar		
Administrative divisions	Belize is divided into 6 districts. 1.Belize 2.Cayo 3.Corozal 4.Orange Walk 5.Stann Creek 6.Toledo		

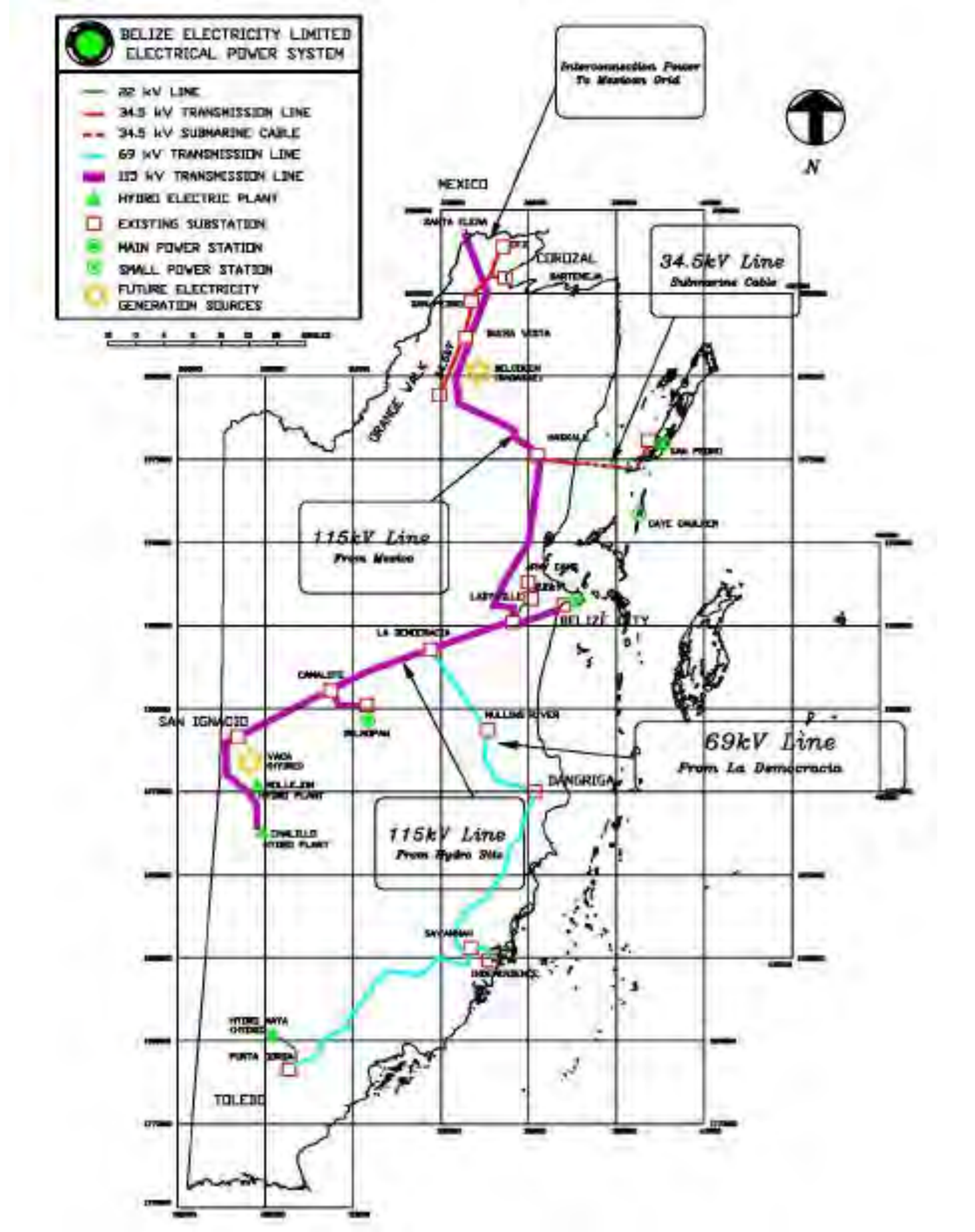
2. Energy Profile in Belize

2.1 Energy

ECONOMIC GROWTH AND FINAL ENERGY CONSUMPTION	GDP growth was 1.9% in 2011, rising to 5.3% in 2012 despite a fall in petroleum and fruit exports, and projected at 2.5% for 2013 Primary energy consumption in 2011 was 13 trillion Btu. Energy intensity is about two-thirds of the regional average.
ENERGY SUPPLY BY SOURCE	Petroleum provides roughly 75% of primary energy. Petroleum consumption in 2013 was about 5,000 barrels per day, while domestic petroleum production was about 3,000 barrels per day. Belize has been producing petroleum from onshore reserves since 2005. The other main sources of primary energy are hydro power and biomass. The country neither produces nor consumes significant amounts of natural gas or coal.
ENERGY SUPPLY AND SECTORAL USE	The transportation sector accounted for 47% of total secondary energy consumption in 2010. The industrial sector consumed 27% (primarily for motors and process heat); the residential sector consumed about 19%; and the commercial sector consumed about 7%.
DOMESTIC ENERGY RESOURCES	Belize has about 10 million barrels of proven petroleum reserves. Hydro power generates about 40% - 45% of electricity, and biomass (primarily bagasse).generates about 15% - 20% of electricity
ENERGY IMPORTS	Belize imports about 2,000 barrels of petroleum per day on a net basis, representing 40% of petroleum consumption. The country imports about 35% - 45% of its annual electricity needs from Mexico primarily to meet seasonal shortfalls in domestic generation.
NATIONAL ENERGY POLICY	Belize established a National Energy Policy Framework in 2011, and revised it in 2012. The Policy Framework sets forth certain concepts, such as sustainability, efficiency, resilience and cost containment, but does not include any measurable goals. The IDB is funding the development of a national RE and EE strategy, which is expected to be finished in late 2014.

2.2 Electric Power Industry

General Feature of Power Industry	Power Utility	Belize Electricity Limited (BEL) is the primary distributor of electricity in Belize. The Government of Belize owned 70.2 per cent. The Company supplies 82,400 customers and is regulated by the Public Utilities Commission (PUC).
	Power Demand Power Supply	Total installed generation capacity is about 100MW includes IPPs The country's peak demand of about 84.3 MW. Breakdown of Electricity Generation by Fuel Hydro: 45.9% Import 27.6% Biomass: 14.1% Diesel: 7.7%
	Power Generation	Belize Electric Company Ltd. (BECOL) Chalillo, Mollejon and Vaca Hydro in Western Belize (38%) Hydro Maya Limited located in Southern Belize (2%) Mexican Utility CFE (46%) Belcogen Energy Limited (4%) BEL's gas turbine unit and diesel fired generators (10%)
	Network Development	customers 603,350 Backbone of the Transmission System: 115 kV. High voltage lines, 69 kV -Medium voltage distribution networks, 34.5 kV which takes the power from substations to the customers, submarine cable at 34.5kV
	Distribution Loss	BEL grid has moderate transmission and distribution losses, at 12%. SAIDI in 2013 is 21 hours / year

	
Current Problems	Inadequate public financing to meet increasingly growing demand. Seasonal differences of the power production from Hydro and biomass. Limited access to electricity services in rural areas. High electricity tariffs. High dependency on Mexican power import Inadequate data on the potential of indigenous renewable energy sources.

2.3 Renewable Energy

Wind	According to the data from NREL, US_DOE, the wind energy potential of Belize in offshore areas is moderate-to-excellent wind resource(average 5-6m/Sec) Most of this windy terrain located in the Maya Mountain Range and the northern cays. But these areas are not much demand and economically not feasible to expand the transmission line.
PV	Belize's solar energy resource is good, about 65% of Belize's land area receives 5.0 to 5.5 KWh/m2/day. PV is very useful technology in the island far from the main grid, but the barrier is the insufficient land area in the island. The generating cost per kWh need to compare with the cost to import from CFE, Mexico.
Biomass	Sugarcane bagasse is currently the main source of biomass fuel in Belize, with sugarcane processors using the cane residue to generate power and connected to the main grid. --- Bagasse Approximately 403,675 tons of bagasse was produced by the BSI Factory from 1.167 million tons of sugar cane. The electricity generated from the steam turbines was supplemented by an additional 5,748 MWhs of electricity from diesel generators to supply the internal electricity needs of BSI and BELCOGEN (55,077 MWhs), and the remaining 48,632 MWhs was sold into the grid. According to BSI, the output to the grid could have been doubled, if all of the bagasse produced was burnt to produce high-pressure steam turbine. The main barior is the bagasse is available only 180days in the year. ----Non-Bagasse Sources: Rough estimates of Belize's biomass potential from other sources were studied in 2009. The quantity of dry biomass obtainable from agricultural and forestry residues and Municipal Solid Waste (MSW). The study estimated that a total of 3 million tons of biomass was available as possible feedstock for energy production: 2.42 million tons from agricultural residues (orange, banana etc.)

	0.22 million tons from forestry residues (saw dust) 0.35 million tons from MSW. Waste wood volumes from logging to wood product in Belize is estimated Logging residues: 125000m3 Sawmill residues: 31,000m3
Geo thermal	No potential
Small/mini Hydro	Just over 50 MW of hydropower has been developed In the Cayo District on the Macal River cascading, 7 MW Chalillo Hydro Plant 25.2 MW Mollejon Hydro Plant 18 MW Vaca Plant 3.2 MW run-of-the-river Hydro Maya, on the Rio Grande Additional potential was located as follows, Rubber Camp (15 MW), Swasey Branch (3 MW), South Stann Creek (2 MW), Bladen Branch (2 MW), and Rio On (0.6 MW). However, these are no longer possible because its potential output is not feasible according to the survey.

2.4 Energy Efficiency

Basic systems to promote energy efficiency in Belize	Belize does not have a formal energy strategy to reduce the sector's extreme vulnerability therefore there is a need for a comprehensive National Energy Policy. The lack of reliable energy data prevents the implementation of energy audits as a tool to improve energy efficiency in buildings. There is no government agency charged with analyzing energy statistics and issuing recommendations, guidelines or policies on improving energy efficiency and curbing demand. Above systems could be established in due course judging from the GOB recent acknowledgement of the importance of EE.
Current Situation	Ministry of Energy, Science & Tech. and Public Utilities conducted the study of Energy Efficiency Measures. This ministry is expected to become core government organization to promote EE. Ministry proposed comprehensive measures in all sectors.

Followings are current situation and expected measures by sector and system		
Residential Sector	Current Situation	Low efficiency of technologies in use, including wood fuel stoves, lights and other appliances. General lack of awareness and other different socio-economic factors
	Measures to be taken	Introducing fuel/technology substitution Electricity for kerosene and wood fuel LPG for wood fuel Solar water heaters for electric water heaters and wood fuel Fluorescent lamps for incandescent lamps Awareness promotion in community, school and mass-media through education, information provision including effectiveness
Building Sector (Public and Commercial)	Current Situation	No EE activities in building sector
	Measures to be taken	Introducing a building code mandating EE Retrofitting the existing buildings with more efficient cooling
Energy-efficient appliances	Current Situation	There are no Labeling system to judge products efficiency by customers
	Measures to be taken	Establishment of product efficiency standards Establishment of product inspection facilities Collaboration of retail stores and importers To be promoted with the collaboration of CARICOM countries
Energy audit and management system	Current Situation	No activities
	Measures to be taken	Education and training of capable auditor candidate are required. Energy management system as national policy should be established
Street lighting Public Sector	Current Situation	No plan to replace current inefficient lamps by high efficiency models
	Measures to be taken	To be studied including the combination with PV technology

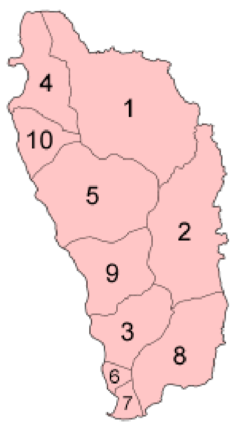
2.5 Donor Activities

CCCCC, Government of Japan	US$1.2M to develop energy efficiency policy options and initiatives in the building sector (2013)
Government of Germany	US$26,000 to identify renewable energy pilot project opportunities in rural communities (2013)
IDB	US$450,000 grant to conduct an energy efficiency baseline study and opportunity assessment (2012)
	Development of a national sustainable energy strategy (2013)
World Bank	US$12.8MM from the Special Climate Change Fund for energy resilience measures (grant pending; not yet finalized). The project will include planning and policy for implementation of energy resilient action, including (a) incentives for greater penetration and integration of alternate sources of energy, (b) introduction of standards and codes, (c) adapted planning and design, and (d) a bio-energy policy

Dominica

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Roseau		
Largest city	Roseau		
Government	President	Charles Savarin	
	Prime Minister	Roosevelt Skerrit	
Area	Total (km2)	754	
	Water (%)	Negligible	
Population	2009 estimate	72,660	
	Density (/ km2)	105	
GDP	PPP 2012 estimate	Total	$1.002 billion
		Per capita	$14,166
	Nominal 2012 estimate	Total	$497 million
		Per capita	$7,022
Independence	From the United Kingdom on 3 November 1978		
Currency	East Caribbean dollar		
Politics	The politics of Dominica takes place in a framework of a parliamentary representative democratic republic, whereby the Prime Minister of Dominica is the head of government, and of a multi-party system. Executive power is exercised by the government. Legislative power is vested in both the government and the House of Assembly. ○Executive branch A president and prime minister make up the executive branch. Nominated by the prime minister in consultation with the leader of the opposition party, the president is elected for a 5-year term by the parliament. The president appoints prime minister as the person who commands the majority of elected		

	representatives in the parliament and also appoints, on the prime minister's recommendation, members of the parliament as cabinet ministers. The prime minister and cabinet are responsible to the parliament and can be removed on a no-confidence vote. ○Legislative branch The House of Assembly has 32 members. 21 members are elected for a 5-year term in single-seat constituencies. 9 members are senators appointed by the President; 5 on the advice of the Prime Minister and 4 on the advice of the leader of the opposition. A Speaker is elected by the elected members after an election. There is also 1 ex-officio member, the clerk of the house. The head of state - the president -is elected by the House of Assembly. The regional representatives decide whether senators are to be elected or appointed. If appointed, 5 are chosen by the president with the advice of the prime minister and 4 with the advice of the opposition leader. If elected, it is by vote of the regional representatives. Elections for representatives and senators must be held at least every 5 years, although the prime minister can call elections any time. ○Political parties Dominica has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for anybody to achieve electoral success under the banner of any other party. The major parties are the Dominica Labor Party and the United Workers' Party.
administrative divisions	Dominica is divided into ten parishes. 1.Saint Andrew 2.Saint David 3.Saint George 4.Saint John 5.Saint Joseph 6.Saint Luke 7.Saint Mark 8.Saint Patrick 9.Saint Paul 10.Saint Peter 

2. Energy Profile in Dominica

2.1 Energy

Energy supply by source	Dominica's energy situation exhibits a high and growing dependence on oil. Excluding wood-fuel and other biomass sources, Dominica's total (primary and secondary energy supply in 2008 was approximately 47,000 Tons of Oil Equivalent (TOE). Of this, renewable energy (hydro) accounts for 3.7 percent, down from a high of 8.5 percent in 2002. Fossil fuel consumption is 900 bbl per day of crude oil equivalent.
Sectoral use and final energy consumption	Dominica's energy consumption is dominated by transportation, which accounted for 47 percent of all energy consumed in 2008, followed by the power sector, with approximately 40 percent of the total consumption. At the end-use level, approximately 12.5 percent of Dominica's total commercial energy supply is estimated to be consumed by households for cooking and electricity, about 7 percent is consumed by business, industry and the public sector (in the form of electricity) and approximately 25 percent is lost, mostly as a result of the rejection of heat in the diesel engines during electricity generation. This heat rejection is an inherent and unavoidable consequence of the thermodynamics of the diesel cycle. Electricity consumption in Dominica is dominated by the household sector, which accounted for 45.5 percent of all electricity sold in 2010, down from a high of 52.5 percent in 2003. The relative consumption of the commercial sector has been growing in recent years and commercial sales (which include government accounts) accounted for 41 percent of total sales in 2010. The balance is made up of industrial 8.6 percent, hotels 3.2 percent, and street lighting 1.8 percent. Electricity production was 99,181 MWh and consumption was 86,775 MWh in 2010. A total of 33,986 customer accounts were being supplied by the national grid at the end of 2010, inclusive of commercial, industrial and street lighting consumers. Of this amount, about 29,000 were domestic customers.

Energy balance	DOMLEC operates three hydro-electric power stations (Laudat, Trafalgar and Padu) and two diesel power stations at Fond Colé and Sugar Loaf. Installed hydro capacity in 2010 was 6.64 MW, which is about 25 percent of the total installed capacity. This is down from 31 percent in 2007, the reduction initially being due to serious damage caused to the Padu hydro plant by landslides that occurred during the passage of Hurricane Dean in August 2007. Although the plant has since been repaired, an additional 4.3 MW of diesel capacity was added in 2009, meaning that the overall percentage of hydro capacity decreased. Hydro capacity in the dry season is reduced to 3.2 MW and is then about 12 percent of the total system capacity. The peak demand is 16.5MW.
Domestic energy resources and energy imports	Dominica's energy situation exhibits a high and growing dependence on oil. Excluding wood-fuel and other biomass sources, Dominica's total (primary and secondary) energy supply in 2008 was approximately 47,000 Tons of Oil Equivalent (TOE). Of this, renewable energy (hydro) accounts for 3.7 percent, down from a high of 8.5 percent in 2002. Fossil fuel consumption is 900 bbl per day of crude oil equivalent. The island consumes 900 barrels (bbl) of crude oil equivalent each day, all of which are imported. Dominica currently has seven importers of petroleum products who are the industry whole salers and retailers, responsible for the importation and supply of the full range of oil and gas used on the island including aviation fuel, LPG and Bunker C. Dominica has significant renewable energy resources, some of which are already in use. The island appears to have the potential for the replacement of a large proportion of the country's fossil fuel imports by renewables.

2.2 Electric Power Industry

General feature of power industry

Most of electricity generating capacity in Antigua is thermal-based, using diesel fuel. In addition, small scale roof-top solar power generating systems are installed.

The generation cost is calculated to be 0.56 EC$/kWh based on amount of diesel fuel consumption, cost of diesel fuel, generated energy and maintenance cost.

Dominica Electricity Services Limited (DOMLEC) supplies electricity to the whole of Dominica, and it is only the electric power company in Dominica. DOMLEC is a private company, 21% of which shares are owned by the governor through Dominica Social Security.

DOMELC has 2 diesel power stations and 3 hydropower stations of which total capacity is 27MW, and all transmission lines of which voltage is 11kV and all distribution facilities are owned by DOMELC.

The power grid is controlled by the Central Dispatch Center owned by DOMLEC. The Central Dispatch Center sends its instruction such as output or voltage to the diesel power stations by phone calls, and the hydropower stations are remotely supervised and controlled.

Although 10 small scale PV generating systems (roof-top type) are connected to the power grid, problems of stability of the power grid have not happened because the total capacity of the PV generating systems are small compared by the capacity of the power grid.

Main features of the power stations owned by DOMLEC are shown in the following table.

Power station	Unit No.	Capacity	Type	Prime mover/ Turbine	Generator	Voltage
Fond Cole	FC1	750	DIESEL - MS	SWD/DIESEL – 6FHD 240	INTL ELECTRIC	3,300
	FC4	750	DIESEL - MS	SWD/DIESEL – 6FHD 240	INTL ELECTRIC	3,300
	FC5	2,840	DIESEL - MS	CATERPILLAR - 3612	KATO	3,300
	FC6	1,750	DIESEL - MS	CATERPILLAR - 3608	KATO	3,300
	FC7	1,400	DIESEL -	CATERPILL	KATO	400

			HS	AR – 3516B		
	FC8	1,400	DIESEL - HS	CATERPILLAR – 3516B	KATO	400
	FC10	1,450	DIESEL - MS	MAN HOLEB – 7L28/32H	AVK	11,000
	FC11	1,450	DIESEL - MS	MAN HOLEB – 7L28/32H	AVK	11,000
	FC12	1,450	DIESEL - MS	MAN HOLEB – 7L28/32H	AVK	11,000
Total		13,270				
Sugar Loaf	SL3	1,350	DIESEL - HS	CATERPILLAR - 3516	CATERPILLAR	400
	SL4	1,400	DIESEL - HS	CATERPILLAR – 3516B	KATO	400
	SL5	1,400	DIESEL - HS	CATERPILLAR - 3515	CATERPILLAR	400
	SL6	1,280	DIESEL - HS	CATERPILLAR – 3516B	CATERPILLAR	400
	SL7	1,400	DIESEL - HS	CATERPILLAR – 3516B	CATERPILLAR	400
Total		6,830				
Laudat		1,240	Hydro	NOELL – PELTON	GARBE	2,200
New Trafalgar	NT 1	1,760	Hydro	NOELL - PELTON	GARBE	2,200
	NT 2	1,760	Hydro	NOELL - PELTON	GARBE	2,200
Padu	PD 1	940	Hydro	GILKES – TURGO IMP	MARELLI	2,300
	PD 2	940	Hydro	GILKES – TURGO IMP	MARELLI	2,300
Total		6,640				
Ground Total		26,740				

Sugar Loaf power station is located at the north of Dominica. Therefore, this power station needs to operate in order to maintain grid stability.

	The total loss including power generation loss, power transmission loss and power distribution loss has been reduced from 17% to 8~10%. This loss reduction is achieved by improving conductors of the transmission lines, replacing low efficiency transformers with high efficiency transformers, improving power factor in the transmission lines by installing power factor improving condensers, reducing station service power, etc.
Electricity tariff	The retail price of electricity in Dominica averaged EC$1.03 per kWh (US 38 cents) during 2010, amongst the highest in the Caribbean. This includes a value added tax of 15 percent. The retail price of electricity provided by DOMLEC to its customers is comprised of an Energy Charge per kWh of electricity consumed, a Fuel Surcharge per kWh of electricity consumed and a Service Charge (for commercial, industrial and hotel customers only) per kVA of customer installed capacity. The residential energy tariff contains two rates, the higher rate being charged for monthly consumption from 51 kWh and over, while the industrial tariff has two rates, charged according to the time of day that the electricity is consumed, with the higher charge applied to the daytime (peak) hours. The first 50 kWh is free of VAT. The average consumption of residential consumers in 1999 was greater than 100 units per month and the lower rate has been implemented to provide a subsidy to the lowest-income (and therefore the lowest-consuming) residential customers. The industrial tariff differentiates simply between a day rate (from 6 am to 10 pm) and a lower, night rate (10 pm to 6 am).The service charge is a demand charge, the purpose of which is to recover DOMLEC's cost of having capacity available, whether used or not, to service the instantaneous demand of its non-residential customers.

2.3 Renewable Energy

Photo Voltaic	Current situation Small scale roof-top type PV generating systems were installed by private sector. Grid stability problems due to installation of the PV generating systems have not occurred. Potential/Future plan The government intends to introduce roof-top type PV generating systems in private buildings as well as public buildings. However, specific plans haven't been decided. Regarding large scale PV generating systems, the government doesn't have intention to introduce them because the government deems that large scale PV generating systems aren't effective in reducing generation costs. DOMLEC wants to reduce the operating time of diesel generators. Since there are uncertainties about startup of the geothermal power plant, DOMLEC is considering the possibility of installing a 1 – 2MW solar generating system at Fond Cole power station. .
Wind Power	Current situation 225kW wind power plant is installed by a private company. Potential/Future plan Potential of wind power is estimated to exist in the east coast area of Dominica. The government has no plans to install wind power plants currently.
Small Hydro Power	Current situation 3 hydropower plants have been operated since 1957, and account for 27% of generated energy. These hydropower plants are owned by DOMLEC. Although the installed capacity of the hydropower stations is 6,640kW, the available capacity of them is 6,020kW, because size of a conduit of Pedu hydropower station is inadequate for the rated output of this hydropower station. Potential/Future plan Potential of hydropower is estimated to exist.

	The government has no plans to install hydropower plants currently. The government is studying the use of small hydropower systems in water supply pipes in cooperation with GIZ.
Geothermal Power	Current situation One potential site for a geothermal plant has been surveyed in detail. The design of a geothermal plant is going to be executed after the exact locations of production wells and rejection wells are determined. Three (3) French companies of GDF Suez, NGE Group and CDC Infrastructure will form a consortium for the development of this project. Potential/Future plan Potential of geothermal power is estimated to be more than 100MW. As a first step, the government plans to install a 7.5MW geothermal plant for bgoaseload power by 2016. However, accurate capacity of the geothermal plant has not yet been determined. Eventually, geothermal capacity is planned to reach 100MW. Surplus electric energy will be exported to Martinique and Guadeloupe by submerged cables.
Biomass Power	Current situation No biomass power is installed. Potential/Future plan Potential of biomass power was studied. However, potential capacity is estimated to be small and uneconomical. Accordingly, a plan to introduce a biomass power plant has not proceeded.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in Dominica

Dominica Electricity Services Limited (DOMLEC)

Smart meter is planned to be installed at 500 households by the governmental budget in Oct. 2014. After this,

Governmental activities

PV Street lights (approx.16 units) already have been installed by government budget.

2.5 Governmental Policy

Renewable Energy	It is the Government's policy to foster a safe, efficient, affordable, and low-carbon national electricity supply that meet international quality standards by promoting the efficient use of imported fossils and of Dominica's domestic renewable energy resources.
Energy Efficiency	It is the Government's policy to reduce the country's energy intensity while increasing its economic growth by adopting best practices in energy efficiency and conservation

2.6 Related Organization

[Ministry of Public Works, Energy and Ports] Ministry of Public Works, Energy and Ports has the minister and permanent secretary, which has some divisions and units. As divisions there are Technical Services, Electrical Services and Postal Services and as units there are Administration, Mritime, Energy and Weather. Each divisions and units have project teams such as Geothermal.
[Dominica Electricity Services Limited (DOMLEC)] DOMLEC has eight departments under the General Manager, which are Generation, ET&D, HR&A, IT, Commercial, Finice, Legal & Corporate Secretariat and PR & Corporate Communication. Only 20% of its shares are owned by the government through the social security

2.7 Donor Activities

OAS	- Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP)
AFD （French Agency for Development）, UN, WB, CDB （Caribbean Development Bank）、CIF (Caribbean Investment Found)	- Development of Geothermal
GIZ	- Study on Hydro Power Generation - EE Labeling System - Establishment of Energy Management System
Chinese Gov.	- Establishment of Cricket Stadium - Installation of PV Street Light (2,500units) (Grant)

Granada

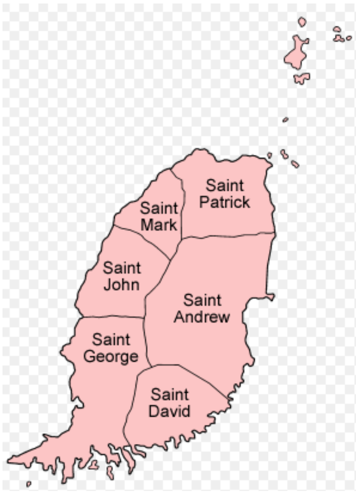
1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	St. George's		
Largest city	St. George's		
Government	Monarch	Elizabeth II	
	Governor-General	Cécile La Grenade	
	Prime minister	Keith Mitchell	
Area	Total (km2)	348.5	
	Water (%)	1.6	
Population	2012 estimate	109,590	
	Density (/ km2)	318.58	
GDP	PPP 2012 estimate	Total	$1.467 billion
		Per capita	$13,900
	Nominal 2012 estimate	Total	$790 million
		Per capita	7,300
Independence	From the United Kingdom on February 7, 1974		
Currency	East Caribbean dollar		
Politics	The politics of Grenada takes place in a framework of a parliamentary representative democracy, whereby the Prime Minister is the head of government. Grenada is an independent Commonwealth realm. It has a prime minister and a cabinet, and a bicameral Parliament with an elected House of Representatives and an appointed Senate. Executive power is exercised by the government. Legislative power is vested in both the government and parliament. ○Executive branch		

<table>
<tr><td></td><td colspan="2">As the head of state, Queen Elizabeth II is represented in Grenada by a governor general who acts on the advice of the prime minister and the cabinet. The leader of the majority party serves as Prime Minister and the head of government. The cabinet consists of members, including the Prime Minister and ministers of executive departments.

○Legislative branch
The Parliament has 2 chambers. The House of Representatives has 15 members, elected for a 5-year term in single-seat constituencies. The Senate has 13 appointed members, 10 appointed by the government and 3 by the leader of the opposition.

○Political parties
Grenada has a 2-party system, which means that there are 2 dominant political parties. For other parties it is extreme difficult to achieve substantial electoral success. The major parties are the National Democratic Congress and the New National Party.</td></tr>
<tr><td>Administrative divisions</td><td>Grenada is divided into six parishes:
Saint Andrew
Saint David
Saint George
Saint John
Saint Mark
Saint Patrick

Carriacou and Petite Martinique, two of the Grenadines, have the status of dependency.
Carriacou and Petite Martinique</td><td></td></tr>
</table>

2. Energy Profile in Grenada

2.1 Energy

Economic growth	Grenada is affectionately known as "The Spice Isle" of the Caribbean and prior to Hurricane Ivan in 2004, was the largest producer of nutmeg in the Caribbean and the second largest globally. The island also produces other spices such as cinnamon, clove, and agricultural products such as cocoa and bananas. Since Ivan, the national economy has been largely based on services and tourism. The total GDP by economic activity was estimated to be approximately 1,386 million EC dollars (approximately US $519 M) in 2009 and is projected to be just over 1,400 million EC dollars (US $524 M) by the end of 2010.
Energy sectoral use and final energy consumption	Grenada's primary energy consumption is dominated by transportation, which took almost half of all energy consumed in 2008, followed by the power sector, with approximately 40% of the total consumption. At the end-use level, approximately 12% of Grenada's total commercial energy supply is estimated to be consumed by households for cooking and electricity, about 7% is consumed by business, industry and the public sector (in the form of electricity) and approximately 25% is lost, mostly as heat during electricity generation. Electricity consumption in Grenada is dominated by the commercial sector, which accounted for 57% of all electricity sold in 2008, followed by the domestic sector, which consumed 38%. The balance is made up of industrial usage 3% and street lighting 2%.
Energy balance	In Grenada the private-public owned Grenada Electricity Services Ltd (GRENLEC) is the sole provider of electricity and operates diesel power stations at Queens Park (installed capacity 45.9 MW) and on the islands of Carriacou (3.2 MW) and Petit Martinique (0.5 MW). The company also maintains 2.8 MW of standby generation capacity at the St George's University campus at True Blue. Peak demand for electricity on GRENLEC's system in 2010 was 30.8 MW, all of which was serviced by a total of 52 MW of diesel power. Electricity sales in 2010 were 185.79 GWh to 41,222 customers, and demand is expected to increase at 4% per annum in the business as usual (BAU) scenario.

Energy imports and domestic energy resources	Grenada's current energy situation exhibits an almost complete dependence on imported petroleum products and an ad hoc approach to energy efficiency. Excluding wood-fuel and other biomass sources, Grenada's total (primary and secondary) energy supply grew from 89,500 TOE in 2006 to approximately 116,000 TOE in 2008. The contribution of renewable energy to this total was negligible. In June 2006 Grenada became a signatory to the Petro Caribe Agreement with Venezuela and is one of thirteen Caribbean signatory countries. Under this agreement petroleum products are accessible to signatories on a concessionary loan-financed basis. This long term supply agreement with Venezuela's state company, Petróleos de Venezuela (PDVSA) meant that Grenada would receive 340,000 barrels of gasoline, fuel oil and diesel annually. With regard to renewable resources, preliminary geochemical data has indicated that Grenada may possess geothermal resources of medium enthalpy in the Mount St. Catherine area and the government has signaled its desire to aggressively pursue this resource.

2.2 Electric Power Industry

General feature of power industry	Most of the generation in Grenada is diesel-fired. In addition, there are small scale roof-top type solar PV system and small scale wind power systems which are connected to the grid installed. Grenada Electricity Services Limited (GRENLEC) supplies electricity to the whole of Grenada, Carriacau and Petite Martinique, and it is only the electric power utility in Grenada. GRENLEC has one diesel power station (Queens Park Power Station) with total installed capacity of 48.6MW. In addition to this, two (2) diesel generators are installed at the university for emergency backup. GRENLEC also has two (2) 33kV substations, 33kV transmission lines and distribution facilities. The diesel power plant and two (2) substations are connected by 33kV transmission lines to form the grid. GRENLEC has responsibility to insure the stability of the grid. The grid is controlled by the control center located in Queens Park Power Station. The control center can

<table>
<tr>
<td></td>
<td>observe status of the grid and control switchgears through SCADA and send instructions regarding output and voltage of the diesel generators to the control room of the power plant.
GRENLEC can observe output of PV generating systems through the Internet.
Currently, output of PV generating systems and wind power systems have no impact on the grid because the output is so small compared with the capacity of the grid.
Power loss including generation loss and transmission loss is approximately 7.5% - 8%. Approximately half of the power loss is considered to be technical loss and accordingly the remaining part is considered to be non-technical loss.</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>In 2008, the price of electricity soared to over 0.81 EC$ (US$0.30/kWh), which is among the highest in the world, placing severe hardship on householders and making businesses and industry uncompetitive.

The retail price of electricity in Grenada has increased significantly since 2004 and averaged EC$1.06 (39 US cents) per kWh in 2008. After 2005, the fuel surcharge has accounted for more than half of the total retail price.

<table>
<tr><td rowspan="2">Domestic</td><td>Minimum Charge</td><td>EC$4/month</td></tr>
<tr><td>Non-fuel Charge</td><td>EC$0.4259/kWh</td></tr>
<tr><td rowspan="2">Commercial</td><td>Floor Area Charge (per 50 sq. feet of floor area)</td><td>EC$0.2/month</td></tr>
<tr><td>Non-fuel Charge</td><td>EC$0.4593/kWh</td></tr>
<tr><td rowspan="2">Industrial</td><td>Horsepower Charge</td><td>EC$2/horsepower
(Minimum - EC$10/month)</td></tr>
<tr><td>Non-fuel Charge</td><td>EC$0.3366/kWh</td></tr>
</table>
</td>
</tr>
<tr>
<td>Electricity demand</td>
<td>The peak power demand is approximately 28-29MW in Grenada.
The peak power demand occurs at the daytime (2pm) and the evening (6pm- 7pm). The daytime peak is considered to be caused by commercial load and the evening peak is considered to be caused by residential load.
GRENLEC doesn’t have clear proportion among the residential load, the commercial load and the industrial load in the power demand.</td>
</tr>
<tr>
<td>Current issues</td>
<td>Power Loss: Approx. Approx. 7.5 - 8%</td>
</tr>
</table>

	Load Factor in Distribution Transformer (2000 units): Approx. 70% 

2.3 Renewable Energy

Photo Voltaic	Current situation Small scale roof-top type PV generating systems were installed at public buildings as well as private buildings. Some of them are operated in isolation from the grid. Currently, electric power generated by the PV generating systems including private sector is 370kW and accounts for approximate 2% of total generated electric energy in Grenada. GRENLEC installed 32kW ground-mounted PV generating system in Petite Martinique island, and will extend its installed capacity up to 100kW in the future. Potential/Future plan Introduction of PV generating systems will be implemented mainly by private sector. The government is going to establish incentive schemes for introduction of renewable energy such as tax exemption for renewable energy equipment. Solar heating systems are quite popular in Grenada to reduce consumption of fossil fuel. The government implements capacity building regarding introduction of PV generating system such as design, installation, etc. in cooperation with Grenada Solar Energy Technology Research Institute (GSETRI) or other organizations. GRENLEC has a plan to install 4MW ground mounted PV generating systems to satisfy the target value of introduction of renewable energy stipulated by the government, in which renewable energy shall cover 20% of generated power by 2020.

Wind Power	Current situation Several small scale wind power systems were installed at private buildings. However, the government and GRENLEC haven't installed wind power plants yet. Potential/Future plan Potential of wind power is considered to exist along the east coast, but specific plans haven't been formed because lands to install wind farms are difficult to be acquired due to high cost of acquisition of such lands. Introduction of wind power will be implemented mainly by private sector. GRENLEC has a plan to install 2MW wind power plant which compose a hybrid system with diesel generators in Carriacau island. This project is supported by EU. GRENLEC considers necessity of study a stabilizing system of the grid including a battery charger.
Small Hydro Power	Current situation Hydropower plants aren't installed. Potential/Future plan Potential of hydropower isn't considered to exist.
Geothermal Power	Current situation GRENLEC implements survey issue of geochemical aspect, and start the feasible study of geothermal power currently. Potential/Future plan Potential of geothermal power is estimated to exist around Mt. St.Catherine. The government intends to develop geothermal power as a base load power source. At the first stage, 10MW geothermal plant is planned to be constructed. However, the plan to develop geothermal power is delayed because budget for the development isn't ensured.

Biomass Power	Current situation The private company (Solid Management Company) implements feasibility study for waste power generation and biofuel production. Potential/Future plan Potential of waste power generation is estimated to be so small that its economic efficiency is insufficient for commercial base. Therefore, specific plans aren't formed.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in Grenada GRENADA ELECTRICITY SERVICES LIMITED (GRENLEC) All street lights (approx. 4,000 units) will be planned to be replaced to LED light in 2015. The smart meter plan is being planned, which the smart meter will be installed into 2/3 of all customers (approx. 44,000 meters) and the AMI already has been installed into the remaining customers. Governmental activities Gov. already has assigned some person to being trained as energy auditor LED light already has been installed into some ministries and inverter AC also has been installed into some ministries and hospitals, etc. as demonstration by grant of Chinese Gov. After the demonstration, Petro Caribe continues to install LED light and inverter AC. Labeling system has been established by support of GIZ.

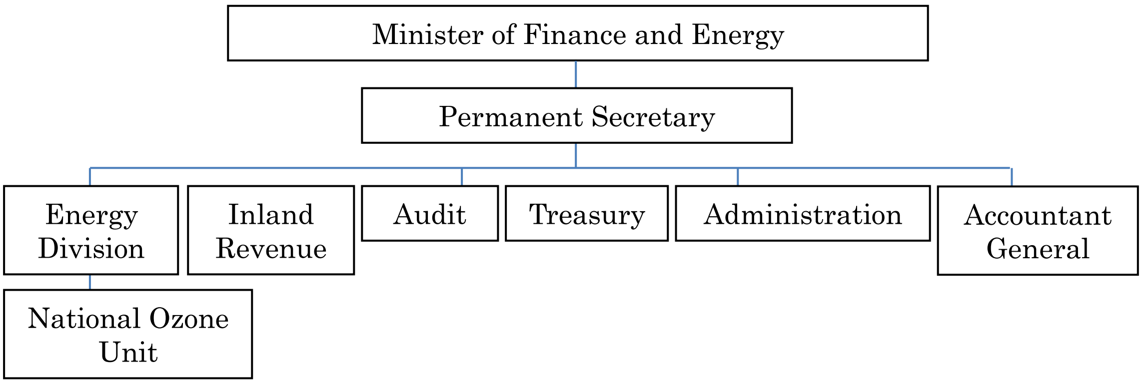
2.5 Governmental Policy

Renewable Energy	20% of all domestic energy usage (electricity & transport) will originate from renewable energy source by 2020.
Energy Efficiency	Reduce the national rate of energy consumption while increasing the economic growth (decoupling), be adopting best practices in energy efficiency and conservation.

2.6 Related Organization

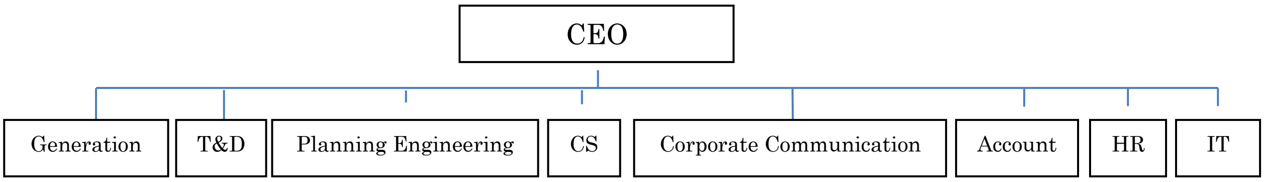
[Ministry of Finance and Energy]

Ministry of Finance and Energy has Minister, Permanent Secretary who supervises some divisions such as Energy Division, Inland Revenue, Audit, Treasury, Administration, and Accountant General. Energy Division is composed of 5 members.



[Grenada Electricity Services Ltd (GRENLEC)]

Since 1960, public electricity in Grenada has been provided by Grenada Electricity Services Ltd (GRENLEC). GRENLEC is now a subsidiary of Grenada Private Power Limited, which holds 50% of GRENLEC'S shares. Of the balance, 40% are held by the general public (including 11% by the National Insurance Scheme) and 10% by the government. As of the end of 2008, there were 41,228 domestic and commercial customers connected to the national electricity grid.



2.7 Donor Activities

OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
GIZ	EE Labeling System
Chinese Gov.	LED light and inverter AC installation by grant Establishment of Cricket stadium by grant

<u>**Republic of Guyana**</u>

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Georgetown		
Largest city	Georgetown		
Government	President	Donald Ramotar	
	Prime minister	Sam Hinds	
Area	Total (km2)	214,970	
	Water (%)	8.4	
Population	2014 estimate	735,554	
	Density (/ km2)	3.502	
GDP	PPP 2012 estimate	Total	$6.155 billion
		Per capita	$7,938
	Nominal 2012 estimate	Total	$2.788 billion
		Per capita	$3,596
Independence	From the United Kingdom on 26 May 1966		
Currency	Guyanese dollar		

<table>
<tr>
<td>Politics</td>
<td colspan="2">The politics of Guyana takes place in a framework of a representative democratic republic, whereby the President of Guyana is the head of government and of a multi-party system. Executive power is exercised by the government. Legislative power is vested in both the government and the National Assembly of Guyana.
○Executive branch
Executive authority is exercised by the president, who appoints and supervises the prime minister and other ministers. The president is not directly elected; each party presenting a slate of candidates for the assembly must designate in advance a leader who will become president if that party receives the largest number of votes.
Only the prime minister is required to be a member of the assembly. In practice, most other ministers also are the members.
○Legislative branch
Legislative power of Guyana rests in a unicameral National Assembly. Now 25 members are elected via proportional representation from 10 Geographic Constituencies. Additionally 40 members are chosen also on the basis of proportional representation from National lists named by the political parties. The president may dissolve the assembly and call new elections at any time, but no later than 5 years from its first sitting.
○Political parties
Guyana has a 2-party system, which means that there are 2 dominant political parties. The People's Progressive Party is supported primarily by Indo-Guyanese people, while the People's National Congress is supported primarily by Afro-Guyanese people.</td>
</tr>
<tr>
<td>Administrative divisions</td>
<td>Guyana is divided into 10 regions:
1. Barima-Waini
2. Cuyuni-Mazaruni
3. Demerara-Mahaica
4. East Berbice-Corentyne
5.Essequibo Islands-West Demerara
6. Mahaica-Berbice
7. Pomeroon-Supenaam
8. Potaro-Siparuni</td>
<td>
</td>
</tr>
</table>

	9. Upper Demerara-Berbice 10. Upper Takutu-Upper Essequibo The regions are divided into 27 neighborhood councils	

2. Energy Profile in Guyana

2.1 Energy

ECONOMIC GROWTH AND FINAL ENERGY CONSUMPTION	Guyana's GDP grew about 4.6% in 2011. Guyana consumes 10,880 barrels of petroleum per day, 100% of which is imported (2013). No domestic refinery capacity.
ENERGY SUPPLY BY SOURCE	In 2011, diesel represented 44% of imported fuel by volume, followed by heavy fuel oil (23%), gasoline (23%), and other petroleum products comprising the remaining 10%.
ENERGY SUPPLY AND SECTORAL USE	Electricity consumption in 2012 was 45% residential, 37% industrial and 18% commercial
DOMESTIC ENERGY RESOURCES	No fossil fuels. Bagasse from the sugar industry is used for onsite generation of heat and power.
ENERGY IMPORTS	10,880 barrels of oil equivalent were imported per day in 2013 at a cost of about US$455 million, representing 27% of all imported goods.
National Energy Policy	Energy policy is part of Guyana's Low Carbon Development Strategy to eradicate poverty, reduce dependence on imported fossil fuels and promote the use of clean energy

2.2 Electric Power Industry

<table>
<tr><td rowspan="2">General Feature of Power Industry</td><td>Costal Area</td><td>Most of Guyana's electricity generating capacity is thermal-based, using heavy-fuel oil or diesel. Guyana Power and Light Inc.(GP&L) is the main public supplier of electricity covered only coastal area, with an installed generating capacity of 172-MegaWatt in year 2013</td></tr>
<tr><td>Hinter Land</td><td>Private companies generate and distribute electricity in the mining town area of Linden and other villages in the coastal areas and the Hinterlands, with an estimated installed capacity of 35-MW.</td></tr>
<tr><td rowspan="2">Current Problems</td><td colspan="2">【High Cost of Electricity】
The cost of electricity in Guyana is among the highest in the region, with tariffs ranging from US$0.28/per kilowatt-hour (kWh) to US$0.32/kWh. This high cost of electricity can be attributed to different factors including:
1) dependence on expensive heavy fossil-fuels for power generation
2) inadequate system operation
3) a high level of technical and commercial losses in the distribution system</td></tr>
<tr><td colspan="2">【The electrification of rural communities】
Electricity coverage in the coastal zone is close to 90%.
But in the Hinterlands, infrastructure is yet to be developed and access to electricity is still limited due to distance from major load centers. Over 80% of the Amerindian population of Guyana lack basic access to electricity.</td></tr>
<tr><td rowspan="2">New Challenge</td><td colspan="2">【Northern Arc Interconnection Project】
Guyana is also a party to a Memorandum of Understanding on the Northern Arc Interconnection Project which seeks to evaluate the feasibility of a possible collaboration on the energy transmission system for the electric interconnection of Guyana, Suriname, French Guiana and the northern cities of Boa Vista (State of Roraima) and Macapá (State of Amapa) (the Northern Arc Countries) with support from the Inter-American Development Bank (IADB).</td></tr>
<tr><td colspan="2">【Loss Reductio measurement】
With financing from the Un-served Areas Electrification Project (UAEP), funded by the IDB Loan, GP&L implemented a set of measures to reduce commercial losses.
1)Implement elements of the Strategic Loss Reduction Plan (SLRP)
2) Replace 6,000 meters with pre-paid meters.
3) Replace 5,800 defective and obsolete meters.</td></tr>
</table>

4) Install additional 300 ITRON AMR meters.

	2013	2014	2015	2016	2017	2018
Technical	14.65	14.40	14.40	13.90	13.50	13.30
Non-Technical	16.75	16.50	16.50	16.00	15.40	14.60
Overall (%)	31,4	30.9	30.9	29.9	28.9	27.9

【Hinterland Electrification Program (HEP)】

Some hinterland communities have intermittent electricity provided by diesel generators, in most cases, at a cost of up to US$0.40/kWh. In 2008, four villages benefited from solar-PV panels under the UAEP, funded by the IDB and executed by OPM's HEU, providing energy to low-income population.

Demonstration phase was: (i) to install 125-Watts peak (Wp) solar PV systems in every home to for lighting and radio/ CD; and (ii) to install a 250-Wp PV system in the primary school and clinic for lighting and to power other equipment (computers, TV/DVD, and fridge/freezers to store medical supplies).

In 2010, Hinterland Electrification Program (HEP) expanded with the UAEP. End-user experiences were generally positive, given that: (i) 90% of the families began performing activities after dark; (ii) family income measurably increased; and (iii) fuel costs for lighting were reduced to approximately US$9.80 per month.

2.3 Renewable Energy

Photo Voltaic	The solar energy potential in Guyana is abundant with irradiation levels ranging from 4.5-kWh/m2/day to 6.5-kWh/m2/day, depending on the location. 【Current facilities under UAEP, Unserved Areas Electrification Program 】 About 1MW of solar photovoltaic systems installed across Guyana. Those are about 11,000 solar photovoltaic systems to those communities without grid access. Two grid-tied solar-PV systems were recently installed in the Hinterland villages of Madhia and Port Kaituma for a total 10 kWp. GEA recently installed an 8.46-kWp grid-tied system on the roof of the GEA'office. 【Future Challenge】 According to GEA and GPL, Institute of Applied Sciences and Technology (IAST) are prepared their own land for new installation of 1 MW PV. They are waiting the organization to financing them.
Small Hydro Power	Guyana has an extensive hydropower potential to be developed. There is certainly scope for small-scale hydroelectric schemes, for Hinterland communities and for grid interconnection, but such policy is not formally pursued due the lack of a legal framework to encourage financing. Feasibility studies and technical studies have been carried out for the Kato Small Hydroelectric Plant of approximately 330-kiloWatts (kW) on the Chiung River. For the Sustainable Energy Program (Program), financial support is sought from the European Union (EU). However, the initiative will require additional resources for implementation and sustainability. Inspections are being carried out on different sites 18 sites in 2013 and 2014. Suitable sites will be assessed for the piloting. GEA will seek to develop run-of-the-river type hydropower stations under 100kW to meet the energy needs of neighboring communities. Pico-hydro (up to 5kW) options will be reviewed.

Wind Power	Under the UAEP, wind speeds were monitored in the following areas: Orealla, Region 6, Jawalla, Region 7, Campbell town, Region 8, Yupukari, Region 9 but the wind speeds were not very attractive. Wind speeds along the coast are sufficient for commercial wind energy projects. The study explored the feasibility of a 10-25MW wind farm to be located at Hope Beach or in the Georgetown foreshore. GP&L signed a Memorandum of Understanding in March 2007, for the development of the project, but construction of the project has not yet been reached.
Biomass Power	【BAGASSE】 Bagasse from sugar cane and rice husk can be used for electricity and heat generation. A recent experience with cogeneration in Guyana was implemented by Guysuco with an available power capacity of 8-MW at Skeldon. Initial experiences show that assistance is needed to strengthen local technical capacities to design and operate such systems. 【RICE HUSK】 In 2012, Guyana milled about 525,000 tons of paddy which generated 105,000 tons of rice husk which has an energy value of 257,442 boe. Among them, about 47% of the rice husk is used for paddy drying. A list of locations, potential biomass quantities from rice mills and a map with the listing of all potential sources of rice husk energy sources have been completed. GEA will seek to establish a 20 to 30kW demonstration unit. 【WOODWASTE】 About 176,498.78 m3 (62,329.68 tons) of biomass is used as input for the industry which produced approximately 64,882.83 m3 of woodwaste in 2012. The total primary energy value of the wood waste produced in 2012 is 25,872 boe. Environmental Protection Agency can create specific central areas for utilizing biomass to produce energy. Areas to store/dump wood-waste can be designated with the objective of sustainable waste-management practices thereby creating centralized areas

	【BIOGAS / Biodiesel】 GEA, with support from UNDP and OPM, installed an additional two bio-digesters in 2012. In an effort to promote the use of bio-digesters in farming communities, GEA has prepared a "Guide for the Design and Construction of Low-cost Bio-digesters" which can be used by small scale farmers to convert animal waste to energy in the form of biogas which can be used for cooking, lighting and electricity generation. Guyana's biomass energy potential was analyzed in the study "Expanding Bioenergy Opportunities in Guyana" financed by the IDB, in which three areas were identified as possible locations for biodiesel production plants: (i) the Canje Basin; (ii) the Intermediate Savannah; and (iii) the Wauna-Yarakita sub-region. United Nations "Economic Commission for Latin America and the Caribbean (ECLAC)" has completed to develop the potential map of biomass resources.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in Guyana leaded by Government organizations Guyana Energy Agency (GEA) Brochure publication or download through internet Energy conservation measures (residential sector, buildings and transportation) Promotion of high efficiency home appliances Energy assessments/audits: 49 Buildings in 2012/2013 Small-scale demonstration projects Replacement of incanbacent light by CFL Replacement of street light by high efficiency lighting (80 units) Solar LED lighting (2 units) Micro hydro in hinterland (5kw-10kw) Ethanol production from biomass (1,000/day) Guyana Power and Light Inc. (GPL) Introduction of Demand Side Management (DSM)

Education of customers Provide information via flyers, radio, TV and prints Utilization of Social Management Program Introduction and expansion of AMI Energy efficient appliances Encouraging the introduction of energy star rating Energy efficient street lighting Education of school children Secondary school debating competition Establishment of database End-use equipment List of energy efficient equipment on the market Energy efficiency consultants / Service providers Above two government organizations started tackling to promote energy efficiency and conservation in all Guyanan sectors. These are focused mainly on system and framework of energy efficiency and conservation. Confirming the result of these activities, government should consider followings: Study and drafting energy conservation law and regulation Collaboration with CARICOM countries Technological evaluation system

2.5 Governmental Policy

Guyana 2012-2016	Guyana 2012-2016, focusing in the priority area of "Sustainable Energy", supporting the strategic objective of "Implement a low-carbon energy framework to reduce the cost of electricity and increase coverage". This Program is included in the 2013 Country Programming Document.

2.6 Related Organization

Office of the Prime Minister (OPM) The Prime Minister is the Minister responsible for energy and electricity and gives directions as to the policy to be followed by the GEA in the performance of its functions. OPM) has principal policy-making and regulatory responsibility in the sector, including for granting licenses to the public utilities and independent power producers and approval of development and expansion plans and of operating standards and performance targets for Guyana Power & Light Inc. (GPL), the principal supplier of electricity.
Guyana Energy Agency (GEA) The GEA, a body corporate, was established in 1997 by the Guyana Energy Agency Act 1997 (Act No. 31 of 1997). 2014 to 2018 Strategic Plan is to guide the activities of the Guyana Energy Agency
Guyana Power and Light Inc. (GPL): The Guyana Power & Light Company Inc. (GPL) is the main power company in Guyana and is responsible for the generation, transmission and distribution of electricity to residential, commercial and industrial customers.
Institute of Applied Sciences and Technology (IAST): The Institute of Applied Science and Technology is an industrial research organization, which has as its mandate the development and/or adaptation of appropriate technology for the utilization of Guyana's natural resources, so that these resources can be gainfully developed and exploited for the benefit of the people of Guyana.

2.7 Donor Activities

Global Environment Fund, IDB, EU	US$24 million Hinterland Electrification Program, including the installation of 11,000 household solar power systems with battery storage, and the construction of small hydro projects for community power
IDB, EU	US$65 million program to upgrade the electricity distribution network and reduce distribution losses with an Advanced Metering Infrastructure, software analytics, smart meters, and other measures
China	Funding from the China Export-Import Bank to build seven distribution substations, upgrade three substations, and construct a 69kV transmission line to interconnect the coastal areas
India	Biomass energy resource assessment study; survey of power factors of electricity distribution lines
EU, Norway, France, UNDP, World Bank	US$23 million program for natural resource management and disaster risk management activities, including forest area measurement, forest degradation reduction, clean energy development, and the establishment by Norway of a US$250 million Trust Fund to finance re-forestation and other environmentally beneficial projects

Jamaica

1. General

<table>
<tr><td>Flag and coat of arms</td><td colspan="3"> 
</td></tr>
<tr><td>Official languages</td><td colspan="3">English</td></tr>
<tr><td>Capital city</td><td colspan="3">Kingston</td></tr>
<tr><td>Largest city</td><td colspan="3">Kingston</td></tr>
<tr><td rowspan="3">Government</td><td>Monarch</td><td colspan="2">Elizabeth II</td></tr>
<tr><td>Governor-General</td><td colspan="2">Patrick Allen</td></tr>
<tr><td>Prime minister</td><td colspan="2">Portia Lucretia Simpson-Miller</td></tr>
<tr><td rowspan="2">Area</td><td>Total (km2)</td><td colspan="2">10,991</td></tr>
<tr><td>Water (%)</td><td colspan="2">1.5</td></tr>
<tr><td rowspan="2">Population</td><td>2012 estimate</td><td colspan="2">2,889,187</td></tr>
<tr><td>Density (/ km2)</td><td colspan="2">252</td></tr>
<tr><td rowspan="4">GDP</td><td rowspan="2">PPP
2012 estimate</td><td>Total</td><td>$25.317 billion</td></tr>
<tr><td>Per capita</td><td>$9,199</td></tr>
<tr><td rowspan="2">Nominal
2012 estimate</td><td>Total</td><td>$15.569 billion</td></tr>
<tr><td>Per capita</td><td>$5,657</td></tr>
<tr><td>Independence</td><td colspan="3">From the United Kingdom on 6 August 1962</td></tr>
<tr><td>Currency</td><td colspan="3">Jamaican dollar</td></tr>
<tr><td>administrative divisions</td><td>Jamaica is divided into 14 parishes, which are grouped into three historic counties that have no administrative relevance.</td><td colspan="2">
</td></tr>
</table>

	Cornwall County	Hanover Saint Elizabeth Saint James Trelawny Westmoreland
	Middlesex County	Clarendon Manchester Saint Ann Saint Catherine Saint Mary
	Surrey County	Kingston Portland Saint Andrew Saint Thomas

2. Energy Profile Suriname

2.1 Energy

ECONOMIC GROWTH AND FINAL ENERGY CONSUMPTION	Jamaica's GDP grew by 1.3% in 2013, and the World Bank estimates continued growth of 1% - 2% per year for the next three to five years. Primary energy consumption in 2011 was 127 trillion Btu. Energy intensity is about average for the region.
ENERGY SUPPLY BY SOURCE	Nearly all of Jamaica's energy needs are supplied by imported petroleum, at significant cost to the nation's economy and balance of trade. The Office of Utility Regulation recently approved the construction of 190MW of natural gas-powered electricity generation, along with an LNG terminal.
ENERGY SUPPLY AND SECTORAL USE	About 47% of Jamaica's petroleum imports were consumed by the transportation sector in 2012. Electricity generation consumed about 31% of petroleum; bauxite and aluminum processing, sugar processing and other manufacturing consumed about 20%; and the residential and other sectors consumed the remaining share.
DOMESTIC ENERGY RESOURCES	Jamaica has no known fossil fuel resources. Roughly 6% of electricity is generated by renewable energy – 3% by hydro and 3% by wind. Solar PV and hot water installations are nominal. A recently completed tender

	for renewable energy will add 80MW (60MW of wind, 20MW of PV).of new capacity in the next year or so, bringing the contribution of renewables up to about 11% of electricity generated.
ENERGY IMPORTS	Jamaica imported about 20 million barrels of oil in 2013, at a cost of US$2.1 billion.
National Energy Policy	National energy policy calls for 12.5% of electricity in 2015 to come from renewable sources, increasing to 20% by 2030. With electricity generation accounting for 31% of petroleum imports, achieving the 2030 goal would only reduce petroleum dependence by 6% versus the 2010 baseline. There is national policy support for energy efficiency, but little substance.

2.2 Electric Power Industry

General Feature of Power Industry	Power Demand	Approximately 820 megawatts (MW) of total installed generation capacity includes 197 MW from the Independent Power Producers (IPPs)
	Power Generation	Jamaica Public Service Limited or JPS JPS Marubeni Caribbean Power Holdings Inc. and Korea-East West power each holds 40 percent ownership, the Government of Jamaica owns approximately 19% JPS have a generation capacity that exceeds 620 Megawatts, using steam (oil-fired), gas turbines, combined cycle, diesel, and hydroelectric 4 Independent Power Producers (IPPs) The two most recent projects are introducing more hydropower and wind power into our fuel diversification. These projects will result in an addition of 9 megawatts (MW) of capacity when complete. 6.3-MW hydroelectricity power plant in Maggotty 3 MW wind farm in Munro
	Network Development	customer-base of nearly 603,350 Backbone of the Transmission System: 138 kV. 69 kV - High voltage lines, 24 kV - Medium voltage distribution network, which takes the power from substations, to customers.
	Distribution	JPS grid has high transmission and distribution losses, at

	Loss	22.3%. About 12% of losses are resulting from the thief and non-payment

Current Problems	High Dependency on Oil the country depends on petroleum imports for over 95% of its electricity generation High Electric Price Electricity prices for Jamaican residents are among the highest in the world, at around 40 U.S. cents per kilowatt-hour High Electric thief and non-payment of the public customer Two biggest power consumptions in public sector are Schools and water pump stations.

2.3 Renewable Energy

In 2009, Jamaica established its National Energy Policy, which includes a commitment to providing 20% of the country's energy from renewable resources by 2030

Wind	Several locations in Jamaica have extremely strong wind energy potential. 10 medium-sized wind farms (60 megawatts each) could provide more than half of Jamaica's current power demand. The 4-turbine 3MW Munro Wind Farm It was officially commissioned, in October 2010 and is located in Munro. It is the first wind power plant to be owned by the Company. JPS also has a Power Purchase Agreement (PPA) with Wigton Wind Farm Limited, as part of our commitment to support the development of renewable energy. Electricity is purchased from the wind farm, which is located at Wigton, Manchester.

	Wind Power Potential With funding from the Inter-American Development Bank (IDB), Wigton Wind farm Ltd. is currently conducting wind assessments at 20 sites. Because these results will provide current and detailed wind resource data from across the country, Jamaica overall has very strong wind potential, and several regions demonstrate resource potentials that are suitable for wind energy development.
PV	Domestic solar resources are particularly strong: average global horizontal irradiance (GHI)—ranges from 5 to 7 kWh/m2/day throughout most of the country, with some areas nearing 8 kWh/m2/day. Jamaica Broilers, the largest poultry producer in the Caribbean, completed installation of 600 kW of solar PV panels across 40 of its chicken houses in 2013—one of the country's largest solar projects to date. JPS and the University of Technology (UTech) signed a Memorandum of Understanding on October 8, 2012 to set up a solar renewable energy facility including the installation of a 100kWp solar photovoltaic system.
Biomass	Sugarcane bagasse is currently the main source of biomass fuel in Jamaica, with sugarcane processors using the cane residue to generate power at their own facilities. Existing bagasse cogeneration capacity in Jamaica is intentionally inefficient in order to dispose of the maximum amount of bagasse through burning, because at the time that the generation plants were built, excess electricity could not be sold to the grid The sugarcane harvest season in Jamaica lasts about 185 days Other agricultural wastes, such as coffee pulp and coconut husks, also could potentially use, but still under investigation. Two wastes to energy are studied at PCJ. They are open damping garbage station near Kingston.
Geo thermal	No potential
Small/mini Hydro	For developing small hydropower potential at Jamaica's remaining viable sites, United Nations Economic Commission for Latin America and the Caribbean conducted assessments to determine the hydropower potential at 11 sites across Jamaica, with most sites demonstrating a potential The new hydro project will expand the existing hydroelectricity to 21MW in

	Maggotty. JPS has nine (9) hydroelectric plants among a mix of generating units. The hydropower plants are as listed below, some of them are very old and can not efficiently produce power. Upper White River Lower White River Roaring River Rio Bueno A and Rio Bueno B Maggotty Plant A Rams Horn Constant Spring Maggotty Plant B

2.4 Energy Efficiency

National Energy Plan (Vision 2030)	In National Energy Plan (Vision 2030), GOJ set target of Energy intensity index (BTU/US$1 Unit of output). (Constant Year 2000 $US) Baseline (2007) : 15,392 2015: 12,700 2030: 6,000
National Energy Policy	To realize above target, GOJ addressed the followings: Low levels of awareness of energy conservation practices by both large and small consumers Jamaica's high energy intensity index Low levels of energy efficiency in key sectors such as bauxite/alumina and power generation. Low levels of energy efficiency from building designs, electrical installations and low levels of energy consumption by end use devices
	Strategies and Key Actions to 2030: Implement demand side management programs that promote public awareness of the energy use importance Facilitate the introduction of energy-saving devices e.g. LED, solar panels, solar street lighting Employ energy-saving approaches in building design and construction Promote energy conservation in the public sector, particularly in the water supply systems

		Develop and implement programs to promote efficient use of energy Use of energy-efficient appliances and equipment Setting and enforcing standards for public sector organizations Public awareness and educational programs
Public awareness	Current Situation	JPC has comprehensive web-site to promote energy conservation for all sectors. However it is not sufficient and effective to raise awareness of energy conservation.
	Measures to be taken	Not only website, other measures like TV, radio, newspaper, school education and seminar should be introduced. Simultaneously, adequate and easily comprehensible educational materials should be prepared.
Lighting	Current Situation	Lighting accounts for a large proportion of electrical consumption in many sectors Cuban government distributed CFL to Jamaica households in 2008. Despite the efforts, initiatives have not sustainable, because of low-quality CFL.
	Measures to be taken	The efficiency of incandescent lamps is lower the compact fluorescent bulbs. CFL: Life 6,000 to 20,000 hours. Jamaica government should consider total prohibition of importing incandescent bulbs. Street lighting: Government has plan to replacing mercury vapor bulbs with more efficient types.

Building design and construction	Measures to be taken	Architectural solution: Exploiting building design, selection of materials and use of natural ventilation and lighting-control devices. Jamaica's national standard agency introduced an initial Energy Efficiency Building Code (EEBC) in 1994. The national Standards Offices has begun the process of updating the EEBC.
Energy Audit & Management System	Current Situation	UNDP and GOJ conducted energy audit in schools and hospitals. But these activities are not sustained for the time being.
	Measures to be taken	Education and training of capable auditor candidate are required. Energy management system as national policy should be established.

Water supply systems	Current Situation	National Water Commission spent huge amount of electricity for water supply to the public. And the efficiency of total system is quite low.
	Measures to be taken	It is highly feasible to reduce electricity consumption by introducing high-efficiency pumps, motors and controlling system.
Energy-efficient appliances	Current Situation	Most imported energy-consuming appliances sold in Jamaica are not energy efficient. Consumers are often unaware of long-term operating costs and differences in energy consumption between models. Salespeople also lack the information and skills needed to help customers choose electrical appliances. Current policy does not prevent low-efficiency appliances entering the country.
	Measures to be taken	Jamaica's Bureau of Standard (BSJ) introduced mandatory labelling for refrigerators in 1990. The label is used in US. But almost never used. It is nearly impossible to create the facilities needed to test appliances and certify them. Effective customs control is nearly impossible. Unified regional effort in the Caribbean Community (CARICOM) is possible solution

2.5 Donor Activities

GiZ	Energy Services Industry – Institutional Capacity Building (2013)
	Sustainable Energy Road Map for Jamaica (2013)
	"Climate Risk Adaptation and Insurance in the Caribbean" in partnership with the Jamaica International Insurance Company (2013)
	Donation of a solar PV system to the HELP Jamaica Education Center (2013)
IDB	"Support to Promote Energy Efficiency, Energy Conservation and Sustainable Energy" – Assessment of the demand for investments in EE and conservation measures by SMEs in Jamaica, development of a training program for energy auditors/managers, and the development and implementation of an integrated demonstration program to highlight benefits of EE and conservation strategies within the SMEs sector (2009)
	Public Sector Energy Efficiency and Conservation Technical Assistance Program (2009)

	Public Sector Energy Efficiency and Conservation Program to help Jamaica enhance its energy efficiency and conservation potential; strengthen the institutional capacity of the Ministry of Energy and Mining to design and implement investment measures in the public sector; and increase awareness and knowledge among key public and private stakeholders. The loan will be repaid by reducing energy fiscal expenses. (2011)
	Wind Resource Assessment
UNDP	Wind Power for Domestic and Community Use – Feasibility Study and Regulatory Review
World Bank	Smart Grid Roadmap for Jamaica
	Hydro Power Feasibility Study

St. Christopher and Nevis

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Basseterre		
Largest city	Basseterre		
Government	Monarch	Elizabeth II	
	Governor-General	Edmund Lawrence	
	Prime minister	Denzil Douglas	
Area	Total (km2)	261	
	Water (%)	Negligible	
Population	2014 estimate	51,538	
	Density (/ km2)	164	
GDP	PPP 2012 estimate	Total	$1.087 billion
		Per capita	$21,260
	Nominal 2012 estimate	Total	$767 million
		Per capita	$14,314
Independence	From the United Kingdom on 19 September 1983		
Currency	East Caribbean dollar		
Politics	The politics of Saint Kitts and Nevis takes place in a framework of a federal parliamentary democracy. Saint Kitts and Nevis is an independent Commonwealth realm. ○Executive branch As the head of state, Queen Elizabeth II is represented by a governor-general who		

	acts on the advice of the prime minister. Following legislative elections, a leader of the majority party or leader of a majority coalition is usually appointed prime minister by the governor-general. All other ministerial appointments, including that of deputy prime minister, are made by the governor-general, but acting upon the advice of the prime minister. ○Legislative branch The National Assembly of Saint Kitts and Nevis consists of 1 house with 11 elected members, and 3 appointed Senators—2 on the advice of the Prime Minister, 1 on the advice of the Opposition Leader. If the Attorney General is not appointed as a Senator, he or she sits in the Assembly as an ex officio member. ○Political parties Saint Kitts and Nevis has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for anybody to achieve electoral success under the banner of any other party. The major parties are the People's Action Movement and the Saint Kitts and Nevis Labor Party.
Administrative divisions	The federation of Saint Kitts and Nevis is divided into fourteen parishes: nine divisions on Saint Kitts and five on Nevis.
	1.Christ Church Nichola Town 2.Saint Anne Sandy Point 3.Saint George Basseterre 4.Saint George Gingerland 5.Saint James Windward 6.Saint John Capesterre 7.Saint John Figtree 8.Saint Mary Cayon 9.Saint Paul Capesterre 10.Saint Paul Charlestown 11.Saint Peter Basseterre 12.Saint Thomas Lowland 13.Saint Thomas Middle Island 14.Trinity Palmett Point 

2. Energy Profile in St. Christopher and Nevis

2.1 Energy

Economic growth and final energy consumption	Petroleum products are fundamental to SKN's socio-economic development and will continue to be so for the foreseeable future. The overall volume of petroleum derivate imports should increase at a lower rate than economic growth through appropriate conservation and efficiency measures to achieve decoupling of energy consumption vis-à-vis economic development, and by substituting the use of petroleum with renewable energies.
Energy supply by source and sectoral use	Importation of petroleum products, including diesel and gasoline as transport fuels, jet fuel and kerosene as aviation and maritime fuels, and LPG for household cooking purposes, accounts for a significant and steeply increasing proportion of total national imports of SKN as well as the electricity generation.
Energy balance	Total installed capacity is approximately 45MW consisting of 44MW diesel and 1MW solar. The peak demand is approximately 24MW.
Energy imports	The cost of fuel imports per unit should be minimized through good supply contract negotiations and management. Also, Renewable Energy Sources in the form of solar, wind, hydro and geothermal are deemed the most appropriate mid to long-term alternative sources to replace imported petroleum products for electricity generation, heat production and as transport fuel in SKN. Key issues include increasingly high costs for imported fuel for power production and the option to use cost-efficient centralized and decentralized approaches to electricity generation and use from natural or indigenous resources, such as wind, solar, waste and geothermal energy.

2.2 Electric Power Industry

<table>
<tr><td rowspan="2">General feature of power industry</td><td>St. Kitts</td><td>Most of electricity generating capacity in St. Kitts is thermal-based, using diesel fuel. In addition, PV generating systems with capacity of 1MW are installed.
SKELEC, the power utility in St. Kitts, has one diesel power station. It has 11 diesel generator units of which total capacity is 44MW.
Electricity is supplied to the whole of St. Kitts by 11kV transmission line from the diesel power station.
The power grid in St. Kitts and that in Nevis aren't connected to each other. Currently, the government has no plan to connect the power grids in St. Kitts and Nevis.</td></tr>
<tr><td>Nevis</td><td>Most of electricity generating capacity in Nevis is thermal-based, using diesel fuel. In addition, a wind power plant with capacity of 2.2MW is installed.
NEVLEC, the power utility in Nevis, has one diesel power station. It has 7 diesel generator units of which total capacity is 14MW.
In the same way as St. Kitts, electricity is supplied to the whole of Nevis by 11kV transmission line from the diesel power station.</td></tr>
<tr><td>Electricity tariff</td><td colspan="2">For residents the energy tariff of EC$0.59-0.68 is charged for every kWh consumed and for industrial and commercial users that of EC$0.65-0.80 is charged for kWh divided by kVA of demand.
<table>
<tr><td rowspan="2">General Services</td><td>Energy Charge</td><td>EC$0.91/kWh</td></tr>
<tr><td colspan="2">With minimum total of EC$11</td></tr>
<tr><td rowspan="5">Domestic Services</td><td>Demand Charge</td><td>For 15 Amps of fuse rating or part thereof of fuse protecting service EC$13</td></tr>
<tr><td colspan="2">Energy Charge</td></tr>
<tr><td>First 50kWh</td><td>EC$0.59/kWh</td></tr>
<tr><td>Next 100kWh</td><td>EC$0.65/kWh</td></tr>
<tr><td>Exceeding 150kWh</td><td>EC$0.68/kWh</td></tr>
<tr><td rowspan="4">Industrial and Commercial</td><td>Demand Charge</td><td>Every kVA of demand or part thereof $15 per kVA</td></tr>
<tr><td colspan="2">Energy Charge</td></tr>
<tr><td>First 50kWh/kVA</td><td>EC$0.80/kWh/kVA</td></tr>
<tr><td>Next 75kWh/kVA</td><td>EC$0.76/kWh/kVA</td></tr>
</table>
</td></tr>
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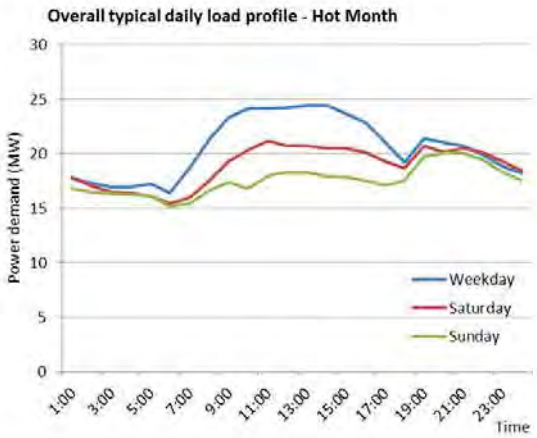
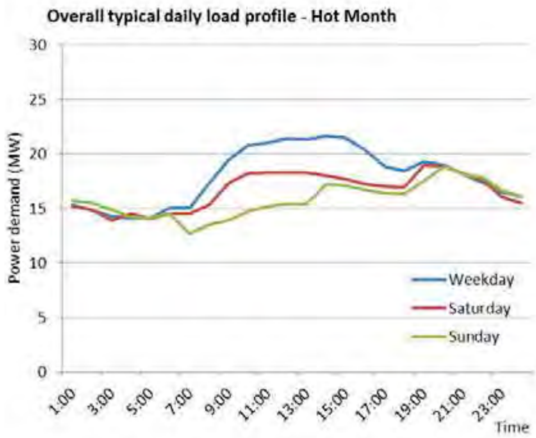
<table>
<tr><td></td><td>
<table>
<tr><td></td><td>Next 125kWh/kVA</td><td>EC$0.72/kWh/kVA</td></tr>
<tr><td></td><td>Exceeding 250kWh</td><td>EC$0.65/kWh/kVA</td></tr>
</table>
</td></tr>
<tr><td>Electricity demand</td><td>
Daily load curve in SKELEC is shown as below.





Regarding the proportion of power demand, it is estimated that the power consumption at households accounts for the major part of power demand and approximate 20% of power demand is consumed by air conditioners.
</td></tr>
<tr><td rowspan="2">Current issues</td><td>
Power loss is estimated to be approximate 30%. However, SKELEC cannot grasp the proportions of technical loss and non-technical loss in the power loss.
SKELEC is implementing a pilot project for introduction of smart meters from the viewpoint of reducing the power loss.
</td></tr>
<tr><td>
Load Factor in Distribution Transformer: Approx. 60%


</td></tr>
</table>

2.3 Renewable Energy

Photo Voltaic	Current situation 750kW PV generating system was installed at the airport in October, 2013, and roof-top type PV generating systems with total capacity of 250kW are planned to be installed. Therefore, PV generating systems with total capacity of 1MW are installed and connected to the power grid. Currently, problems on instability of power grid operation due to installation of the PV generating systems haven't happened. The government applies import tax exemption to renewable energy equipment in order to promote introduction of renewable energy equipment. However, the feed-in tariff scheme for renewable energy hasn't been implemented yet. Potential/Future plan Roof-top type PV generating systems with total capacity of 750kW are planned to be installed by the end of 2014. In addition to the above, approximately 1MW PV generating system is planned to be installed near the central bank. The government deems that allowable capacity to introduce renewable energy should be considered from the viewpoint of ensuring stability of the power grid.
Wind Power	Current situation 2.2MW wind power system is installed in 2010 at Nevis. Currently, problem on instability of power grid operation due to installation of the wind power plant hasn't happened. Potential/Future plan Potential of wind power is estimated as 11MW. However, installed capacity is limited in consideration of power demand in Nevis in order to ensure stability of power grid operation.
Small Hydro Power	Current situation No hydro power is installed. Potential/Future plan Potential of hydro power isn't found.

Geothermal Power	Current situation No geothermal power has been developed currently. Potential/Future plan Potential of geothermal power is estimated to exist. Due to power demand in Nevis, geothermal power can hardly be developed. In consideration of power demand in Nevis, the power grid in St. Kitts and that in Nevis are needed to be connected to each other by submerged cables in order to develop geothermal power.
Biomass Power	Current situation No biomass power is installed. Potential/Future plan Potential of biomass power is under study and specific amount hasn't been estimated.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in Saint Christopher and Nevis St. Kitts Electricity Company Limited (SKELEC) Smart meter is planned to be installed to 500 household by the governmental budget in Oct. 2014. After this, SKELEC will install smart meter to all of customers in 2 years by the governmental budget which has not been decided yet officially.

Governmental activities

Street lights (approx. 250units) already have been installed into main street from airport based on the support from TAIWAN Gov.

LED is planned to be installed into public building (e.g. ministry, hospital, school) based on the support from TAIWAN Gov.

The ECO park which will be utilized for promoting renewable energy and energy efficiency is under construction based on the support from TAIWAN Gov. Approx. 80 units of PV street lights already have been installed around the ECO park based on the support from TAIWAN Gov.

The lights in main cricket stadium already have been changed to LED.


2.5 Governmental Policy

Renewable Energy	Energy Generation Safe, reliable and affordable supplies of fuels and their efficient and clean handling while in parallel significantly increasing the deployment, access and utilization of renewable energy in the Federation of St. Kitts and Nevis. Energy Supply or Imports Safe, efficient, reliable, affordable and environmentally friendly electricity generation and access for all consumers in St. Kitts and Nevis.
Energy Efficiency	Minimize energy input and achieve lowest possible energy intensity of economic services in all sectors of the society.

2.6 Related Organization

[Ministry of Housing, Public Works, Energy & Public Utilities] The minister of Ministry of Housing, Public Works, Energy & Public Utilities has the permanent secretary which has two assistant secretaries, one is Mr. Paul Lloyd and the other is Mr. Charles Williams. Mr. Paul Lloyd is in charge of the water and energy department and Mr. Charles Williams is in charge of the housing department. The public works department, which is the largest department and has 250 staffs, is directly administered by permanent secretary.
[St. Kitts Electricity Co. Ltd. (SKELEC)] The St. Kitts Electricity Company Limited (SKELEC) is a public utility that provides electric power generation, transmission and distribution services. The power station is located at Needsmust, and comprises ten (10) diesel generators with a total capacity of 43 MW. This services a peak demand of approximately 24 MW and a base load of approximately 14 MW. The transmission system comprises twelve (12), 3-phase, 3-wire, 11 KV radial feeders originating at the generator bus bar at power station. It comprises both underground and overhead feeders. The 11 KV is converted to 3-phase, 4-wire, 400V and single phase, 2-wire, 230V, respectfully supplied to consumers. The system frequency is 60 Hz.
[Nevis Electricity Co. Ltd (NEVLEC)] The Nevis Electricity Company Limited is the sole provider of electricity on the island of Nevis. The company, which starts electric power supply service on September 1, 2000, is a fully owned subsidiary of the Nevis Island Administration. NEVLEC began its operation with the aim of providing quality electricity service to the island of Nevis.

2.7 Donor Activities

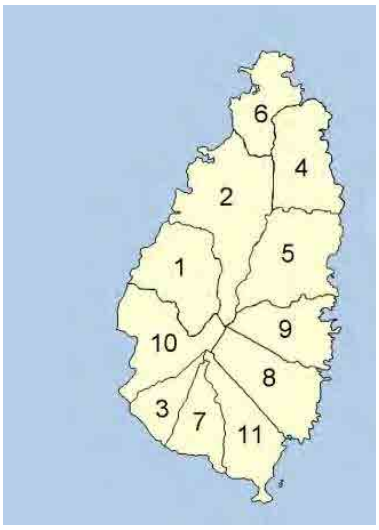
OAS(Organization of American States)	-Creation of National Energy Policy 2011 under the scope of the Caribbean Sustainable Energy Program(CSEP)
TAIWAN ICDF	Renewable Energy Policy Consultant-Dispatching Project - 750kW PV generating system at the airport - Installation of street LED light (Total approx. 250 units) & Public buildings - Construction of ECO Park

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit)	Establishment of EE Labeling System

St. Lucia

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Castries		
Largest city	Castries		
Government	Monarch	Elizabeth II	
	Governor-General	Pearlette Louisy	
	Prime Minister	Kenny Anthony	
Area	Total (km2)	616	
	Water (%)	1.6	
Population	2009 census	173,765	
	Density (/ km2)	298	
GDP	PPP 2011 estimate	Total	$2.101 billion
		Per capita	$12,927
	Nominal 2011 estimate	Total	$1.239 billion
		Per capita	$7,76
Independence	From the United Kingdom on 22 February 1979		
Currency	East Caribbean dollar		
Politics	The politics of Saint Lucia takes place in a framework of an independent parliamentary democratic constitutional monarchy. The Governor General exercises basically ceremonial functions, but residual powers, under the constitution, can be used at the governor general's discretion. The actual power in St. Lucia lies with the prime minister and the cabinet, usually representing the majority party in parliament. ○Executive branch As the head of state, Queen Elizabeth II is represented by a governor general who acts on the advice of the prime minister and the cabinet. Following		

	legislative elections, a leader of the majority party or leader of a majority coalition is usually appointed prime minister by the governor general. ○Legislative branch The Legislature has 2 chambers. The House of Assembly has 17 members, elected by universal adult suffrage for a 5-year term in single-seat constituencies. The Senate has 11 members appointed by the governor general. The parliament may be dissolved by the governor general at any point during its 5-year term, either at the request of the prime minister—in order to take the nation into early elections—or at the governor general's own discretion, if the house passes a vote of no-confidence in the government. ○Political parties Saint Lucia has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for anybody to achieve electoral success under the banner of any other party. The major parties are the Saint Lucia Labor Party and the United Workers Party.
administrative divisions	The quarters or parishes of the island, established by the French colonial government and continued by the British, are: 1.Anse-la-Raye 2.Castries 3.Choiseul 4.Dauphin 5.Dennery 6.Gros-Islet 7.Laborie 8.Micoud 9.Praslin 10.Soufriere 11.Vieux-Fort 

2. Energy Profile in St. Lucia

2.1 Energy

Energy supply by source and sectoral use	Energy services are required for a number of activities including, inter alia; electricity generation, water supply, agriculture production, transportation and telecommunications. All of these services are integral to the development of Saint Lucia and to the well-being and advancement of its people.
Energy balance	There is only one diesel power station, Cul de Sac Power Station, whose total install capacity is approximately 86MW and the peak demand is approximately 58MW.
Domestic energy resources	National resource assessments will be performed in order to derive the technically and economically available indigenous energy resources that could be explored either for local use or for export. These results will enable the subsequent adjustment quotas for the contribution of realistic, cost-effective, competitive and affordable alternative energy generation as a fraction of the national electricity matrix. Alternative energy sources in this context include, among others: geothermal energy, wind energy, solar energy, waste energy, biomass energy, and hydropower, as well as technologies that may become commercially mature in the future.
Energy imports	Saint Lucia is a net importer of fossil-based energy, with the power and transport sectors relying exclusively on imported oil derivates. All economic sectors have been affected by increasing oil prices in recent times. This has also had negative impacts on the country's balance of trade. The effects of energy supply interruptions and oil price shocks on economic performance are therefore of major concern, given the island's almost complete dependence on imported energy. The Government will undertake all efforts to diversify the sources of petroleum supply to make the nation less vulnerable in the event of a disruption in the supply of oil and oil derivatives. In this regard, the Government's foreign trade policy will seek to strengthen bilateral relations with energy-supplying countries within, and outside of, the

	region and establish medium- and/or long-term agreements.

2.2 Electric Power Industry

General feature of power industry	Most of electricity generating capacity in St. Lucia is thermal-based, using diesel fuel. In addition, small scale roof-top type solar power generating systems are installed. St. Lucia Electricity Services Limited (LUCELEC) supplies electricity to the whole of St. Lucia, and it is only the electric power utility company in St. Lucia. LUCELEC is a private company, a part of which shares are owned by the government. LUCELEC has one diesel power stations (Sans Souci Power Station)of which total capacity is 88MW, and all transmission lines of which voltage is 66kV, six (6) 66kV substations and all distribution facilities are owned by LUCELEC. The six (6) 66kV substations are connected through 66kV transmission lines to closed loop grid, and the distribution lines go out of the substations. The power grid is controlled by the Control Center in Sans Souci Power Station. The Control Center sends its instruction such as output or voltage to the diesel power stations by phone calls. The equipment in the power station can be controlled from the control room of the power station. Additionally, the switchgear in the substations can be controlled from the Control Center. Although 100kW small scale PV generating systems (roof-top type) including the public sector and the private sector are connected to the power grid currently, there have been no problems with grid stability because the total installed capacity of the PV generating systems are small compared to the capacity of the power grid.
Electricity tariff	The Regulatory Commission will ensure that the electricity tariff is designed to reflect: (a) The full costs of producing electricity, including duties and taxes, on a non-discriminatory basis to all consumers of electricity; (b) Indexation of fuel cost fluctuations; (c) Adjustments for inflation based on a retail price index minus an incentive factor for productivity improvements; (d) The long-run marginal cost of supply to each consumer category, each supply voltage level and the cost of supplying capacity and energy to consumers at different times of day, etc.;

	The average energy tariff is approximately US$0.20 per kWh without fuel surcharge.
Electricity demand	Peak power demand in St. Lucia was 60.2MW three years ago, but current peak power demand is 58MW. The reason why peak power demand decreased is improved energy efficiency. Peak power demands occur at daytime (11am-2pm) and nighttime (6pm-7pm).
Current issues	Power Loss: Approx. 8.8% LUCELEC already has conducted power loss improvement program.
	Load Factor in Distribution Transformer: Approx. 40% 

2.3 Renewable Energy

Photo Voltaic	Current situation The government installed twenty-two (22) small scale roof-top PV generating systems on public buildings as a pilot project to verify a business model on introduction of such PV generating systems. Besides the above, small scale roof-top type PV generating systems were installed on private buildings by private sector. Power utility has a plan to install 5MW PV generating systems in the south area of the island (Vieux Fort). Potential/Future plan Potential of solar power is estimated to be approximate 18-20 MW. The government has a plan to install 3MW PV generating system. This plan will be proposed to Carbon War Room, an NGO, in the near future. In addition to the above, the government has a plan to install 75kW roof-top PV generating systems on public buildings.
Wind Power	Current situation No wind power plant is installed currently. Potential/Future plan The government has a plan to install 12-15MW wind power plant, but the details are not yet decided. The land required for construction of wind power plants is difficult to obtain due to high prices. Most such lands are privately-owned.
Small Hydro Power	Current situation No hydropower plants are installed currently. Potential/Future plan The government has no plan to develop hydropower because the development of hydropower requires construction of dams and has social and environmental impact. On the other hand, the government considers potential of hydropower in the form of micro hydro power utilizing canals for agriculture irrigation, but specific plans have not been made.

Geothermal Power	Current situation One installation candidate point for a geothermal plant, Soufriere, has been surveyed. However, the government has not evaluated its commercial potential. Potential/Future plan Potential of geothermal power is estimated to be approximately 30MW. The government intends to develop geothermal power as a base load power source.
Biomass Power	Current situation No biomass power is installed. Potential/Future plan According to the study by the government, the scale of biomass power is estimated to be too small to be commercially viable. The government is studying potential of bio fuel generated from agricultural wastes.
OTEC (Oscan Thermal Energy Conversion)	Current situation The government does not have a plan to install OTEC plant currently. Potential/Future plan Potential of OTEC is considered to exist in the west coast area, especially in Soufriere. Considering the power demand in St. Lucia, the installed capacity of OTEC plant is limited up to approximate 10MW. Therefore, collaboration between OTEC plant and other industries such as agriculture and marine culture is required to improve its economic efficiency.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in St. Lucia

St. Lucia Electricity Services Limited (LUCELEC)

The first smart meters were installed 7 years ago. Approx.35,000 units have now been installed for approx.63,000 customers.

LED lights have been installed into All LUCELEC buildings.

LUCELEC plans to participate to exchange to LED Street Light as ESCO.

LUCELEC already has conducted power loss improvement program (Power loss: approx. 8.8%).

Governmental activities

Gov. already has installed LED lights in 2 Gov. buildings (Ministry of Infrastructure, NEMO (National Energy Management Office)). Gov. continues to install LED lights in all other Gov. buildings.

50 street lights already have been exchanged for LEDs by Gov. budget.

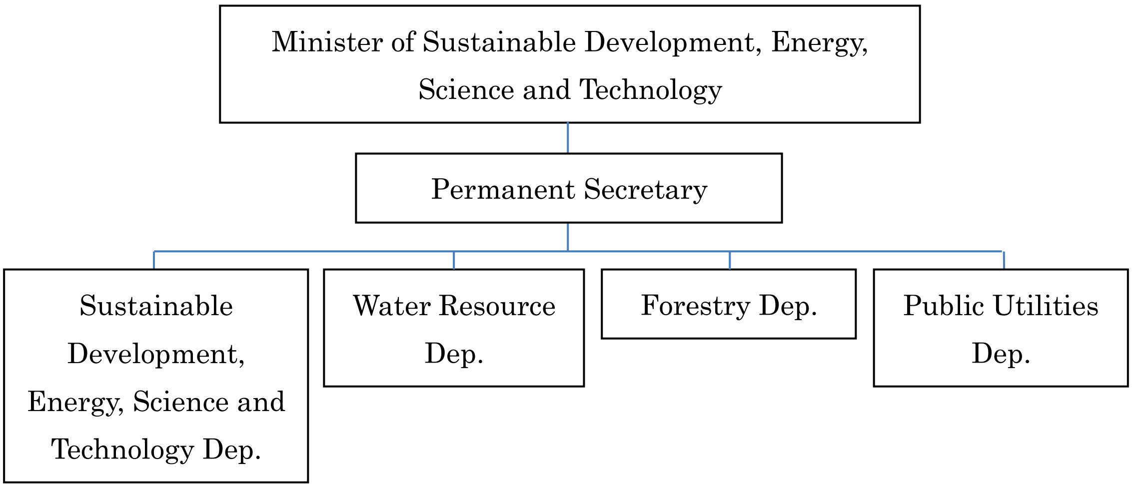
2.5 Governmental Policy

Renewable Energy	National Energy Policy "As a first target, quotas will be set in such a way that at least 5% of the electricity generated in 2013, and at least 15% in 2015, will originate from renewable energy sources. The quota should reach at least 30% by 2020." However, based on the interview with Ministry of Sustainable Development, Energy, Science and Technology, the target was changed to "at least 35% by 2020. "
Energy Efficiency	In National Energy Policy, specific numerical target is not mentioned. However, based on the interview with Ministry of Sustainable Development, Energy, Science and Technology, the target is to reduce 20% energy consumption by 2020.

2.6 Related Organization

[Ministry of Sustainable Development, Energy, Science and Technology]

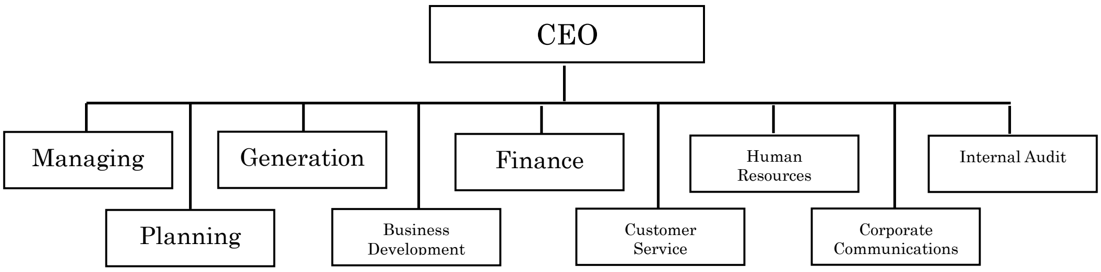
The minister of Sustainable Development, Energy, Science and Technology has the permanent secretary which supervises departments, Sustainable Development Energy, Science and Technology, Water Resource, Forestry and Public Utilities. Each department has chief officer as its top.



[St. Lucia Electricity Services Limited (LUCELEC)]

The Lucia Electricity Services Limited (LUCELEC) is a private utility since 1994 but the government is one of the shareholders. It has Chief Executive Officer which has several departments such as Managing, Planning, Generation, Business Development, Finance, Customer

Service, Human Resources, Corporate Communication, and Internal Audit. As for Generation department, Chief Engineer is the top of the department.



2.7 Donor Activities

OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
GIZ	EE Labeling System
Chinese Gov.	Establishment of Cricket Stadium
Private Company	- Study on 3MW Solar Farm

Saint Vincent and the Grenadines

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Kingstown		
Largest city	Kingstown		
Government	Monarch	Elizabeth II	
	Governor-General	Frederick Ballantyne	
	Prime Minister	Ralph Gonsalves	
Area	Total (km2)	389	
	Water (%)	Negligible	
Population	2013 estimate	103,000	
	Density (/km2)	307	
GDP	PPP 2011 estimate	Total	$1.259 billion
		Per capita	$11,700
	Nominal 2011 estimate	Total	$695 million
		Per capita	$6,342
Independence	From the United Kingdom on 27 October 1979		
Currency	East Caribbean dollar		
Politics	The politics of Saint Vincent and the Grenadines takes place in a framework of a parliamentary democracy. Saint Vincent and the Grenadines is an independent Commonwealth realm. The prime minister is a leader of the majority party of the House of Assembly, and the cabinet conducts affairs of		

	state. The Governor-General exercises ceremonial functions, but reserve powers, under the constitution, can be used at the Governor General's discretion. The parliamentary term of office is five years, although the prime minister may call elections at any time. ○Executive branch As the head of state, Queen Elizabeth II is represented by a governor general who acts on the advice of the prime minister and the cabinet. ○Legislative branch The House of Assembly has 21 members; 15 members elected for a 5-year term in single seat constituencies and 6 appointed senators. ○Political parties Saint Vincent and the Grenadines has a 2-party system, which means that there are 2 dominant political parties, with extreme difficulty for electoral success of smaller parties. The major parties are the New Democratic Party and the Unity Labor Party.
administrative divisions	Administratively, Saint Vincent and the Grenadines is divided into six parishes. Five parishes are on Saint Vincent, while the sixth is made up of the Grenadine islands. Saint David Parish Saint Patrick Parish Charlotte Parish Saint Andrew Parish Saint George Parish Grenadines Parish
Major city	Kingstown Georgetown Fancy Chateau vire a

2. Energy Profile in St. Vincent and the Grenadines

2.1 Energy

Economic growth and final energy consumption	SVG's residential and commercial sectors, including the government, are the largest consumers of electricity. On the other hand, there are few industrial activities on the island, and consumption for street lighting is minimal. Total consumption went from 74.6 GWh in 1998, to 122.9 GWh in 2008—a 70% increase in 10 years.
Energy supply and sectoral use	While energy demand from all sectors increased due to economic growth and rising incomes, the transportation sector fuels the fastest-growing demand. With more than 25,382 vehicles registered in SVG in July 2009, private and public transport is the largest energy consuming sector, with 9.7 million imperial gallons of diesel and 6.4 million imperial gallons of gasoline spent in 2008. Most of the vehicles are privately owned sedans, but there is also a significant quantity of mini-vans operated by privately owned public transport business. As of 15th December 2009, there were approximately 1095 vessels operating in the waters of St. Vincent and the Grenadines/utilizing fuel from St. Vincent and the Grenadines. Of these: 50 inclusive of nine (9) local Roro passenger ships, cargo ships are registered with the Maritime Administration; 745 are fishing vessels, of which 738 are propelled by gasoline outboard engines and seven (7) are propelled by diesel engines; there is an estimated 200 private vessels of which 15 have diesel engines; and, there is an estimated 100 small commercial yachts.
Energy balance	In 2009, SVG's state-owned utility VINLEC had almost 49 MW installed capacity. There is 40.5 MW of capacity on the main island of St. Vincent: two diesel generating facilities -- Cane Hall (26.2 MW) and recently commissioned Lowman's Bay (8.7 MW) -- and three hydro power stations (Cumberland 3.7 MW, Richmond 1.1 MW, and South Rivers 0.9 MW). There are diesel fuelled units on Bequia (2.9 MW), Union Island (1.3MW), Canouan (3.1 MW) and Mayreau (180 kW). About 11.5% of VINLEC's installed capacity is hydro. Hydro capacity on St. Vincent has remained at5.6MW for the last decade or more, while diesel generation capacity grew from 20.8 MW in 1998 to 35 MW in 2007, an

	almost 70% increase. The other Grenadines islands are supplied by privately owned diesel generators. Bequia, Union Island, Canouan and Mayreau are also completely reliant on diesel power. Since hydro power is not available at full scale year-round and some diesel plants work only as back-up systems, the firm capacity is far lower, and reached only approximately 40 MW in 2009. For St. Vincent alone, the firm capacity was 32 MW, while peak demand was 20 MW in 2008, thus leaving sufficient reserve margin during most of the year. Peak demand in St. Vincent alone has risen from less than 14 MW in 1998, to 20 MW in 2008 – a 40% increase in 10 years. Peak demand in the Grenadine islands (with the exception of Mayreau) has shown similar increases. Canouan's peak demand has increased by about 60%.
Domestic energy resources	The total energy consumption (only fossil fuels) went from 64,840 Tons of Oil Equivalent (TOE) in 2002 up to ~91,000 TOE2 in 2008. Meanwhile, hydro power contributed slightly less than 2,000 TOE in 2008, i.e. the share of renewable energy (not counting non-commercial biomass, charcoal and solar thermal energy) was about 2% of total energy consumption. On St. Vincent alone, renewable energy in the form of hydro power contributed an estimated 5% to the total primary energy consumption. Diesel and gasoline provide over 90% of SVG's energy supply.
Energy supply by source and energy imports	The country is currently almost completely dependent on imported petroleum products like gasoline (for transport), diesel (transport and electricity generation), kerosene (cooking) and butane/LPG (cooking, water heating, and industry).

2.2 Electric Power Industry

General feature of power industry	Most of electricity generating capacity in St. Vincent and the Grenadines is thermal-based, using diesel fuel. In addition, small scale roof-top type solar power generating systems are installed. St. Vincent Electricity Services Limited (VINLEC) supplies electricity to the whole of St. Vincent and the Grenadines, and it is only the electric power utilities in St. Vincent and the Grenadines which is owned by the government. On St. Vincent, VINLEC has 2 diesel power stations with total installed capacity of 37MW, and 3 hydropower stations with total capacity of 5.6MW. In addition, VINLEC owns all of the island's substations, 33kV transmission lines and distribution facilities. Regarding the Grenadines, a diesel power plant is installed in Bequia, Canouan, Union Island and Mayreau respectively, and these diesel power plants are owned by VINLEC. The power grid is controlled by the grid control center owned by VINLEC. The grid control center controls the outputs of diesel power stations and hydropower plants to keep the frequency and voltage of the grid constant. One hydropower plant (Richmond) halted operations due to damage at its conduit caused by flood in December 2013. Therefore, energy generated by the hydropower plants decreased accordingly. VINLEC intends to finish rehabilitation of this hydropower plant by the first quarter of the next year. According to the government's plan, 800-900kW PV generating systems will be connected to the grid in the near future. Interconnection of such scale PV generating systems is not expected to have an impact on the grid. 175KW PV generating systems have been already installed in Bequia, where maximum power demand is 1.6MW and minimum power demand is 600-700kW. Unlike the situation in St. Vincent, hunting phenomenon occurs to the diesel generators in Bequia power plant due to output fluctuation of the PV generating system. The power loss including generation, transmission and distribution is approximate 7%.

Electricity tariff	Electricity tariffs are composed of a unit cost per kWh, a minimum base charge for domestic and commercial consumers, a demand charge for commercial and industrial customers, and a fuel surcharge per kWh, which varies monthly depending on fuel costs (in April 2006, the fuel surcharge was EC$ 0.372/kWh). In addition, a 15% Value-Added Tax (VAT) is levied on kWh consumption of over 200 units for domestic consumers, and on the total consumption for commercial and industrial consumers. As a consequence of oil price hikes, electricity tariffs increased considerably in recent years. In 2007 households paid on average EC$0.89/kWh including fuel surcharge, in 2008 this increased to nearly EC$ 1.05/kWh, i.e. the average annual household bill for electricity increased to about EC$ 1700. Due to lower fuel prices, average consumer costs for electricity have dropped to EC$ 0.85/kWh in mid 2009. For every US$ 10 per barrel of petroleum, the fuel surcharge varies by about US$ 0.02/kWh. The raise in tariff is clearly due to the fuel surcharge, which augmented from a yearly average of EC$0.09/kWh in 1998, to EC$0.52/kWh in 2008, an increase of more than 570% in 10 years. In 1998, the fuel surcharge was 15% of the full tariff paid by consumers. In 2008 it was 50%.

Domestic	Minimum Charge (0-17kWh)	EC$5/month
	50kWh or less	EC$0.425/kWh
	More than 50kWh	EC$0.5/kWh
Commercial	Minimum Charge (0-17kWh)	EC$15/month
	18-150,000kWh	EC$0.54/kWh
	150,001-200,000kWh	EC$0.513/kWh
	Over 200,000kWh	EC$0.486/kWh
Industrial	0-150,000kWh	EC$0.42/kWh
	150,001-200,000kWh	EC$0.399/kWh
	Over 200,000kWh	EC$0.378/kWh

<table>
<tr><td>Electricity demand</td><td>Peak demand is shown in the table below.
<table><tr><td>Location</td><td>Peak demand (kW)</td></tr><tr><td>St. Vincent</td><td>21,100</td></tr><tr><td>Bequia</td><td>1,600</td></tr><tr><td>Canouan</td><td>2,500</td></tr><tr><td>Union Island</td><td>550</td></tr><tr><td>Mayreau</td><td>70</td></tr></table>
The peak demand occurs 11AM to 2PM. The peak demand is estimated to be caused by air conditioners. However, VINLEC does not know the exact proportion demand from the residential, commercial and industry sectors.</td></tr>
<tr><td rowspan="4">Current issues</td><td>As mentioned in the above, hunting phenomenon occurs to the diesel generators in Bequia power plant due to output fluctuation of the PV generating systems with their installed capacity of 175kW. Therefore, some measures to stabilize output of the PV generating systems should be taken.</td></tr>
<tr><td>The Government has a plan to expand the percentage of installed capacity of renewable energy up to 60% by 2020. However, to meet this expansion plan, solar power and wind power will not be sufficient. Therefore, development of geothermal power is indispensable.</td></tr>
<tr><td>Power Loss: Approx. 7.0%</td></tr>
<tr><td>Load Factor in Distribution Transformer (1100-1200units): Approx. 70%
</td></tr>
</table>

	Regarding the Labeling System in EE, its establishment is being conducted by support of GIZ in the CARICOM countries. However, the CARICOM countries do not have certification organization and test equipment. So, the CARICOM countries do not certificate energy conservation performance of imported productions by themselves.

2.3 Renewable Energy

Photo Voltaic	Current situation The government installed 190kW roof-top type PV generating systems at public buildings and is installing 300kW ground-mounted type PV generating system in VINLEC diesel power station (Lowmans Bay). Besides the above, small scale roof-top type PV generating systems were installed at private buildings. These PV generating systems are connected to the national grid. Potential/Future plan The government has a plan to install 260kW ground-mounted type PV generating system in VINLEC diesel power station (Lowmans Bay) in addition to the 300kW PV generating system. The government has a plan to expand installed capacity of PV generating systems to 800-900kW. This installed capacity includes public sector and private sector. Considering the current situation on power supply and demand, installed capacity of PV generating systems should be limited up to 2-3MW. The government considers possibility of a hybrid system of PV generating systems and electric vehicle because 60% of imported oil fuel is consumed in the transportation sector and its energy efficiency should be improved to reduce consumption of the oil fuel.
Wind Power	Current situation No wind power plant is installed currently. The government had a plan to install two wind power plants at the south-east coast area, but this plan was cancelled because these sites are so close to the international airport that the planned size of the wind power plant had to be decreased, and its economic efficiency was also decreased.

	Potential/Future plan Potential of wind power is considered to exist at the south-east coast area, but most of land of potential area for wind power is owned by the private sector, and accordingly, acquisition of the land is costly as well as difficult from the viewpoint of social impact. The government is executing feasible study in central mountainous area.
Small Hydro Power	Current situation Three (3) hydropower plants are installed, but one of them was damaged by flood in December 2013 and has halted operations. The government does not have a plan to develop a new hydropower plant because such development has a social and environmental impact. Two (2) hydropower plants started their operations from 1952 and 1961 respectively, and the equipment in these hydropower plants is deteriorated due to aging. Potential/Future plan The government intends to finish rehabilitation of the damaged hydropower plant by the first quarter of the next year. The government intends to replace the old hydropower plant because it has operated for more than 50 years, and is deteriorating. In addition to the above, the government intends to install small hydropower systems such as an inline propeller type turbine at irrigation canals or water supply pipes because such small hydropower systems do not require construction of dam.
Geothermal Power	Current situation Potential of geothermal power is estimated to be approximate 100MW in the north mountainous area. Private companies in Canada and Iceland are going to implement feasibility study in this area in cooperation with VINLEC to verify business models regarding development of geothermal power. Potential/Future plan The government intends to develop geothermal plant as a base load power source.

	The government is establishing suitable legislation on geothermal development and studying appropriate installed capacity of a geothermal power plant. In the first stage of development of geothermal power, the government considers installation of a geothermal plant with installed capacity of 10MW. This development of geothermal power can satisfy the government's renewable energy target. Currently, PPA (Power Purchase Agreement) is being discussed among relevant parties including the government and VINLEC. In the second stage, the installed capacity of geothermal power is planned to be increased up to 100MW, and surplus generated energy is considered to be exported to other countries such as Barbados or St. Lucia.
Biomass Power	Current situation No biomass power is installed. Potential/Future plan In pre-feasibility studies, potential of biomass power is estimated to be too small to be commercially viable. There is no current plan to develop biomass power.
OTEC (Oscan Thermal Energy Conversion)	Current situation The government does not currently plant to install an OTEC plant. Potential/Future plan Potential of OTEC is considered to exist in the west coast area, especially near Kingstown. Therefore, the government intends to implement feasible study on OTEC. Considering the power demand in St. Vincent, the installed capacity of OTEC plant should limited. Therefore, collaboration between OTEC plant and other industries such as agriculture and marine culture is needed to improve economic efficiency to commercial base.

2.4 Energy Efficiency

Current energy efficiency and conservation activities in St. Vincent and the Grenadines

St. Vincent Electricity Services Limited (VINLEC)

LED Street lights (approx. 90 units) already have been installed with support from GIZ as a demonstration project, and VINLEC plans to exchange other street lights for LEDs after the demonstration project is completed.

VINLEC already has installed high efficiency equipment such as lights and AC into all of their offices.

VINLEC advises its customers to install high efficiency equipment; however, it does not conduct energy audits.

Governmental activities

Gov. already has installed LED light, central AC and SHS to Ministry of National Security as one model with support by WB. Later, Gov. plans to install LED light (by Gov.), Inverter AC (by WB) and SHS (by OAS) into 70 places such as other ministries, hospital and school and so on.

Gov. will install BEMS into Ministry of National Security by the grant of EU in 2015. Installation stage will take approx. 3 months and after it monitoring stage will start. Total duration is approx. 1 year.

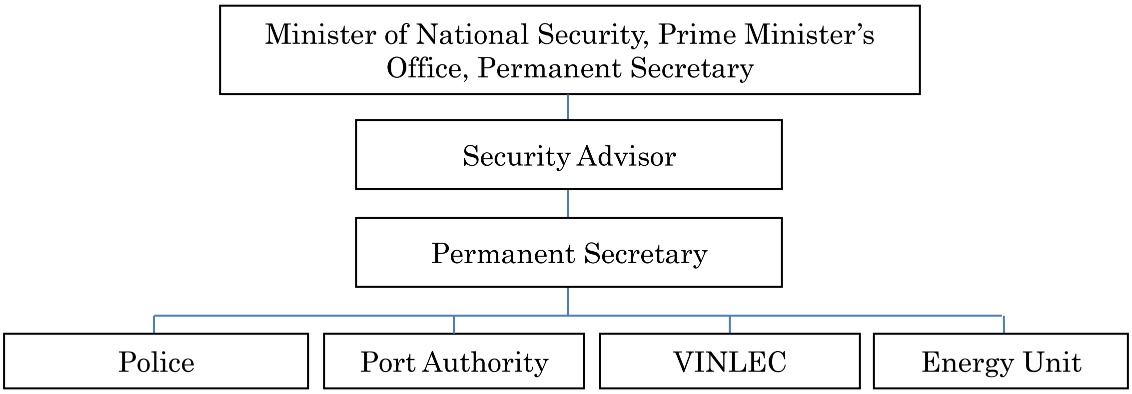
2.5 Governmental Policy

Power Sector	"Safe, efficient, reliable, affordable and environmentally friendly electricity generation and supply for all parts of St. Vincent and the Grenadines." ↓ "Reduce projected increase in peak demand by 5% by 2015 and 10% by 2020, and strive to reduce power losses down to a total of 7% by 2015 and 5% by 2020."
Renewable Energy	"Increase the utilization of renewable energy technologies on all islands of Saint Vincent and the Grenadines." ↓ "Deliver 30% of projected total electricity output from Renewable Energy by 2015 and 60% by 2020."
Energy Efficiency	"Minimized energy input and lowest possible energy intensity for all energy-related services." ↓ "Reduce projected electricity generation by 5% by 2015 and 15% by 2020."

2.6 Related Organization

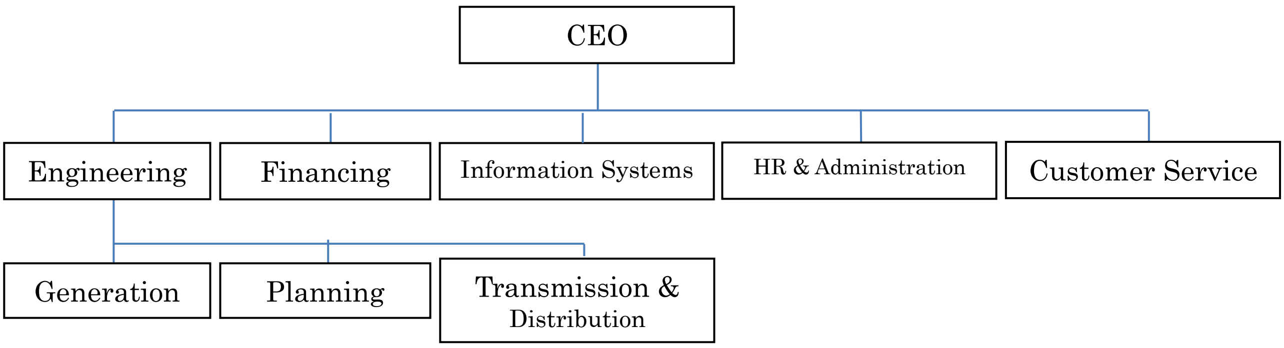
[Ministry of National Security, Prime Minister's Office, Permanent Secretary]

Ministry of National Security, Prime Minister's Office has a security advisor and permanent secretary under which there are departments such as police, port authority and energy unit. VINLEC is also one of those departments because all of its shares are wholly owned by the government. The total number of personnel is approximately 3,000 including approximately 800 for police, 200 for port authority and 1,000 for VINLEC. The Prime Minister concurrently holds the post of minister of this ministry.



[St. Vincent Electricity Services Limited (VINLEC)]

St. Vincent Electricity Services Limited (VINLEC) is a public utility whose shares are wholly owned by the government. Under CEO, there are 5 departments such as Engineering, Financing, Information Systems, HR & Administration and Customer Service. Technically speaking, Engineering department has Generation, Planning and Transmission & Distribution divisions.



2.7 Donor Activities

OAS	- Creation of National Energy Policy under the scope of the Caribbean Sustainable Energy Program(CSEP)
WB and OAS	- Gov. plans to install LED light (by Gov.), Inverter AC (by WB) and SHS (by OAS) into 70 places such as other ministries, hospital and school and so on.
EU	BEMS will be installed into the Ministry of National Security in 2015.
GIZ	EE Labeling System Approx. 90 LED street lights already have been installed with VINLEC
Private Company (EMRE)	- VINLEC and EMRE are conducting a feasibility study on Geothermal.

<u>**Republic Suriname**</u>

1. General

Flag and coat of arms	 		
Official languages	Dutch		
Capital city	Paramaribo		
Largest city	Paramaribo		
Government	President	Dési Bouterse	
	Prime minister	-	
Area	Total (km2)	163,270	
	Water (%)	1.1	
Population	2013 estimate	566,846	
	Density (/ km2)	2.9	
GDP	PPP 2011 estimate	Total	$5.060 billion
		Per capita	$12,398
	Nominal 2011 estimate	Total	$3.790 billion
		Per capita	$8,853
Independence	From the Netherlands on 25 November 1975		
Currency	Surinamese dollar		

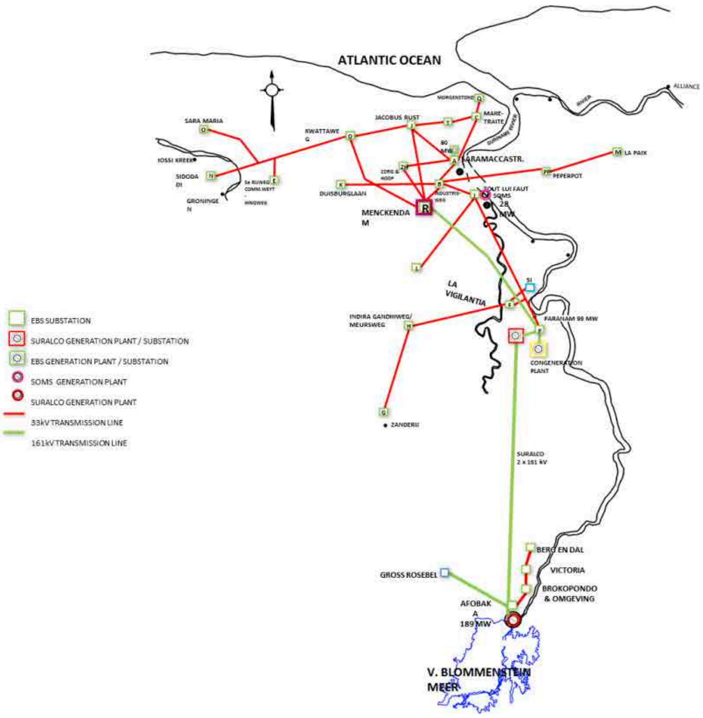
Administrative divisions	The country is divided into ten administrative districts . 1.Brokopondo 2.Commewijne 3.Coronie 4.Marowijne 5.Nickerie 6.Para 7.Paramaribo 8.Saramacca 9.Sipaliwini 10.Wanica	

2. Energy Profile Suriname

2.1 Energy

ECONOMIC GROWTH AND FINAL ENERGY CONSUMPTION	Suriname's GDP has been growing about 5% per year in real terms for the past decade. Its economy is nearly twice as energy intensive as the regional average, due primarily to aluminum refining and gold mining activities. Suriname produced 440 billion Btu of primary energy in 2011, and consumed 350 billion Btu.
ENERGY SUPPLY BY SOURCE	Suriname produced 15,270 barrels of oil per day in 2013, consumed 14,520 barrels, and exported 760 barrels. There is no domestic coal or natural gas production.
ENERGY SUPPLY AND SECTORAL USE	Electricity consumption in 2011 was 48% residential, 33% industrial and large commercial, 15% small commercial, 2% street lighting and 2% other.
DOMESTIC ENERGY	Suriname produces oil from land-based wells. Offshore sites have not yet been explored. A 160MW hydropower facility owned by ALCOA, a

RESOURCES	US aluminum company, supplies ALCOA's own operations and about half of the country's electricity needs. Domestically-produced heavy fuel oil is used to power another 100MW of generation operated by the state-owned electric utility and oil company. Wood waste and rice husks could provide energy, but are mostly not used.
ENERGY IMPORTS	Essentially no energy imports.
National Energy Policy	Suriname provides free electricity to its indigenous Amerindians, and subsidized electricity to everyone else. There are no real incentives for renewable energy or energy efficiency. Low hydro levels in 2014 due to cyclical El Nino patterns recently led to brownouts and calls for energy conservation. The government is now considering an electricity tariff increase for the first time in many years. Plans for new large-scale generation are apparently focused on coal and LNG.



2.2 Electric Power

General Feature of Power Industry	Power Demand	273MW in 2013 = Sulalco Hydro（180MW）+ Saatsoile（15MW）+ Suraico（78MW）
	Power Development	Grankiki Hydro Project Jai-Tapanahony Diversion Kabalebo Hydro-Power Project
	Network Development	The surroundings of Paramaribo are interconnected by the Electricity Supply Paramaribo and Surroundings (EPAR) grid. The smaller Electricity Nieuw-Nickerie (ENIC) system exists in the west of the country near Nieuw-Nickerie.
	Power Supply Coastal Area	Energy Bedrijven Suriname (EBS) supply EPAR system (Energy Paramaribo) which is 82MW about 80% of all national population. The smaller towns (Albina, Moengo, Boskamp, Coronie, Wageningen, and Apoera) are supplied by local diesel plants. About 79% of the total population in Suriname receives electricity from the grid.
	Power Supply Interior Area	These units are owned and operated by the Rural Electrification Agency, named, Dienst Electrificatievoorziening (DEV), which depends on the MNH. About 100 of these villages are provided with diesel fuel by DEV. The population in the Hinterlands served by diesel generators with a capacity of 4,500-kiloWatts (kW) is estimated at approximately 30,000 people in 217 villages. The electricity supply is restricted to up to 6 hours per day. All costs associated to the electricity service provided by DEV are covered by government. The average cost of diesel-generated electricity is estimated at US$0.63 per kWh, of which US$0.41 per kWh for diesel fuel.
	Electrification Rate	The no served population in the Hinterlands is around 75,000 people. The overall electrification rate in Suriname is estimated at 85%

<table>
<tr><td></td><td>Distribution Loss</td><td>About 10%, no power preferege
Upgrade of distribution voltage was studied but stopped because of the economical reason.</td></tr>
<tr><td>Current Problems</td><td colspan="2">The increasing demand for energy
The amount to demand in2014 (260 MW) will reach to 380MW in 2020

Low energy security through low supply due to low generation capacity
Depend on the one big hydro power Sulalco Hydro but it is not enough during dry season from August to October.

No cost-effective energy rates
The electricity tariffs are not cost-effective. The costs for generating and transporting a kWh are much more above the rates charged by the EBS. This will result in insufficient fund. To investigate this effect, the Government in this planning period measures to gradually move from object to grant a much more efficient system.

For the measurements against above mentioned problems, the national energy policies are conducted as follows,
To ensure reliable electricity supply.
The Government places high priority on availability of sufficient power and energy at any time;
Provide affordable electrical energy.
The Government is working to an electricity supply industry, with affordable rates and cost recovery;
Pursue a national facility.
The Government aims to increase generation, transmission and distribution capacity, so that both the coastal plain and inland reliable and affordable electric power is available.

The Government will opt for a pragmatic approach with seven (7) priorities:
1. the construction of thermal power stations in order to improve the national availability;
2. the construction of hydroelectric plant to realize the short and long term affordability;
3. the expansion of transmission and distribution facilities to reduce the losses</td></tr>
</table>

	4. the introduction of a tariff system based on the cost recovery 5. the strengthening the institutional framework to improve efficiency in the sector; 6. the encouragement and support rational energy use and energy saving projects; 7. The promotion of alternative energy in the context of increasing energy security. Additionally, rural electrification initiatives using RE technologies were mostly unsuccessful as a result of improper design, O&M failures and a general lack of follow-up due to internal conflicts.

2.3 Renewable Energy

Wind	Wind speed measurement towers are installed in Nickerie and Galibi in cooperation with CREDEP, Caricom Renewable Nergy Development Program. Wind measurements have been limited to low heights of 30m. The east coast of the Brokopondo Reservior is the good site to install small type of wind turbines
PV	Irradiation is in Suriname is high about 5 kWh/m2day by the research in Flemish University. The Anton de Kom University (Adek) is measuring the solar intensity in the interior area. There are few examples of renewable energy technologies in Suriname, mostly financed by the Dutch Government. The PV project in the Amerindian village Kwamala Samutu supplied electricity to 140 people and a school, refrigeration units, and radio for communication.
Biomass	There are three potential to have F/S in Suriname. 1_ Rice husk mill generator at 4MW in Nickerie, 2_Sugarcane power plant at several MW in Wageningen 3_Bio waste to energy power plant in 10MW
Geo thermal	No potential
Small/mini Hydro	a mini hydro plant (700-kW) is being constructed at Gran Holo Sula Puketi 40Kw: In Puketie, a 40-kW hydro plant was built in 1979-1981, but went down 4 years later as a result of inadequate maintenance. Panato 20kW is also planned and waiting for developments.

2.4 Energy Efficiency

Policy, regulatory and institutional frameworks	There are no standards, regulation or laws and mechanism of efficient energy use in Suriname. There is no official agency in Suriname responsible for energy efficiency issues. There are no regulatory entities or energy service companies (ESCO) in Suriname	
Energy efficiency measures	Installing efficient bulbs in the residential sector Only mobiles that are less than five years old may be imported	
Key actors in the energy efficiency and their effective roles	Ministry of Natural Resources	Responsible for the overall energy policy
	State Power Company (NV-EBS)	Own policy to promote energy efficiency (Replacing diesel by heavy gas oil/ Reducing losses in transmission and distribution)
	Universities	Anton de Kom University of Suriname
Since there is no national energy efficiency program in operation or being designed, it is impossible to determine what quantity of resource would be required to develop such a program.		

2.5 Donor Activities

IDB	"Introduction of Sustainable Business Models in Suriname Rural Electrification," US$1.7 million project, start date September 2012
IDB	"Support for the Preparation of the Sustainable Energy Framework," US$700,000 project, start date October 2012
IDB	"Support to the Institutional and Operational Strengthening of the Energy Sector," US$15 million project, start date November 2012

Republic of Trinidad and Tobago

1. General

Flag and coat of arms	 		
Official languages	English		
Capital city	Port of Spain		
Largest city	Chaguanas		
Government	President	Anthony Carmona	
	Prime minister	Kamla Persad-Bissessar	
Area	Total (km2)	5128	
	Water (%)	Negligible	
Population	2014 estimate	1,223,916	
	Density (/ km2)	254.4	
GDP	PPP 2013 estimate	Total	$28.414 billion
		Per capita	$21,287
	Nominal 2013 estimate	Total	$26.711 billion
		Per capita	$20,056
Independence	From the United Kingdom on 31 August 1962		
Currency	Trinidad and Tobago dollar		

Administrative divisions	

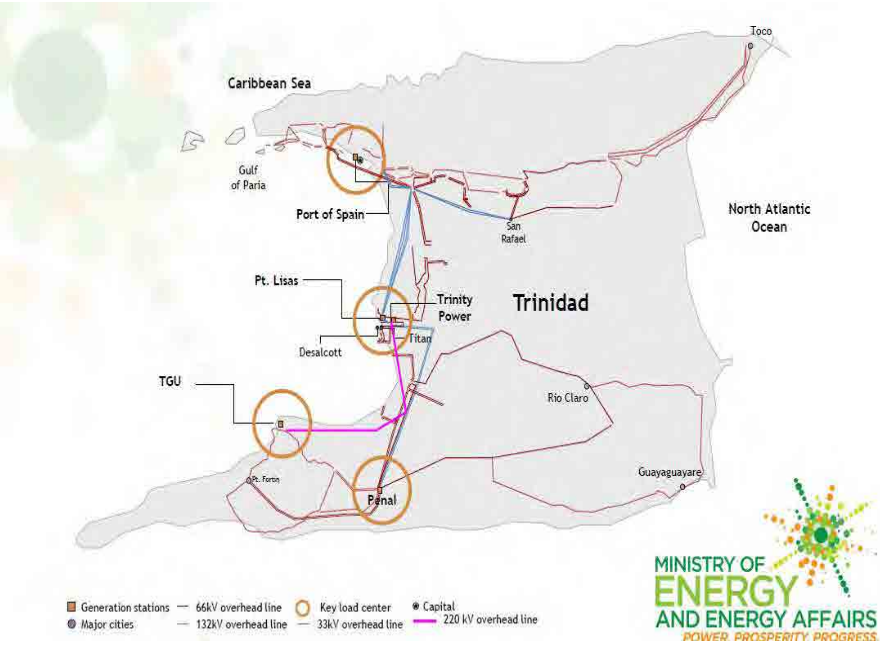
2. Energy Profile in Trinidad and Tobago

2.1 Energy

ECONOMIC GROWTH AND FINAL ENERGY CONSUMPTION	Real GDP growth in 2013 was 0.5%; nominal growth was 6.1%
ENERGY SUPPLY BY SOURCE	Primary energy consumption in 2010 equaled about 21 million tons of oil equivalent; of which about 90% came from natural gas, and 10% from oil. Essentially all electricity is produced with fossil fuels using domestic reserves. About 99% of electricity in 2011 was generated with natural gas; diesel powered the remaining 1%
ENERGY SUPPLY AND SECTORAL USE	Natural gas utilization by sector, 2013: liquefied natural gas for export 57%; ammonia production 14%; methanol production 14%; power generation 8%; iron and steel production 3%; other 4%
DOMESTIC ENERGY RESOURCES	Natural gas, oil
ENERGY IMPORTS	None
National Energy Policy	Policies to encourage renewable energy and energy efficiency have been in place for several years. A comprehensive policy framework has been drafted and is being finalized for public consultation. In addition to addressing renewable energy and energy efficiency, the policy framework also includes support for compressed natural gas as a transportation fuel.

2.2 Electric Power Industry

Outline	【Key note】 ・Distribution facilities reaches the same level of Japan, utilizing abundant capital funding from oil resource. ・The level human resource of engineers are relatively high. 【Facilities】 ・As power sources locate near consuming regions in the narrow land, the system configuration is quite ideal. ・Network facilities of high level 1) High SAID by transforming SCADA and distributing Recloser (System Average Interruption Duration Index (SAIDI):30 Mins) 2) Automatic reading meter: 95% Adoption rate 3) Distribution loss: 8%	
Total installed Capacity	1,829MW Peak lad: 1,121MW Natural gas of T&T is directly utilized to power generation.	
Total electricity consumption in 2007	7,034 billion kWh	
Transmission line	Trinidad and Tobago are connected by two submarine cables of 33 kV. Though one cable is broken down and not use. It makes possible to increase the additional transmitting capacity by 40 MW.	
Growth rate	Electricity consumption from 2003 to 2008 grew annually 4.4% 6,088GWh to 7,544GWh	
Sector-wise	Industry	64%
	Residential	26%
	Commercial	10%
Tariff	US$0.04～0.05kWh (Refer: Attachment)	
	Renewable energy：US0.03kWh	
Electrification rate	Over 97%	


Caribbean Sea
Gulf of Paria
Port of Spain
San Rafael
North Atlantic Ocean
Toco
Pt. Lisas
Trinity Power
Trinidad
Desalcott
Titan
TGU
Rio Claro
Pt. Fortin
Penal
Guayaguayare
Generation stations
Major cities
66kV overhead line
132kV overhead line
Key load center
33kV overhead line
Capital
220 kV overhead line
MINISTRY OF ENERGY AND ENERGY AFFAIRS
POWER. PROSPERITY. PROGRESS.

2.3 Renewable Energy

【Target】

Setting a target of 60 MW of generation by RE by 2020;

That is 5% of the present peak demand

1) Wind energy

2) Solar energy

3) Waste to energy

To achieve this target, this measurement proposed.

Establishment of a Renewable Energy (RE) and Energy Efficiency Agency

Conducting a study to examine the potential for local wind resources

Conducting a feasibility study for a demonstration wind power generation project

【Dissemination Regulation】

25% Tax Credit on Solar Water Heaters (SWH)

0% VAT on SWH& Solar PV Systems

Wear & Tear Allowance on 150% of cost of acquisition of SWH; SWH Plant , Machinery and Equipment & Solar PV Systems

Conditional Duty Exemptions for SWH Manufacturers

0% VAT on Wind Turbines

Wear & Tear Allowance on 150% of cost of acquisition of Wind Turbines and supporting equipment

Solar	【Current Situation】 The result of the study not only the cost barrior、it is difficult to get a large land area (2 to 4 hectares per megawatt). 【Future Challenge 】 Researching household solar photovoltaic (PV) technology is conducted to have opportunities for small scale applications. PV for off-grid supply to provide backup power for various uses e.g. security lighting and emergency radio systems.
Wind	【Current Situation】 According to F/S, 20 MW wind plant could require an area of approximately 5 km2 (500 hectares). Land acquisition is the barrier Conducting a study to examine the potential for local wind resources to demonstrating large scale wind power generation project. 【Future Challenge】 feasibility study for wind power generation for electrification of a

	community based project
Biomass City Waste	【Current Situation】 R&D is conducting waste to energy technologies; however, it would require a program for waste segregation to be a viable option. 【Future Challenge】 System for waste segregation which would allow for the use of suitable waste products for power generation including gasification

2.4 Energy Efficiency

Measures of energy efficiency and conservation focused by T/T government
Replacement of incandescent light bulbs with efficient compact fluorescent models
Approximately 75% less power
Phase out the use and importation of incandescent bulbs

Possible Savings from Replacing 10 60W Incandescent Bulbs with CFL

	10 60W incandescent bulbs	10 equivalent CFL	Savings
Bi-monthly usage (kWh)	360	90	270
Bi-monthly bill at $0.25/kWh	$90.00	$22.50	$67.50
Annual bill for lighting	$540	$135	$405
Aggregate annual lighting bill for 314,480 domestic customers	$169,819,200	$42,454,800	$127,364,400

Source: University of the West Indies, Engineering Institute 2009

Introduction of LED light bulbs
More energy efficient than compact fluorescents
Replace incandescent bulbs with compact fluorescent or Light Emitting Diode (LED) lighting
Introduction of Energy Labelling (ENERGY STAR® Program of the USA)
Voluntary base
60 product categories including major appliances, office equipment, lighting, and home electronics
Promote the use of energy-efficient appliances

Possible Savings from Replacing Standard Appliances with ENERGY STAR® Qualified Ones

	Standard Appliances	ENERGY STAR® Appliances	Savings
Bi-monthly usage (kWh)	1129.4	951.95	177.45
Bi-monthly bill at $0.25/kWh	$282.35	$237.99	$67.50
Annual bill	$1,694.10	$1,427.93	$266.18
Aggregate annual bill for 314,480 domestic customers	$532,760,568.00	$449,053,854.00	$83,706,714

Implementation of green building codes

Internationally recognized standard for building efficiency (Leadership in Energy and Environmental Design (LEED) green building certification)

Establish new energy efficient design standards for buildings

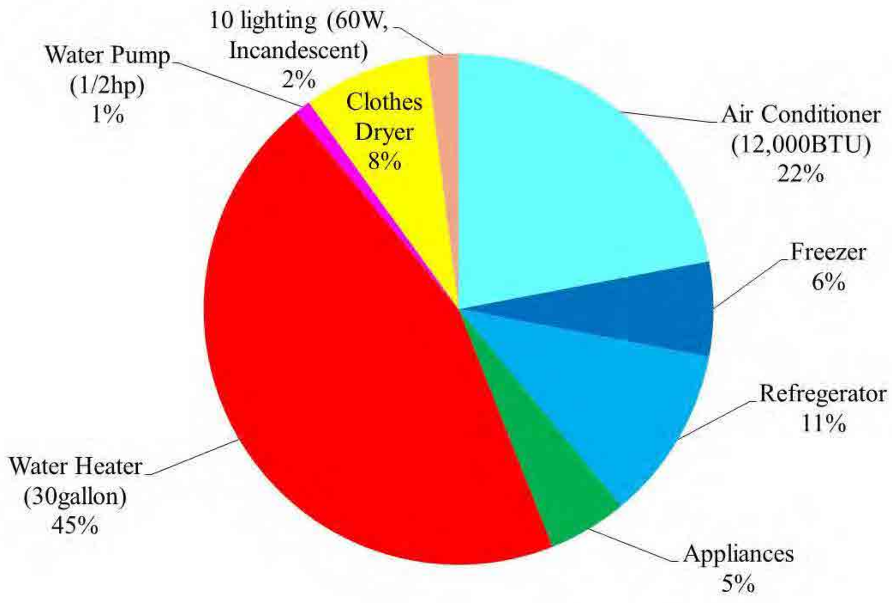
Insulated windows, doors and walls

Solar water heaters with insulated hot water pipes

Promote energy-efficient life-styles

Natural ventilation and cooling instead of power-consuming air conditioning units

Breakdown of Major Electricity Consumption in a Typical Household



Source: Ministry of Energy and Energy Affair, January 2011"FRAMEWORK FOR DEVELOPMENT OF A RENEWABLE ENERGY POLICY FOR TRINIDAD AND TOBAGO"

Finance Act No. 13 of 2010 regarding to ESCO

Energy Efficiency
150% TAX Allowance for the design and Installation of energy saving systems by an Energy Service Company
ESCO can write off value of assets in two years: 75% Depreciation on plant, machinery and equipment acquisition; 25% Wear & Tear allowance in the following year.

2.5 Donor Activities

United Nations Environment Program (UNEP)	development of Framework for Feed in Tariffs policy instruments to incentivise renewables Amendment of two act as follows, T&TEC Act and Regulated Industries Commission (RIC) Act,)
IDB	Assisted Sustainable Energy Program (SEP) loan agreement with IDB the development of a Sustainable Energy Framework.(2012/11/30-2014/07/08) Energy Audits for 8 selected Government buildings $2.8 M Trust Fund by GEF(local social housing sector)
United States Department of Energy (USDOE)	Establishment of a Regional RE Research Center.(2013/05) the procurement of services of a consultant will be undertaken
International Renewable Energy Agency (IRENA)	Become the member in February 15th 2014 capacity building, technical and policy support
University of the West Indies (UWI)	National Wind Recourse Assessment Program (WRAP) in August 2012 Area Identification, Wind Resource Evaluation
SiTeK Ltd (International consortium)	Solar Industrial Development Plan (Solar Park)

Preliminary Calculation on Project Costs for Various Technologies

In this Chapter, we provide a preliminary cost-benefit analysis only for each project. For example, returns are based on the avoided cost of diesel fuel offset by newly installed renewable generation.

I. Antigua and Barbuda

a. Country Financial Summary

1. Credit Ratings:

Moody's:	(not rated)
S&P:	(not rated)

2. Interest Rates:

Overnight lending:	(not available)
10-Year Bond:	(not available)

3. Currency

East Caribbean Dollar (ECD)

Exchange Rate (Sep 2014): 1 US$ = 2.7 EC$

The ECD has been at USD1 = ECD2.70 since 1976.

4. GDP

PPP	US$1.579 billion (2012 estimate)
Per capita	US$18,026
Nominal	US$1.176 billion (2012 estimate)
Per capita	US$13,428

5. Retail Electricity Tariff

Domestic	Minimum Charge	EC$25
	Consumption Charge	
	Up to 300kWh	EC$0.40/kWh
	Over 300kWh	EC$0.38/kWh
Commercial	Minimum Charge	EC$45
	Monthly Demand Charge	EC$8/kVA
	Consumption Charge	
	100kWh of demand	EC$0.45/kWh
	250kWh of demand	EC$0.42/kWh
	All remaining kWh	EC$0.38/kWh

3MW and 5MW Solar Power Project

a. Technical Assumptions

1. Technology: Solar PV (polycrystalline solar panels)
2. Capacity: 3MW and 5MW
3. Project Lifespan: 20 years
4. Annual production decline: 0.5%
5. Availability: 16%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 10.9 million (3MW)
     USD 17.5 million (5MW)
   - Avoided cost (revenue): USD 0.378/kWh

2. O&M: USD 15/MWh

Assmptions (3MW)

Capacity (kW)	3,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	10,900,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	1,200,000
Avoided Cost of diesel (USD/kW)	0.378

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Assmptions (5MW)

Capacity (kW)	5,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	17,500,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	2,000,000
Avoided Cost of diesel (USD/kW)	0.378

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category (3MW)	% of Installed Cost	Cost (USD)
Modules	45%	4,851,000
Structures	26%	2,871,000
Inverters	7%	792,000
Power System Control Apparatus	9%	1,000,000
Balance of Plant	6%	693,000
EPC:	2%	198,000
Owner’s Cost:	5%	495,000
Total	100%	10,900,000

Category (5MW)	% of Installed Cost	Cost (USD)
Modules	46%	8,085,000
Structures	27%	4,785,000
Inverters	8%	1,320,000
Power System Control Apparatus	6%	1,000,000
Balance of Plant	7%	1,155,000
EPC:	2%	330,000
Owner’s Cost:	5%	825,000
Total	100%	17,500,000

3. Project returns

<u>3MW Project</u>

- Payback period:
  - 100% Equity — Profitable from seventh year
- IRR:
  - Equity IRR — 14%

<u>5MW Project</u>

- Payback period:
  - 100% Equity — Profitable from seventh year
- IRR:
  - Equity IRR — 15%

<u>Wind Power Project</u>

a. Technical Assumptions

Installed cost assumption of US$2,500 / kW is higher than recent US average of less than US$2,000 / kW. Capacity factor is set at 20%

1.	Technology:	On-shore wind-turbines
2.	Capacity:	3 MW
3.	Project Lifespan:	20 years
4.	Capacity factor:	20%
5.	Availability:	95%

b. Preliminary Financial Analysis

1. Costs
   - Installed cost: USD 8.5 million
   - Avoided cost (revenue): USD 0.378/kWh

2. O&M: USD 10/MWh

Assmptions

Capacity (kW)	3,000
Installed Cost (USD/kW)	2,500
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	8,500,000
O&M (USD / MWh)	10
Avoided Cost of diesel (USD/kW)	0.378

Capacity Factor	20%
Availability	95%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wind Turbine	60%	5,100,000
Distribution	9%	750,000
Power System Control Apparatus	12%	1,000,000
Balance of Plant	11%	975,000
EPC:	4%	300,000
Owner's Cost:	4%	375,000
Total	100%	8,500,000

3. Project returns

- Payback period:
  - 100% Equity Profitable from fifth year
- IRR:
  - Equity IRR 23%

Energy Efficiency Project Amorphous Transformer Installation

a. Technical Assumptions

1. Technology: Amorphous metal transformer (AMT)
2. Units: 1,050
3. Project Lifespan: 30 years
4. Annual energy production: 338 GWh
5. Distribution loss benefit: 17%

b. Preliminary Financial Analysis

1. Costs

    - Installed cost: USD 4.8 million
    - Avoided cost (revenue): USD 0.378/kWh

2. O&M: USD 350/unit/year

Assmptions

Potential Number of Units	1,050
Installed Cost (USD / Unit)	4,600
Total Installed Cost (USD)	4,830,000
O&M (USD / Unit)	350
Avoided Cost (USD / kWh)	0.378

Rate of Saving	17%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Transformers	70%	3,381,000
EPC	30%	1,449,000
Total	100%	4,830,000

3. Project returns

    - Payback Period
        - 100% Equity Profitable from ninth year
    - IRR
        - Equity IRR 15%

II. Barbados

a. Country Financial Summary

1. Credit Ratings

Moodyt : Ba3

S&P : BB-

2. Interest Rates (Sep. 2014):

Overnight lending: 3.40% (Estimated)

10-Year Bond: 9.25% (Estimated)

3. Currency

Barbadian Dollar (BBD)

Exchange Rate: 1 USD = 2 BBD

The present dollar was created after the establishment of the Central Bank of Barbados replacing the East Caribbean dollar in 1973. Since 1975, the Barbados dollar has been pegged to the US dollar at USD1 = BBD$2

4. GDP

PPP $7.053 billion (2013 estimate)

Per capita $25,100

Nominal $4.490 billion (2012 estimate)

Per capita $16,151

5. Retail Electricity Tariff

Domestic	Customer Charge *Customer's 30-day average kWh consumption over the previous 12 months	0-150kWh	BB$6/month	Base Energy Charge	First 150kWh	BB$0.15/kWh
		151-500kWh	BB$10/month		Next 350kWh	BB$0.176/kWh
		Over 500kWh	BB$14/month		Next 1,000kWh	BB$0.2/kWh
					Over 1,500kWh	BB$0.224/kWh
General	Customer Charge *Customer's 30-day average kWh consumption over the previous 12 months	0-100kWh	BB$8/month	Base Energy Charge	First 100kWh	BB$0.184/kWh
		101-500kWh	BB$11/month		Next 400kWh	BB$0.217/kWh
		Over 500kWh	BB$14/month		Next 1,000kWh	BB$0.259/kWh
					Over 1,500kWh	BB$0.29/kWh
Large Power	Customer Charge	BB$300/month	Demand Charge	BB$22/kVA	Base Energy Charge	BB$0.117/kWh

<u>**3MW and 5MW Solar Power Generation Projects**</u>

a. Project Technical Assumptions

1. Technology: Solar PV (polycrystalline solar panels)
2. Capacity: 3MW and 5MW
3. Project Lifespan: 20 years
4. Annual production decline: 0.5%
5. Availability: 16%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 10.9 million (3MW)
     USD 17.5 million (5MW)
   - Avoided cost (revenue): USD 0.246/kWh
2. O&M: USD 15/MWh

Assmptions (3MW)

Capacity (kW)	3,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	10,900,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	1,200,000
Avoided Cost of diesel (USD/kW)	0.246

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
Revenue	2.5%
O&M	2.5%

Assmptions (5MW)

Capacity (kW)	5,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	17,500,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	2,000,000
Avoided Cost of diesel (USD/kW)	0.246

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
Revenue	2.5%
O&M	2.5%

Category (3MW)	% of Installed Cost	Cost (USD)
Modules	45%	4,851,000
Structures	26%	2,871,000
Inverters	7%	792,000
Power System Control Apparatus	9%	1,000,000
Balance of Plant	6%	693,000
EPC:	2%	198,000
Owner’s Cost:	5%	495,000
Total	100%	10,900,000

Category (5MW)	% of Installed Cost	Cost (USD)
Modules	46%	8,085,000
Structures	27%	4,785,000
Inverters	8%	1,320,000
Power System Control Apparatus	6%	1,000,000
Balance of Plant	7%	1,155,000
EPC:	2%	330,000
Owner’s Cost:	5%	825,000
Total	100%	17,500,000

3. Project returns

3MW Project

- Payback period:
  - 100% Equity Profitable from 11th year
- IRR:
  - Equity IRR 8%

5MW Project

- Payback period:
  - Equity 100% Profitable from 10th year
- IRR:
  - Equity IRR 8%

III. Belize

a. Country Financial Summary

1. Credit Ratings (2013):

Moody's:	Ca
S&P:	Selective Default

2. Sovereign Interest Rates:

Short-term lending:	2.75% (estimated)
Long-term bonds:	18% (estimated)

3. Currency

Belize Dollar (BZD)	
Exchange Rate:	1 USD = 2 BZD

4. GDP

PPP	US$2.999 billion (2012 estimate)
Per capita	US$8,753
Nominal	US$1.554 billion (2012 estimate)
Per capita	US$4,535

5. Utility Energy Costs

	Belize Dollar	US Dollar
Utility Revenues (2013)	232,000,000	116,000,000
Cost of Power (2013)	151,000,000	76,000,000
Cost per kWh	310,000	160,000*

* Different from what is in Financial Analysis.

Wind Power Project

a. Project Assumptions

Installed cost assumption of US$2,500 / kW is higher than the recent U.S. average of US$2,000 / kW. Assumed capacity factor is set at 20% due to the relatively modest quality of wind resources in Belize. Assumed revenues of US$0.12 / kWh is within the range of Belize's historical wholesale power costs, and below the revenue range quoted by Belize wind project developers in response to a 2014 Request for Proposals.

1. Technology: On-shore wind-turbine
2. Capacity: 10 MW
3. Project Lifespan: 20 years
4. Capacity factor: 20%
5. Availability: 95%

b. Preliminary Financial Analysis

1. Total Installed cost: USD 26 million
2. Costs
   - Avoided cost (revenue): USD 0.12/kWh

Assmptions

Capacity (kW)	10,000
Installed Cost (USD/kW)	2,500
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	26,000,000
O&M (USD / MWh)	10
Avoided Cost of diesel (USD/kW)	0.12

Capacity Factor	20%
Availability	95%
Annual Production Degradation	0.5%
Annual Escalators	
Revenue	2.5%
O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wind Turbine	65%	17,000,000
Distribution	10%	2,500,000
Power System Control Apparatus	4%	1,000,000
Balance of Plant	13%	3,250,000
EPC:	4%	1,000,000
Owner's Cost:	5%	1,250,000
Total	100%	26,000,000

3. Project Returns:

- Payback period:
  - 100% Equity: Profitable from 13th year
- IRR
  - Equity IRR: 5%

IV. Dominica

a. Country Financial Summary

1. Credit Ratings (2013):

Moody's:	(not rated)
S&P:	(not rated)

2. Currency

East Caribbean Dollar (ECD)

Exchange Rate (Sep 2014): 1 US$ = 2.7 EC$

The ECD has been pegged to the US Dollar at USD1 = ECD2.70 since 1976.

3. Interest Rates (Sep. 2014):

Overnight lending:	6.5%
10-Year Bond:	7.5%

4. Economic Output – GDP

PPP	USD 1.002 billion (2012 estimate)
Per capita	USD 14,166
Nominal	USD 497 million (2012 estimate)
Per capita	USD 7,022

5. Retail Electricity Tariff

The retail price of electricity in Dominica averaged EC$1.03 per kWh (US 38 cents) during 2010, amongst the highest in the Caribbean. This includes a value added tax of 15 percent.

3MW and 5MW Solar Power Generation Projects

a. Project Technical Assumptions

1. Technology: Solar PV (polycrystalline solar panels)
2. Capacity: 3MW and 5MW
3. Project Lifespan: 20 years
4. Annual production decline: 0.5%
5. Availability: 16%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 10.9 million (3MW)
     USD 17.5 million (5MW)
   - Avoided cost (revenue): USD 0.457/kWh

2. O&M: USD 15/MWh

Assmptions (3MW)

Capacity (kW)	3,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	10,900,000
O&M (USD / MWh)	15
Avoided Cost of diesel (USD/kW)	0.457

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Assmptions (5MW)

Capacity (kW)	5,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	17,500,000
O&M (USD / MWh)	15
Avoided Cost of diesel (USD/kW)	0.457

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category (3MW)	% of Installed Cost	Cost (USD)
Modules	45%	4,851,000
Structures	26%	2,871,000
Inverters	7%	792,000
Power System Control Apparatus	9%	1,000,000
Balance of Plant	6%	693,000
EPC:	2%	198,000
Owner's Cost:	5%	495,000
Total	100%	10,900,000

Category (5MW)	% of Installed Cost	Cost (USD)
Modules	46%	8,085,000
Structures	27%	4,785,000
Inverters	8%	1,320,000
Power System Control Apparatus	6%	1,000,000
Balance of Plant	7%	1,155,000
EPC:	2%	330,000
Owner's Cost:	5%	825,000
Total	100%	17,500,000

3. Project returns

<u>3MW Project</u>

- Payback period:
  - 100% Equity — Profitable from sixth year
- IRR:
  - Equity IRR — 18%

<u>5MW Project</u>

- Payback period:
  - Equity 100% — Profitable from sixth year
- IRR:
  - Equity IRR — 19%

V. Grenada

a. Country Financial Summary

1. Credit Ratings (2014):

Moody's:	(not rated)
S&P:	(not rated)

2. Currency

East Caribbean Dollar (ECD)

Exchange Rate: 1 USD = 2.7 ECD

3. GDP

PPP	US$ 1.467 billion (2012 estimate)
Per capita	US$ 13,900
Nominal	US$790 million (2012 estimate)
Per capita	US$7,300

4. Retail Electricity Tariff

Domestic	Minimum Charge	EC$4/month
	Non-fuel Charge	EC$0.4259/kWh
Commercial	Floor Area Charge (per 50 sq. feet of floor area)	EC$0.2/month
	Non-fuel Charge	EC$0.4593/kWh
Industrial	Horsepower Charge	EC$2/horsepower (Minimum - EC$10/month)
	Non-fuel Charge	EC$0.3366/kWh

Geothermal Power Generation Projects

a. Project Assumptions

1. Technology: Geothermal -- Binary System
2. Capacity: 10 MW
3. Project Lifespan: 35 years
4. Operating Factor: 90%

b. Preliminary Financial Analysis

1. Costs
    - Total Installed cost: USD 90 million
    - Avoided cost (revenue): USD 0.323/kWh

2. O&M:

    Fixed: USD 100/kW/year

    Variable: USD 0.00

Assmptions

Capacity (kW)	10,000
Installed Cost (USD/kW)	9,000
Total Installed Cost (USD)	90,000,000
O&M (USD / year)	1,000,000
Avoided Cost of diesel (USD/kW)	0.323

Capacity Factor	90%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wells	26%	23,400,000
Gathering System	8%	7,200,000
Heat Exchanger	2%	1,800,000
Turbines	13%	11,700,000
Balance of Plant	26%	23,400,000
EPC:	8%	7,200,000
Owner's Cost:	17%	15,300,000
Total	100%	90,000,000

3. Project returns

- Payback period:
  - 100% Equity: Profitable from fourth year
- IRR:
  - Equity IRR : 30%

VI. Jamaica

a. Country Financial Summary

1. Credit Ratings

Moody's:	Caa3
S&P:	B-

2. Sovereign Interest Rates:

Short-term lending:	6.5%
Long-term bonds:	7.5% (estimated)

3. Currency

Jamaican Dollar (JMD)

Exchange Rate:	1 USD = 112.35 JMD

4. GDP

PPP	US$2.999 billion (2012 estimate)
Per capita	US$8,753
Nominal	US$1.554 billion (2012 estimate)
Per capita	US$4,535

5. Jamaica Public Service Financial Summary

Utility Revenues (2013)	J$ 120,890 Million	(US$ 1,099 Million)
Cost of Power (2013)	J$ 91,630 Million	(US$ 833 Million)
Cost of Power per kW-hour	J$ 23.10	(US$ 0.21)
Mean Electricity Tariff ($/kWh)	J$ 38.50	(US$ 0.35)

3MW and 5MW Solar Power Project

a. Technical Assumptions

1. Technology: Solar PV (polycrystalline solar panels)
2. Capacity: 3MW and 5MW
3. Project Lifespan: 20 years
4. Annual production decline: 0.5%
5. Availability: 16%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 10.9 million (3MW)
     USD 17.5 million (5MW)
   - Avoided cost (revenue): USD 0.210/kWh

2. O&M: USD 15/MWh

Assmptions (3MW)

Capacity (kW)	3,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	10,900,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	1,200,000
Avoided Cost of diesel (USD/kW)	0.210

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Assmptions (5MW)

Capacity (kW)	5,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	17,500,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	2,000,000
Avoided Cost of diesel (USD/kW)	0.210

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category (3MW)	% of Installed Cost	Cost (USD)
Modules	45%	4,851,000
Structures	26%	2,871,000
Inverters	7%	792,000
Power System Control Apparatus	9%	1,000,000
Balance of Plant	6%	693,000
EPC:	2%	198,000
Owner's Cost:	5%	495,000
Total	100%	10,900,000

Category (5MW)	% of Installed Cost	Cost (USD)
Modules	46%	8,085,000
Structures	27%	4,785,000
Inverters	8%	1,320,000
Power System Control Apparatus	6%	1,000,000
Balance of Plant	7%	1,155,000
EPC:	2%	330,000
Owner's Cost:	5%	825,000
Total	100%	17,500,000

3. Project returns

<u>3MW Project</u>

- Payback period:
  - 100% Equity Profitable from 14th year
- IRR:
  - Equity IRR 5%

<u>5MW Project</u>

- Payback period:
  - 100% Equity Profitable from 13th year
- IRR:
  - Equity IRR 6%

Wind Power Project

a. Technical Assumptions

1. Technology: On-shore wind-turbine
2. Capacity: 10 MW
3. Project Lifespan: 20 years
4. Capacity factor: 20%
5. Availability: 95%

b. Preliminary Financial Analysis

1. Total Installed cost: USD 26 million / MW
2. Costs
   - Avoided cost (revenue): USD 0.210/kWh

Assmptions

Capacity (kW)	10,000
Installed Cost (USD/kW)	2,500
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	26,000,000
O&M (USD / MWh)	10
Avoided Cost of diesel (USD/kW)	0.21

Capacity Factor	20%
Availability	95%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wind Turbine	65%	17,000,000
Distribution	10%	2,500,000
Power System Control Apparatus	4%	1,000,000
Balance of Plant	13%	3,250,000
EPC:	4%	1,000,000
Owner's Cost:	5%	1,250,000
Total	100%	26,000,000

3. Project Returns:

- Payback period:
  - 100% Equity: Profitable from eighth year
- IRR
  - Equity IRR: 13%

<u>Inverter Air Conditioners for Schools Project</u>

a. Project Assumptions

1. Technology: Inverter-based room air conditioner
2. Power Consumption: 1.4kW
3. Capacity factor: 25%
4. Electrical efficiency: 25% less electricity than standard A/C
5. O&M: same as for standard air conditioner
6. Project duration: 15 years (equal to expected equipment life)

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 3.6 million
   - Installed cost: USD 1,800 per unit; two units per classroom
   - Project size: USD 3,600 per classroom; 1,000 schools potential
   - Avoided cost: USD 0.35 / kWh

<u>Assmptions</u>

Inverter A/C Consumption (kW)	1.4
Standard A/C Consumption (kW)	1.9
Rate of Saving	25%
Rate of Operation	25%
Avoided Cost (USD / kWh)	0.35
Unit Price (USD)	1,800
Potential Number of Units	2,000
Total Installed Cost (USD)	3,600,000
O&M (USD / MWh)	Same as for Standard A/C

2. Payback period:

- Payback period:
  - 100% Equity: Profitable from fifth year
- IRR
  - Equity IRR : 18%

<u>**Inverter Pumps for Water Pumping**</u>

a. Project Assumptions

Water pumps operated by the National Water Commission consume about 45% of Jamaica's electricity supply. The water pumps most widely used by the NWC are rated at 100 horsepower. Our project model assumes ten high-efficiency, 10-horsepower pumps to equate to one standard, 100-horsepower pump. The installation cost, maintenance and useful life of high-efficiency water pumps are assumed to be equivalent to standard water pumps. The assumed avoided cost of US$0.35 / kWh approximates the midpoint of Jamaica's electricity tariff. The tariff is assumed to remain flat during the ten-year life of the project.

1. Technology: Inverter-based water pumps
2. Power Consumption: 7.5kW per pump
3. Capacity factor: 16%
4. Electrical efficiency: 15% less electricity required than standard pump
5. O&M: Same as for standard pump
6. Project duration: 10 years (equal to expected equipment life)

b. Preliminary Financial Analysis

1. Costs

- Total Installed cost: USD 11.7 million
- Installed cost: station USD 1,500/unit; ten units per
- Project Size: potential USD 15,000/station; 7,800 pumps
- Avoided cost: USD 0.35 / kWh

Assmptions

Inverter Pump Consumption (kW)	7.5
Standard Pump Consumption (kW)	8.8
Rate of Saving	15%
Rate of Operation	16%
Avoided Cost (USD / kWh)	0.35
Unit Price (USD)	1,500
Potential Number of Units	7,800
Total Installed Cost (USD)	11,700,000
O&M (USD / MWh)	Same as for Standard A/C

2. Project Returns:

- Payback period:
  - 100% Equity: Profitable from third year
- IRR
  - Equity IRR: 41%

VII. St. Christopher and Nevis

a. Country Financial Summary

1. Credit Ratings (2013):

Moody's:	(not rated)
S&P:	(not rated)

2. Currency

East Caribbean Dollar (ECD)

Exchange Rate: 1 USD = 2.7 ECD

3. GDP

PPP	US$1.087 billion (2012 estimate)
Per capita	US$21,260
Nominal	US$767 million (2012 estimate)
Per capita	US$14,314

4. Retail Electricity Tariff

5. General Services	Energy Charge	$0.91/kWh
	With minimum total of $11	
Domestic Services	Demand Charge	For 15 Amps of fuse rating or part thereof of fuse protecting service $13
	Energy Charge	
	First 50kWh	$0.59/kWh
	Next 100kWh	$0.65/kWh
	Exceeding 150kWh	$0.68/kWh
Industrial and Commercial	Demand Charge	Every kVA of demand or part thereof $15 per kVA
	Energy Charge	
	First 50kWh/kVA	$0.80/kWh/kVA
	Next 75kWh/kVA	$0.76/kWh/kVA
	Next 125kWh/kVA	$0.72/kWh/kVA
	Exceeding 250kWh	$0.65/kWh/kVA

* EC$

<u>**Wind Power Project**</u>

a. Project Assumptions

1. Technology: On-shore wind-turbine
2. Capacity: 3 MW
3. Project Lifespan: 20 years
4. Capacity factor: 20%
5. Availability: 95%

b. Preliminary Financial Analysis

1. Total Installed cost: USD 8.5 million
2. Costs
    - Avoided cost (revenue): USD 0.21/kWh

Assmptions

Capacity (kW)	3,000
Installed Cost (USD/kW)	2,500
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	8,500,000
O&M (USD / MWh)	10
Avoided Cost of diesel (USD/kW)	0.210

Capacity Factor	20%
Availability	95%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wind Turbine	60%	5,100,000
Distribution	9%	750,000
Power System Control Apparatus	12%	1,000,000
Balance of Plant	11%	975,000
EPC:	4%	300,000
Owner's Cost:	4%	375,000
Total	100%	8,500,000

3. Project Returns:

- Payback period:
  - 100% Equity: Profitable from eighth year
- IRR
  - Equity IRR: 12%

Energy Efficiency Project Amorphous Transformer Installation

a. Technical Assumptions

1. Technology: Amorphous metal transformer (AMT)
2. Units: 400
3. Project Lifespan: 30 years
4. Annual energy production: 150 GWh
5. Distribution efficiency benefit: 17%

b. Preliminary Financial Analysis

1. Costs

- Installed cost: USD 1.8 million
- Avoided cost (revenue): USD 0.210/kWh

2. O&M: USD 350/unit/year

Assmptions

Potential Number of Units	400
Installed Cost (USD / Unit)	4,600
Total Installed Cost (USD)	1,840,000
O&M (USD / Unit)	350
Avoided Cost (USD / kWh)	0.210

Rate of Saving	20%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Transformers	70%	1,288,000
EPC	30%	552,000
Total	100%	1,840,000

3. Project returns

- Payback Period
  - 100% Equity Profitable from 14th year
- IRR
  - Equity IRR 9%

VIII. St. Vincent and the Grenadines

a. Country Financial Summary

1. Credit Ratings (2013):

Moody's:	B2
S&P:	(not rated)

2. Currency

East Caribbean Dollar (ECD)

Exchange Rate: 1 USD = 2.7 ECD

(The ECD has been pegged at this rate since 1976)

3. Interest Rates (Sep. 2014):

Overnight lending:	6.4%
10-Year Bond:	n/a

4. GDP

PPP	US$ 1.259 billion (2011 estimate)
Per capita	US$ 11,700
Nominal	US$695 million (2011 estimate)
Per capita	US$6,342

5. Retail Electricity Tariff

	Tariff	ECD Cost	USD Equivalent
Domestic	Minimum Charge （0-17kWh）	5/month	1.85
	50kWh or less	0.425/kWh	0.157
	More than 50kWh	0.5/kWh	0.185
Commercial	Minimum Charge (0-17kWh)	15/month	5.556
	18-150,000kWh	0.54/kWh	0.200
	150,001-200,000kWh	0.513/kWh	0.190
	Over 200,000kWh	0.486/kWh	0.180
Industrial	0-150,000kWh	0.42/kWh	0.156
	150,001-200,000kWh	0.399/kWh	0.148
	Over 200,000kWh	0.378/kWh	0.140

3MW and 5MW Solar Power Project

a. Project Technical Assumptions

1. Technology: Solar PV (polycrystalline solar panels)
2. Capacity: 3MW and 5MW
3. Project Lifespan: 20 years
4. Annual production decline: 0.5%
5. Availability: 16%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 10.9 million (3MW)
     USD 17.5 million (5MW)
   - Avoided cost (revenue): USD 0.324/kWh

2. O&M: USD 15/MWh

Assmptions (3MW)

Capacity (kW)	3,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	10,900,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	1,200,000
Avoided Cost of diesel (USD/kW)	0.324

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Assmptions (5MW)

Capacity (kW)	5,000
Installed Cost (USD/kW)	3,300
Power System Control Apparatus (USD)	1,000,000
Total Installed Cost (USD)	17,500,000
O&M (USD / MWh)	15
Inverter Replacement in year 12 (USD)	2,000,000
Avoided Cost of diesel (USD/kW)	0.324

Capacity Factor	16%
Annual Production Degradation	0.5%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category (3MW)	% of Installed Cost	Cost (USD)
Modules	45%	4,851,000
Structures	26%	2,871,000
Inverters	7%	792,000
Power System Control Apparatus	9%	1,000,000
Balance of Plant	6%	693,000
EPC:	2%	198,000
Owner's Cost:	5%	495,000
Total	100%	10,900,000

Category (5MW)	% of Installed Cost	Cost (USD)
Modules	46%	8,085,000
Structures	27%	4,785,000
Inverters	8%	1,320,000
Power System Control Apparatus	6%	1,000,000
Balance of Plant	7%	1,155,000
EPC:	2%	330,000
Owner's Cost:	5%	825,000
Total	100%	17,500,000

3. Project returns

<u>3MW Project</u>

- Payback period:
  - 100% Equity — Profitable from eighth year
- IRR:
  - Equity IRR — 12%

<u>5MW Project</u>

- Payback period:
  - Equity 100% — Profitable from eighth year
- IRR:
  - Equity IRR — 12%

<u>Geothermal Power Generation Projects</u>

a. Project Assumptions

A Geothermal Binary ("Binary") Facility with 10 MW consisting of one heat recovery power generation system operating on a closed looped Rankine cycle using geothermal brine as a heat source, with a brine temperature of 275°F. The brine heats the working fluid within an evaporator.

1. Technology:	Geothermal -- Binary System
2. Capacity:	10 MW
3. Project Lifespan:	35 years
4. Operating Factor:	90%

b. Preliminary Financial Analysis

1. Costs
   - Total Installed cost: USD 90 million
   - Avoided cost (revenue): USD 0.324/kWh

2. O&M:

Fixed: USD 100/kW/year

Variable: USD 0.00

Assmptions

Capacity (kW)	10,000
Installed Cost (USD/kW)	9,000
Total Installed Cost (USD)	90,000,000
O&M (USD / year)	1,000,000
Avoided Cost of diesel (USD/kW)	0.324

Capacity Factor	90%
Annual Escalators	
---Revenue	2.5%
---O&M	2.5%

Category	% of Installed Cost	Cost (USD)
Wells	26%	23,400,000
Gathering System	8%	7,200,000
Heat Exchanger	2%	1,800,000
Turbines	13%	11,700,000
Balance of Plant	26%	23,400,000
EPC:	8%	7,200,000
Owner's Cost:	17%	15,300,000
Total	100%	90,000,000

3. Project returns

- Payback period:
  - 100% Equity: Profitable from fourth year
- IRR:
  - Equity IRR : 30%

Report on OTEC Introduction to CARICOM Countries

1. Seawater Temperature Difference Distribution and Bathymetric Map of CARICOM

Figure 1 shows the bathymetric for CARICOM Area and the world distribution of ocean temperature differences. Due to accessibility of water at a depth of more than 1,000m in much of the region and the widespread availability of 20 degree C or more temperature difference between surface seawater and deep seawater, seawater conditions for most of the region are suitable for applying OTEC (Ocean Thermal Energy Conversion) technology.

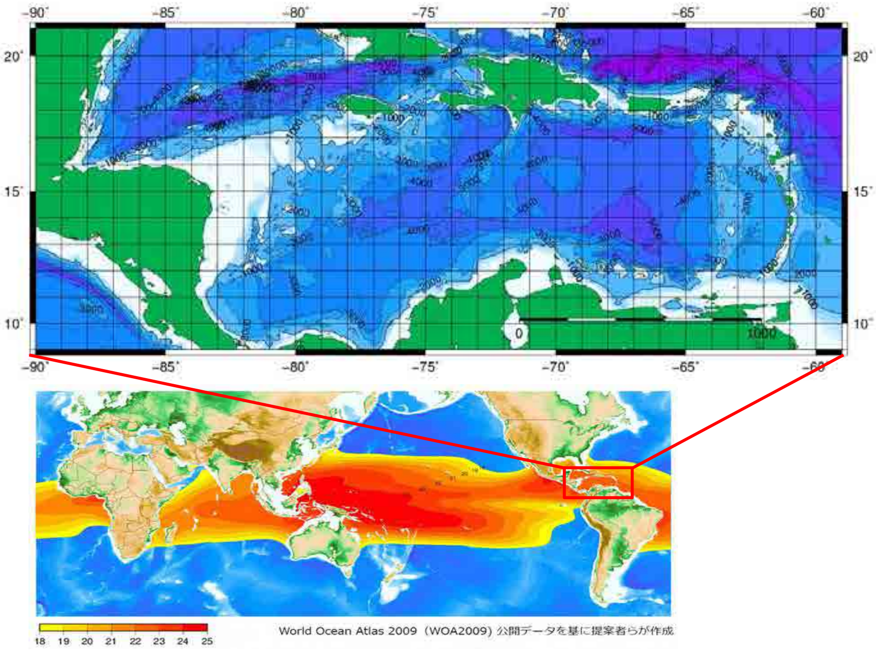


Figure 1 Bathymetrical map of CARICOM Area
and Ocean Temperature Difference Distribution of the world

2. Investigation of OTEC Potential

This report covers the potential for OTEC in 12 countries, surveyed in-house. It consist the seawater depth distribution, annual fluctuation of deep and surface seawater temperature, depth distribution of water temperature, and vertical profile of the shortest distance to the depth of 1,000m from land. As a result, we outlined the potential of OTEC technology and chose three (3) countries at which to conduct field survey in this Project. For the 12 target countries, due to the short study period, divided into two (2) teams for survey convenience. Team B (1. St. Kitts &Nevis, 2. Antigua & Barbuda, 3. Dominica, 4. St. Lucia, 5. St. Vincent & the Grenadines, 6. Barbados, and 7. Grenada) and Team A (8. Trinidad Tobago, 9. Guyana, 10. Suriname, 11. Jamaica, and 12. Belize) surveyed their respective countries. Three (3) of Team B surveyed countries (St. Lucia, St. Vincent and Barbados) were selected for the OTEC field survey. Maps for each countries studied in-house survey are shown below.

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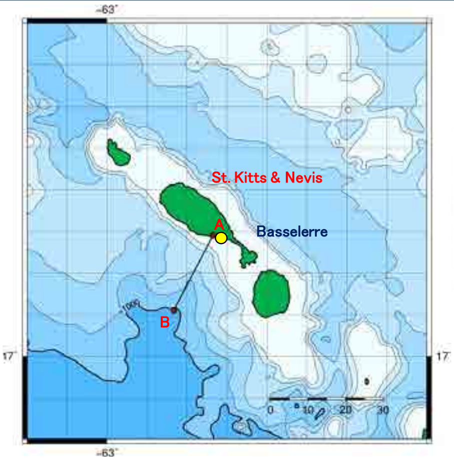
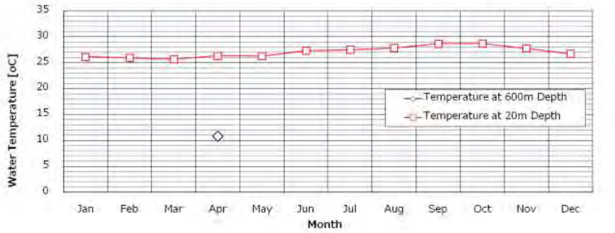
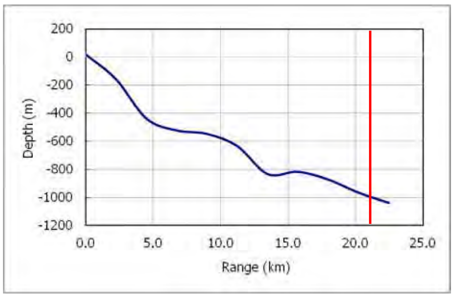
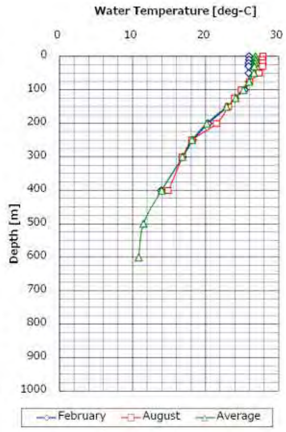
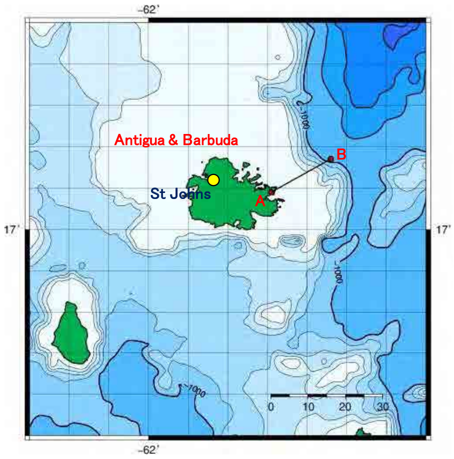


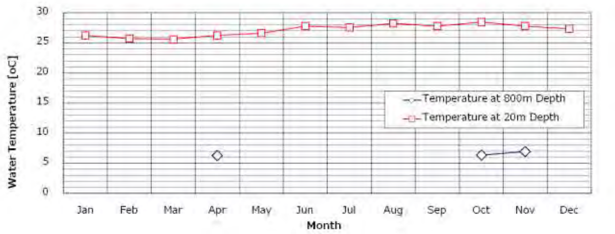


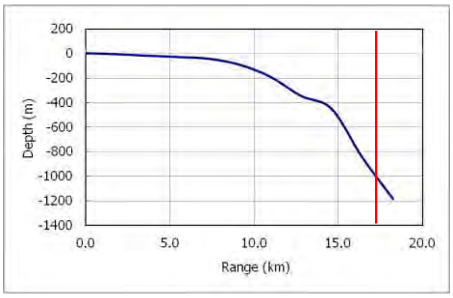


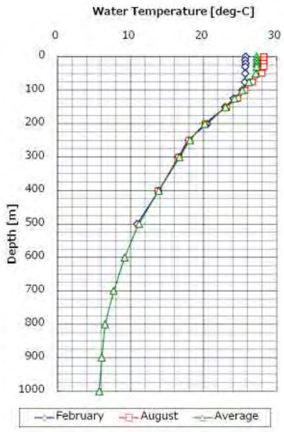


2.Antigua & Barbuda

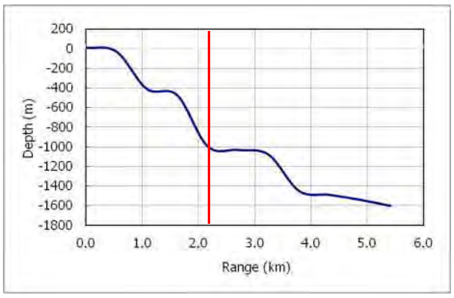


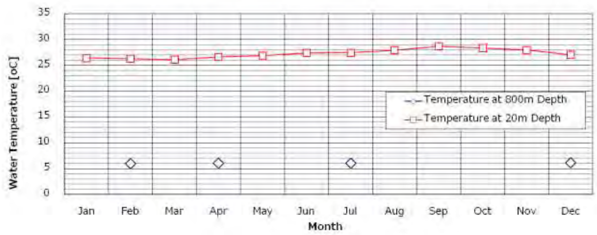


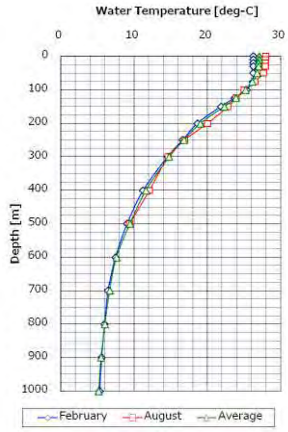




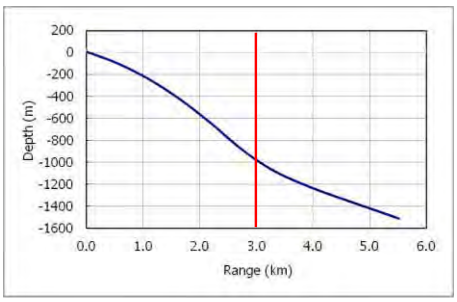
3.Dominica

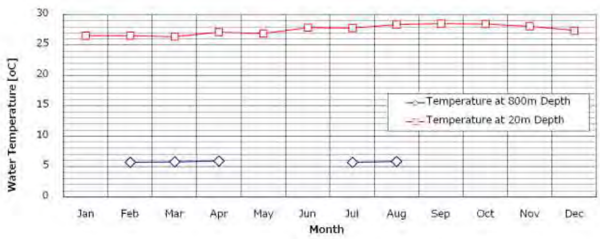


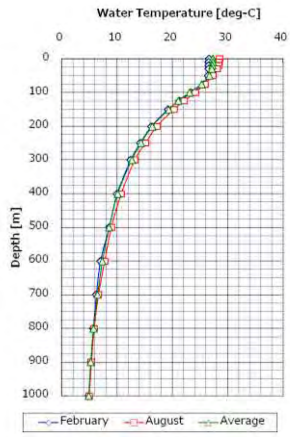




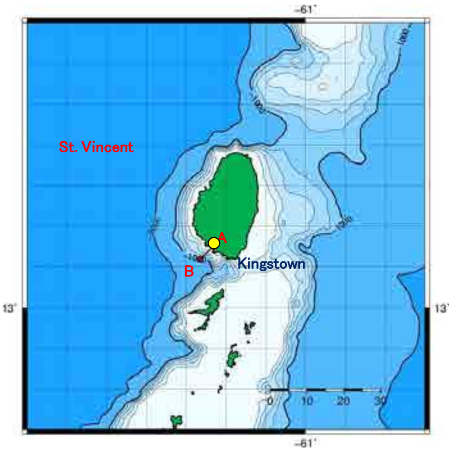
4.St. Lucia

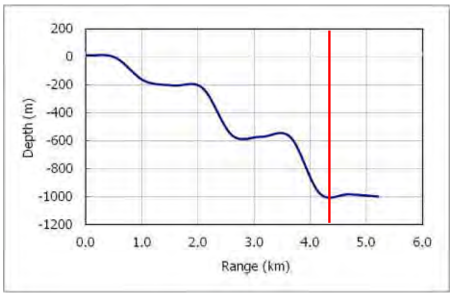


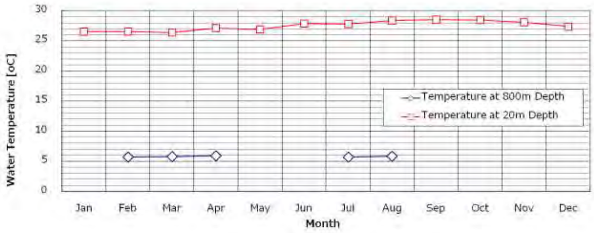


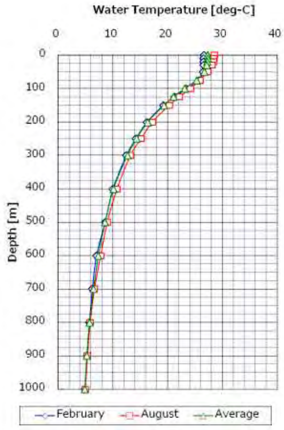


5.St. Vincent

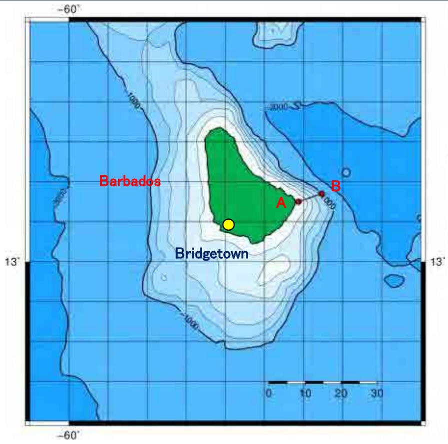


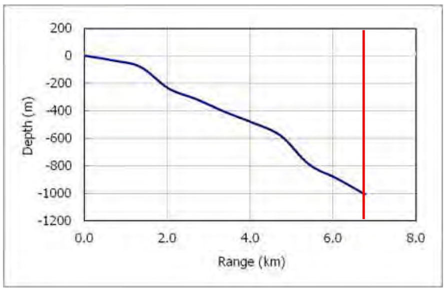


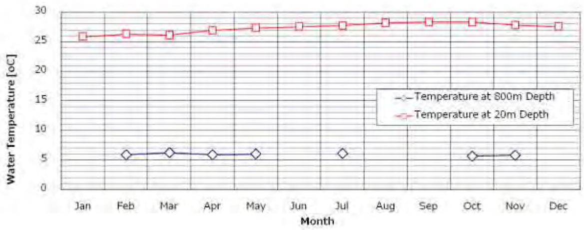


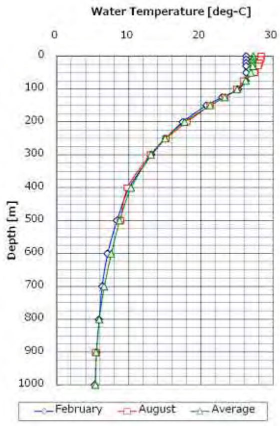


6.Barbados

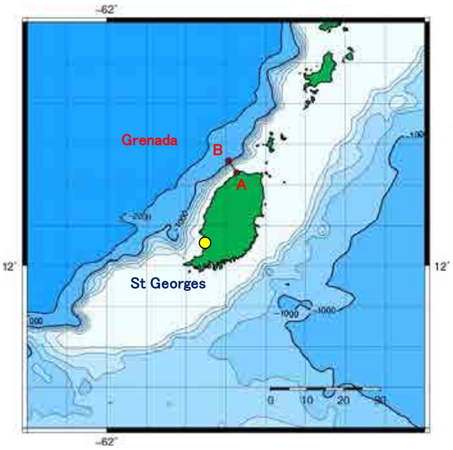


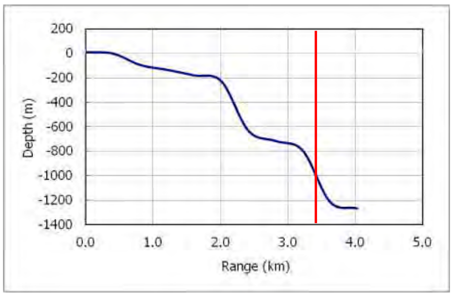


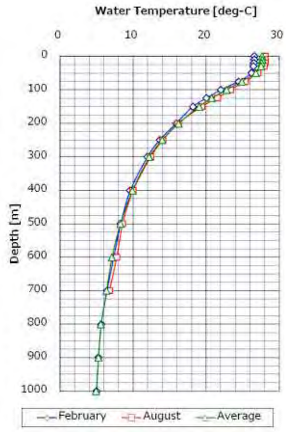




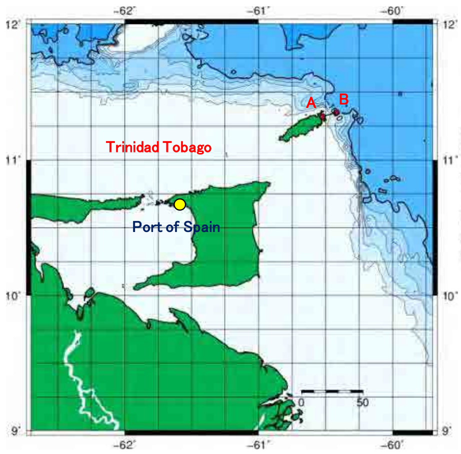
7.Grenada

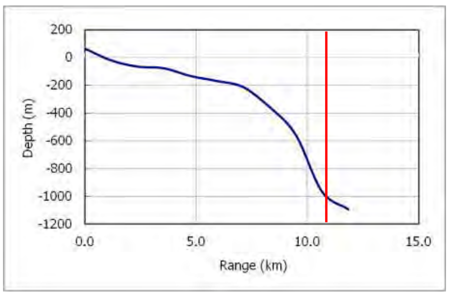


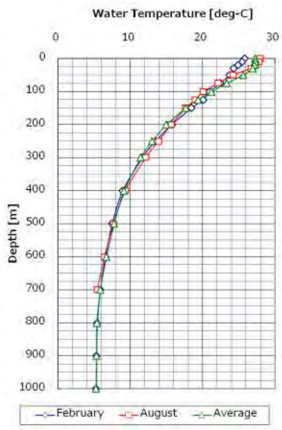




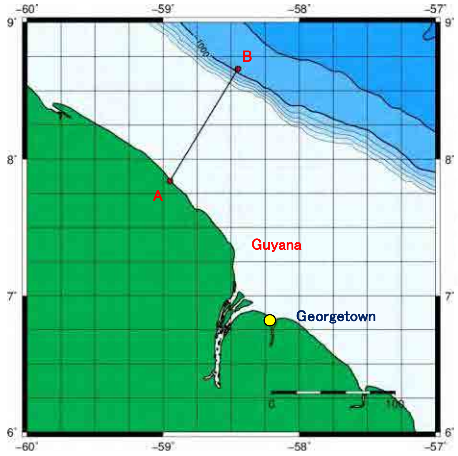
8.Trinidad Tobago

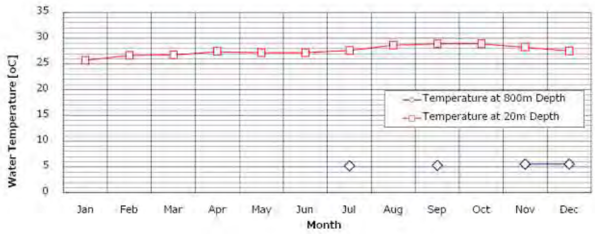


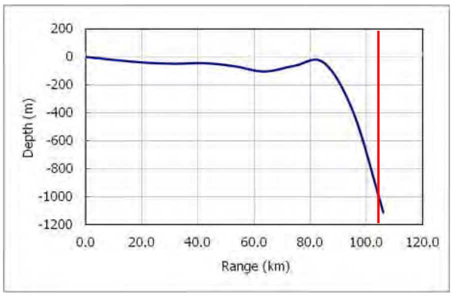


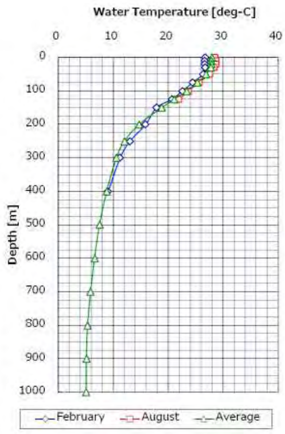


9.Guyana

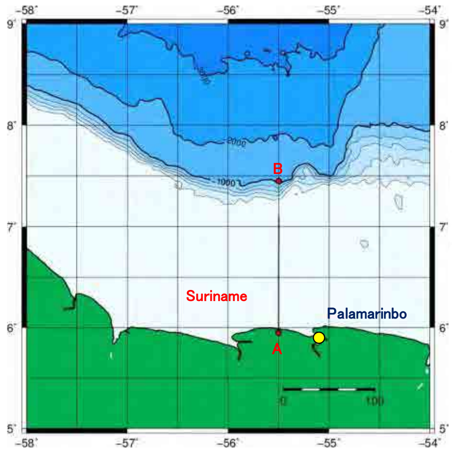


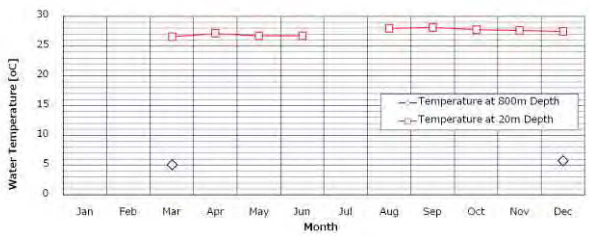


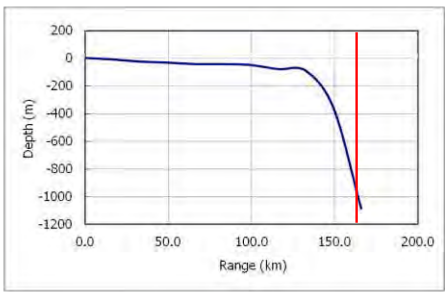


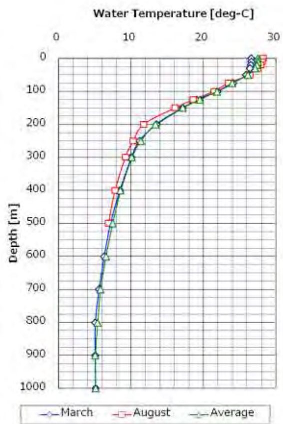


10.Suriname

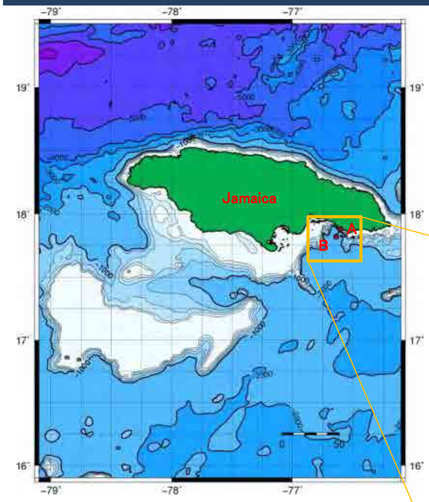


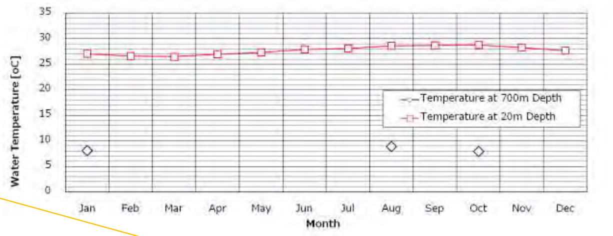


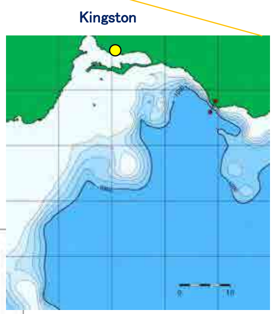


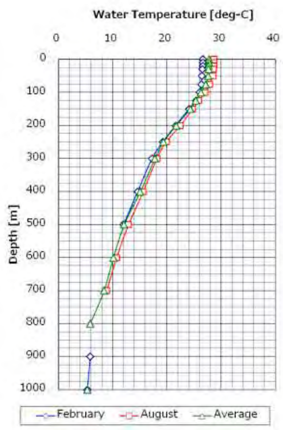


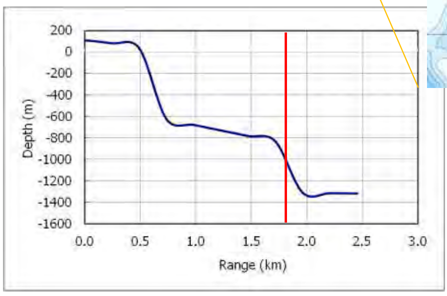
11.Jamaica



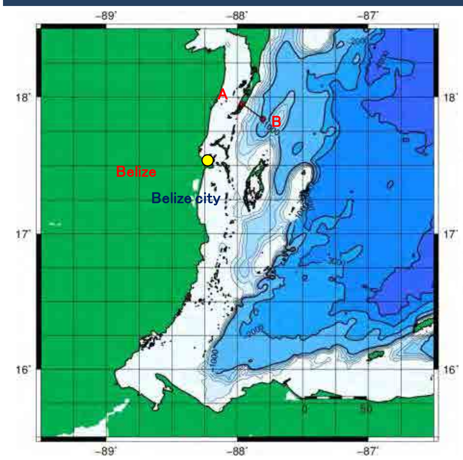


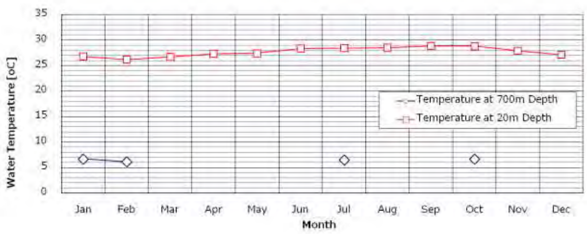


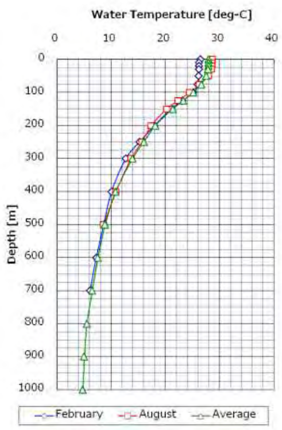


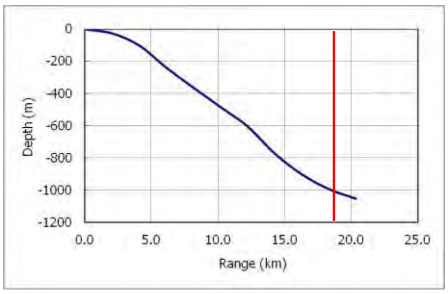


12.Belize









The table below summarizes the results of the in-house survey. Group B includes the countries surveyed by Team B, while Group A includes the countries surveyed by Team A. As a result, within the seven countries of Group B, St. Kitts & Nevis and Barbuda have low potential for land-based OTEC based on the larger distance from land of 1,000m depth. And conclusion is that the other five countries have high potential for both land-based and offshore OTEC.

Table 1-1 OTEC Potential from in-house survey (Group B)

Group B	Distance to 1,000m depth	Land-base OTEC Potential	Offshore OTEC	Population	Power Supply (MW)
St. Kitts & Navis	>20km	Low	High	51,000	55
Antigua & Barbuda	>15km	Low	High	91,000	27
Dominica	>3km	High	High	73,000	97
St. Lucia	>3km	High	High	182,000	76
St. Vincent & the Grenadine	>4km	High	High	102,000	47
Barbados	>8km	High	High	285,000	150
Grenada	>5km	High	High	110,000	52

Table 1-2 OTEC Potential from in-house survey (Group A)

Group A	Distance to 1,000m depth	Land-base OTEC Potential	Offshore OTEC	Population	Power Supply (MW)
Trinidad Tobago	>70km(>11)	Low	High	1,341,000	2,350
Guyana	>100km	Low	High	762,000	363
Suriname	>150km	Low	High	573,000	410
Jamaica	>2km	High	High	2,930,000	1,175
Belize	>18km	Low	High	340,000	178

For the five countries Team A surveyed in Group A, although it was determined all have high potential for offshore OTEC, only Jamaica have high potential for land-based OTEC.

Proposed OTEC power generation capacity for land-based systems includes 1MW to 10MW, and larger 10MW to 100MW scale plants can be built offshore. Land based OTEC plant will be installed in coastal land, and in accordance with submarine topography conditions, deep seawater intake pipe will be installed up to about a depth of 800m in the order of a few kilometers from land. Further, in the case of offshore type OTEC plants, power unit will be stored in the floating structure, and intake pipe will be installed from the floating structure to vertically about water depth 800m ~ 1,000m.

In the case of land based OTEC, it becomes more small-scale facility as compared to the

offshore type. In the case of more than 10MW OTEC, offshore type has large advantage for intake pipe construction costs and piping diameter than land based OTEC (Intake deep seawater pipe construction becomes difficult when the pipe diameter increases. Therefore, it is necessary to consider such embedding the plurality by suppressing small pipe diameter).Also, although the land based OTEC is a small scale compare to offshore type, deep seawater will be pumped up to the land. So, it becomes possible to make more economical proposal by multipurpose use of deep seawater, such as building air conditioning, district cooling, seawater desalination and aquaculture, agricultural use, and even food and beverage.
On the other hand, in the case of offshore type OTEC, multipurpose use of deep seawater is difficult because the facility is far from land. Therefore, it is necessary to construct large-scale plat for lowering the power generation unit cost.
In addition, the generated power is required to consider the transmission in submarine transmission cable, and energy transportation that will be converted to other forms such as hydrogen and liquid fuel from the power.

Incidentally, the power generation cost and construction costs for OTEC are estimated in Japan. Roughly, the commercialized 10MW class OTEC plant will cost 278 million US$ with a 0.19-0.23 US$/kWh power generation cost. A 100MW class OTEC plant will cost roughly 926 million US$ with 0.07-0.09 US$/kWh power generation cost. For OTEC, the largest costs are required surround the installation of the intake pipes for deep seawater. For land-based plant, it is hard to do profitably since there is no economy of scale in the smaller facilities; however, considering multipurpose use of the deep seawater in combined plan creates the critical economic efficiencies.
Though the intake pipe construction of deep seawater require large initial investment, deep seawater is close to infinity at a low temperature of 5 to 7 degree C throughout the year.
Also, there is no depletion and concerns of seasonal variation, and development cost is not required.

3. OTEC Site Survey (St. Lucia)

3.1 Introduction

Figure 2 shows the bathymetrical condition surrounding St. Lucia. When determining the suitability of OTEC, land-based is considered when there is deep seawater close to shore and offshore for when deep water is further away as a basic. In the case of St. Lucia, seawater from a depth of 1,000m can be reached in a distance from shore of 5km in the neighborhood of Soufriere Bay (the yellow mark in Figure 2).

It should be noted that the St. Lucia Ministry of Sustainable Development, Energy, Science, and Technology recognizes the area around Soufriere as the optimal location for land-based OTEC.

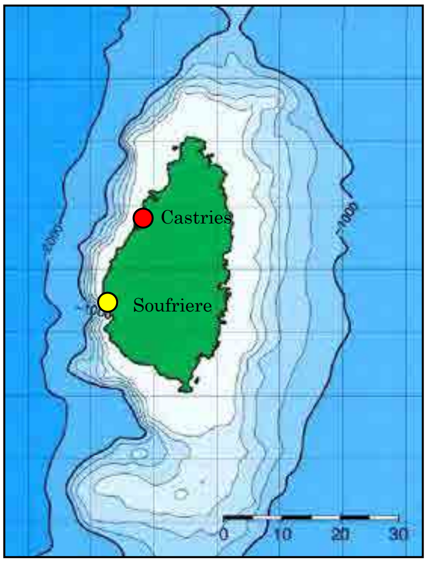


Figure 2: Bathymetrical map of St. Lucia

3.2 Soufriere Bay Area Situation

Soufriere is a port city on the west coast facing Soufriere Bay, which is around 20km south of Castries, the capital of St. Lucia. With a population of about 8,000 the city was the traditional capital and center of the island until it was transferred to Castries. From Castries there is a small town on the west coast called Anse-la-raye and Canaries. It takes about an hour to an hour and a half to drive down the west road of the island, which passes through the rainforest that spreads through the island's center.

Photo1: Soufriere and Piton Mountain World Heritage Site

While Soufriere depends on fishery, the areas surrounding the town focus on agriculture with scattered cacao and banana plantations. It is also close to the Piton Mountain Area that was designated a World Natural Heritage Site in 2004. The town now depends on Piton Mountain tourism.

3.3 Multi-Purpose Use of Deep Seawater with Land-Based OTEC Power Generation

Saint Lucia has a population of about 17 million people with a power demand of 60MW. The cost for power generation is very high, nearly 30 yen/ kWh (0.28 US$) with nearly 100% of the power consumed on the island created with diesel generators (power production capacity is 75MW). Proposed OTEC power generation capacity for land-based systems includes 1MW to 10MW. Larger 10MW to 100MW commercial scale plants can be built offshore. Speaking in terms of scale, all of St. Lucia's power needs could be covered by one offshore OTEC plant.

For example, in the case of St. Lucia, the candidate site for land-based OTEC is around Soufriere, close to the Piton Mountain World Heritage Site. Deep seawater from 800m to 1,000m is cold (5-7degree C throughout the year) and can be used in the air conditioning (resorts or large hotels) of tourist facilities, for district cooling systems, and other uses. The mineral rich deep seawater can also be used in aquaculture of fisheries or to promote fisheries by providing nutrients and minerals. It is also possible to develop aquaculture industries such as fish and shellfish farming to improve value and increase the catch. In addition, combined power generation and successful use of deep seawater can lead to an increase in tourism from eco-tourism and the combined industries. Particularly for island nations, the use of deep seawater can energize local economies while improving water resource issues by adding value to the utilization of deep seawater through research into new industries and the production of drinking water. Use of cold deep seawater can lead to the development of new specialty products and locally produced vegetables, rather than relying on imports.

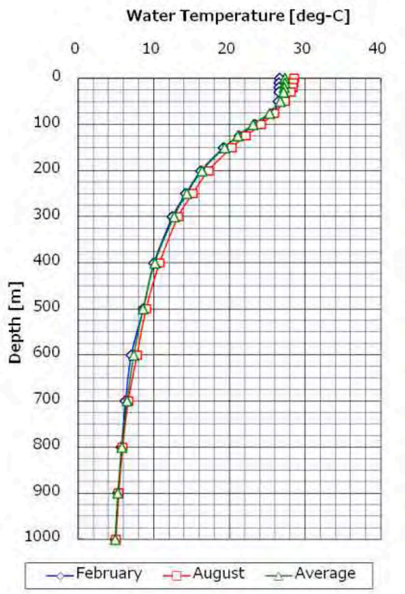


Figure 3: St. Lusia's Ocean Temperature / Depth Distribution

3.4 Offshore OTEC Potential

St. Lucia meets the conditions for offshore OTEC around the entire island. Since the west coast has deep seawater within 5-10km and deep water of a depth 1,000m within 20km even on the east coast, there is deep seawater accessible for commercial offshore OTEC of 50MW class in the future.

It should be noted that common to both land and offshore OTEC facilities are the influence of tidal currents, hurricanes and poor weather conditions, the risk of tsunami caused by seismic activity, and the effects of volcanic activity. It is considered necessary to develop a specific plan for these contingencies and also to conduct basic research to consider the impact on the marine environment of the beautiful Caribbean and on the Piton Mountain World Heritage Site.

3.5 OTEC Explanation to Related Organizations

In St Lucia, OTEC technology was explained and discussed with Ministry of Sustainable Development, Energy, Science, and Technology Unit Director Ms. Judith, Officer Ms. Maier Sifflet, Agency Communications Unit Mr. Shawwon Lebourne (Information Assistant), Public Utilities Department Officer Mr. Michael Flood, and Ministry of Agriculture, Department of Fisheries Mr. Leroy Aubroise.

Director Judith leads the Alliance of Small Island States (AOSIS) and is the representative of St. Lucia in SIDS DOCK. She is also the contact person in St. Lucia for OTEC technology. SIDS DOCK is an organization supporting change for the sustainable economic development of the energy sector, including OTEC, for small island developing nations. For SIDS DOCK activities in St Lucia there have been discussions and studies made of OTEC in the past to obtain information, and that there are also study document.

Therefore, there is high interest in St. Lucia for OTEC. At the same time, there was a strong interest from the Fishery Ministry for the application of technologies such as seaweed and seafood cultivation and enriching fishing grounds with multiple use of deep seawater. In addition, there were questions about the impact of OTEC on the natural environment (such as coral and marine life) during the briefing.

Introduction and discussion for OTEC technology was conducted to the LUSLEC power company. Here as well was a high level of interest and learning about OTEC. They were aware of ocean energy's potential use as a base load power supply for St. Lucia.

4. OTEC Site Survey (St. Vincent)

4.1 Introduction

Figure 4 shows the bathymetry condition around St. Vincent and the Grenadines. When considering the suitability of OTEC, land based facilities are viable for areas with deep seawater close to shore while offshore is viable for deep water at further distances as a basic. St. Vincent has access to deep seawater of a depth of 1,000m 5-10km from the western shore. In Figure 4 the red circle is the capital Kingstown in Kingstown bay. It should be noted that while topographical conditions on the north side of the island also lead to access of deep water at 5-10km distance, the island roads do not connect to the north and it is a volcanic region.

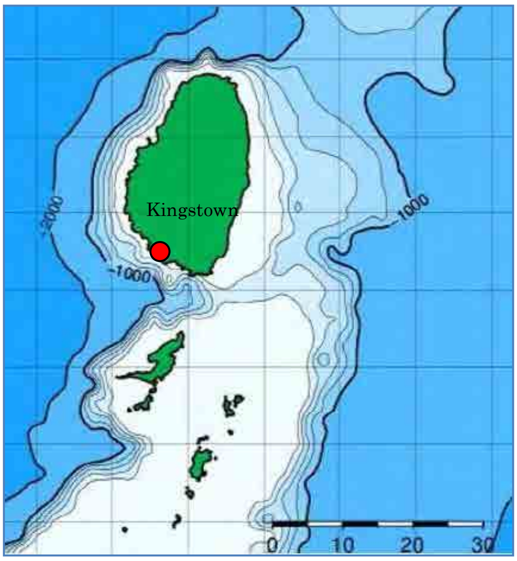


Figure 4: Bathymetrical map of St. Vincent

4.2 OTEC Candidate Sites (West Coast)

St. Vincent (including the Grenadines) has a population of about 100,000 people with about 15,000 people living in the capital Kingstown. The main town on the west coast is a port town that developed around the bay. The road follows the coast north to its end at Richmond Beach. While anywhere along the west coast have favorable conditions as an OTEC candidate site, 5-10km distance to deep seawater, the shortest distance to deep seawater is near the capital Kingstown. Considering the interconnection of the system, industrial population, access, and the fact that the demand for power is concentrated in the southern part of the island it seems Romans Bay (3km northwest of Kingstown) is the leading candidate site for land-base OTEC in St. Vincent. The power company VINLEC also operates a diesel power plant at there.

Photo 2: OTEC Candidate Site, Offshore from Kingstown Beach

4.3 Land Based OTEC with Power Generation and Multiple Use of Deep Seawater

St. Vincent (excepting the Grenadines) has power consumption of 10MW to a peak of 20MW, thus it is possible to cover 50% of the power demand by a land based 10MW OTEC facility. In addition, three places on St. Vincent have renewable hydroelectric energy plants with a capacity of 5.6MW or about 20% of total power consumption. Currently, the power generation cost for 80% of the island demand is extremely high at 0.34-0.36 US$/kWh via diesel power generation.

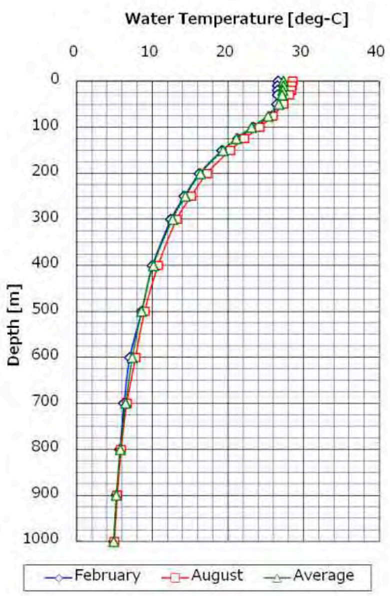


Figure 5: St. Vincent' s Ocean Temperature / Depth Distribution

St. Vincent's major industries include tourism, agriculture, and fishery. The fishery in particular is important for the diversification of the economy, food security, job security, poverty reduction, and water industry in the national development plan. Japan's construction and renovation of the fish market of Kingstown has been implemented under the auspices of fishery cooperation and assistance by ODA (see Photo 3).

Photo 3: St. Vincent Fish Market

(Construction from Grant Aid in 1988, renovated 2003)

The OTEC plan for St. Vincent combines power production with the industries mentioned above. Deep seawater from 800m to 1,000m is cold (5-7 degree C throughout the year, see Figure 5) and can be used in the air conditioning (resorts or large hotels) of tourist facilities, for district cooling systems, and other uses. The mineral rich deep seawater can also be used in aquaculture of fisheries or to promote fisheries by providing nutrients and minerals. It is also possible to develop aquaculture industries such as fish and shellfish farming to improve value and increase the catch. In addition, combined power generation and successful use of deep seawater can lead to an increase in tourism from eco-tourism and the combined industries. Particularly for island nations, the use of deep seawater can energize local economies while improving water resource issues by adding value to the utilization of deep seawater through research into new industries and the production of drinking water. Use of cold deep seawater can lead to the development of new specialty products and locally produced vegetables, rather than relying on imports.

4.4 Offshore OTEC Possibilities

The areas surrounding St. Vincent meet the conditions for offshore OTEC. Since the west coast has deep seawater within 5-10km and deep seawater of a depth 1,000m within 20km even on the east coast there is deep water accessible for commercial offshore OTEC of 100MW class in the future.

On the other hand, large scale OTEC would create surplus power even when considering the 20MW power demand including the Grenadines demands with the current situation in St. Vincent. If large scale OTEC is planned for St. Vincent, the export of power to neighboring countries is required.

It should be noted that common to both land and offshore OTEC facilities are the influence of tidal currents, hurricanes and poor weather conditions, the risk of tsunami caused by seismic activity, and the effects of volcanic activity. It is considered necessary to develop a specific plan for these contingencies and also to conduct basic research to consider the impact on the marine environment of the beautiful Caribbean.

4.5 Explanation of OTEC to Related Organizations

In St. Vincent, explanation of OTEC technology and discussion was conducted to Mr. Pompey, Permanent Secretary of the Ministry of National Security, Prime Minister's Office, Mr. Dacon, Director of the Energy Station, Mr. Thornley, CEO of VINLEC Power Company, and Mr. Lully, manager of VINLEC Lowmans Bay Power Station.

Generally they already understood the potential usefulness of OTEC technology and had high expectations. They did not reveal any commitment to research or proposed application of OTEC technology, including from other countries.

Energy Director Mr. Dacon (the person responsible for energy conservations including OTEC and renewable energy), mentioned the expectation to progress to the OTEC research stage with Japan, and ready to apply for an ODA formal request through the Prime Minister's Office. The OTEC candidate sites he described based on the development situation of industry and power demand are same as around Kingstown Area as mentioned above.

5. OTEC Site Survey (Barbados)

5.1 Introduction

Barbados is an island nation located in the eastern-most end of the Lesser Antilles in the West Indies. The island is mostly flatland with an area of 430 square kilometers formed by coral reef. Figure 6 shows the bathymetric condition surrounding Barbados (the capital Bridgetown is represented by the red circle). In studying the suitability of OTEC, an land based facility should have access to seawater from a depth of 1,000m from a distance of about 5km from shore, longer distances suggests an offshore solution. For Barbados, the distance to 1,000m seawater depth is 5 to 10km on the northeast side. The terrain of the island leads to distances longer than 10km for a 1,000m depth for the North, South, and Western parts of the island.

Figure 6: Bathymetrical map of Barbados

5.2 OTEC Candidate Sites (Northeast Coast)

The northeast side of Barbados Island faces the Atlantic Ocean with relatively mild landscape different from the Caribbean side (see photo 4). The coast is dotted with small bays and fishing villages where small scale fishing carries on. Locals and tourists visit the region especially for the fresh red snapper sold cheaply at restaurants and market.

Photo 4: OTEC Candidate Site Northeast Coast of the Island (Atlantic Side)

Though no large towns have been developed along the northeast coast, when considering the distance to deep seawater in the case of land based OTEC, the northeast coast becomes a predominate candidate site in Barbados. It should be noted that specific conditions in addition to geography and topography such as ease of connecting to the grid and utilization of deep seawater for agriculture and fisheries must be considered for the expansion of new industries using deep seawater.

5.3 Composite Use of Deep Seawater and Power Generation by Land Based OTEC

With a population of 280,000 people, the power demand on Barbados is roughly 150MW during the May to August peak season. Currently, Barbados is supplied with power by Barbados Light & Power Co. Ltd. (BLPC) operating from three locations with diesel power plant with a supply capacity of about 240MW.

Land-based OTEC is limited to 10MW class size, which if producing 10MW of power for sale would cover only around 7% of the peak demand. However, since conducting a study for offshore OTEC of 100MW is premature, several MW land-based OTEC could be proposed that takes into account the economic efficiencies of combining with desalination and other deep seawater use industries.

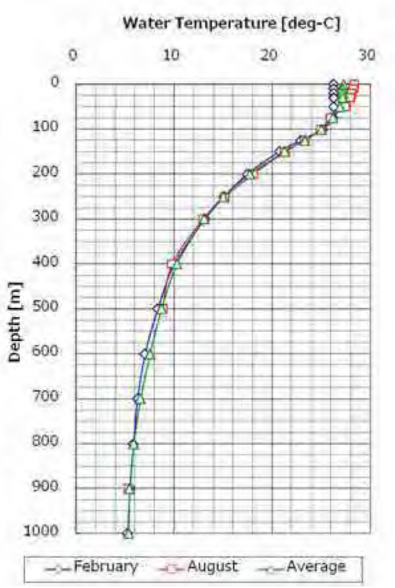


Figure 7: Barbados' s Ocean Temperature / Depth Distribution

Possible power generation equipment capacity for OTEC includes 1MW to 10MW for land-based systems and 10MW to 100MW for large scale offshore OTEC. Japan has estimated the power generation cost and construction costs for OTEC. Roughly, the commercialized 10MW class OTEC plant will cost 278 million US$ with a 0.19-0.23 US$/kWh power generation cost. A 100MW class OTEC plant will cost roughly 926 million US$ with 0.07-0.09 US$/kWh power generation cost. It is possible to supply power at a lower price than current diesel generators (about 0.23 US$/kWh generation cost) used in Barbados.

Barbados's major industries are tourism, agriculture, and fishery. In the agriculture sector, sugar and rum from sugarcane cultivation have become particularly major export resources (see Photo 5).

Photo 5: Barbados Sugarcane fields

The OTEC plan for Barbados combines power production with the industries mentioned above. Deep seawater from 800m to 1,000m is cold (5-7 degree C throughout the year, see Figure 7) and can be used in the air conditioning (resorts or large hotels) of tourist facilities, for district cooling systems, and other uses. The mineral rich deep seawater can also be used in aquaculture of fisheries or to promote fisheries by providing nutrients and minerals. It is also possible to develop aquaculture industries such as fish and shellfish farming to improve value and increase the catch. In addition, combined power generation and successful use of deep seawater can lead to an increase in tourism from eco-tourism and the combined industries. Particularly for island nations, the use of deep seawater can energize local economies while improving water resource issues by adding value to the utilization of deep seawater through research into new industries and the production of drinking water. Use of cold deep seawater can lead to the development of more specialty products and vegetables other than sugarcane as well.

5.4 The Possibility of Offshore OTEC (Future Plans)

The areas surrounding Barbados Island meet the conditions for offshore OTEC. As described above, the northeast coast has access to deep seawater within 5-10km. The North, South, West, and even the southwest coast have access to OTEC's needed 1,000m water depth within 10-20km. Since Barbados has access to the necessary deep water, a commercial offshore OTEC facility of 100MW class is possible.

The population density of Barbados is the highest in the Caribbean with 280,000 inhabitants on 431 square kilometers of land with a peak power demand of 150MW. In other words, 60% of the domestic demand can be covered with one large 100MW offshore OTEC facility. In the future, with two offshore OTEC facilities the power demand of the country could be covered. Planning and the export of surplus power to neighboring countries are also possible. For large offshore OTEC facilities, rather than planning in one country, island regions such as the Caribbean with small adjacent islands may be able to develop plans for flexible power sharing among neighboring countries.

It should be noted that common to both land and offshore OTEC facilities are the influence of tidal currents, hurricanes and poor weather conditions, the risk of tsunami caused by seismic activity, and the effects of volcanic activity from neighboring countries. It is considered necessary to develop a specific plan for these contingencies and also to conduct basic research to consider the impact on the marine environment of the beautiful Caribbean.

5.5 Explaining OTEC to Relevant Organizations

In Barbados, explanation of OTEC technology was conducted to Mr. Jehu Wiltshire Permanent Secretary of the Prime Minister's Office, Mr. Willam Hinds (Chief Energy Conservation Officer), and Mr. Horace Archer (Senior Technical Officer), and described the OTEC overview and possibilities for Barbados. There are three OTEC projects in

motion.
The first is a pre-FS investigation (desk research) submitted from SIDS DOCK a few years ago in cooperation with Japan. A more detailed study is expected in the future.

The second is an ocean energy research plan supported by IDB. The target is the ocean energy field (OTEC, wave, ocean cooling, offshore wind) with the EU and IDB to provide support. It is expected that IDB will bid in 2015 and that mapping of the ocean energy potential using a GIS will be performed from the end of 2014.

The third is that Barbados Light and Power Co. Ltd. is preparing a memorandum for the investigation of OTEC along with a French company. It is undecided whether the Barbados government will be involved.

It should be noted that Permanent Secretary Mr. Jehu Wiltshire is in charge of the office concerning OTEC technology in Barbados. It was confirmed that Mr. Jehu is the Barbados representative to SIDS DOCK.

OTEC technology was explained in the same way with the Barbados power company Barbados Light and Power Co. Ltd. They confirmed the situation in respect to the memorandum of understanding relating to OTEC research with DCNS of France and the above BLPC. As of now there is no signed memorandum of understanding relating to OTEC between the power company and the French company (DCNS), but they are at the stage of consultation for a feasibility study and exchange of information. At this time there is no budget attached. Interest is very high in considering the possibility of desalination at the same time of power generation with OTEC since the demand for water is growing in Barbados. However, BLPC does not consider OTEC as a technology that can be implemented within the next five years so they are focusing on obtaining information and hoping techniques improve further.

6. OTEC Project Flow

Regarding OTEC Projects, Figure 8 shows the flow of the entire business plan required from schematic design, detailed design, and until project implementation. For the field surveys conducted at three countries St. Lucia, St. Vincent and Barbados were confirmed the candidate site suitable for land-based OTEC in particular through consultation with the relevant local organizations. Because OTEC is the most promising energy technologies for base load coverage in the future, interest is very high in all three countries. In this survey, information on land-based OTEC candidate sites was shared in each country among the related organizations.

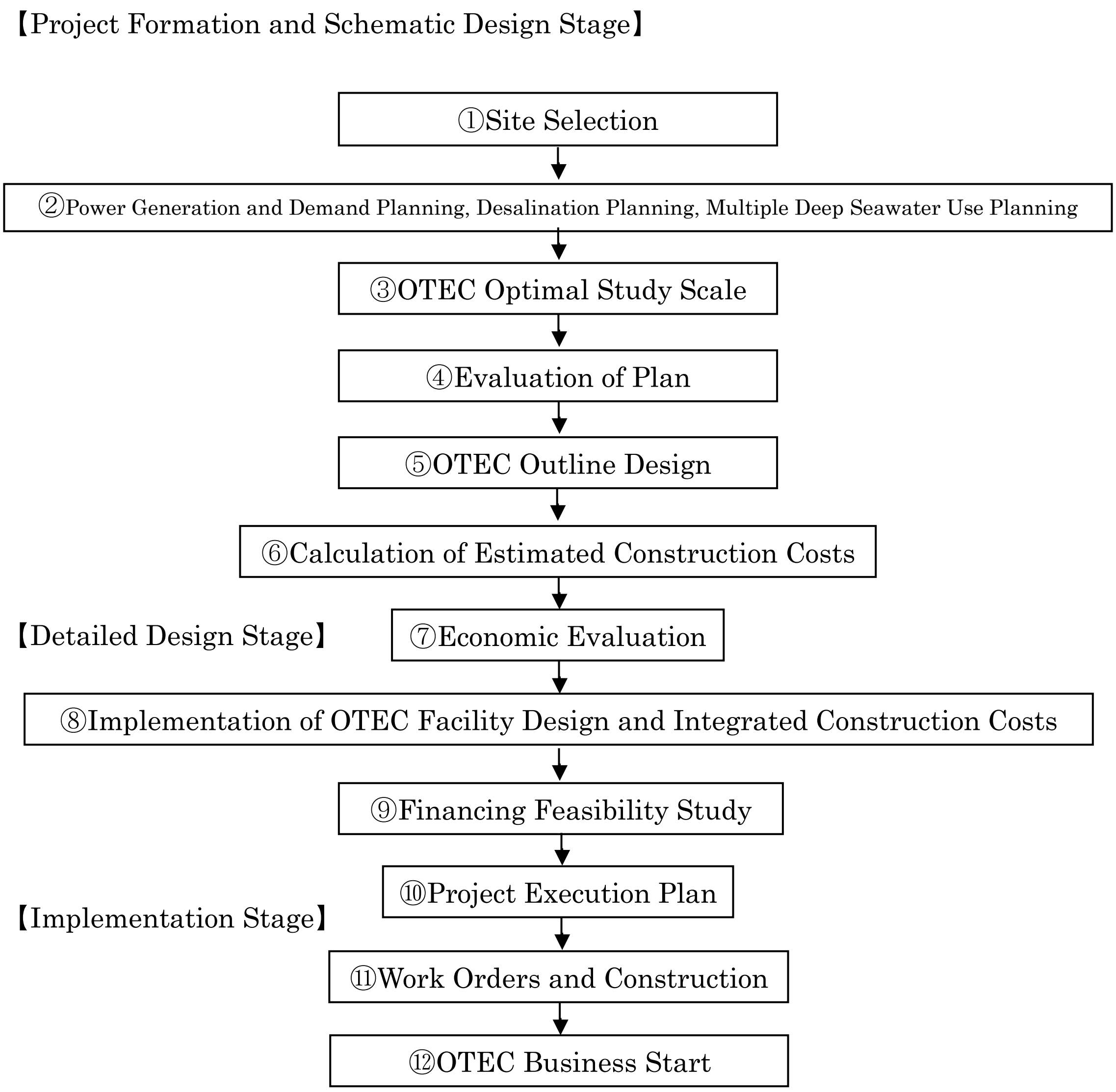


Figure 8 OTEC Business Flow Chart

7. OTEC Business Plan

As shown in the table below the three countries that conducted field survey have populations between 110,000 and 280,000 people. They are island nations similar in size to Awaji Island in Japan. Since St. Vincent is sparsely populated, there is a 20MW power demand with 60MW in St. Lucia, and 150MW in Barbados. These three countries have established goals to introduce renewable energies to cover 20-30% of their demand and are working to increase energy savings while reducing consumption of diesel power generation, which has high rates. On the other hand, achieving a stable power supply through renewable energy such as solar can be difficult since there is a limit to the stability when working in cooperation with an existing grid system. Introduction of a renewable energy that is stable and can be used as for base load is desired. In this environment, there is attention on hydro and geothermal power, however, it is expected that OTEC technology will have larger output in the future.

To meet the goals above, the next steps in the flow of OTEC development after site selection, required activities such as "power demand planning", "multiple deep seawater use planning", "power generation planning", "OTEC Optimal Study", "evaluation of the plan", and "OTEC outline design" in order as shown in Figure 8.

Table 2 OTEC Related Information of Three Surveyed Countries

	St. Lucia	St. Vincent	Barbados
Population	180,000	110,000	280,000
Power Demand	60MW	20MW	150MW
Major Industries	Tourism (World Natural Heritage Site), Fishery, Agriculture	Tourism, Fishery, Agriculture	Tourism (World Heritage Site), Fishery, Agriculture (sugarcane)
Multiple Deep Seawater Use Possibilities	Seawater Desalination, Fishery (aquaculture), Tourism Use (local products, souvenirs)	Seawater Desalination, Fishery (aquaculture), Capital District Cooling, Tourism Use (local products, souvenirs)	Seawater Desalination, Fishery (aquaculture), Tourism Use (local products, souvenirs)
OTEC Potential (Land/ Offshore)	High / High (Distance to 1,000m depth is within 3km from land)	High / High (Distance to 1,000m depth is within 4km from land)	High / High (Distance to 1,000m depth is within 8km from land).
OTEC Scale (Land/ Offshore)	1MW～10MW (Land) 10MW～50MW (Offshore)	1MW～10MW (Land)	1MW～10MW (Land) 10MW～100MW (Offshore)

Table 2 compiles OTEC related information from the three countries surveyed. The major industries of the Caribbean are tourism, fishery, and agriculture. In addition to the OTEC power and desalination businesses, multiple use of deep seawater has great potential in fishery, agriculture, and tourism development. While the scale is different from country to country, considering the construction of power generation facilities of 10MW-100MW class in the future, there is a need to confirm the size that can be applied. For the construction cost and power generation unit price of OTEC, which is estimated in Japan, construction cost of OTEC of 10MW class that have the potential to achieve a power generation unit price 0.19-0.23 US$/ kWh is roughly 278 million US$.

In this study, the construction cost of the land based OTEC which have a potential of multiple use of deep seawater such as desalination, schematic consideration of economic efficiency for 500kW (0.5MW), 1MW and 3MW class was carried out as below, from the viewpoint of considering the OTEC introduction through donor assistance to the Caribbean island countries.

8. Estimated Construction Costs of Small Scale OTEC Facilities

Estimated result of specifications, construction costs and power generation cost for 0.5 MW, 1 MW and 3 MW land based OTEC are shown in the table below. Construction cost was calculated based on the existing estimated results in 1MW land based OTEC in Japan, O&M costs of 50kW class OTEC demonstration facilities in Kume-island, and reference value of deep seawater intake facilities in abroad.

In addition, the cost of a 0.5MW and 3MW facility was calculated by the 0.7 multiply method (using 0.6-0.7 square proportion to account for the economies of scale as a rule of thumb).

Table 3 Land-Based 0.5MW / 1MW /3MW OTEC Specifications, Construction Costs, and Power Generation Costs (Reference Value)

Item	0.5MW Land Based OTEC	1MW Land Based OTEC	3MW Land Based OTEC
Generation Output (Yearly Average)	830kW	1,660kW	4,983kW
Equipment Utilization	85%	85%	85%
Net Output (Yearly Average)	0.5MW	1MW	3MW
Construction Costs (Power Generation)	32.4 million US$ (Breakdown: 14.8 million US$ Power Generation Facility, 17.6 million US$ Water Intake Equipment)	52.8 million US$ (Breakdown: 25 million US$*1 Power Generation Facility, 27.8 million US$*2 Water Intake Equipment)	113.9 million US$ (Breakdown: 53.7 million US$ Power Generation Facility, 60.2 million US$ Water Intake Equipment)
Intake information (Reference Value for 1MW)	N/A	Pipe Dia.: 1.5m Depth : 1,000m Length : 3,000m Intake :200,000m3/d	N/A
Personnel Expenses (per year)	23,000 US$	46,000 US$	93,000 US$
Maintenance Costs (per year)	46,000 US$	93,000 US$	185,000 US$
Power Generation Costs (US$/kWh)	0.30 US$ 0.32 US$ (with Desalination)	0.25 US$ 0.25 US$ (with Desalination)	0.18 US$ 0.16 US$ (with Desalination)

Item	0.5MW	1MW	3MW
Desalination	1,200m3/day	2,400m3/day	7,200m3/day
Construction Costs (Desalination)	6.0 million US$	9.7 million US$	21.3 million US$
Maintenance Costs	30,000 US$	46,000 US$	111,000 US$
Electricity cost for desalination (3kWh/m3) *3	343,000 US$	565,000 US$	1,220,000 US$
Desalination Water Cost (US$/m3)	0.62 US$	0.5 US$	0.37 US$

*1: Domestic estimation cost for1MW land-based OTEC power generation unit

*2: Referenced value based on overseas intake pipe construction cost for 1MW land-based OTEC (App. 27.8～46.3 million US$)

*3: Electricity cost for desalination is calculated by using 0.3 for 0.5MW, 0.25 for 1MW and 0.18 US$ / kWh for 3MW

A breakdown of the OTEC construction costs for power generation unit includes " facility design and engineering expenses", "equipment and material costs (especially the heat exchanger)", and "equipment installation costs (piping, electronics, civil engineering, and construction)". In addition, breakdown of maintenance costs includes various pumps, turbine generator, and heat exchanger maintenance costs (condenser and evaporator).

For the facility specification, gross output for the facilities with a 39.8% intramural utilization is calculated at 1,660kW, 4,983kW and 830kW respectively with net output of 1,000kW (1MW), 3,000kW (3MW) and 500kW (0.5MW). In addition, the desalination portion is basically expected to utilize 8,000m^3 per hour of surface water with 8,000m^3 per hour of deep seawater post power generation to produce 2,400m^3 per day of fresh water for 1MW OTEC by flash evaporation method. For 3 MW and 0.5 MW OTEC, 7,200m^3 and 1,200m^3 per day of fresh water could be produced respectively.

Power generation cost of 0.5MW to 1MW class power generation (0.25-0.30 US$/kwh) became equivalent to the electricity price of the current state of the Caribbean (0.3US$ = 32.4 yen/kWh), and power generation cost of 3MW OTEC facilities, 0.18 US$/kwh is the price that has a competitive edge to the electric price of the current state of the Caribbean.

The numerical values shown in this report such as estimated OTEC construction costs and the consideration of economy is the only reference value.

For power generation facility is likely to be more economical depending on the development of future technology in the world. On the other hand, it should be noted that construction cost may vary greatly by changing of material and method, based on weather and ocean conditions, topography and geology of the seabed, setting of the safety margin for intake facilities.

Also, transmission and water facilities, it is necessary to consider that the necessary costs will be fluctuated depending on the consuming region and OTEC construction site.

Therefore, in order to perform a more specific study, it is necessary to evaluate on the basis of the latest design and estimation suitable for location of candidate sites including the size of OTEC.

9. Consideration of Small-Scale OTEC Economy

As mentioned above, construction cost of 1MW Land based OTEC was estimated as 52.8 million US$ in total. In this case, study results on economic efficiency for this 1 MW land based OTEC facilities are shown in the below table 4-1, for each of the following cases (1) power generation only, (2) power generation and desalination, (3) power generation and desalination (20% up of water price), (4) power generation and desalination and multiple use of deep seawater.

Table 4-1 Consideration of Economic Efficiency of 1MW land-based OTEC

(US$)

1MW Land-Based OTEC	Item	Case(1) Power Generation Sale Price Power 0.3US$/kwh	Case(2) Power Generation & Desalination Sale Price Power 0.3US$/kwh Water 0.75US$/m3	Case(3) Power Generation & Desalination(+20%) Sale Price Power 0.3US$/kwh Water 0.9US$/m3	Case(4) Power Generation & Desalination & Multiple use Sale Price Power 0.3US$/kwh Water 0.75US$/m3
Initial Investment	Power Generation	25,000,000	25,000,000	25,000,000	25,000,000
	Desalination	0	9,722,000	9,722,000	9,722,000
	Intake Pipe	27,778,000	27,778,000	27,778,000	27,778,000
	Sub Total ①	52,778,000	62,500,000	62,500,000	62,500,000
Income /year	a. Power	2,232,000	2,232,000	2,232,000	2,232,000
	b. Water	0	558,000	669,000	558,000
	c. Multiple use	0	0	0	1,852,000
	Sub Total ②	2,232,000	2,790,000	2,901,000	4,642,000
Expenses /year	d. Personnel	46,000	46,000	46,000	46,000
	e. Maintenance	93,000	139,000	139,000	139,000
	Sub Total ③	139,000	185,000	185,000	185,000
Balance (=②−③)		2,093,000	2,605,000	2,716,000	4,457,000

Production Price (US$/kwh) Power Generation Cost)	0.25	0.23	0.21	N/A
Payback(year)(=①/(②−③)	25.2	24.0	23.0	14.0
IRR (%)	1.2	1.5	1.8	5.8
Electricity sales price for achieving IRR 6% in 30 years (US$/kwh)	0.54	0.56	0.55	0.31
Electricity sales price for achieving IRR 4% in 30 years (US$/kwh)	0.43	0.44	0.42	0.19
Electricity sales price for achieving IRR 2% in 30 years (US$/kwh)	0.34	0.33	0.31	0.08

(1US$=108yen : Exchange rate in September 2014)

In case of case (2), power generation and desalination use of 1MW class OTEC, average cost of income from electricity 32.4yen=0.3US$/kwh and water 81yen=0.75US$/m3 (1.5US$/m3[1] minus power charge for desalination 0.25US$ x 3.0 kwh), produced by OTEC will be 2.79 million US$ per year, payback period is 24.0 years and IRR is 1.5% in the case where the project period sets 30 years.

[1] Analogize from national average water rate 3,199 yen of 2015 Japan / 20m3 (160 yen =1.48 US$/m3)

In case of case(4), suppose to have income of 1.85 million US$ per year[2] in the multiple use of deep seawater for agriculture and fisheries, air conditioning, tourism, etc in addition to power and desalination, payback is 14 years, and IRR is 5.8%.

In addition, when back-calculate power generation unit cost to achieve a 6%, 4% and 2% of IRR in project period 30 years, when IRR is 2%, electric sales price close to the status of power tariff levels = 0.3US$ (In case of assuming the additional revenue by multiple use of deep seawater, IRR is 6%).

In a similar way, consideration results in the case of 3MW and 0.5MW are shown in Table 4-2 and Table 4-3.

Table 4-2　Consideration of Economic Efficiency of 3MW land-based OTEC

(US$)

3MW Land-Based OTEC	Item	Case(1) Power Generation Sale Price Power 0.3US$/kwh	Case(2) Power Generation & Desalination Sale Price Power 0.3US$/kwh Water 0.9US$/m3	Case(3) Power Generation & Desalination(+20%) Sale Price Power 0.3US$/kwh Water 1.08US$/m3	Case(4) Power Generation & Desalination & Multiple use Sale Price Power 0.3US$/kwh Water 0.9US$/m3
Initial Investment	Power Generation	53,704,000	53,704,000	53,704,000	53,704,000
	Desalination	0	21,296,000	21,296,000	21,296,000
	Intake Pipe	60,185,000	60,185,000	60,185,000	60,185,000
	Sub Total ①	113,889,000	135,185,000	135,185,000	135,185,000
Income /year	a. Power	6,696,000	6,696,000	6,696,000	6,696,000
	b. Water	0	2,009,000	2,410,000	2,009,000
	c. Multiple use	0	0	0	5,556,000
	Sub Total ②	6,696,000	8,705,000	9,106,000	14,261,000
Expenses /year	d. Personnel	93,000	93,000	93,000	93,000
	e. Maintenance	185,000	296,000	296,000	296,000
	Sub Total ③	278,000	389,000	389,000	389,000
Balance（=②−③）		6,418,000	8,316,000	8,717,000	13,872,000

Production Price (US$/kwh) Power Generation Cost)	0.18	0.13	0.11	N/A
Payback(year)(=①/(②−③)	17.7	16.3	15.5	9.7
IRR（%）	3.8	4.5	4.9	9.6
Electricity sales price for achieving IRR 6% in 30 years (US$/kwh)	0.39	0.37	0.35	0.12
Electricity sales price for achieving IRR 4% in 30 years (US$/kwh)	0.31	0.28	0.29	0.03
Electricity sales price for achieving IRR 2% in 30 years (US$/kwh)	0.24	0.20	0.18	0

(1US$=108yen：Exchange rate in September 2014)

In the case of the power generation of 3MW class OTEC, IRR was calculated as 3.8% for base case (1).

[2] By utilizing the deep seawater of 13,000m3 per day, sales by the relevant business in Kume-island is over 2 billion yen (18.5 million US$) per year (Reference: "Basic Study for deep seawater multiple use " research report, March 2011: Kumejima town). In the case of 1MW class OTEC facility, around 200,000 m3 of deep seawater has significant potential to expected industrial activities and revenues there from.

In addition, when back-calculate power generation unit cost to achieve a 6%, 4% and 2% of IRR in project period 30 years, it is possible to achieve 4% IRR with electricity sales price that almost equivalent to current electricity rates 0.3US$/kwh.

Table 4-3 Consideration of Economic Efficiency of 0.5MW land-based OTEC

(US$)

0.5MW Land-Based OTEC	Item	Case(1) Power Generation Sale Price Power 0.3US$/kwh	Case(2) Power Generation & Desalination Sale Price Power 0.3US$/kwh Water 0.6US$/m3	Case(3) Power Generation & Desalination(+20%) Sale Price Power 0.3US$/kwh Water 0.72US$/m3	Case(4) Power Generation & Desalination & Multiple use Sale Price Power 0.3US$/kwh Water 0.6US$/m3
Initial Investment	Power Generation	14,815,000	14,815,000	14,815,000	14,815,000
	Desalination	0	6,019,000	6,019,000	6,019,000
	Intake Pipe	17,593,000	17,593,000	17,593,000	17,593,000
	Sub Total ①	32,408,000	38,427,000	38,427,000	38,427,000
Income /year	a. Power	1,116,000	1,116,000	1,116,000	1,116,000
	b. Water	0	223,000	268,000	223,000
	c. Multiple use	0	0	0	926,000
	Sub Total ②	1,116,000	1,339,000	1,384,000	2,265,000
Expenses /year	d. Personnel	23,000	23,000	23,000	23,000
	e. Maintenance	46,000	76,000	76,000	76,000
	Sub Total ③	69,000	99,000	99,000	99,000
Balance (=②−③)		1,047,000	1,240,000	1,285,000	2,166,000
Production Price (US$/kwh) Power Generation Cost)		0.31	0.31	0.30	N/A
Payback(year)(=①/(②−③)		31.0	31.0	29.9	17.7
IRR (%)		-0.2	-0.2	0.0	3.8
Payback (year) with free investment of 9.3 million US$		22.1	23.5	22.7	13.5
IRR (%) with free investment of 9.3 million US$		2.1	1.6	1.9	6.2
Electricity sales price for achieving IRR 6% in 30 years (US$/kwh)		0.65	0.72	0.70	0.46
Electricity sales price for achieving IRR 4% in 30 years (US$/kwh)		0.52	0.56	0.55	0.30
Electricity sales price for achieving IRR 2% in 30 years (US$/kwh)		0.41	0.43	0.41	0.18

(1US$=108yen : Exchange rate in September 2014)

In the case of smallest 0.5MW class OTEC among this study, if in accordance with construction cost estimate method described above, and do not assume the additional income, IRR was calculated as negative.

If it is assumed that grant aid is 9.3 million US$, IRR is estimated as positive value 1.6 to 2.1 %.

10. Future Development of OTEC Projects in the Caribbean

Caribbean countries are eager to introduction of renewable energy and energy-saving technologies, shows the high interest in OTEC technology.

OTEC has no track record of the world's commercial operation. In addition, power generation unit price of OTEC is higher than geothermal and hydropower, OTEC is a one of base power of renewable energy that can introduce for island countries and even small scale OTEC if appointed optimal conditions, it has the potential to replace the diesel power.

On the other hand, the construction cost of large scale OTEC that necessary to secure a certain economy as a private projects, is very large compare to the economy of the island regions. For this reason OTEC as a private sector project, it is supposed to be preceded by low-risk developed countries than developing countries (Oceania, the Caribbean island countries).

Therefore, in order to realize the OTEC in the Caribbean island country, it is considered as shortcut way to carry out preparation work (basic and feasibility study including candidate site selection), and to develop a precision plan that can be reflected in the future energy plan, while chasing the movement of public-private OTEC projects in developed countries.

In addition, depending on the possibility of donor support, as a partner the public sector of the Caribbean island countries, preceding the small scale projects with assistance of public sector as a demonstration is considered effective way for promotion of future large-scale project. For example, the intake facilities necessary to 0.1 ~ 0.3MW class OTEC will be built by government subsidies, then, power generation facilities recruit private IPP (Independent Power Producer).

In Japan, basic OTEC technology has been confirmed through the establishment of a 100kW class demonstration unit operated continuously, and preparations are underway for a 1,000kW (1MW) class facility (See Figure 9: OTEC Demonstration Plant installed in Kume island, Okinawa Prefecture). Including Japan, to keep the selected specific OTEC candidate sites for the next 1MW ~ 10MW class, it is considered necessary to the implementation of feasibility studies of the Caribbean countries with high OTEC potential.

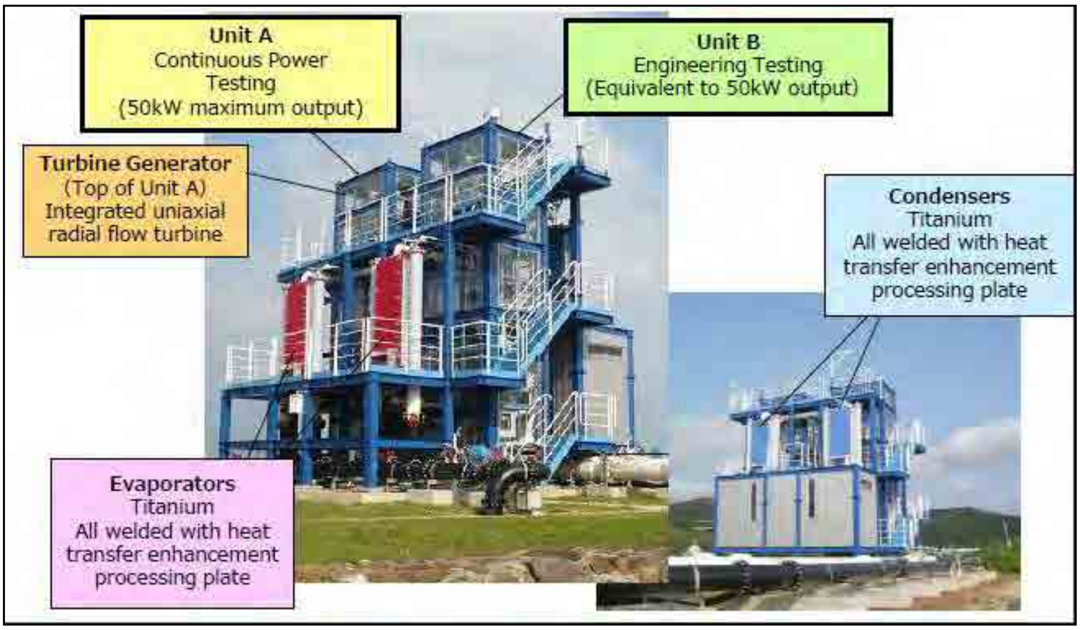


Figure 9 The Installed and Running OTEC Demonstration Facility at the Okinawa Deep Seawater Research Institute (Kume Island)

Summary of survey on geothermal potential in Dominica

1. Geothermal Wells:

The government of Dominica began with three thermal gradient wells (Figure 1 and Table 1) and later with additional commercial geothermal wells (Table 2). The well WW-P1 is located at the same drilling platform of WW-3. Well WW-R1 is located at "point 2" of the selected injection area (see Figure 1).

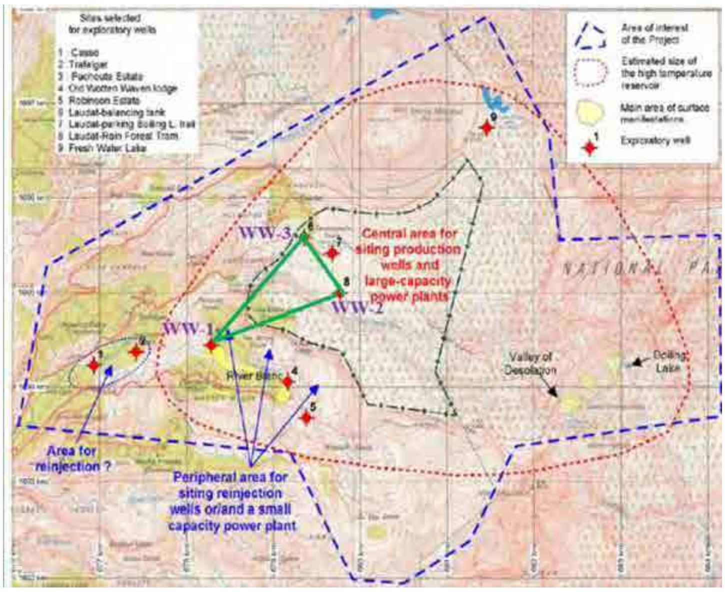


Figure 1. Project Area – Wotten Waven Geothermal Project.

Information on these three slim wells is found in Table 1.

Table 1. Exploratory Wells WW-1, WW-2 & WW-3.

Activity	WW-2	WW-3	WW-1
Commencement Date	16-Dec-2011	15-Feb-2012	28-Mar-2012
Completion Date	28-Jan-2012	14-Mar-2012	27-Apr-2012
Final Depth	1,469 m	1,613 m	1,200 m
Estimated Power	0.5 MW	2.9 MW	3.9 MW

Table 2 provides information on the commercial wells:

Table 2. Commercial Wells in Dominica

Activity	WW-R1	WW-P1
Commencement Date	6-Nov-2013	14-Jan-2014
Completion Date	20-Dec-13	28-Feb-2014
Final Depth	1,915 m	1,505
Estimated Power	0	+/- 10 MW
Well Type	Vertical	Directional

The drilling and testing of three exploratory wells found two commercial wells and proved the existence of a viable geothermal resource. The Government of the Commonwealth of Dominica (GoCD) is now seeking to develop a 5–10MW Small Geothermal Power Plant (SGPP) within the Roseau Valley Geothermal field.

2. Field Trip to the Wotten Waven Geothermal Field:

Mr. Alexis George, who manages the GPMU, escorted the team to all the wells in the Wotten Waven Geothermal Field (Figure 2).

Figure 2.　Geothermal Well Site Tour

The team first visited the injection well WW-R1 (Figure 3, Table 2). Unfortunately, this well does not have permeability and therefore cannot be used as an injection well.

Figure 3. WW-R1 Geothermal Well

Well information is found in Figure 4.

Figure 4. Information on WW-R1 Geothermal Well

The team continued the field trip at WW-1, the well that Dominica is now planning to use as the injection well for the development of their small power plant.

Figure 5. WW-1 Geothermal Well

There are several superficial manifestations in the Wotten Waven. The team had a chance to visit one of them (Figure 6).

Figure 6. Thermal Manifestation in the Wotten Waven Area.

The team was taken to see wells WW-3 and WW-P1, which are located at the same drilling pad (Figures 7, 8 & 9).

Figure 7. WW-PI Geothermal Well

Figure 8. Information on the WW-P1 Geothermal Well

Figure 9. WW-3 Geothermal Well.

Finally, the team was taken to well WW-2, the last drilling pad visited in this field trip (Figure 10). The information on this well is shown in Figure 11.

Figure 10. WW-2 Geothermal Well.

Figure 11. Information on WW-2 Geothermal Well.

3. New Geothermal Information in Dominica:

Mr. Alexis George provided two related reports: the WW-P1 drilling report (see WW-P1 Drilling Report.pdf) and the preliminary production test report (see WW-P1 Production Test Report.pdf) of the same production well. The report summarizes newly available information from the Wotten Waven geothermal project, including the geothermal wells.

Geothermal development in Wotten Waven is expected to be financed by a consortium including: GDF Suez (http://www.gdfsuez.com/en/), Groupe NGE (http://www.groupe-nge.fr/actualites.php) and CDC Infrastructure. (http://www.cdcinfrastructure.com/lang-uk/index.html).

The Government of Dominica is interested in having JICA provide support for the development of additional geothermal resources located in the following regions:

1. Picard, Portsmouth: Signs of geothermal activity can be found in this area in the form of hot region area in the Picard River and offshore in the Caribbean Sea. No studies

have been done in this area as of yet (Figure 12).

2. Soufriere: This area exhibits a good deal of geothermal activity, including steam vents, fumaroles and hot springs. A license was given to West Indies Power in 2008 to carry out geothermal exploration in that area. To date, nothing has been done and the Government is seeking to terminate the license. This area has strong potential for the development of another geothermal field (Figure 12).

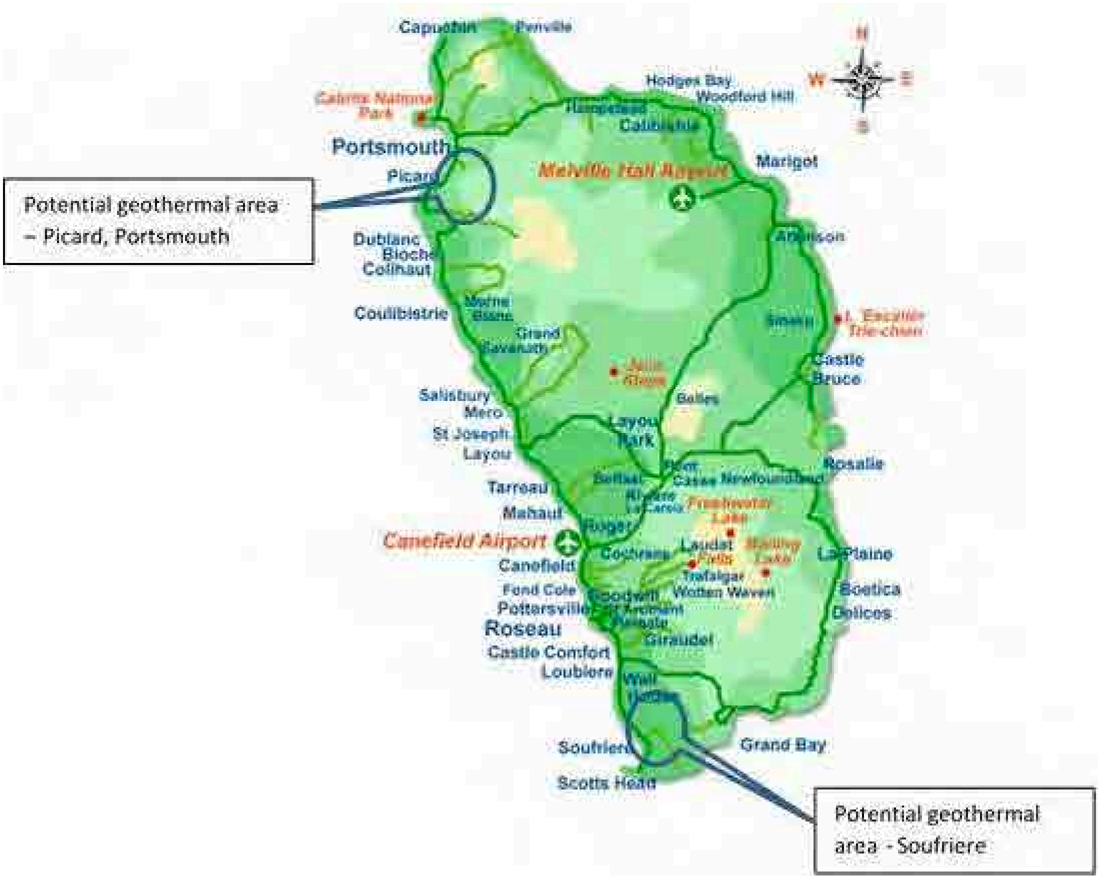


Figure 12. Identified Geothermal Areas in Dominica.

The environmental study of the Wotten Waven geothermal field started in December 2013 and it is expected to be concluded in June 2015. This initial assessment will examine several areas and they will be managed by different companies:

a) Fauna/Flora: identification of species and assessment of the challenges (Eclipse Inc., Biodiversite)
b) Acoustics: measurement of noise levels and modelling of noise propagation generated by activities (RAF Acoustique)
c) Hydrography and hydrobiology: hydraulic studies and assessment of the

biological quality of the water and of the biotope (Asconit Consultants)

d) Meteorology: gathering of meteorological data and modelling of water flows in the Roseau Valley, including the use of different means of measurement (Enviroconsult)
e) Socio-economics: highlight the challenges relating to the existing economic, social and cultural context (Adret & Territoires)
f) Landscape: complete identification of landscape and heritage features (Caraibe Environnement)
g) Natural hazards: flooding, seismic and volcanic risk, hurricane risk and landslides (IMS RN, ISL Ingenierie)
h) Consultation: organization of sensitization meetings, discussions and follow-up sessions for various target groups (residents, elected officials, farmers, tourism stakeholders, etc.). (Caraibe Environnement, Teranov, Eclipse Inc.)

GPMU is considering the implementation of an additional geophysical Magneto telluric (MT) survey to identify locations for future drilling of production and injection wells for the Wotten Waven geothermal field. It would include an analysis of aerial photographs to ascertain structural features (faults, caldera borders, etc.) which would represent permeable zones. These particular studies would look at the entire project area. The estimated cost of these works is 200,400 Euros and includes the following:

#	Activity	Amount (US $)
a.	Magneto Telluric (MT) Resistivity, Geological Survey	223,070
b.	Aerial Photography Analysis	30,950
c.	Project Management, Workshop with GPMU	12,200
	Total	266,200

4. Main Remarks on the Wotten Waven Geothermal Development:

The government of Dominica was planning to use the two geothermal wells located at the same drilling pad (WW-3 and WW-P1) for geothermal power development. WW-P1 would be the production well and WW-3 would be the injection well for a small geothermal power plant of 5-10 MW) at the Wotten Waven geothermal field. This small plant would be used to obtain important reservoir information while producing geothermal energy for Dominica.

During the WW-P1 production test, a small tracer test was conducted to understand if the production and the injection well are connected. Unfortunately, there is a fast connection between the two wells, effectively eliminating WW-3 as an injection well for this type of development. Because of this, Dominica is now planning to use WW-1 as the injection well.

When testing production wells it standard practice is to carry out a short-term production test while the rig is in place, or up to a few months after the rig has been removed. Normally, a short-term production test last from 7 to 30 days and is performed to estimate the capacity of the well, with the resulting mass data used to estimate power generation capacity. These tests provide "initial estimates" where: a) the test is done with the rig in place or soon after the rig is mobilized, the temperature within the well does not reach stabilization with respect the temperature of the formation, and b) even if the sort term test is done after temperature stabilization is reached, the short test does not permit pressures within the production zone to stabilize. In both cases, the results are not the stabilized values. Again, this testing provides only an indication of the possible capacity of a well. In Dominica, even though all of the elements for a long-term production test exist, the test was done over a short 6 days, due mainly to budgetary restrictions.

If positive results from this preliminary test are obtained, a long-term production test would follow, including injection into the well and monitoring of adjacent wells in the field.

Dominica has performed a preliminary test, but needs to carry out a long-term production test. The full evaluation would include the production well, the injection well and the possible connection between them. When Dominica obtains the funds to carry out this testing, a 1 to 3 month test would occur to obtain current production parameters. Pressure monitoring equipment would be necessary to monitor the effects of mass extraction on other wells. Also it will be necessary to include an additional tracer test.

From the information received, it is possible to conclude the following:

1. Injection cannot take place with the existing well adjacent to the production well. This well could become a spare production well in the future, but it cannot be used as an injection well for the geothermal development,
2. A new production test would be needed to understand the stable conditions of the

production well and verify whether injection can occur, 3. More equipment could be required to monitor the pressure in other wells, 4. A new tracer test should be conducted to verify that geothermal fluids do not return from the injection into the production zones, 5. All of the above research would need to be completed prior to determining the output of a small power plant.
Material given： WW-P1 Drilling Report, WW-P1 Production Test Report

Summary of survey on geothermal potential in Saint Lucia

1. Geothermal Drilled Wells:

Seven exploratory boreholes were drilled in the Qualibou depression between 1974 and 1976 by Merz and McLellan Co., (associated with the Institute of geological Sciences (IGS) of London) and the Seismic Research Unit of the University of West Indies, Trinidad. This work was funded by the United Kingdom Overseas Administration (UKODA).

The exploratory drilling was at depths ranging from 116 m to 726 m. The result was the discovery of a steam-dominated reservoir below Sulphur Springs at a depth of 200-350 meters producing superheated steam with low pH (approximately 2.8) and a high rate of non-condensable gases.

The better understand the geology of the Qualibou depression and the Sulphur Springs geothermal system, additional surveys were conducted by two new contractors. They performed geological reconnaissance, a hydro-geochemical survey and electrical resistivity survey of the Qualibou caldera. Further surveys were carried out by Italian (Aquater SpA, 1982) and American (Los Alamos National Laboratory, 1983) consultants, funded by the United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE) and the United States Agency for International Development (USAID), respectively.

A follow-up feasibility study started in 1986. Two deep exploratory boreholes, SL-1 and SL-2, were drilled in 1987-88 with a New Zealand consultant (GENZL) performing partial testing on the SL-2 well in 1990-91. The most recent evaluation of the Sulphur Springs project was carried out by an Italian consultant (Geotermica Italiana) with the financial support of the UNDTCD (United Nation Department of Technical Cooperation for Development).

The results of the exploratory boreholes SL-1 and SL-2 are shown in Table 1.

Table 1 Main results in boreholes SL-1 and SL-2

Well	Total depth (m)	Completion	Max. Temp. (^{0}C)	Depth Reservoir (m)	Production (t/h)	Enthalpy (kJ/kg)
SL-1	2.208	7" liner	263	-	-	-
SL-2	1.408	7" liner	285	1,300	62-63	2,900

Well SL-1 (Figure 1) showed high temperatures (260^{0}C) but was non-productive. A lack of permeability has been ascribed to the sealing of natural fractures by hydro-thermal deposits.

Figure 1. Well SL-1

Well SL-2 (Figure 2) intersected permeable zones from 800 to 1,400 meters, producing high temperature fluids (285 – 290 ^{0}C). A short production test was carried out after drilling.

The theoretical potential of the well was estimated around 3 MWe based on production of 33 t/h at 10 bars. However, due to the strong acidity of the steam and scaling problems, the fluid produced by well SL-2 is not directly usable for commercial power production.

Figure 2 Well SL-2

2. Recent Geothermal Events in Saint Lucia:

"Government making more progress in geothermal development in Saint Lucia."

> "*The Government of Saint Lucia (GoSL) is continuing to make significant progress in developing the country's geothermal potential. This progress is encouraged by the recent receipt of grants from the Global Environment Facility (GEF) and the Small Island Developing States Renewable Energy project (SIDS DOCK), facilitated by the World Bank. The GEF and SIDS DOCK, through the World Bank, have approved US$2 Million to contribute towards the first phase of geothermal development assistance to the Government of Saint Lucia. These funds will include further support for surface exploration, as well as transaction and negotiations assistance in order to help the Government of Saint Lucia reach a fair and equitable concession agreement with the geothermal developer. It will facilitate agreements on off-take and integration of*

geothermal power within the domestic power market, for which LUCELEC currently has exclusivity."

Figure 3 Meeting with Mrs. Judith Ephraim

"Governments of Saint Lucia and New Zealand Sign Geothermal Support Partnership Agreement"

"*The Partnership Agreement is designed to provide key technical assistance to support geothermal exploration in Saint Lucia. Specifically, the partnership with the New Zealand Government will help the Government of Saint Lucia, through the Ministry of Sustainable Development, Energy, Science and Technology, define the prospects for advancing geothermal development in Saint Lucia. The historic Agreement is also designed to support training opportunities in geothermal energy through New Zealand Development Scholarships, and facilitate, where possible, practical skills development opportunities.*"

Annex 5-1

Invitation Program Report

2014

North and Latin America Area

CARICOM Countries

Renewable Energy / Energy Efficiency

Data Collection Mission

Invitation Program

November 2014

Shikoku Electric Power Co., Inc.

Content

1. Report Content

(1) Course Outline

(a) Course Name

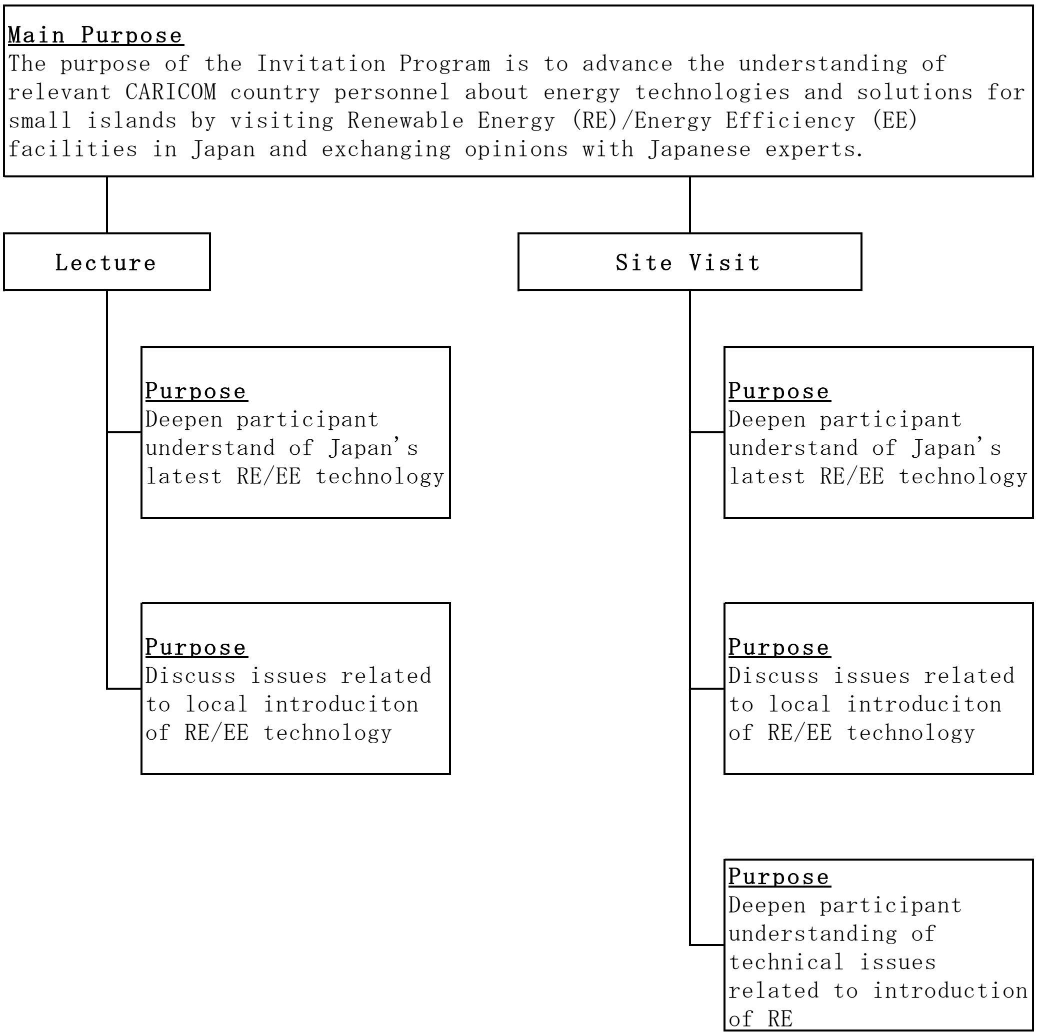
JICA Invitation Program of Energy Sector for CARICOM Countries

(b) Period of Invitation: From October 28^{th} (Thursday) to November 7^{th} (Friday) 2014

(c) Number of Invited Officials: 21

(2) Content of Invitation Program

(a) Overall Conceptual Diagram of Invitation Program



(b) Schedule of Invitation Program

Schedule (Day of Week)	Time	Items	Venues
28th October (Tuesday)		Visit to Japan	
29th October (Wednesday)	9:00～10:00	Orientation	➢ JICA Headquarter ➢ Foreign Ministry ➢ Ministry of Economics and Industry
	10:00～12:00	➢ Courtesy visit to JICA Senior General Officer in charge of Central & South America ➢ Courtesy visit to Foreign Ministry ➢ Courtesy visit to Ministry of Economics and Industry	
	13:30～17:00	Technology Introduction of RE/EE	JICA Tokyo
30th October (Thursday)	9:30～12:00	Visiting EE Products	Panasonic Center Tokyo
31st October (Friday)	Biomass Group (Fukuoka Prefecture)		
	13:30～15:30	Garbage Power Plant	Kougou Saki Factory in Kitakyushu City
	Geothermal Group (Kagoshima Prefecture)		
	9:00～10:30	Lecture on Geothermal Power Generation	Kagoshima chamber of commerce and industry
	13:30～15:00	Visit to Geothermal Power Station	Ogiri Geothermal Power Station
1st November (Saturday)		Travelling	
2nd November (Sunday)	9:00～11:30	Visiting OTEC (Ocean Thermal Energy Conversion) facilities	Ocean Deep Water Research Center in Okinawa Prefecture
3rd November (Monday)		Travelling	
4th November (Tuesday)	9:00～11:30	Visiting Smart Community	Miyako Kurima-Jima
	13:30～15:00	Visiting Mega-Solar	Demonstration Site of Miyako-Jima
5th November (Wednesday)	13:30～17:00	Prior Meeting for Seminar Individual Hearing to 12 countries	JICA Headquarter
6th November (Thursday)	9:30～12:30	Japan – Caribou Exchange Seminar	JICA Headquarter
	15:00～16:30	Introduction of RE/EE examples	JICA Global Square
7th November (Friday)		Leaving Japan	

(c) Curriculum

① Lectures ＜JICA Tokyo＞

Day and Time	29th October (Wednesday) 13:30～14:00
Lecture Theme	High Efficiency Transformer (Amorphous)
Lecturer (Official Title)	Mr. Daichi Azuma (Senior Engineer-Engineering Dep. Soft Magnetic Material Business Unit, High-Grade Metals Company, Hitachi Metals, Ltd.)
Summary of Lecture	・Efficiency of Electric Power Transformer using Amorphous Ribbon ・Adoption Record by Foreign Countries and Economics ・Maintenance and Lifetime after installation
Content	CARICOM country invitees generally had little prior knowledge or experience with amorphous technologies. Invitees seemed to find the lecture informative, and they expressed enthusiasm for high-efficiency transformers. Invitees from power utilities asked questions related to the maintenance and life of the equipment. The lecturer confirmed that there are few differences from standard transformers The following was covered in the Q&A session: 1. What is the degree of efficiency improvement (average %) of amorphous, over standard transformers? (Antigua and Barbuda) 2. Is the lifespan of recycled amorphous transformers shorter than for a new product? (Dominica) 3. What specifications are useful to include in a Request for Proposals for these transformers? (Saint Vincent) Hitachi Metals, Ltd. retains a US factory to manufacture iron cores and does not provide technical assistance. Therefore, CARICOM countries would require technical assistance directly from the transformer company.

Day and Time	29th October (Wednesday) 14:00～14:50
Lecture Theme	Energy Management in Micro-Grid Technology of Geothermal Power Generation
Lecturer (Official Title)	Mr. Masataka Fukuda (Chief Specialist, Project Planning and Development Group 3, Thermal Power Plant Project Engineering Dept. Thermal & Hydro Power Systems & Services Div. Toshiba Corporation Power Systems Company) Mr. Eiichi Arakawa (Chief Specialist, Technical Solution Dept. TT.Network Infrastructure Japan Corporation)
Summary of Lecture	・Outline of Micro-Grid Technology by Toshiba Corporation ・Project Examples (Miyako-Island and Maldives) ・Introduction of Geothermal Technology provided by Toshiba
Content	It was explained that the introduction of renewable energy from a single energy source is destabilizing to the grid. Invitees already recognized this problem, and showed strong interest in learning more about the topic. In particular, the Miyako-Island and Maldives demonstration projects should be relevant to CARICOM countries. Judging from the invitees' questions, they are interested in batteries and charging capacity. Their questions included: 1. What are the weak points of quick charge? (Guyana) 2. What is the meaning of independent power source in Islet Region, and the current Toshiba PV battery capacity? (Antigua and Barbuda) 3. Is there a demonstration project showing high penetration of renewable energy? (Belize) 4. What was the financing source for the Miyako-Island demonstration? (Dominica) 5. How good was the solar resource at the site of the Maldives PV + Battery demonstration project (St. Vincent) Additionally, invitees expressed considerable interest in high-efficiency thermal generation turbines. State-of-the-art technologies include maintenance-free performance with super rotors, output boost, and double flush systems. Invitees were also interested in how these technologies improved project economics.

Day and Time	29th October (Wednesday) 14:50～15:20
Lecture Theme	Biomass Power Generation Technology
Lecturer (Official Title)	Mr. Haruo Tarui (Senior Adviser, International Business Division, Overseas Sales Promotion Office, Biomass Energy Sec. SATAKE CORPORATION) Mr. Iwao Kodama (Senior Staff, International Business Division Overseas Sales Promotion Office, SATAKE CORPORATION)
Summary of Lecture	・The Technology of Satake Gasification Power Generation ・Applicable Materials as Biomass Resources ・Introduction of Technology Adoption in Micronesia
Content	Power generation by biomass gasification has good potential in the continental CARICOM countries. The lecture discussed the gasification process and removal of troublesome tar. With the spread of invasive lemongrasses in the CARICOM region, bio-gasification could be an interesting solution. Invitees from Guyana, Suriname and Belize showed great interest. Lessons from successful projects in Micronesia could be applied in CARICOM islands. With their experience with rice milling machines, Sataka Ltd. explained gasification technology in detail. They explained that fast-growing shrubs are a problem in Micronesia; and in the Caribbean, fast-growing shrubs such as “Lucilla” and EFB (Empty Fruit Bunch) could provide sufficient feedstock. Invitees asked for more information about the following: ➢ Solutions for minimizing silica content, such as micronized mineral and briquette technology, to prevent mechanical wear ➢ Gasification technology ➢ Pyrolysis process ➢ Relative merits of down draft designs Each CARICOM country has various potential feedstock plants, fruits and grains (including lemongrass, which is damaging the forest in Dominica). The main questions asked were as follows: 1. What is the average heat value of EFB how do the economics compare to oil-based generation; what is the minimum power output; and what is the potential of banana production waste as a feedstock? (St. Vincent) 2. Are documents detailing the technology behind the claims available?

	(Jamaica and others) 3. Are there examples of this technology at work using bagasse as a feedstock? (Antigua and Barbuda) 4. What is the fuel ratio of biomass and waste? (Dominica and others)

Day and Time	29th October (Wednesday) 15:40～16:10
Lecture Theme	Power Meter for Preventing Theft of Electricity
Lecturer (Official Title)	Mr. Shinichi Wakatsuki (Representative Managing Director, General Manager Central & South America, EDMI JAPAN CO., LTD) Mr. Masayuki Suzuki (CEO, NURI Telecom Co., LTD)
Summary of Lecture	・Overseas Business Development by EDMI and NURI Telecom ・System Configuration of Meter for Preventing Theft of Electricity ・Introduction of Technology Adoption in Nicaragua
Content	Distribution losses are a serious problem in Antigua / Barbuda and Guyana. Accordingly, CARICOM countries started adopting digital meters. Invitees were interested to learn that EDMI Co., Ltd. owns a meter manufacturing factory in Colombia, and used their products in Nicaragua. EDMI has a worldwide sales network. EDMI's pilot projects in Latin America, and especially Nicaragua, showcased the performance of anti-theft electricity meters, which could be used as smart meters in the future. Invitees were particularly curious about the idea of using fake meters synchronized with radio waves. The main questions asked by invitees were as follows: 1. Is there a possibility of designing something other than box type units? (Belize) 2. How similar is a fake meter to a real one? (Antigua Barbuda, Dominica) 3. What is the reason for using electricity meters with fake meters; and is replacement necessary? (Dominica) 4. If customers start a fake meter and then cut the wire, what happens? How would this be deployed in an apartment building? (Belize) Invitees were greatly surprised to learn that in Managua, losses from theft decreased by more than 50% after the introduction of 300 anti-theft meters in the neighborhood with the highest pilferage rate.

Day and Time	29th October (Wednesday) 16:10～16:40
Lecture Theme	Control Technology of Micro-Grid
Lecturer (Official Title)	Mr. Shinsuke Nii (Senior Manager, Smart Community Grand Design Dept. Power & Social Infrastructure Business Group, Fuji Electric Co., Ltd) Mr. Tomoyuki Kawagoe (Chief Expert, Power & Social Strategy Dept. Corporate Sales Planning Office, Sales Group, Fuji Electric Co., Ltd)
Summary of Lecture	・Control Technology for Micro-Grid by Fuji Electric Co., Ltd. ・Issues Related to Renewable Energy Hybrid Systems ・Introduction of Systems installed in Isolated Islands in Kyushu
Content	Invitees were greatly interested in micro grid system control. Battery-based grid stabilization, implemented in isolated islands in Kyushu and Tonga, could be used in CARICOM countries. Demonstration projects on isolated Kyushu islands were of particular interest to CARICOM invitees. They wanted to know about how much renewable energy could be used in a grid system. Essential points of the Kita-Kyushu demonstration special zone are as follows: Kyushu Electric Co., Ltd and Okinawa Electric Co., Ltd, have been serving customers on isolated islands with costly and polluting diesel generation. On a trial basis, renewable energy was introduced, supported by micro-grid management technology The objectives are energy conservation and optimal balance of renewable energy supply and local demand. For the initial trial, smart meters were installed in 200 households on isolated islands. A new tariff system composed of five different levels was established to incentivize demand reduction. The result was a 20% reduction in electricity consumption, and a decrease in carbon dioxide emissions. Based on this success, microgrid systems were introduced in Tonga in the Kamchatsky region. Following the presentation, discussion topics included the following: 1. PV is one solution for introducing RE. However, battery capacity, performance and cost are the important problems. (St. Vincent) 2. How can demand-side management best be used as part of a CO2 reduction project (Dominica)

Day and Time	31st October (Friday) 9:00～10:30
Lecture Theme	Overseas Development of Japanese Technology in the area of Geothermal
Lecturer (Official Title)	Mr. Hiroyuki Tokita (Senior Reservoir Engineer, Registered Engineer, Geothermal Department, WEST JAPAN ENGINEERING CONSULTANTS, INC.)
Summary of Lecture	・Required Study Procedure for the Development of Geothermal Power Generation ・Worldwide Trend of Geothermal Development ・Introduction of Japan and Overseas Project implemented by West Japan Engineering Consultants, Inc.
Content	The following topics were covered: ➢ Outline of geothermal generation in Japan ➢ Objectives of a preliminary geothermal site study, and other issues critical to successful geothermal project development ・ Forecast of geothermal storage layer ・ Funding sources for a preliminary study Invitees gained an understanding of the situation of geothermal in Japan through dialogue with expert lecturers and questions/answers. The lectures and discussion helped prepare invitees for a site visit to the Ogiri geothermal plant. The site visit was useful in demonstrating the maintenance, operation and management of a geothermal plant. (Q&A) Q1 : Should private companies take all the development risk in geothermal power generation? A1 : To take examples from Japan and Indonesia, the government has conducted nationwide potential surveys for geothermal power generation and disclosed the result, so that the government can contribute to reducing the risk for public companies to participate. Q2 : How accurate are the predictions? A2 : It depends heavily on the volume and quality of information; however, the accuracy of predictions can be improved with the accumulation of information.

	Q3：What is the rate of decline of geothermal power generation? A3：It depends on the features of each geothermal reservoir, and there is no definite answer. However, there is one example where approximately 3% decline in generation occurred per year during thirty years of operation.

② Visiting

Day and Time	30th October (Thursday) 9:30～12:00
Visiting Place	Panasonic Tokyo Center
Corresponding Personnel (Official Title)	Mr. Toshiyuki Nagasaki （Senior Coordinator, Business Promotion Office for Latin America, Panasonic Corporation）
Lecture Content	・Future-Oriented Technology of Energy Efficiency ・Actual Feeling of Future Residence Life targeted by 2020 ・Observation of Energy Storage Technology
Comments	Invitees were impressed that future electronic technologies from Panasonic could be brought to reality and are not just in the realm of science fiction. On the other hand, their mission to improve the energy problem in CARICOM had them more focused on solar energy and electric vehicles.

Day and Time	31st October (Friday) 13:30～15:30
Visiting Place	Kogasaki Incineration Facility
Corresponding Personnel (Official Title)	Mr. Kouji Okuo (Deputy Director, Kogasaki Incineration Facility, Environment Bureau, City of Kitakyusyu)
Visiting Content	・Explanation of Garbage Treatment ・Explanation of Combined Power Generation using Steam from Garbage Burning and City Gas ・Visiting Garbage Treatment Factory (Q&A) Q1：What is the tipping fee? A1：The charge is 100 Japanese-Yen per 10kg. Q2：What kind of fuel is used for incineration of garbage? A2：At first, kerosene is used to start a fire, then incineration can be continued by adjusting volume of air. Q3：Are all of the incineration ashes landfilled? A3：Some of the incineration ashes are utilized in the production of cement.
Comments	There are many questions related to the segregation and treatment of garbage. There are many countries where garbage is not appropriately treated and becomes a serious social problem. Invitees gained new ideas on how to

	tackle the problem.

Day and Time	31st October (Friday) 13:30～15:00
Visiting Place	Ogiri Geothermal Power Station
Corresponding Personnel (Official Title)	Mr. Tatsuya Oshikawa (Manager, Ogiri Geothermal Power Station, Kyusyu Electric Power Co., INC) Mr. Naoto Hiraga (General Manager, Kirishima Geothermal Co., LTD.)
Visiting Content	・Outline explanation of power station and generation well ・Visiting facilities of power station and generation well (Q&A) Q1：How much is construction cost per kw? A1：It is approximately 8,000 USD/kw for 30MW class power stations such as Ogiri Geothermal Power Station. Q2：How long is the construction period after drilling production well? A2：Construction takes approximately two years after drilling the production well.
Comments	Invitees were interested in the success rate of test drilling, project construction costs, and time to completion in Japan. Japan's accumulated technology and knowledge is useful for geothermal development in CARICOM countries.

Day and Time	2nd November (Sunday) 9:00~11:30
Visiting Place	Okinawa Deep Seawater Research Center
Corresponding Personnel (Official Title)	Mr. Shinichiro Kakuma (Director Ph.D. , Okinawa Deep Seawater Research Center) Mr. Benjamin Martin (International Relations Coordinator, Xenesys Inc.) Mr. Kazuhisa Ota (General Manager, Marketing Group, Xenesys Inc.) Mr. Yasuyuki Ikegami (Deputy Director, Institute of Ocean Energy) (Professor, Dr. Eng. , Saga University)
Visiting Content	・Explanation of Okinawa Deep Seawater Research Center ・Introduction of OTEC Potential in Each Country ・Visiting OTEC Facilities ・Visiting the Cultivation of Ocean Grape, Facility of Prawn Aqua Farming and Cosmetic Production Facility (Q&A) Q1 : What is construction cost for intake pipes in Okinawa Deep Seawater Research Center? A1 : The construction of intake pipes was conducted not for power generation, but for research. (It was answered based on construction costs fifteen years ago) Cost reduction is one of the Center's research goals. Q2 : Why is deep seawater used for prawn and ocean grape aqua-farming? A2 : Main purpose of using deep seawater is to adjust water temperature. In Kumejima, prawn and ocean grape aqua-farming businesses have been successful.
Comments	Although there are many countries possessing the potential for OTEC, construction cost would be rather expensive. Invitees were interested in visiting multi-purpose facilities, and came to understand the merits of OTEC compared to other sources of generation.

Day and Time	4th November (Monday) 9:00~11:30
Visiting Place	Miyako Island Smart Community
Corresponding Personnel (Official Title)	Mr. Satoru Mikami (Staff, Eco-Island Promotion Division, Planning Department, City of Miyakojima)
Visiting Content	・Demonstration Project Explanation of Island Type Smart Community ・Visiting Bio-Ethanol Factory ・ Explanation of 100% Independent Demonstration Project in Kurima-Shima by RE (Q&A) Q1：How much is the demand in Miyakojima? A1：It is 50-55MW in peak summer. Q2：What are the capacities of the solar power generation and battery storage systems? A2 : Capacity of solar power generation is approximately 380kw. Capacity of battery is approximately 100kW and storage capacity of the battery is 176kWh. One array of batteries has already been installed, and the second array, with the same specifications, is under construction. Q3：Is the battery operated with frequency control? Has there been any impact on grid frequency from operation of the battery? A3 : The main purpose of battery is to cover shortfalls in electricity supply. Additionally, fluctuation from the battery is approximately 200kW only, so there is no impact to operation of the grid on the island.
Comments	There were many questions about the effect on frequency from the introduction of renewable energy and batteries. They were not only interested in electricity, but also underground water storage dams for drought, and bio-ethanol factories.

Day and Time	4th November (Monday) 13:30~15:00
Visiting Place	Mega-Solar in Miyako Island
Corresponding Personnel (Official Title)	Mr. Hirofumi Nakama (Chief, Research & Development Dept. The Okinawa Electric Power Co., Inc.) Mr. Naoya Komine (Research & Development Dept. The Okinawa Electric Power Co., Inc.)
Visiting Content	・ Outline Explanation of Demonstration Research Facility of Mega-Solar ・Explanation of Grid Stability by the Introduction of Solar Power Generation ・Visiting the NAS Battery and Compensating Devices of Reactive Power (Q&A) Q1 : What is the maximum amount of solar power generation and wind power generation that can be installed without impacting grid stability? A1 : As this matter is still under study, there is not yet a clear answer.
Comments	Although there is a need to introduce solar and wind power, many countries are considering RE limits on small grid systems. They did not get definitive answers here; however the knowledge and experience gained from visiting demonstration facilities was quite useful.

③ Seminar <JICA Head Quarter>

Day and Time	6th November (Thursday) 9:30~14:00
Seminar Title	Current Situation of Energy Sector in Caribbean Region
Organizers: JICA / Joint Hosting: Inter-American Development Bank (IDB) and Latino Association / Support: Foreign Ministry	
Seminar Content	・Japanese Economic Assistance to KARICOM countries (Country Assistance Planning Division 2, International Cooperation Bureau, Ministry of Foreign Affairs) ・Issues and Needs in the Fields of RE/EE in Caribbean Region (International Activities Project, Business Planning Department, SHIKOKU ELECTRIC POWER CO., INC.) ・CDB Activity in Energy Field toward Caribbean Region (Renewable Energy Energy Efficiency Unit, Caribbean Development Bank) ・IDB Activity in Energy Field toward Caribbean Region (Energy Division, Infrastructure and Environment Department, Inter-American Development Bank) ・Panel Discussion

④ Latest Information by Country

Day and Time	November 5, 2014 (Tuesday) 13:40 ~ 17:00
Venue	214 Meeting Room, JICA Headquarters
Interviewers	Shikoku Electric Power Co., Inc.: Mr. Kenichi Kuwahara and Mr. Yoshitetsu Fujisawa TechnoSoft Co., Ltd.: Mr. Hiroshi Omori Training Coordinator: Ms. Junko Hattori

Antigua and Barbuda

Attendants	Mr. MATTHIAS, Andre (Antigua Public Utilities Authority) Mr. LEE, Luther (Antigua Public Utilities Authority)
Hearing Contents	Because it is a high income country, it is confirmed that it is ineligible for loans or grants. Grid interconnected systems for solar and wind generation in the 100-200 kW class are anticipated. The know-how for the economic operation and maintenance of these systems will need to be acquired.

Barbados

Attendants	Mr. HINDS, William Alexander L. (Government of Barbados)
Hearing Content	"Solar PV": "30MW". And amendment to 10MW was requested. "Wind Power": "Government". An amendment to the utility was requested.

Belize

Attendants	Mr. COBB, Ryan Michael-Lee (Ministry of Energy, Science & Technology and Public Utilities) Mr. USHER, Mark Anthony Fitzgerald (Public Utilities Commission) Mr. PERALTA, Ahnivar Ancelmo (5C)
Hearing Contents	RE: "Current utilization of biomass": The entire production of bagasse is burnt to generate steam to drive two 23MW steam turbines. A power purchase agreement of 13.5MW was completed, and electricity is being supplied to the grid. EE: ✓ "Inverter Air Conditioner": Already available on the market. ✓ Important issues include the education and public awareness of EE. This includes appliance labeling systems and the establishment of energy efficiency standards.

Dominica

Attendant	Mr. CARRETTE, Samuel (Ministry of Finance)
Hearing Contents	An MOU with France is already in effect. However collaboration with Japan is probable, depending on the results of negotiations with France. The potential of solar and wind energy are concentrated in the Eco Green Park on the west coast. The concept exhibited by Panasonic is what is imagined as the future of renewable energy utilization. Electric vehicles are interesting and attractive. And OTEC technology has promising prospects to be studied incrementally in the future.

Grenada

Attendants	Mr. JOSEPH, Christopher (Ministry of Finance & Energy) Mr. JOHN, Carl (T. A. Marryshow Community College)
Hearing Contents	The problem for utilities in using renewable energy is one of economics. In addition, it is difficult see benefits even if utilizing a Feed-In-Tariff (FIT). A legal framework for renewable energy has not been established. Human resource development is in the planning stage. As other donors, including New Zealand, deploy in different islands, there should not be a problem with overlap. As for geothermal projects, financial assistance from Japan is expected.

Guyana

Attendants	Mr. PYLE, Trevlon Alexander (Office of the Prime Minister) Mr. CHETRAM, Nigel Anthony (Guyana Power & Light Inc.)
Hearing Contents	RE: ✓ "Roof-Top solar PV": Should be extended from urban areas to rural areas. ✓ The greatest potential for REs is large and small-scale hydro power. ✓ The capital city has a critical garbage overflow situation. It is urgent that they install a Waste-to Energy biomass plant. EE: ✓ The transmission losses are as high as 31%. To reduce losses, a test project for smart meters and AMI technology is being implemented. ✓ The energy grading system found in Japanese electricity appliance shops would be a worthy idea. ✓ Although amorphous transformers are rather expensive, they could become attractive if a test project demonstrated a reduction in power loss.

Jamaica

Attendants	Ms. EDWARDS, Yvonne Barretts (Ministry of Science, Technology, Energy and Mining) Mr. GALLIMORE, Kevin (Petroleum Corporation Of Jamaica)
Hearing Contents	Petroleum Corporation of Jamaica is currently working on energy conservation projects of public buildings. There are fifteen schools targeted for energy conservation for air conditioners and lighting. Combined with the introduction of renewable energy facilities, fossil fuel-based electricity consumption is expected to be reduced. The National Irrigation Commission and National Water Commission expect further energy conservation with high-efficiency pumps. There are still areas of Jamaica without electrification. Supplies are expected to come from hybrid electricity systems comprised of solar and wind. Institutional programs, such as wheeling and feed-in-tariffs, do not currently exist. Optimally, they would be introduced to promote renewable energy utilization.

Saint Christopher and Nevis

Attendants	Mr. MATTHEW, Leoan Pentonville ()
Hearing Contents	RE: Roof-mounted PV: "Installed a total of 250kW of capacity" EE: "Amorphous transformer": As losses in the SKELEC system are as high as 30%, this technology is of great interest.

St. Lucia

Attendants	Mr. HAYNES, Carryl Omar (LUCELEC)
Hearing Contents	RE: ✓ "Solar Energy": Utility has plans to install a 5MW mega-solar plant in Vieux Fort on the south island. ✓ "Geothermal": Initial plans completed about fifteen to twenty years ago estimated that generation capacity could be 30MW. EE: ✓ Power losses are as low as 8.8%. The transition to high-efficiency transformers (not amorphous) has already been completed.

Saint Vincent

Attendants	Mr. MYERS, Thornley O. A. O. (St. Vincent Electricity Services Limited (VINLEC))
Hearing Contents	Canadian and Icelandic companies are jointly studying geothermal and have already entered into an MOU. There are promising locations for 10MW-class geothermal generation. Japanese financial assistance would be greatly appreciated to develop future renewable energy resources, as the country is targeting 60% of its generation to come from renewables by 2020. As the country lacks know-how, a collaborative relationship with Japan is expected. There are also plans to develop solar energy plants in the 70kW size range.

Suriname

Attendants	Mr. TAUS, Mohamed Idries (Ministry of Natural Resources) Mr. WONGSOREDJO, Guilliano Soedie (NV EBS)
Hearing Contents	RE: ✓ "Solar PV": There is a six-month dry season and a six-month wet season. In remote villages, telecommunication companies are installing PV and batteries on antenna towers as independent systems. EE: ✓ High subsidies from the government results in low tariff levels. Accordingly, EE would be difficult to implement.

Trinidad and Tobago

Attendants	Mr. MAURICE, Randy (Ministry of Energy and Energy Affairs) Mr. CLARKE, Allen (Trinidad and Tobago Electricity Commission)
Hearing Contents	RE: ✓ "Solar power": MW class facilities are not planned. ✓ "Wind power": A current study of wind has not yet proven the feasibility of wind power. EE: ✓ "Building code": An NGO is consolidating a code to be adopted by the government. ✓ "Labelling": Adding that there is no legal obligation. ✓ "CFL + LED": Repeal of import tax for CFL

(3) Observations on Invitation Program

(a) Lecture

Five Japanese companies delivered lectures focusing on the application of energy technologies to CARICOM countries. Invitees had so many questions that the time allocated to question-and-answer had to be extended considerably. Each company's presentation documents were delivered to invitees. After exchanging business cards, participating companies could answer invitees' inquiries separately.

(b) Site Visit

The purpose of the Invitation Program is to advance the understanding of relevant CARICOM country personnel about energy technologies and solutions for small islands by visiting Renewable Energy (RE)/Energy Efficiency (EE) facilities in Japan and exchanging opinions with Japanese experts.

Followings are facilities visited by invitees:

- Panasonic Center Tokyo: EE products and technologies
- Kougou-Saki Garbage Power Station: Technology of biomass power generation
- Okiri Geothermal Power Station: Technology of geothermal power generation
- Ocean Deep Water Research Center in Okinawa Prefecture: OTEC (Ocean Thermal Energy Conversion) Technology, facility of prawn and ocean grape aqua farming utilizing ocean deep water
- Miyako-Jima Smart Community: Demonstration project of smart community
- Miyako-Jima Mega-Solar: Demonstration project of mega-solar introduction in independent grid

Visiting sites are selected focusing followings:

- Geographically similar with island countries
- RE/EE technologies applicable to CARICOM countries
- Introduction potential of RE/EE technology by each country

Invitees exhibited great interest at each site visit, engaging in a spirited dialogue with the site hosts Lessons learned included the following:

- Untreated and buried garbage is a serious hygienic and health problem. Power generation from garbage with proper segregation and treatment is quite beneficial. Invitees saw that these technologies could be introduced to their own countries.
- In small grid systems of island countries, allowable amount of solar and wind generation power without impinging on grid stability is great concern. The use of battery-based energy storage to increase renewable energy penetration will be studied.
- Although the plant construction cost of OTEC technology is rather expensive, the

multiple uses of ocean deep water from OTEC, such as for ocean grape cultivation, prawn aqua farming and cosmetic production would be beneficial.

(c) About the schedule of invitation program

Appropriate

(d) About text and Materials

Lecture texts and outline pamphlets of visiting sites were written in English for invitees' reference after they return home. Documents were distributed electronically. During site visits, wireless transmitters and receiver (Pana-Guide) were used to facilitate communication. Use of the Pana-Guide was especially helpful at noisy locations.

(4) Invitees

(a) Necessary qualifications

- Responsible for making policy related to RE/EE
- Able to understand issues related to RE/EE technology and its application

(a) Eagerness and interest in the invitation program

All invitees participate with eagerness. Lectures were favorably received. High-spirited question-and-answer sessions were conducted.

(5) Result Utilization of Invitation Program

(a) Result of Invitation Program

Through visit to RE/EE facilities and opinion exchange with relevant experts, invitees acquired knowledge of the technologies and their application.

(b) Result Utilization Method

Invitees will bring back this knowledge to their home countries to share with other officials and colleagues. Invitees intend to track further developments in these areas. Not only could CARICOM government agencies benefit from Japanese technical and financial assistance, but the private sector could also gain from utilizing Japanese technologies.

(6) Environmental Issues of Program

Proper and appropriate

(7) Other Special Issues

- Some of the invitees complained that higher-ranking invitees were placed in better hotels than the others, despite the fact that all invitees were participating in the same program.
- Given logistical concerns about transporting a group of more than twenty people to

numerous locations, the schedule included allowances for delays and other contingencies. Even so, the program still ran behind schedule.

- During the first two or three after arriving in Japan, invitees appeared to be suffering from jet lag. Especially for elderly persons, the schedule was very full. This should be considered when planning future events.

2. Attachment

Attachment1: JICA Invitation Program of Energy Sector for CARICOM Countries

Attachemnt2: Participants List

Attachemnt3: Result of Questionnaire

Attachment4: Pictures

JICA Invitation Program of Energy Sector for CARICOM Countries

Date		Time	Contents	Accommodation
28Oct.	Tue		Arrival in Japan	**Tokyo Green Palace*1**
			【Drive】 Airport ～ Hotel Check-in	
29Oct.	Wed	8:30 ～ 9:00	【Drive】 Hotel ～JICA Headquarters	Tokyo Green Palace
		9:00 ～ 10:00	Invitation Program Orientation	
		10:00 ～ 10:30	Courtesy Call on Vice-President in charge of Latin America and the Caribbean Department	
		10:30 ～ 10:50	【Drive】 JICA Headquarters ～ Ministry of Foreign Affairs	
		10:50 ～ 11:20	Courtesy Call on Ministry of Foreign Affairs	
		11:20 ～ 11:40	【Drive】 Ministry of Foreign Affairs ～ Ministry of Economy, Trade and Industry	
		11:40 ～ 12:10	Courtesy Call on Ministry of Economy, Trade and Industry	
		12:10 ～ 12:40	【Drive】 Ministry of Economy, Trade and Industry ～JICA Tokyo	
		12:40 ～ 13:30	【Lunch】 at JICA Tokyo Restaurant	
		13:30 ～ 17:00	Introduction of Renewable Energy and Energy Saving Technologies by Japanese private companies	
		17:00 ～ 18:00	【Drive】 JICA Tokyo ～ Hotel	
30 Oct.	Thu	8:30 ～ 9:30	【Drive】 Hotel ～ Panasonic Center Tokyo	
		9:30 ～ 12:00	Observation Tour of the Energy Saving Technology at Panasonic Center Tokyo	
		12:00 ～ 12:30	【Drive】 Panasonic Center Tokyo ～ Haneda Airport	
		12:30 ～ 15:10	【Lunch】 at the airport	
			GROUP A (Biomass)	
		15:10 ～ 17:05	【Fly in】 Haneda Airport～Fukuoka Airport	**Grand Hyatt Fukuoka*3; Canal City Fukuoka Washington*4**
		17:05 ～ 18:00	【Drive】 Fukuoka Airport～Hotel	
			GROUP B (Geothermal Power)	
		15:15 ～ 17:15	【Fly in】 Haneda Airport～ Kagoshima Airport	**Kagoshima Sun Royal Hotel*2**
		17:15 ～ 19:00	【Drive】 Kagoshima Airport～Hotel	
31 Oct.	Fri		**GROUP A**	
		10:30 ～ 13:30	【Drive】Hotel～Kougasaki Waste Power Generation System (waste-to-energy) 【Lunch】	Grand Hyatt Fukuoka ; Canal City Fukuoka Washington
		13:30 ～ 15:30	Tour of Kougasaki Waste Power Plant	
		15:30 ～ 17:00	【Drive】Kougasaki Waste Power Plant ～Hotel	
			GROUP B	
		8:30 ～ 9:00	【Drive】Hotel～Kagoshima Chamber of Commerce	Kagoshima Sun Royal Hotel
		9:00 ～ 10:30	Lecture on Geothermal Power Generation	
		10:30 ～ 13:30	【Drive】Kagoshima C.C. ～Ogiri Geothermal Power Plant 【Lunch】	
		13:30 ～ 15:00	Tour of Ogiri Geothermal Power Plant	
		15:00 ～ 16:30	【Drive】Ogiri Geothermal Power Plant ～Hotel	
1 Nov.	Sat		**GROUP A**	
		9:30 ～ 10:15	【Drive】 Hotel～Fukuoka Airport	
		11:50 ～ 13:35	【Fly in】Fukuoka Airport～Naha Airport	
			GROUP B	
		8:00 ～ 9:00	【Drive】 Hotel～Kagoshima Airport	
		10:00 ～ 11:30	【Fly in】Kagoshima Airport～Naha Airport	
		15:10 ～ 16:30	【Fly in & Drive】 Naha Airport～Kumejima Airport～Hotel	**Cypress Resort Kumejima*5 Resort Hotel Kume Island*6**
2 Nov.	Sun	8:00 ～ 9:00	【Drive】 Hotel ～ Okinawa Prefecture Deep Sea Water Ocean Thermal Energy Conversion (OTEC) Demonstration Facility	**Rihga Royal Gran Okinawa*7 Hotel Chura Ryukyu*8**
		9:00 ～ 11:30	Tour of the OTEC Demonstration Facility and Surrounding Facilities	
		11:30 ～ 12:00	【Lunch】	
		12:00 ～ 12:40	【Drive】 OTEC ～ Kumejima Airport	
		13:25 ～ 14:45	【Fly in & Drive】Kumejima Airport ～ Naha Airport ～ Hotel	
3 Nov.	Mon	9:30 ～ 10:15	【Drive】 Hotel ～ Shuri-jo Castle	**Hotel Atoll Emerald *9**
		10:15 ～ 12:00	Sightseeing at Shuri-jo Castle	
		12:00 ～ 14:30	【Drive】 Shuri-jo Castle ～ Naha Airport 【Lunch】	
		15:45 ～ 17:00	【Fly in & Drive】 Naha Airport～Miyako Airport ～ Hotel	
4 Nov.	Tue	8:30 ～ 9:00	【Drive】 Hotel ～ Smart Community Demonstration Site	Tokyo Green Palace
		9:00 ～ 11:30	Tour of the Smart Community Demonstration Site	
		11:30 ～ 13:30	【Drive】Smart Community Demonstration Site ～ Megasolar Power Generation Demonstration Site 【Lunch】	
		13:30 ～ 14:50	Tour of Megasolar Power Generation Demonstration Site	
		14:50 ～ 15:30	【Drive】Megasolar Power Generation Site ～ Miyako Airport	
		16:15 ～ 21:40	【Fly in & Drive】 Miyako Airport ～ Naha Airport ～ Haneda Airport ～ Hotel	
5 Nov.	Wed	10:30 ～ 11:00	Hotel～JICA Headquarters	Tokyo Green Palace
		11:00 ～ 12:00	Pre-meeting for the "Japan-CARICOM Friendship Year Seminar "	
		12:00 ～ 13:30	【Lunch】	
		13:30 ～ 17:00	Country Meetings	
		17:00 ～ 17:30	JICA Headquarters ～ Hotel	
6 Nov.	Thu	9:00 ～ 9:30	【Drive】 Hotel ～ JICA Headquarters	Tokyo Green Palace
		9:30 ～ 12:30	Japan-CARICOM FriendshipYear Seminar "Present Status of Energy Sector in CARICOM Countries"	
		12:30 ～ 12:45	【Drive】JICA Headquarters ～ Lunch Reception Venue	
		12:30 ～ 14:00	【Lunch】Lunch Reception	
		14:00 ～ 15:00	【Drive】Lunch Reception Venue ～JICA Global Plaza	
		15:00 ～ 16:30	Case Studies on Renewable Energy and Energy Saving Technologies (Secretariat of Japanese Business Alliance for Smart Energy Worldwide)	
		16:30 ～ 17:00	【Drive】 JICA Global Plaza ～ Hotel	
7 Nov.	Fri		【Drive】 Hotel ～ Airport	
			Departure for home countries	

< Hotel Address and Telephone Number List >

***1 <u>Tokyo Green Palace</u> : Ni-banchi, Niban-cho, Chiyoda-ku, Tokyo, 102-0084 JAPAN Tel: ++81(Japan/From Overseas)- 3-5210-4600 Fax: ++81-3-5210-4644**

***2 <u>Kagoshima Sun Royal Hotel</u> : 1-8-10 Yojiro, Kagoshima City, Kagoshima-ken, 890-8581 JAPAN Tel: ++81-99-253-2020 Fax: ++81-99-255-0186**

***3 <u>Grand Hyatt Fukuoka</u> : 1-2-82 Sumiyoshi, Hakata-ku, Fukuoka 812-0018 JAPAN Tel: ++81-92-282-1234 Fax: ++81-92-282-2817**

***4 <u>Canal City Fukuoka Washington Hotel</u> : 1-2-20 Sumiyoshi, Hakata-ku, Fukuoka, Fukuoka-ken, 812-0018 JAPAN Tel:++81-92-282-8800 Fax: ++81-92-282-0757**

***5 <u>Cypress Resort Kumejima</u> : 803-1, OHARA, KUMEJIMA-CHO SHIMAJIRI-GUN, OKINAWA, 901-3132 Tel: ++81-98-985-3700 Fax: ++81-98-985-3701**

***6 <u>Resort Hotel Kume Island</u> : 411 Aza Magari, Kumejima-cho, Shimajiri-gun, Okinawa-ken, JAPAN Tel: ++81-98-985-8001 Fax: ++81-98-985-8009.**

***7 <u>Rihga Royal Gran Okinawa</u> : 1-9 Asahimachi, Naha City,Okinawa-ken, 900-0029, JAPAN Tel: ++81-98-867-3331 Fax: ++81-98-867-3332**

***8 <u>Hotel Chura Ryukyu</u> : 1-18-24, Matsuo, Naha City, Okinawa-ken JAPAN Tel: ++81-98-862-6121 Fax: ++81-98-866-3702**

***9 <u>Hotel Atoll Emerald</u> : 108-7 Shimozato, Hirara City, Miyako Island, Okinawa-ken, JAPAN Tel: ++81-980-73-9800 FAX : +81-980-73-0303**

Attachment 2

Participants List

Twenty-one participants

Country	Last Name	Given Name	Sex(M/F)	age	Company/Institution	Department	Position
Antigua & Barbuda	MATTHIAS	ANDRE MASCALL	M	48	Antigua Public Utilities Authority	Electricity	Chief Electrical Engineer
Antigua & Barbuda	LEE	LUTHER LOGAN	M	58	Antigua Public Utilities Authority	———	Chairman of APUA Board
Barbados	HINDS	WILLIAM ALEXANDER L	M	53	Government of Barbados	Energy and Telecommunications Division Prime Ministers Office	Chief Energy Conservation Officer
Barbados	WILLIAMS	JOSEPH ANTHONY	M	50	CARIBBEAN DEVELOPMENT BANK	RENEWABLE ENERGY ENERGY EFFICIENCY UNIT	ENERGY CONSULTANT
Belize	COBB	RYAN MICHAEL-LEE	M	28	Ministry of Energy, Science & Technology and Public Utilities	——	Energy Officer
Belize	USHER	MARK ANTHONY FITZGERALD	M	46	Public Utilities Commission	Electricity Sector	Engineering Officer
Belize	PERALTA	AHNIVAR ANCELMO	M	29	Caribbean Community Climate Change Centre	Economic & Social Impact Unit	Research Assistant
Dominica	CARRETTE	SAMUEL	M	57	Government of DOMINICA	Ministry of Finance	Chief Development Planner
Grenada	JOSEPH	CHRISTOPHER ROBIN	M	44	Ministry of Finance & Energy	Energy Division	Energy Officer
Grenada	JOHN	CARL IGNATIUS	M	62	T. A. Marryshow Community College	School of Applied Arts and Technology, Electronic Engineering Department	Professor
Guyana	PYLE	TREVLON ALEXANDER	M	32	Office of the Prime Minister	Hinterland Electrification Unit	Electrical Engineer
Guyana	CHETRAM	NIGEL ANTHONY	M	43	Guyana Power & Light Inc.	Quality Control	Quality Manager
Jamaica	BARRETT	YVONNE ALICIA	F	41	Ministry of Sience, Technology, Energy and Mining	Renewable Energy & Energy Efficiency Department	Energy Economics & planning Unit
Jamaica	GALLIMORE	KEVIN CHRISTOPHER	M	43	PETROLEUM CORPORATION OF JAMAICA	Renewable Energy & Energy Efficiency Department	TECHNICAL ENGINEER
St.Kitts & Nevis	LEOAN	MATHEW	M	35	St. Christopher Air and Sea Port Authority	——	Projects and Technology Cordinator
St.Lucia	HAYNES	CARRYL OMAR	M	27	LUCELEC	GENERATION	Electrical Engineer
St. Vincent	MYERS	THORNLEY ORSINO A. O.	M	52	St. Vincent Electricity Services Limited (VINLEC)	———	Chief Executive Officer
Suriname	WONGSOREDJO	GUILLIANO SOEKARDIE	M	33	NV EBS	Project Engineering	Mechanical Engineer
Suriname	TAUS	MOHAMED IDRIES	M	63	Ministry of Natural Resources	Ministry of Natural Resources	Advisor to the Minister of MNR and Project Manager of Renewable Energy Project financed by the IDB (GEF SU
Trinidad & Tobago	MAURICE	RANDY GREGORY	M	56	Ministry of Energy and Energy Affairs	Energy Research and Planning	Senior Energy Analyst
Trinidad & Tobago	CLARKE	EDWARD ALLEN	M	55	Trinidad and Tobago Electricity Commission	System Control and Generation Interface	Manager System Control and Generation Interface

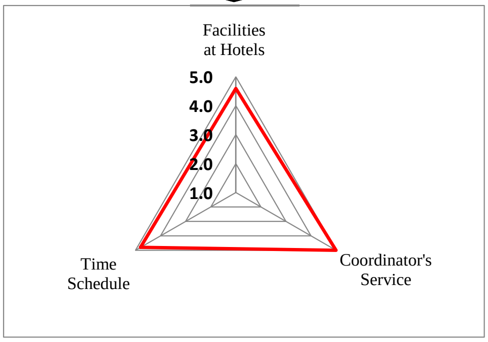
Result of Questionnaire

■ Overall program

How do you rate the following?

	← Satisfied				Unsatisfied →
・Facilities at Hotels	□5	□4	□3	□2	□1
・Coordinator's Service	□5	□4	□3	□2	□1
・Time schedule	□5	□4	□3	□2	□1

Ave.

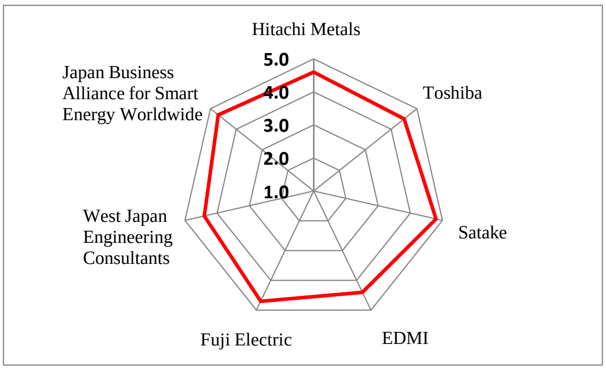


■ Presentation

How do you rate the following?

Company/Institution	Date	Theme	← Interesting				Not Interesting →
・Hitachi Metals	29-Oct	Amorphous transformer	□5	□4	□3	□2	□1
・Toshiba	29-Oct	・Geothermal power generation ・Energy management of microgrid	□5	□4	□3	□2	□1
・Satake	29-Oct	Biomass power generation	□5	□4	□3	□2	□1
・EDMI	29-Oct	Smart meter	□5	□4	□3	□2	□1
・Fuji Electric	29-Oct	Technology of microgrid control	□5	□4	□3	□2	□1
・West Japan Engineering Consultants	31-Oct	Overseas expansion of geothermal power technology	□5	□4	□3	□2	□1
・Japan Business Alliance for Smart Energy Worldwide	6-Nov	―	□5	□4	□3	□2	□1

Ave.



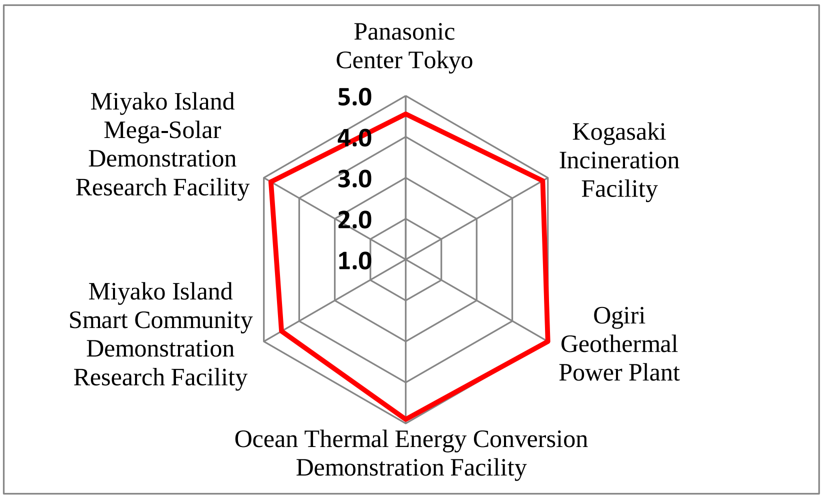
■ Field Trip

How do you rate the following?

*If you didn't visit, please mark X.

Company/Institution	Date	Theme	← Satisfied				Unsatisfied →	X
･Panasonic Center Tokyo	30-Oct	Energy efficiency technology	□5	□4	□3	□2	□1	□X
･Kogasaki Incineration Facility	31-Oct	Waste power generation	□5	□4	□3	□2	□1	□X
･Ogiri Geothermal Power Plant	31-Oct	Geothermal power generation	□5	□4	□3	□2	□1	□X
･Ocean Thermal Energy Conversion Demonstration Facility	2-Nov	Ocean Thermal Energy Conversion	□5	□4	□3	□2	□1	□X
･Miyako Island Smart Community Demonstration Research Facility	4-Nov	Smart Community	□5	□4	□3	□2	□1	□X
･Miyako Island Mega-Solar Demonstration Research Facility	4-Nov	Solar power generation	□5	□4	□3	□2	□1	□X

Ave.



■ Outcome

Can knowledge and information you acquired be utilized for your work?

← Yes				No →
□5	□4	□3	□2	□1

Ave. 4.6

■ Expectation for JICA

Regarding renewable energy or energy efficiency, would you like to conduct cooperative project with JICA?

← Yes				No →
□5	□4	□3	□2	□1

Ave. 4.8

Regarding cooperative project of renewable energy or energy efficiency with JICA, please describe your idea, if any. (Some examples are described.)

- TT: Waste management program and waste-to-energy project would be beneficial.
- Guyana: Biomass power generation has a large potential because they have a lot of waste from the production of sugar and rice.
- Jamaica: LED Lighting Technology
- Grenada: OTEC would be significant implications for Grenada and the region.
- CDB: 1. Deepen the current support for geothermal energy with JICA/IDB/CDB Upfront technical assistance for countries in 3G's assessments
  2. TA support in EE in establishing ESCO's for public sector
  3. Support for MRV in the context of establishment of ESCO's

■ Free description (Some examples are described.)

The tour was planned and executed extremely well. Although the sites were widely separated, your arrangements allowed us to see a lot of technology in a short time. From what we saw, Japan has knowledge which can help the CARICOM with many present and future problems.

Pictures

31 October,2014
Lecture on Geothermal Power Generation

31 October,2014
Outline Explanation of Ogiri Geothermal Power Station

31 October,2014
Facility Tour at Ogiri Geothermal Power Station

31 October,2014
Facility Tour at Ogiri Geothermal Power Station

31 October,2014
Exterior of Ogiri Geothermal Power Station

31 October,2014
Explanation of Garbage Treatment at Kogasaki Incineration Facility

31 October,2014
Facility Tour at Kogasaki Incineration Facility

2 November, 2014
Explanation of Okinawa Deep Seawater Research Center

2 November, 2014
Souvenir Picture in front of OTEC Facilities

2 November, 2014
Facility Tour at Okinawa Deep Seawater Research Center

2 November, 2014
Water Storage Facility at Okinawa Deep Seawater Research Center

4 November, 2014
Explanation of Demonstration Project of Island Type Smart Community

4 November, 2014
Explanation of Demonstration Project of Island Type Smart Community

4 November, 2014
Explanation of electric vehicle

4 November, 2014
Storage Battery System in Kurima Island

4 November, 2014
Explanation of Demonstration Research Facility of Mega-Solar

4 November, 2014
Exterior of Mega-Solar Facilities and Wind Turbine in Miyako Island

4 November, 2014
Exterior of Mega-Solar Facilities in Miyako Island

Annex 5-2

Current Situation and the Challenge On Renewable Energy and Energy Efficiency In the CARICOM Countries

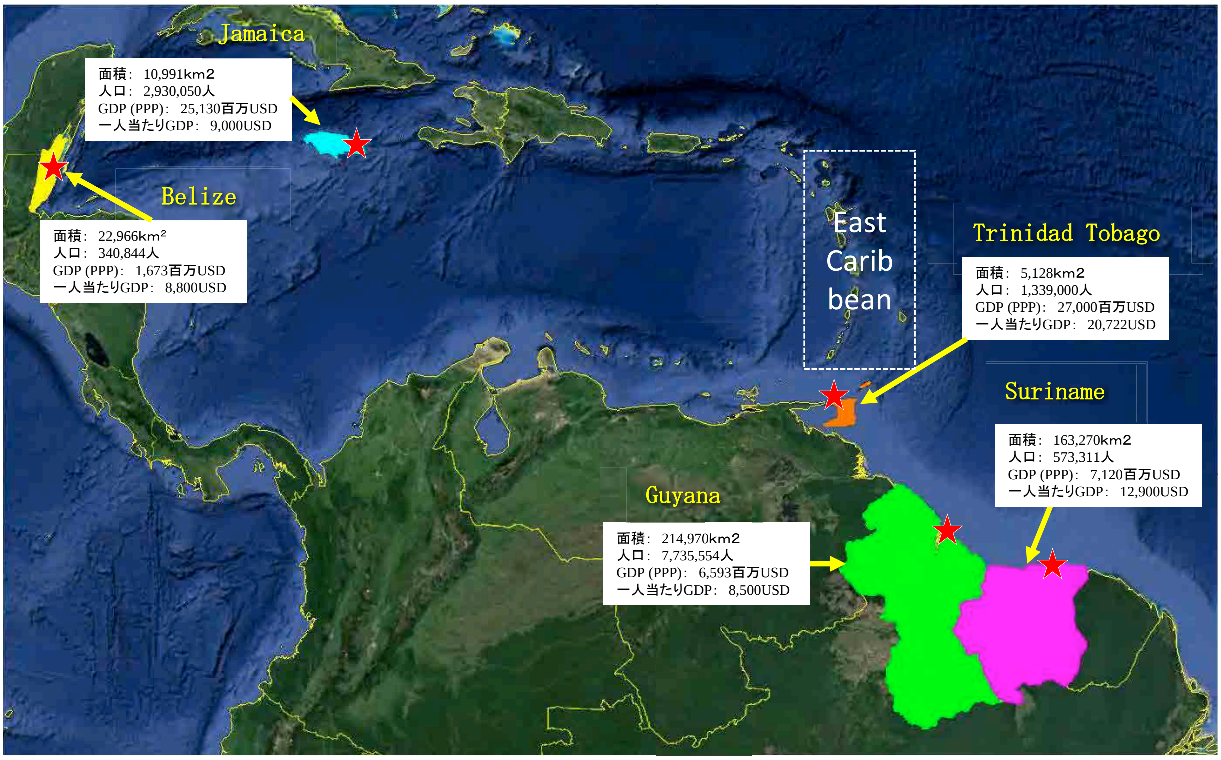
Shikoku Electric Power Co. KEN Kuwahara

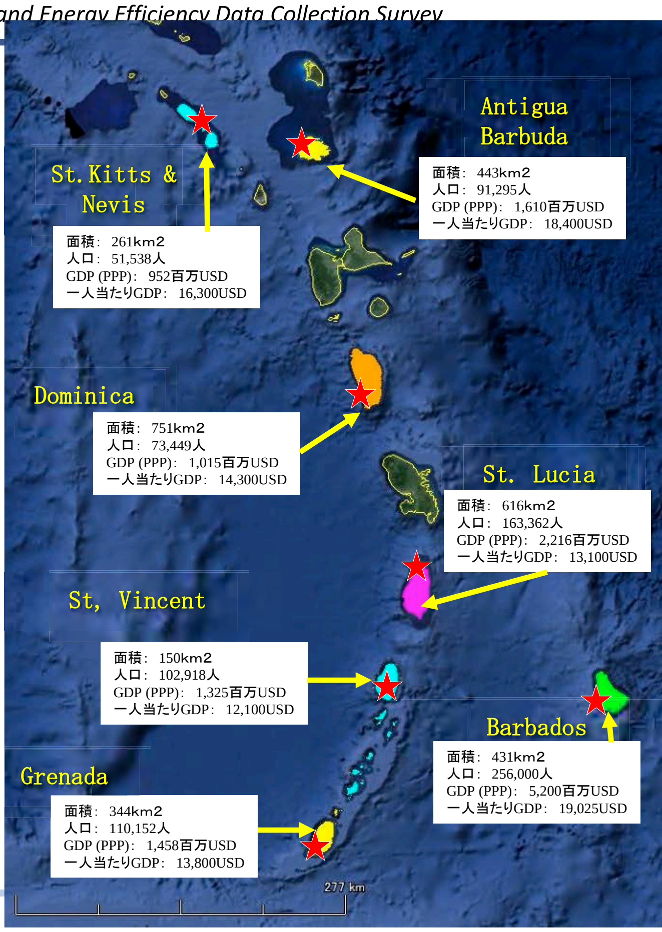
四国電力㈱ 海外事業プロジェクト 桑原 憲一

CARICOM: Renewable Energy and Energy Efficiency Data Collection Survey

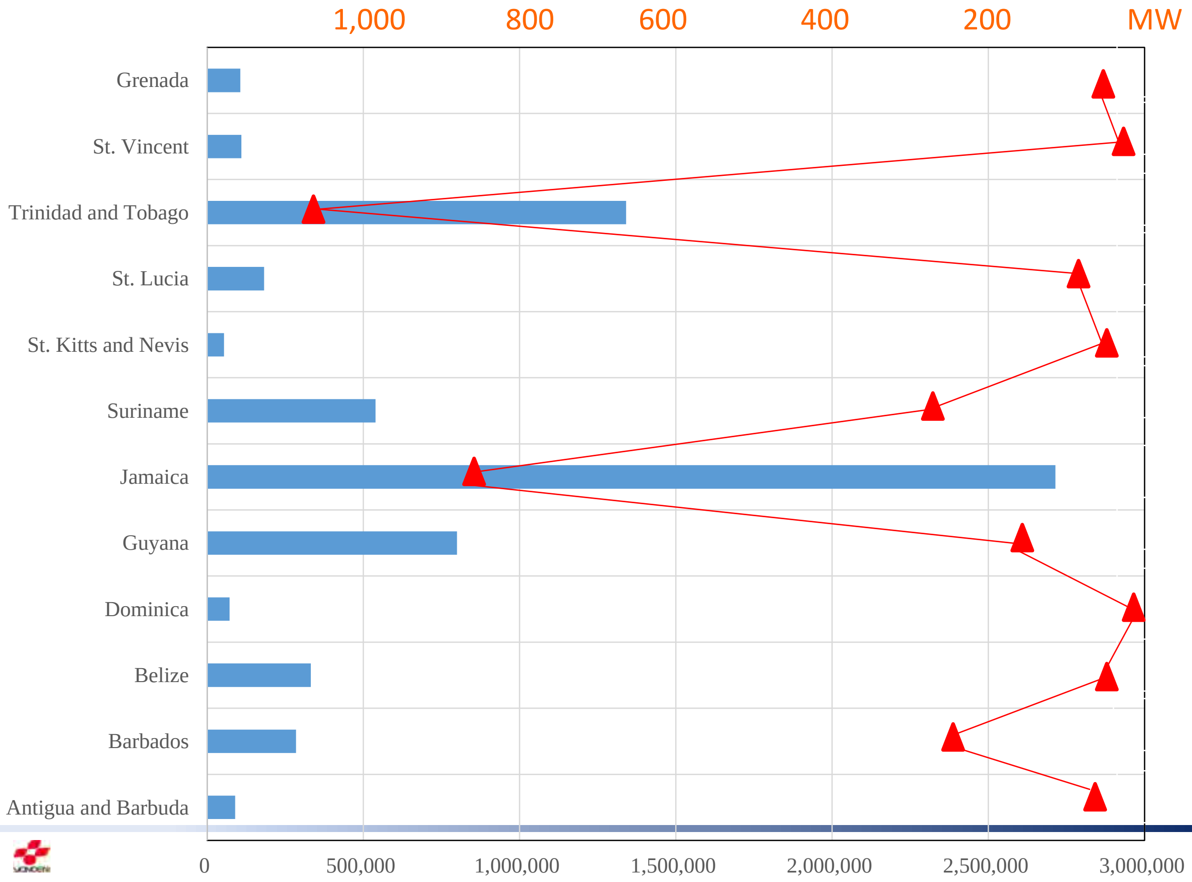
1. Outline of Caricom Countries
2. Potential Renewable Energy
3. Potential Energy Efficiency
4. Operate Large scale Renewable Energy Sources (Japanese case)

   Appendix: Power Supply Securities after the earthquakes (2012)

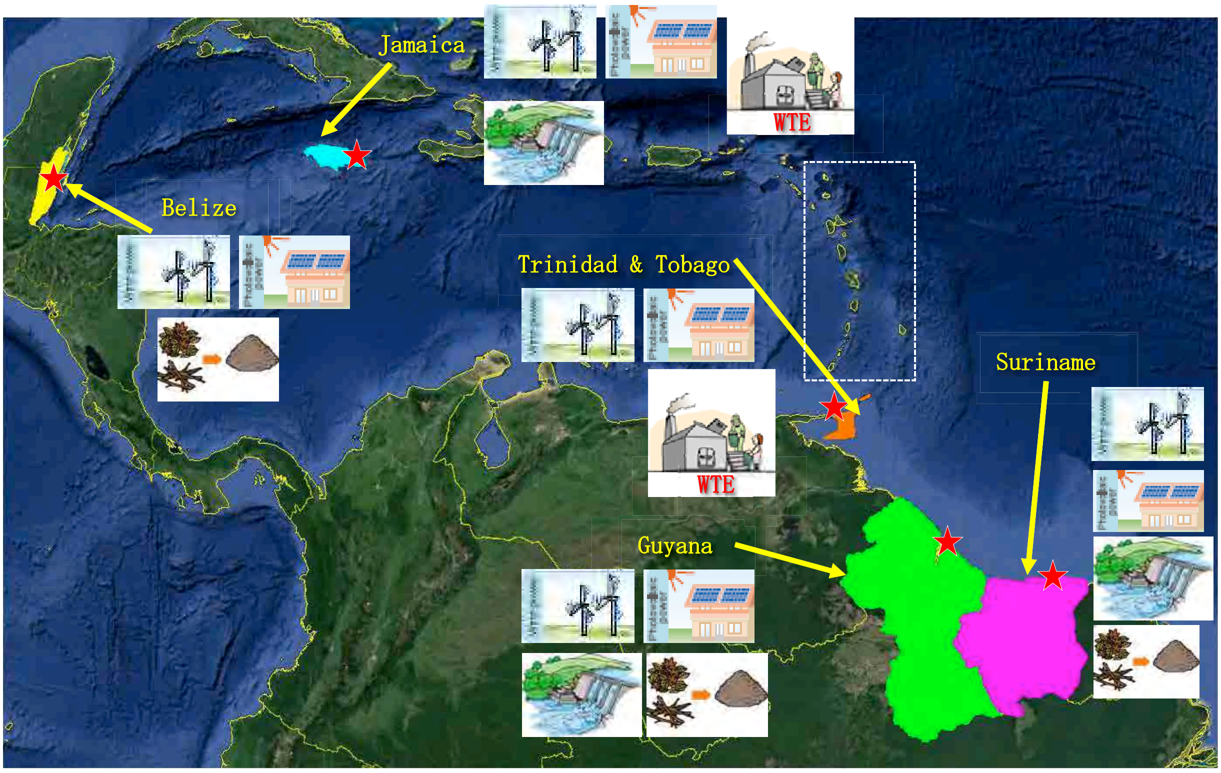

Jamaica
面積：10,991km2
人口：2,930,050人
GDP (PPP)：25,130百万USD
一人当たりGDP：9,000USD
Belize
面積：22,966km²
人口：340,844人
GDP (PPP)：1,673百万USD
一人当たりGDP：8,800USD
East Carib bean
Trinidad Tobago
面積：5,128km2
人口：1,339,000人
GDP (PPP)：27,000百万USD
一人当たりGDP：20,722USD
Suriname
面積：163,270km2
人口：573,311人
GDP (PPP)：7,120百万USD
一人当たりGDP：12,900USD
Guyana
面積：214,970km2
人口：7,735,554人
GDP (PPP)：6,593百万USD
一人当たりGDP：8,500USD

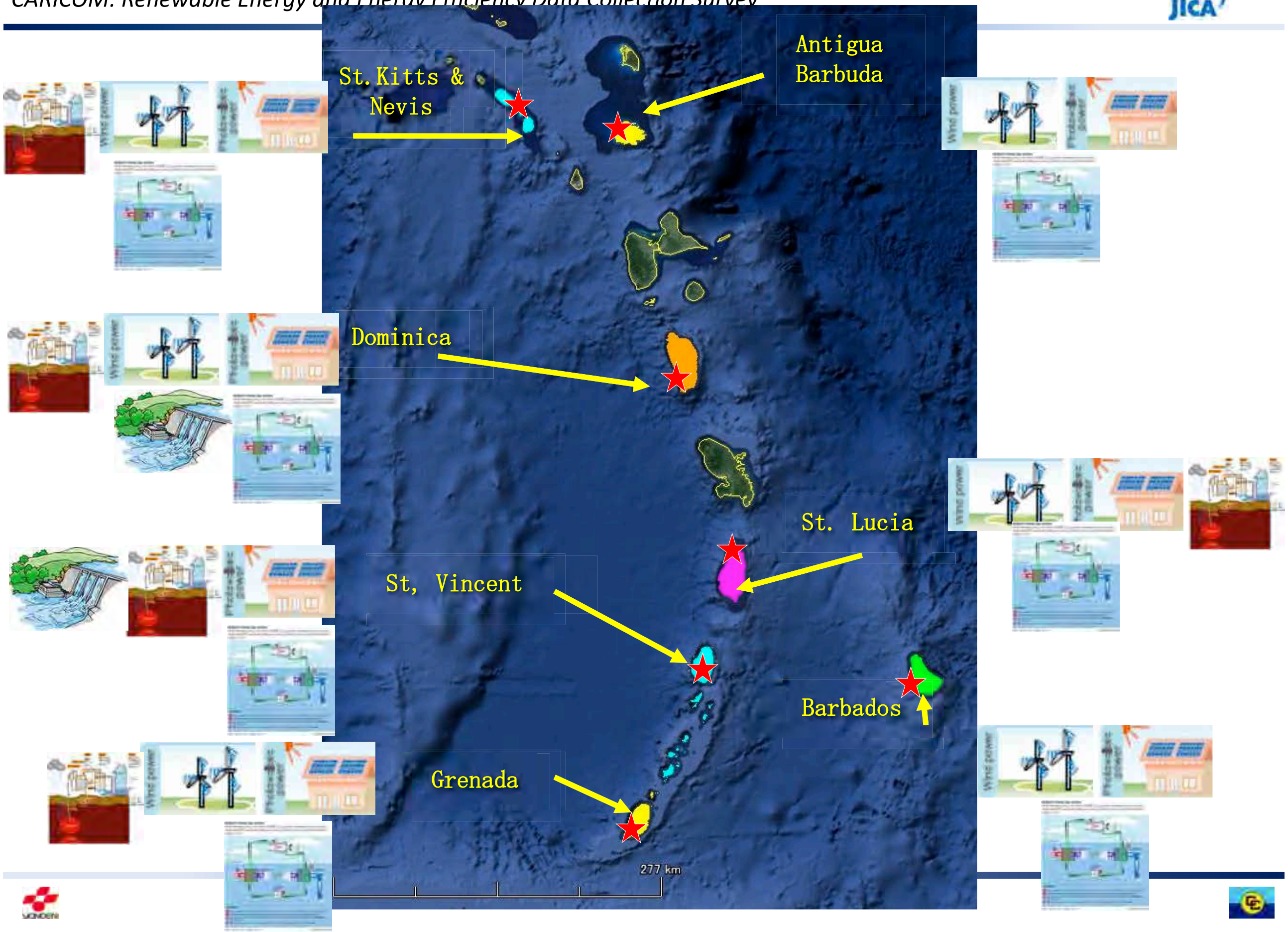

Antigua Barbuda
面積：443km2
人口：91,295人
GDP (PPP)：1,610百万USD
一人当たりGDP：18,400USD
St.Kitts & Nevis
面積：261km2
人口：51,538人
GDP (PPP)：952百万USD
一人当たりGDP：16,300USD
Dominica
面積：751km2
人口：73,449人
GDP (PPP)：1,015百万USD
一人当たりGDP：14,300USD
St. Lucia
面積：616km2
人口：163,362人
GDP (PPP)：2,216百万USD
一人当たりGDP：13,100USD
St, Vincent
面積：150km2
人口：102,918人
GDP (PPP)：1,325百万USD
一人当たりGDP：12,100USD
Barbados
面積：431km2
人口：256,000人
GDP (PPP)：5,200百万USD
一人当たりGDP：19,025USD
Grenada
面積：344km2
人口：110,152人
GDP (PPP)：1,458百万USD
一人当たりGDP：13,800USD
277 km

Population and Power Demand in 2013



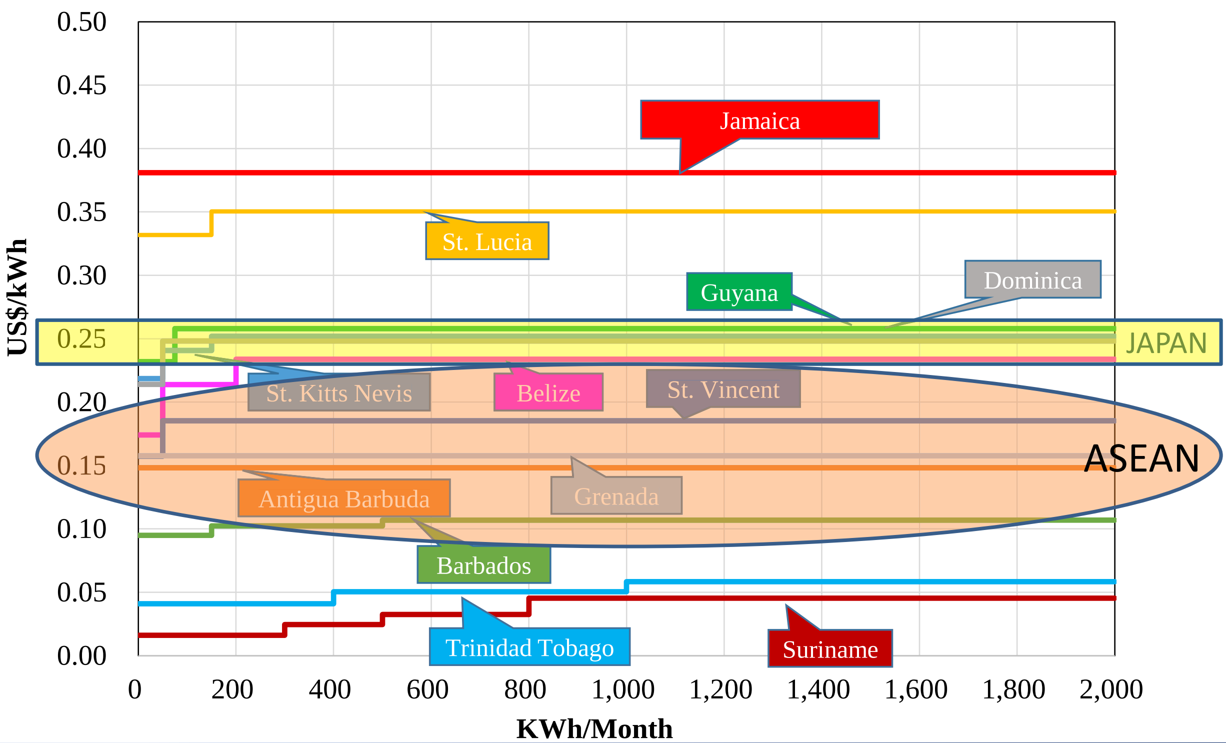
Potential to introduce Renewable Energy



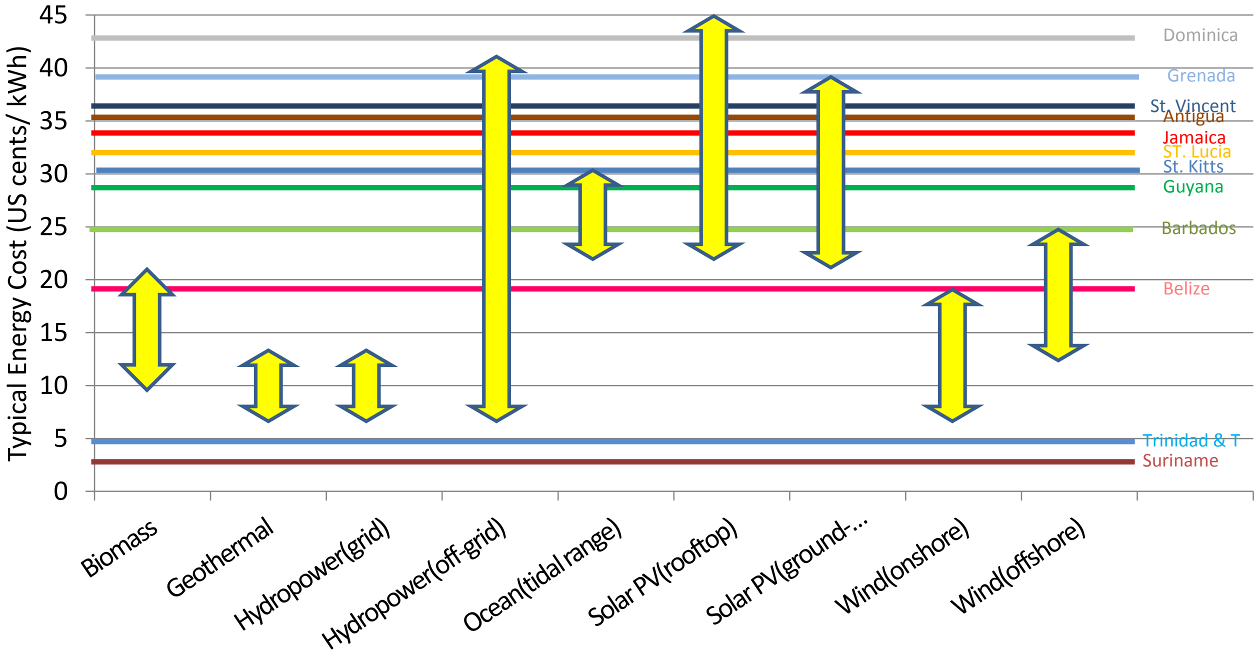


CARICOM: Renewable Energy and Energy Efficiency Data Collection Survey

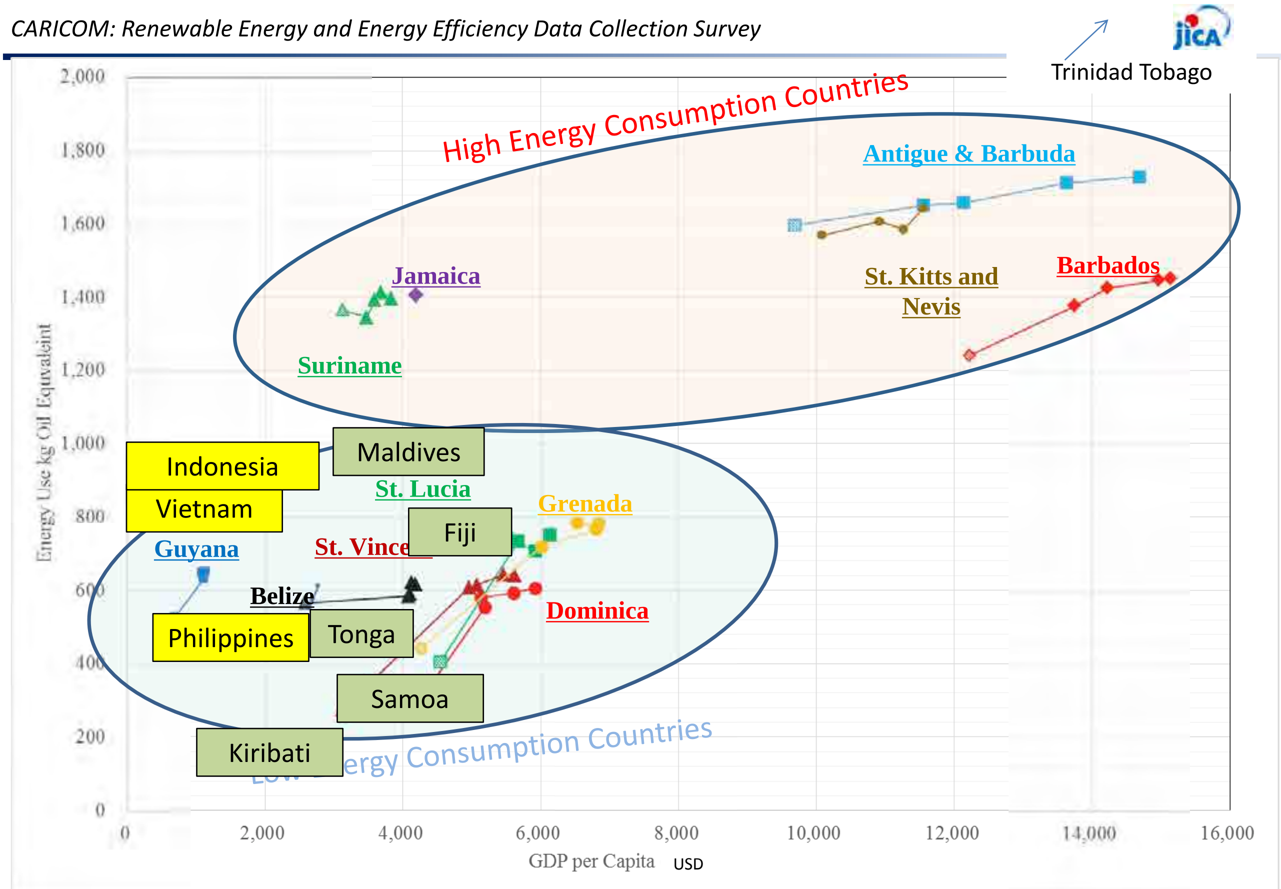
Residential Power Tariff



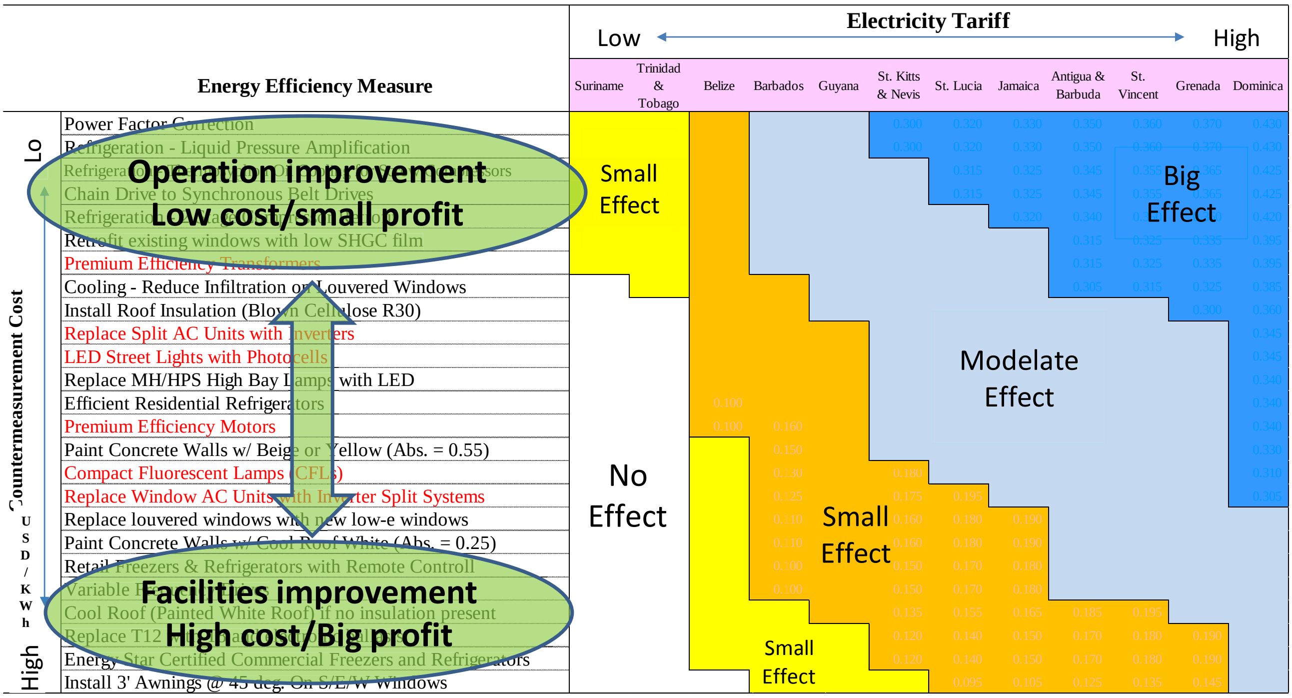
Global power generation cost , compared to the range of electricity tariffs in Caricom



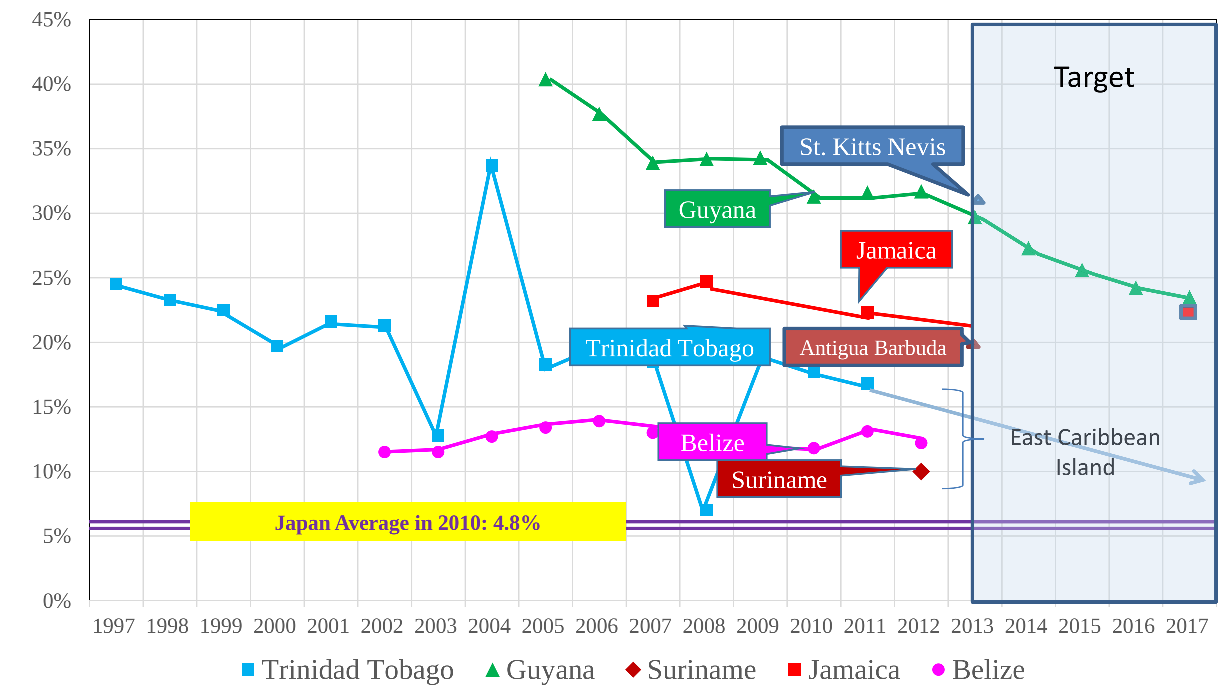
CARICOM: Renewable Energy and Energy Efficiency Data Collection Survey



Energy Efficiency Cost & Benefit Comparison

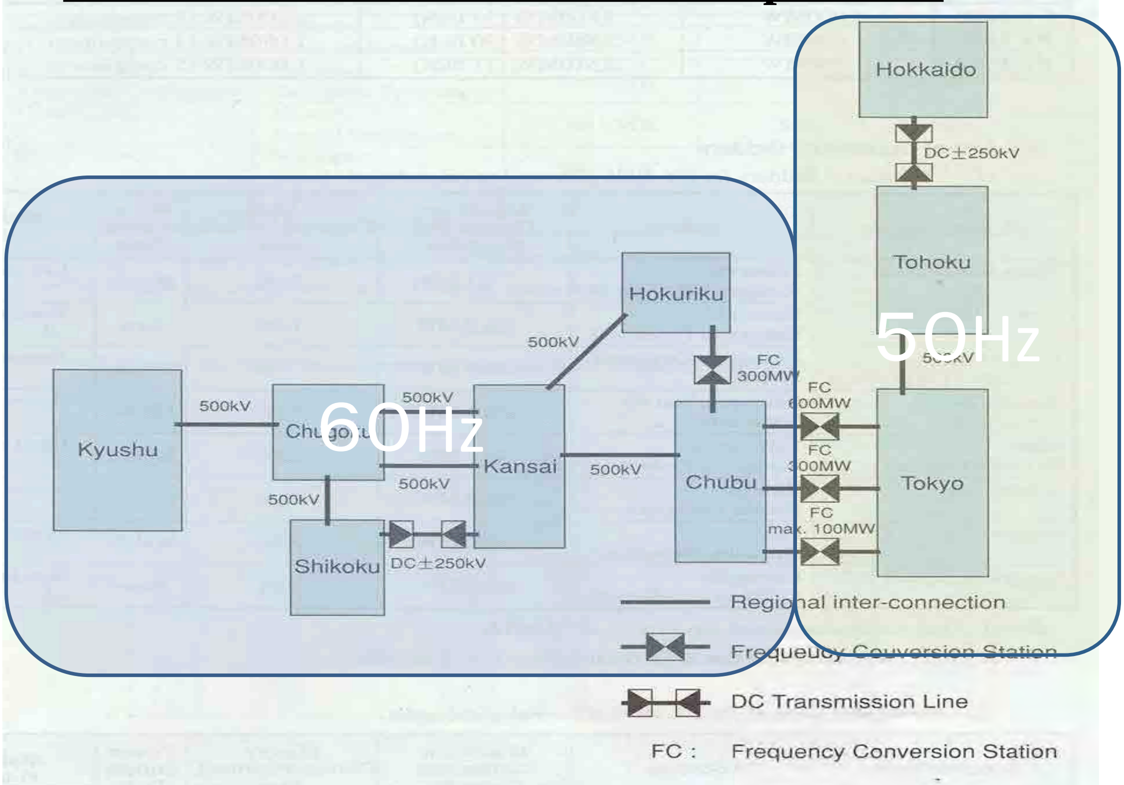


Transmission & Distribution Loss



Source: Data from Each Countries

Interconnection for Wide-area Operation



FIT in Japan, Tariff and Duration in 2012

Energy source		Solar PV		Wind power		Geothermal power		Small Hydro
Procurement category		10 kW or more	Less than 10 kW (purchase of excess electricity)	20 kW or more	Less than 20 kW	15MW or more	Less than 15MW	1MW or more but less than 3MW
Cost	Installation cost	325,000 yen/kW	466,000 yen/kW	300,000 yen/kW	1,250,000 yen/kW	790,000 yen/kW	1,230,000 yen/kW	850,000 yen/kW
	Operating and maintenance costs (per year)	10,000 yen/kW	4,700 yen/kW	6,000 yen/kW	—	33,000 yen/kW	48,000 yen/kW	9,500 yen/kW
Pre-tax IRR (Internal Rate of Return)		6%	3.2%(*1)	8%	1.8%	13%(*2)		7%
Tariff (per kWh)	Tax inclusive (*3)	42.00 yen	42 yen(*1)	23.10 yen	57.75 yen	27.30 yen	42.00 yen	25.20 yen
	Tax exclusive	40 yen	42 yen	22 yen	55 yen	26 yen	40 yen	24 yen
Duration		20 years	10 years	20 years	20 years	15 years	15 years	

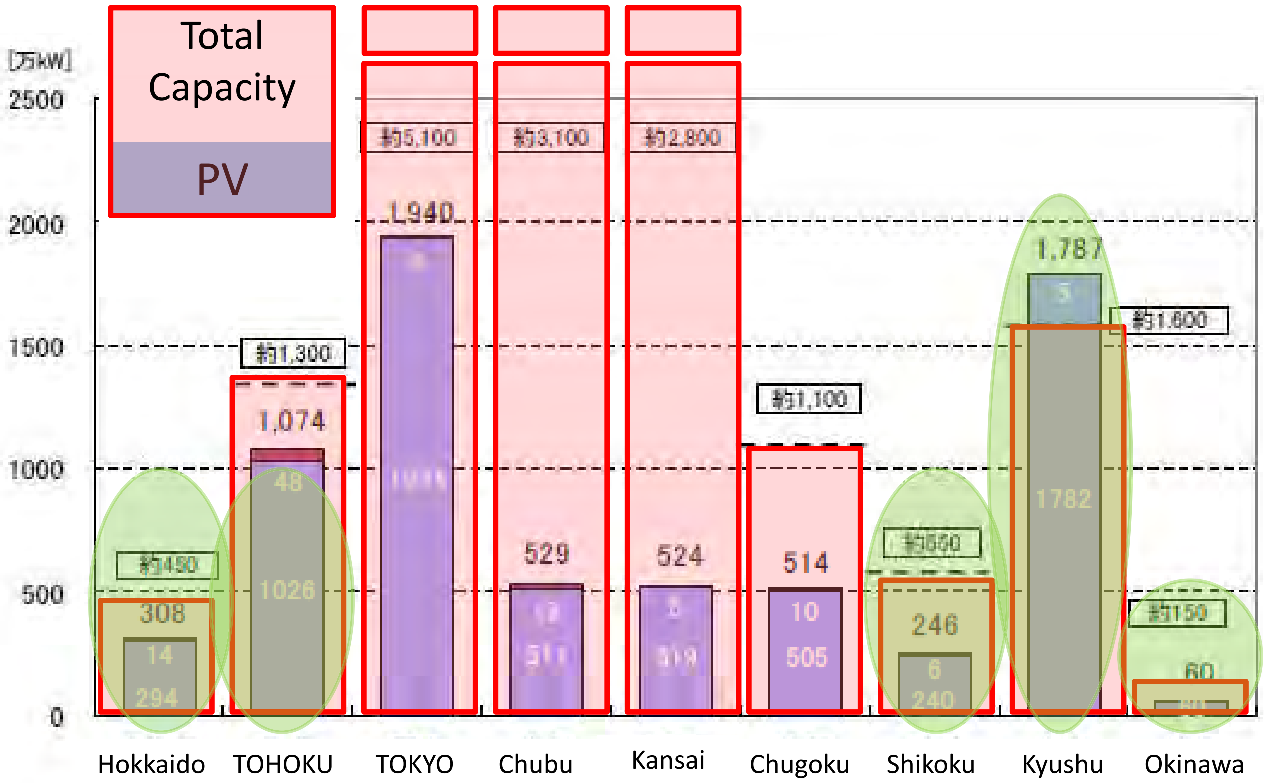
http://www.enecho.meti.go.jp/category/saving_and_new/saiene/kaitori/index.html

Mega Solar Projects in Japan

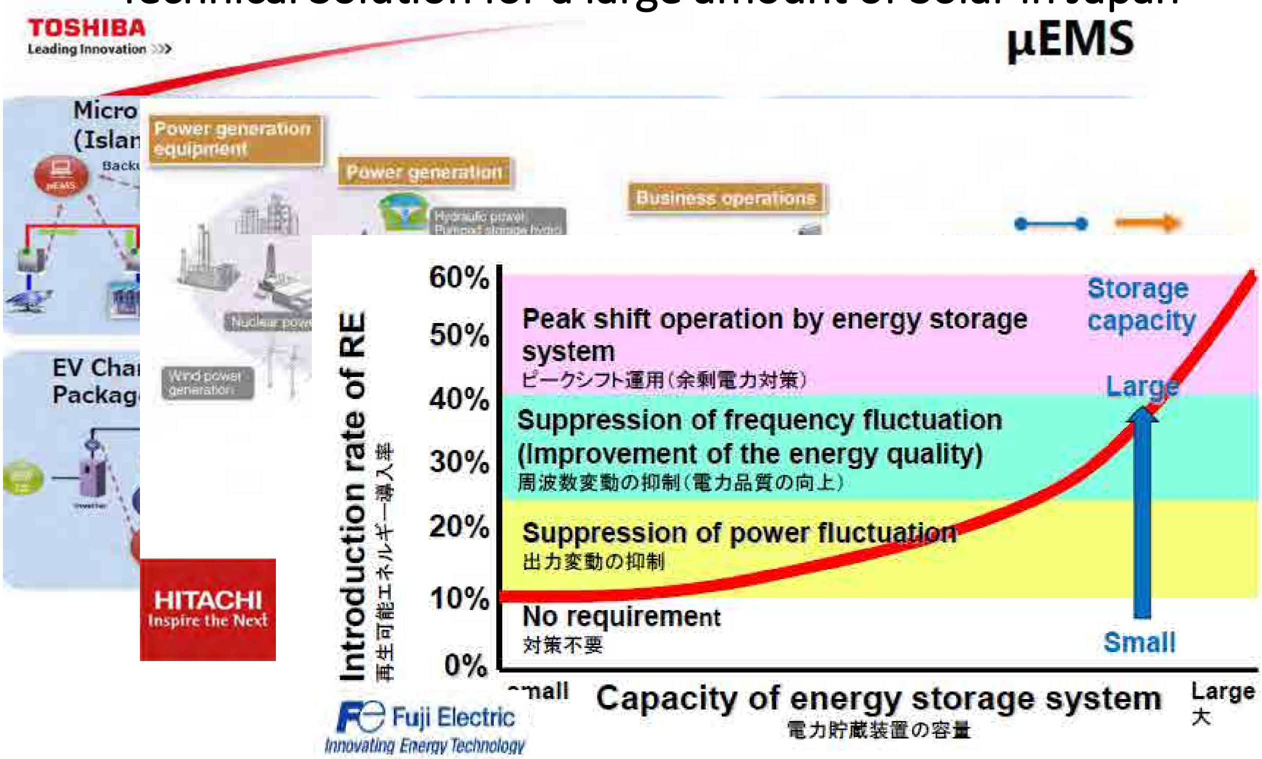
Company	Site	Capacity (MW) Total	Capacity (MW) Operating	Commission	Location
Hokkaido	1	1	1	Jun. 2011	Date Solar Power Plant
Tohoku	3	1.5	1.5	Dec. 2011	Hachinohe Solar Power Plant
		2	2	May 2011	Sendai Solar Power Plant
		1	-	Jan. 2015	Haramachi Thermal Power Station site
Tokyo	3	7	7	Aug. 2011	Ukishima Solar Power Plant
		13	13	Dec. 2011	Ogishima Solar Power Plant
		10	10	Jan. 2012	Yonekurayama Solar Power Plant
Chubu	3	7.5	7.5	Oct. 2011	Mega Solar Taketoyo
		1	1	Jan. 2011	Mega Solar Iida
		8	-	Feb. 2015	Mega Solar Shimizu
Hokuriku	4	1	1	Mar. 2011	Shika Solar Power Plant
		1	1	Apr. 2011	Toyama Solar Power Plant
		1	1	Sep. 2012	Mikuni Solar Power Plant
		1	1	Nov. 2012	Suzu Solar Power Plant
Kansai	4	10	10	Sep. 2011	Sakai Solar Power Plant
		18	-	undecided	Sakai City
		0.5	-	FY2013	Oi Town
		0.5	-	FY2014	Takahama Town
Chugoku	2	3	3	Dec. 2011	Fukuyama Solar Power Plant
		3	-	Dec. 2014	Ube Solar Power Plant
Shikoku	1	4.3	2	Dec. 2010	Matsuyama Solar Power Plant
Kyushu	2	3	3	Nov. 2010	Omuta Mega Solar Power Plant
		13	-	May. 2013	Omura Town
Okinawa	2	4	4	Oct. 2010	Miyako Island Mega Solar Research
		1	1	Mar. 2012	Abe Mega Solar Research
Total	**25**	**116.3**	**70**		**(As of Mar.2013)**

CARICOM: Renewable Energy and Energy Efficiency Data Collection Survey

Stop introduction of Solar in Japan



Technical Solution for a large amount of Solar in Japan



Annex 5-3

"Activities and Prospects of CDB in the Energy Sector "

Seminar on Current Situation of Energy Sector
--CARICOM – Japan Friendship Year 2014---

JICA, Tokyo, Japan
November 6 2014

Joseph Williams
Energy Consultant
REEEU/Office of VP Operations, CDB

Caribbean Context

Vulnerabilities and Structural Challenges

5 'Degrees' of vulnerabilities in Caribbean

Dot sized (small open economies)

Discrete (most island states)

Debt (High levels)

Disaster (natural, climate)

Dependence imported fossil fuel (high)

Population: vary - 5K in Mon to 10M in Haiti
Total population 16M approx Chile
Dis-economies of scale
Varying economic Indicators

1. - GDP/Capita
2. - low economic growth
3. - pockets of poverty
4. - economic uncompetitiveness

Most countries are hostage to international oil price volatility

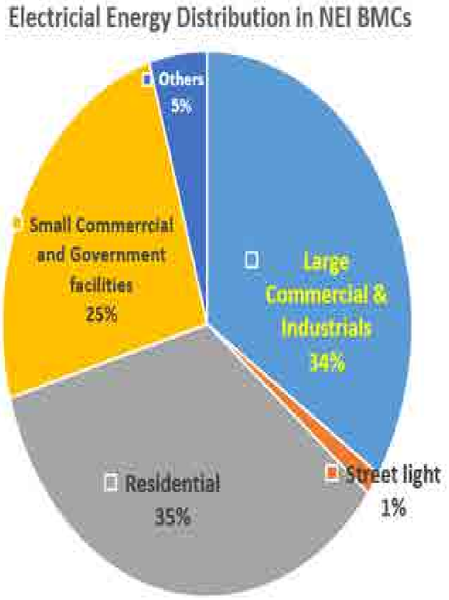
ONE SIZE DOES NOT FIT ALL !!

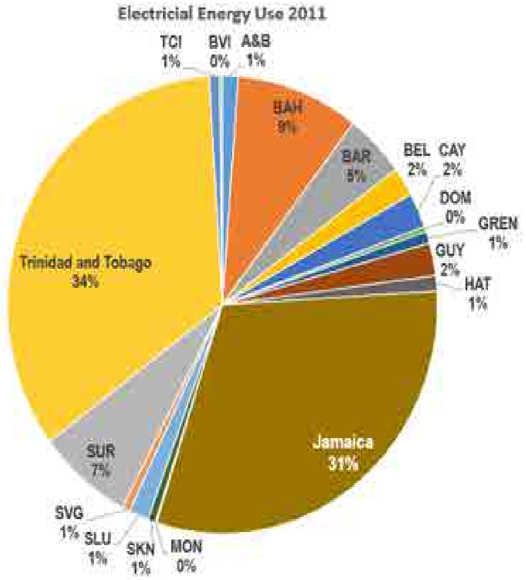
Energy Use, Cost, Distribution - 2011

In 2011 NEI BMCs

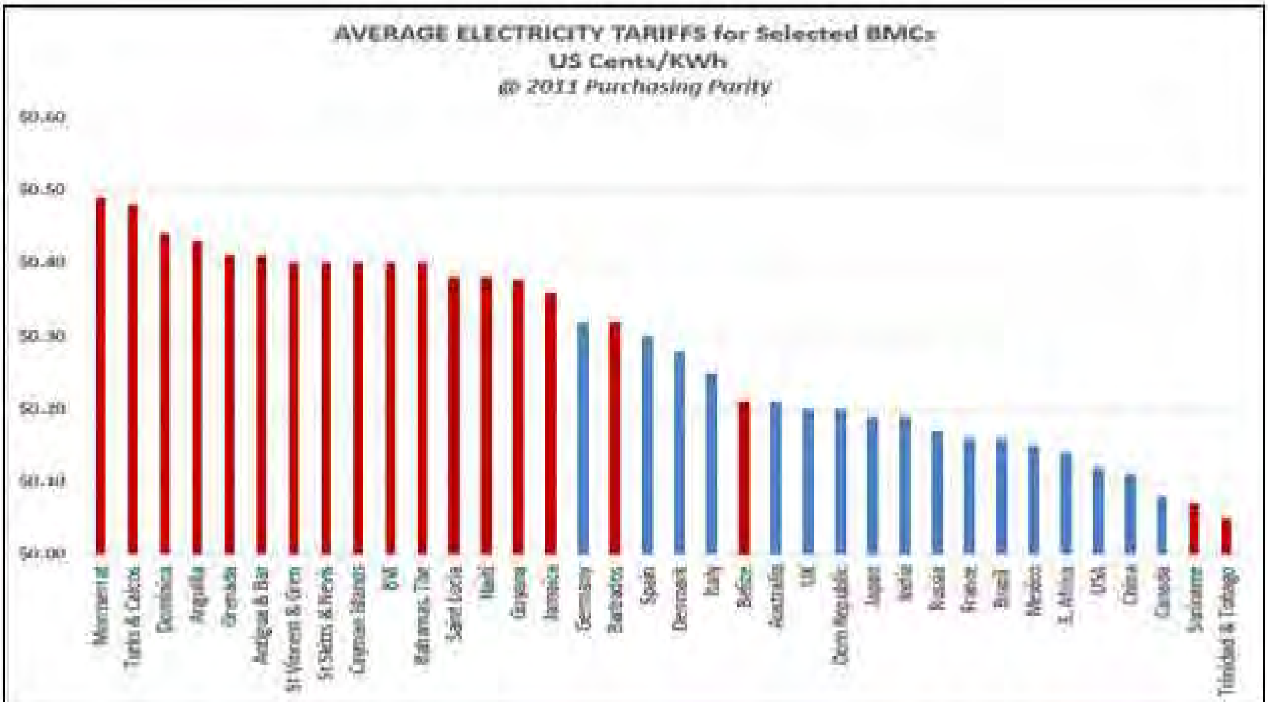
- *Used 61 MBOE* crude and products
- *Cost approx.* *US$6.5billion (rep 12-14% GDP)*

- *Total Gen capacity* **4,275 MW** ; Total Peak Demand **2,783 MW**
- *Electricity Consumption*: **9,775 GWh/year**
- *Growth rates*: ***4.9%, 4.7% and 2.4%:*** for energy consumption, Elec. energy; Gen capacity respectively (over 1993-2007).

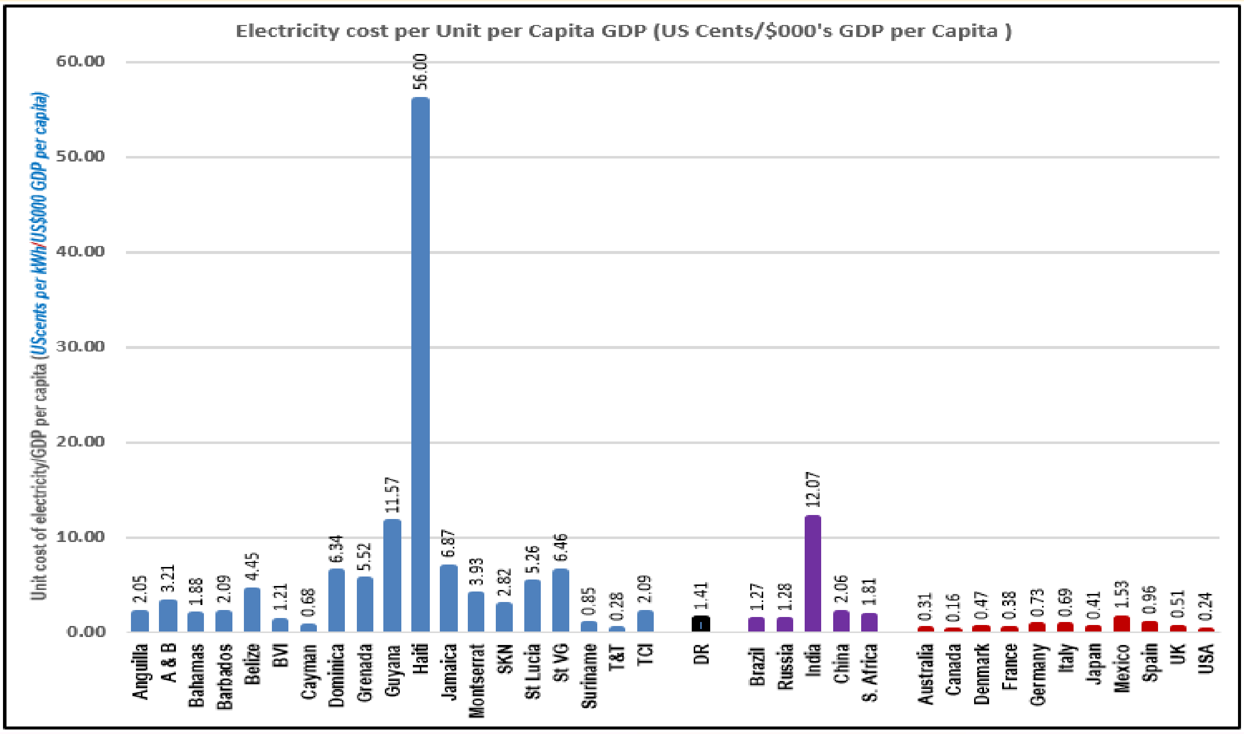




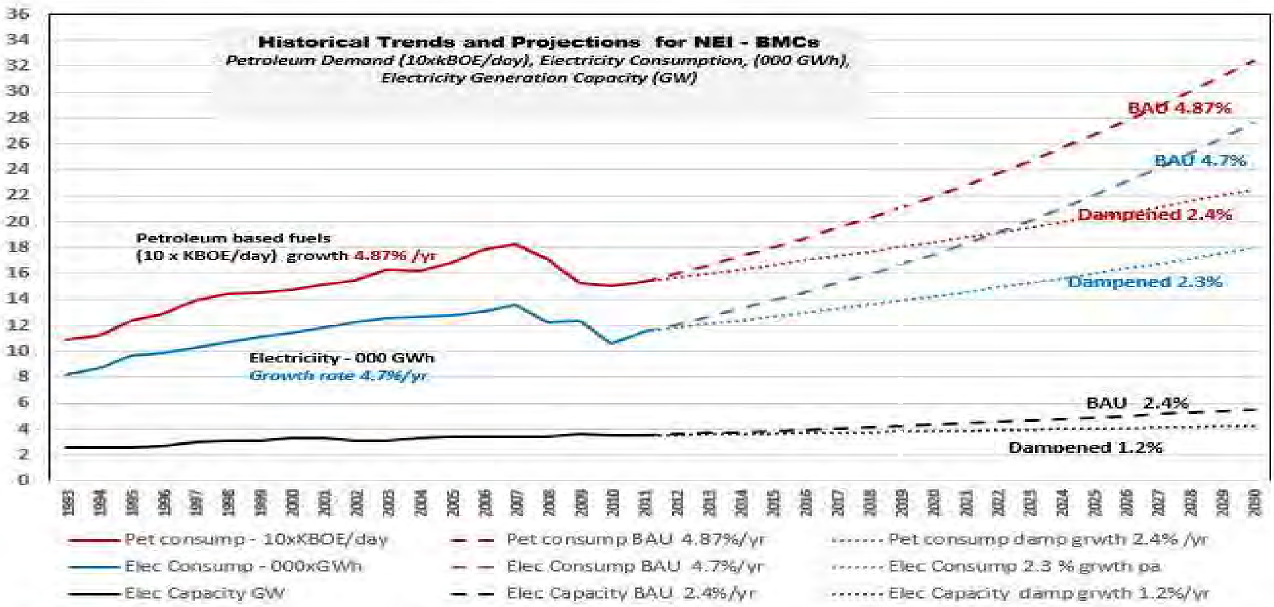
Electricity Tariffs



Energy Affordability



Energy Consumption Trends



Age of Generation Capacity

Table Summary of Generation Capacity of Selected BMCs which have age of greater than 15 years in 2019*

BMCs	Description	location	Make	Type of fuel	**Installed Capacity MW	Operating Years to 2019 Yrs	Capacity > 20 years in 2019 MW	Capacity > 15 years in 2019 MW
	All Utility & IPP	11 BMCs*	Thermal Units	All Fuels including RE	1,572.7			
	Utility Owned	11 BMCs	Thermal Units	HFO, Diesel	1,359.4		846.3	1,106.5
	Share of Generation over 20 yrs & 15 years respectively in 2019						62.3%	81.4%

**10 BMCS analyses based on availability of data: Anguilla, Barbados, Dominica, Grenada, Guyana, Dominica, Jamaica, St Kitts and Nevis, St Lucia, St Vincent & Grenadines, Suriname*

*** The total installed capacity considered in the analysis represents 55% of the capacity of net energy importing BMCs in 2011*

Overview of Policy & Regulatory Framework

COUNTRIES	Ownership Utility	% RE Power	Regulator	Policy Framework	*Regulatory Authority	*Policies	*Self-generation allowed	*Utility scale grid connected RE
Anguilla	40% gov; 60% citizen	<1	Ministry of comm, utilities, housing	Nat Energy Policy (NEP) adopted 2009	○	◗	○	○
Antigua/ Barbuda	100% gov	<1	Min of utilities; Energy	NEP approved Oct 2011	○	◗	●	○
Bahamas	100% gov	0%	Utilities Regulatn	Draft NEP 2012	◗	○	○	○
Barbados	80% p 20% g	<1	Fair Trading Comm	NEP 2012	●	○	●	○
Belize	100% gov	40%	Public Utilities Comm	Draft NEP 2012	●	◗	○	●
British VI	100% gov	0%	Min Comm & works	No NEP	○	●	○	○
Cayman		0%	Ministry	No NEP	●	◗	●	●
Dominica	52 % pvt, 48% other	28%	Indep Regulatory Commission (INDP)	Draft 2011	●	◗	●	●
Grenada	50% p 50% o	<1	OPM	NEP finalized 2011	◗	◗	●	○
Guyana	100% gov	2%	Public Utilities Commission	Low carbon development strategy address energy	◗	◗	○	●
Haiti	100% gov	22	Ministry	No NEP	○	○	●	●
Jamaica	80% p: 20% gov	6%	Office of Utilities Regulation (INDP)	Approved NEP 2009; + sub-sector policies	●	●	●	●
Montserrat	100% gov	<1		Draft 2008 NEP	○	●	○	○
St. Kitts/Nevis	100% gov	8%	Public Utilities Commission	Drfat NEP 2010	●○	○○	○○	●●
St. Lucia	54% pvt, 46% other	<1	Ministry of Public Utilities	Draft NEP 2010	○	◗	●	○
St. Vincent/ & gren	100% gov	25%		Approved NEP 2009,	○	◗	●	●
Suriname	100% gov	60%		draft RE Policy	●	○	○	○
Trinidad/Tobago	100% gov;	<1	Regulated Industries Comm	Draft RE Green paper; for RE and EE + incentives	●	○	○	○
Turks & Caicos		0%			○	◗	○	○

Legend: ● Have and works; ◗ Have but not functional; ○ Do not have; NA Information not available

Key Deficiencies of Energy Systems

- **In general, legacy legal and regulatory frameworks persist**
- **General absence of true independent regulator**
- **Lack of available public funds at national levels**
- **Aged generation infra-structure - inefficient** (diesel, Simple Cycle-GT)
- **Limited long range planning**, mainly traditional least cost planning

Key Deficiencies of Energy Systems (contd)

- **Inadequate capacities**
- **Inefficient energy end-use devices**
- **Price subsidies in some BMCs**
- **Small and discrete nature of EE projects**
- **Insufficient RE/EE awareness**
- **Inadequate financing instruments for supporting EE & RE**
- **Vehicle stock lags behind the frontier clean & fuel efficiency**

Opportunities & Challenges – CDB's Perspective

- **Improving energy security, competitiveness, sustainability of BMCs:**
  - –Investment in Energy infrastructure
  - –Green Economy
- **Increased CDB's presence/relevance**
- **Business development/expansion in BMCs**
- **Increased Bank's Operations**

KEY CHALLENGE:

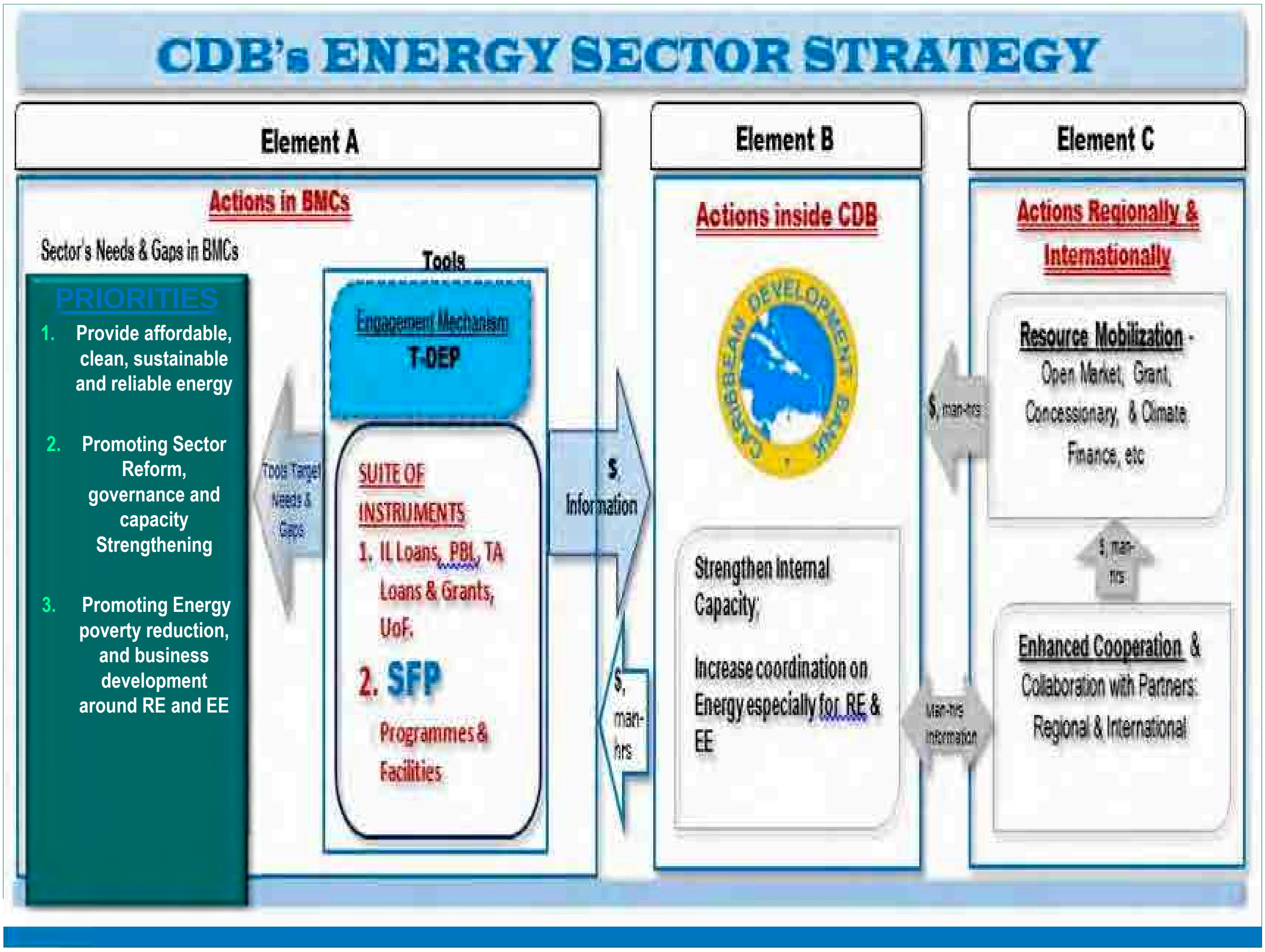
- Constraints on BMC borrowing

Goal & Priority Areas

Goal: ***To drive economic growth, and poverty reduction through increasing energy security and sustainability in BMCs***

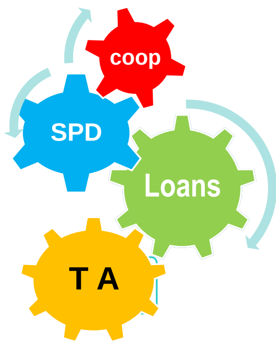
Priorities

1. **Infrastructure & energy options: affordable, reliable, clean, RE & EE**
2. **Sector reform, good governance and capacity strengthening.**
3. **Energy poverty reduction & energy business dev thru RE & EE**



Caribbean Development Bank's Response:
Intensified Focus on Energy Sector

1. **Established Renewable Energy and Energy Efficiency Unit;**
2. **Developing Energy Sector Policy and Strategy**
3. **CDB will provide**
   - **Continue to support T&D upgrade & conventional generation projects**
   - **Technical Assistance** in specific areas
   - **Investment & Policy Based Financing - RE, EE, General**
   - **Innovative financing instruments in l**ine with broader objectives
     - To incentivise achievement of targets
     - Encourage coordination of regional projects
   - **Structured Policy Dialogue** to overcome deadlocks and slow progress, plus policy based loans to assist the process
   - Innovative instruments to support ***de-risking*** of early stage RE project development
   - **Working closely with Donors and regional organizations** to translate initiatives into investment opportunities eg – systematic resource assessment



CDB's Thrust in BMCs

Renewable Energy & Energy Efficiency

- EE - Across all sectors; special opportunities in public sector
- RE – Base-load options – Hydro, GE, Biomass
- Special opportunities
  - Interconnection around Geothermal in EC, hydropower in Guyana & Suriname, Trinidad & Tobago
  - Distributed Generation especially for Solar PV
  - Wind-Solar complement

RE Potential

Table · Status of Renewable Energy in Power Sector in BMCs

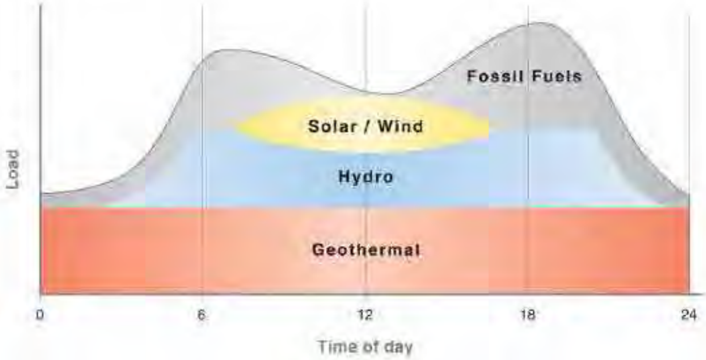
BMCs	SOLAR (large solar potential in all countries)	Other RE Resource	Estimated* Current RE capacity Installed (MW)	Potential (MW) *(Excluding Solar)*	Current Elec Demand (MW)
Anguilla	high	wind			14
Antigua and Barbuda	high	wind	0.05	58	63.8
Bahamas	high	wind, Marine	0.01	*400*	250.2
Barbados	high	wind, Bomass, Marine	10.0	58	163
Belize	high	biomass	60.0	*35*	79.3
BVI	high	wind	-		33.7
Cayman	high	wind	0.50	*20*	102
Dominica	high	Hydro, Geo, Wind	4.50	300	17.2
Grenada	high	biomass, GE, wind	0.32	*400*	32.3
Guyana	high	Hydro, Biomass, wind	10.00	7,100	103.9
Haiti	high	Hydro, Wind	50.00	*100*	225
Jamaica	high	Hydro, wind, biomass	71.00	260	617.7
Montserrat	high	wind, GE	-	*900*	2.3
St. Kitts and Nevis	high	Wind, GE, Biomass	2.00	331	32
St. Lucia	high	GE, Hydro, wind	0.08	*250*	60.3
St. Vincent & Grenadines	high	Hydro, Biomass, GE, wind	5.90	125	21.8
Suriname	high	Hydro, biomass,	183.0	*1,320*	244
Trinidad and Tobago	high	wind		50	736
TCI	high	wind			38.3
Total			**402.5**	**11,707**	**2774.8**

*Author's elaboration: - various reports (Nextant, Worldwatch, Worldbank) ** not continuous

GE Supplying Baseloads

Use of Geothermal as Base Load

- One of the limiting factors for geothermal power is that it should be used as pure base load to prevent increasing generation costs.



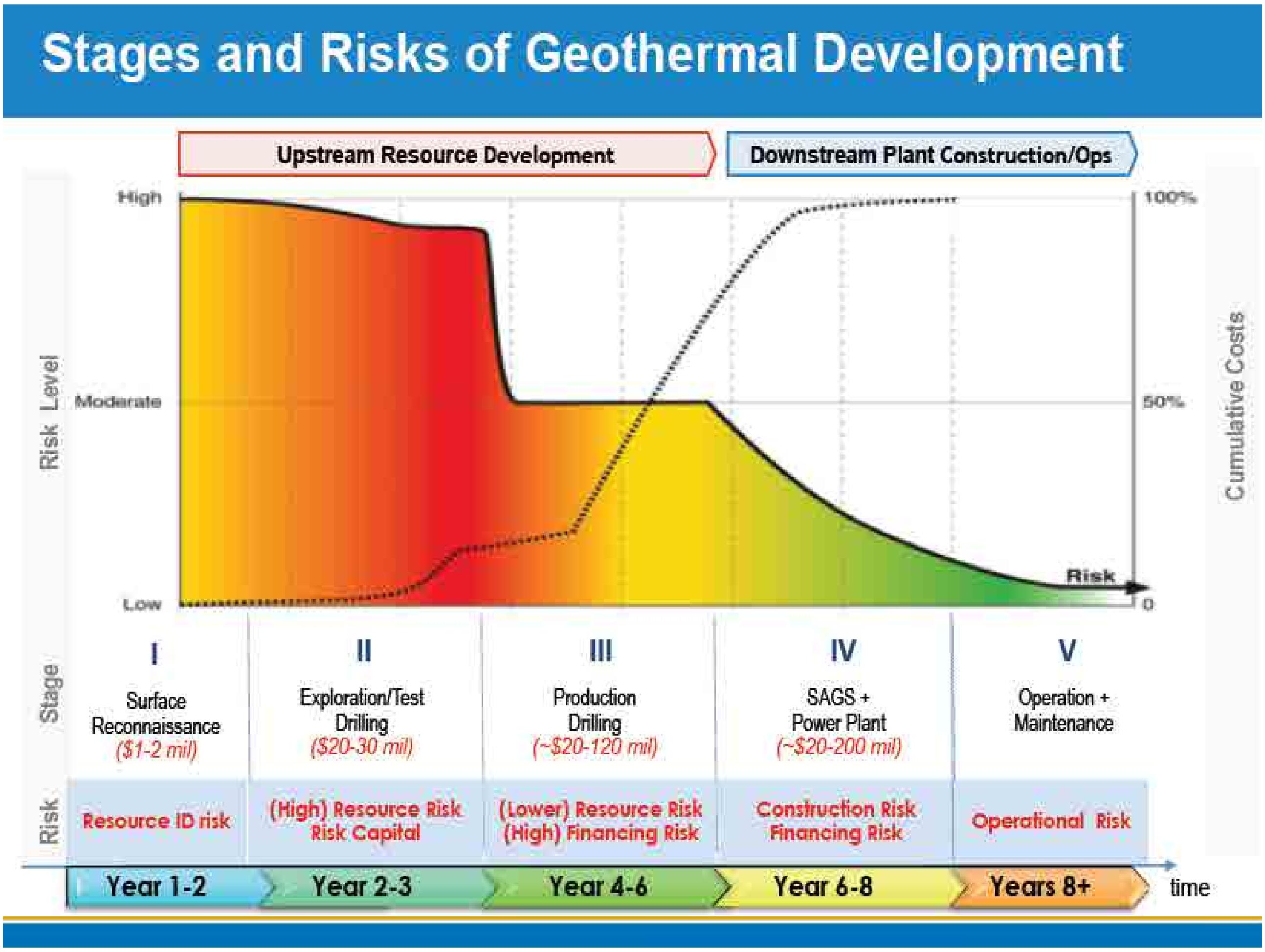
Baseloads

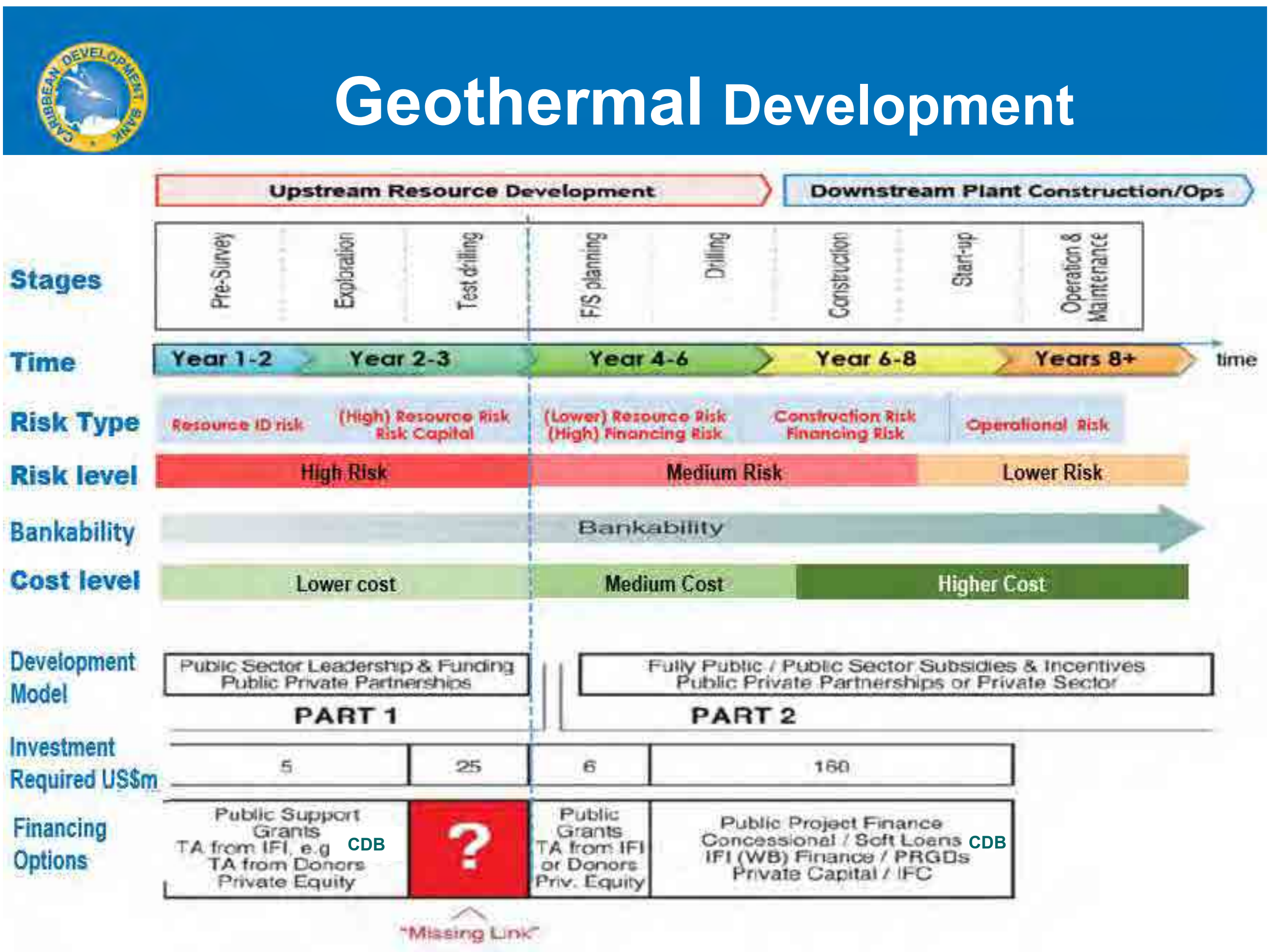
Table 1: Estimates of GE Potential in Eastern Caribbean

Countries	Installed Capacity	Peak Demand	Approx* Base-load	Estimate of GE potential (MW)	
	(MW)	(MW)	(MW)	World Bank	'Nextant' Report
Dominica	*27*	17	9	>500	100
Grenada	*52*	30	18	>30+	400
Montserrat	*9*	2	1	>100+	-
St Kits & ***Nevis***	*59*	36	**4****	>25+	300
St Lucia	*89*	60	37	>75+	25
St Vincent and Grenadines	*51*	26	12	>75+	-
Total	**287**	**171**	**81**	**>805**	**> 825**

*Trevor Byer/CARICOM Country assessments

**Nevis has been identified as having GE potential; base-load refers to Nevis Island only


Stages and Risks of Geothermal Development
Upstream Resource Development
Downstream Plant Construction/Ops
High
Moderate
Low
Risk Level
100%
50%
0
Cumulative Costs
Risk
Stage
I
Surface Reconnaissance
($1-2 mil)
II
Exploration/Test Drilling
($20-30 mil)
III
Production Drilling
(~$20-120 mil)
IV
SAGS + Power Plant
(~$20-200 mil)
V
Operation + Maintenance
Risk
Resource ID risk
(High) Resource Risk
Risk Capital
(Lower) Resource Risk
(High) Financing Risk
Construction Risk
Financing Risk
Operational Risk
Year 1-2
Year 2-3
Year 4-6
Year 6-8
Years 8+
time


Geothermal Development
Upstream Resource Development
Downstream Plant Construction/Ops
Stages
Pre-Survey
Exploration
Test drilling
F/S planning
Drilling
Construction
Start-up
Operation & Maintenance
Time
Year 1-2
Year 2-3
Year 4-6
Year 6-8
Years 8+
time
Risk Type
Resource ID risk
(High) Resource Risk
Risk Capital
(Lower) Resource Risk
(High) Financing Risk
Construction Risk
Financing Risk
Operational Risk
Risk level
High Risk
Medium Risk
Lower Risk
Bankability
Bankability
Cost level
Lower cost
Medium Cost
Higher Cost
Development Model
Public Sector Leadership & Funding
Public Private Partnerships
PART 1
Fully Public / Public Sector Subsidies & Incentives
Public Private Partnerships or Private Sector
PART 2
Investment Required US$m
5
25
6
160
Financing Options
Public Support
Grants
TA from IFI, e.g CDB
TA from Donors
Private Equity
?
Public
Grants
TA from IFI
or Donors
Priv. Equity
Public Project Finance
Concessional / Soft Loans CDB
IFI (WB) Finance / PRGDs
Private Capital / IFC
"Missing Link"

Objectives of GeoFEC

1. Mechanism for financial & technical support for GE
2. Allows rapid development of GE potential
3. Catalyzes global funding efforts; provide long term loans
4. Allows for stepwise, and portfolio approaches to GE dev
5. *Mitigates project risks by following actions:*

- *investigating technical readiness of projects*, including diligence on developer, proof of resource and its size, country readiness in terms regulatory frameworks & infrastructure.
- *ensuring project addresses needs of the country.*
- *supporting developers in all stages of the project*.

CDB/JICA/IDB Memorandum of Cooperation

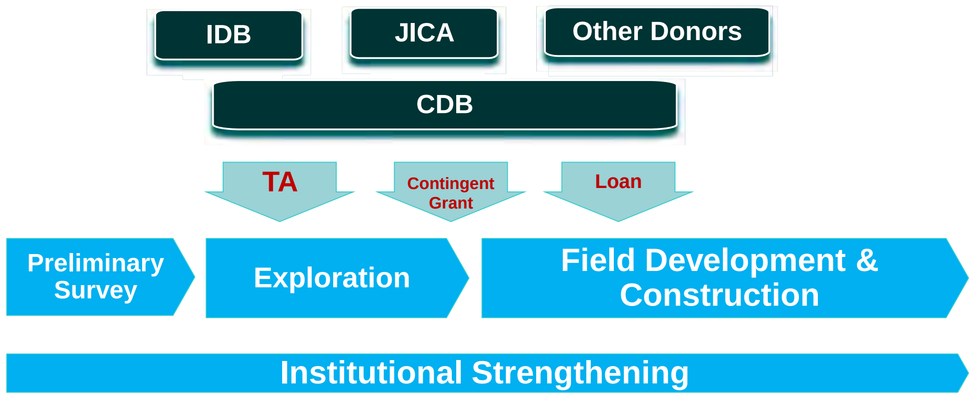
- Signed July 2013 in Trinidad & Tobago
- Focus on RE and EE support
  - Concessional loans and grants
  - Focus on GE development in EC
    - Basis for Geothermal Energy Facility

Support for Geothermal Facility for Eastern Caribbean

Basic Concept

•Comprehensive & flexible initiative

•Providing different type of supports which matches nature & necessity of every & each stage of geothermal development



Design Options Being considered Basic Form

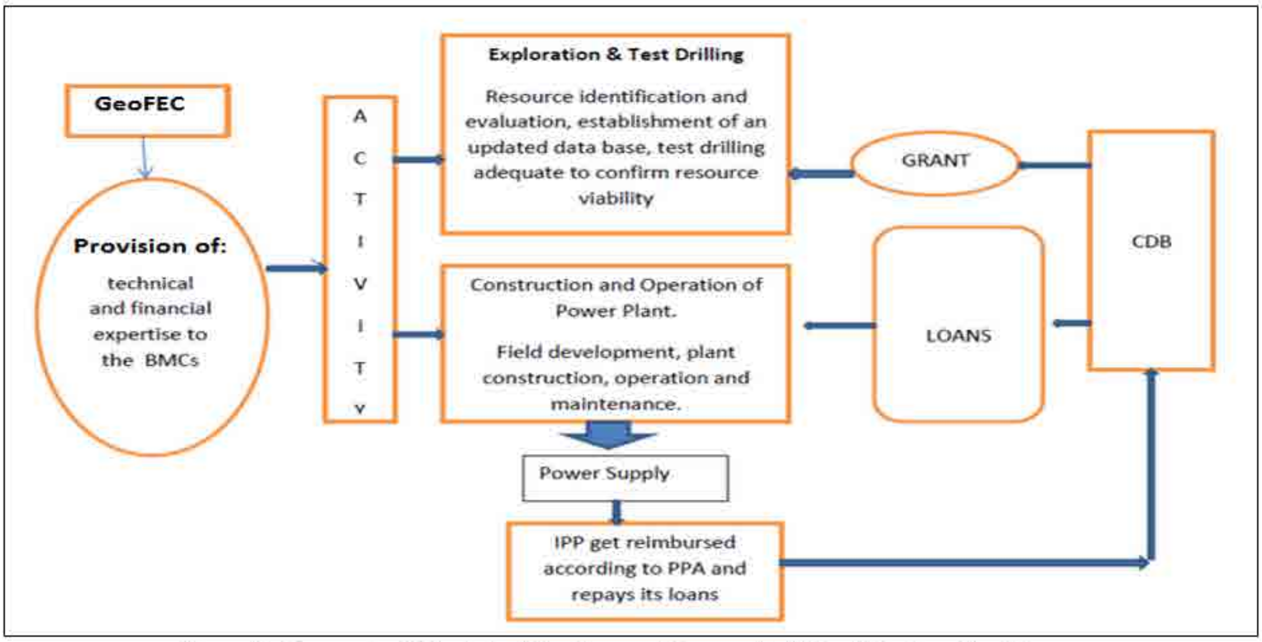
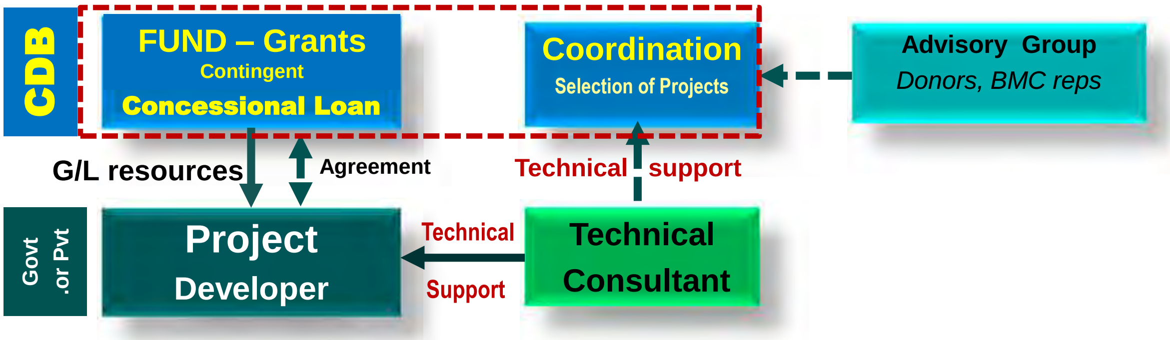


Figure 3: Conceptual Model of Geothermal Energy Facility of Eastern Caribbean

Operation of *GeoFEC*

Supporting Exploratory Phase



- *Technical Consultant engaged by CDB*
- *Advisory Group of Donors, BMC reps, etc: IDB, JICA, EU, KfW, etc*

Status of GeoFEC

CDB has over the last Six months:

1. ***Communicated widely willingness to lead*** on same in region: with support from relevant BMCs, IDB, JICA, Gov. of Germany, EU Del ;
2. ***Developed Partnerships****:*
   - **CDB/IDB/JICA Memorandum of Cooperation – July 2014:**
   - Government of Germany, and KfW which agreed to support efforts
     - CDB is observer in LA GDF working group; Technical Advisory Support
   - EU Delegation Barbados & EC

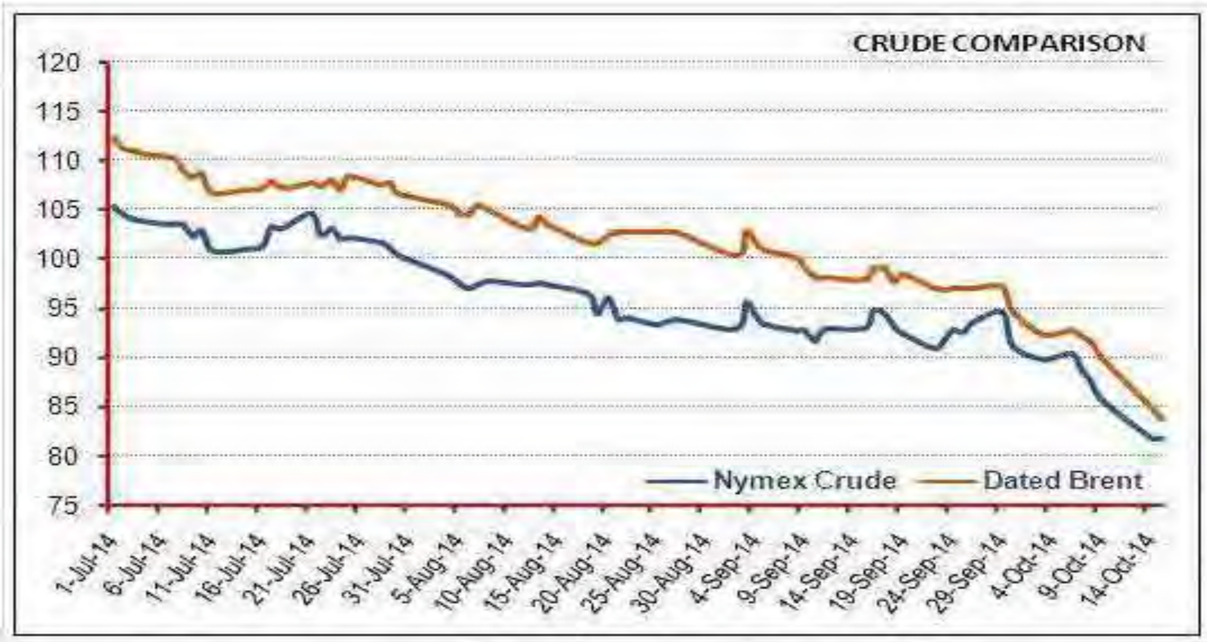
3. ***Commenced resource mobilization, & coordination - OECS***
   - IDB/JICA targeting concessional loan resources and grant funding -- ***being pursued jointly***; also CTF resources targeted
   - Proposed application EU-CIF for grant funding with EU; Others targeted

4. ***Engaged Consultants, d***eveloped initial design options (in progress):

5. ***Started visiting countries to have specific discussions – Sept 2014***

6. Endorsed by Ministers with responsibility : environmental sustainabilty

Double edged sword



The End

Thank you

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Seminar on Current Situation of Energy Sector in CARICOM Countries:

Towards a Diversified Caribbean Energy Matrix

Christiaan Gischler
Senior Energy Specialist

JICA seminar
Tokyo Japan
November 6, 2014

Caribbean Energy Sector Characteristics and Challenges

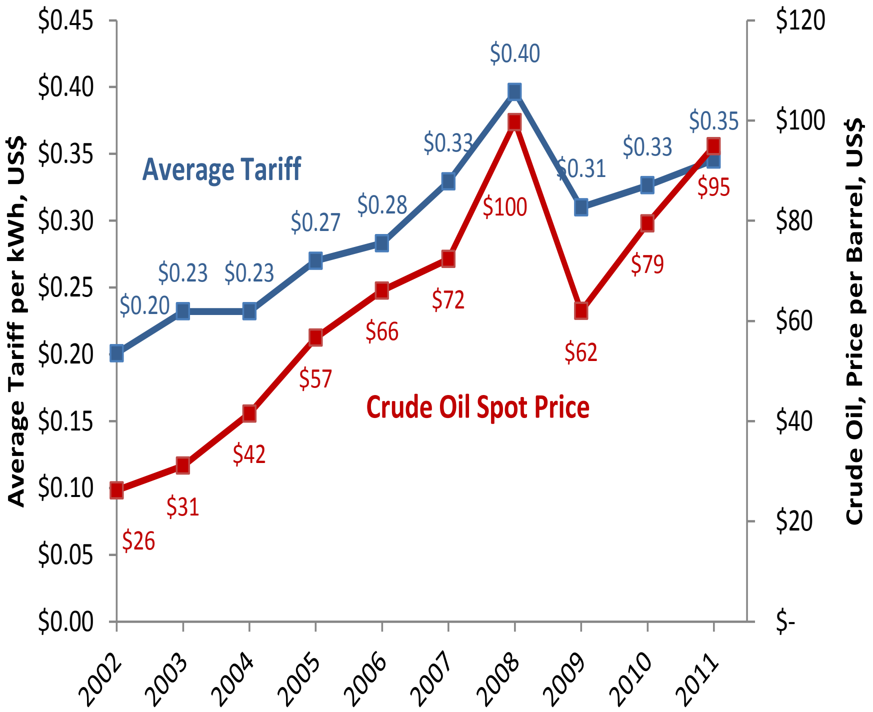
- **Technical**
  - Heavy dependency on fossil fuels
  - Disaggregated small and isolated loads, difficult to achieve economies of scale
  - High cost of interconnections (with some exceptions)
  - Load growth projected to increase by more than 3% annually in the next two decades

Caribbean Energy Sector Characteristics and Challenges (cont.)

- **Social and Economic**
  - Low penetration of Renewable Energy (RE) and (EE)
  - High cost of generation, both fossil and renewable
  - Low capital investment capacity
  - Limited skilled work force
  - Limited enabling Regulatory Framework to promote RE and EE (with some exceptions)

IDB

Tariffs and Oil Prices



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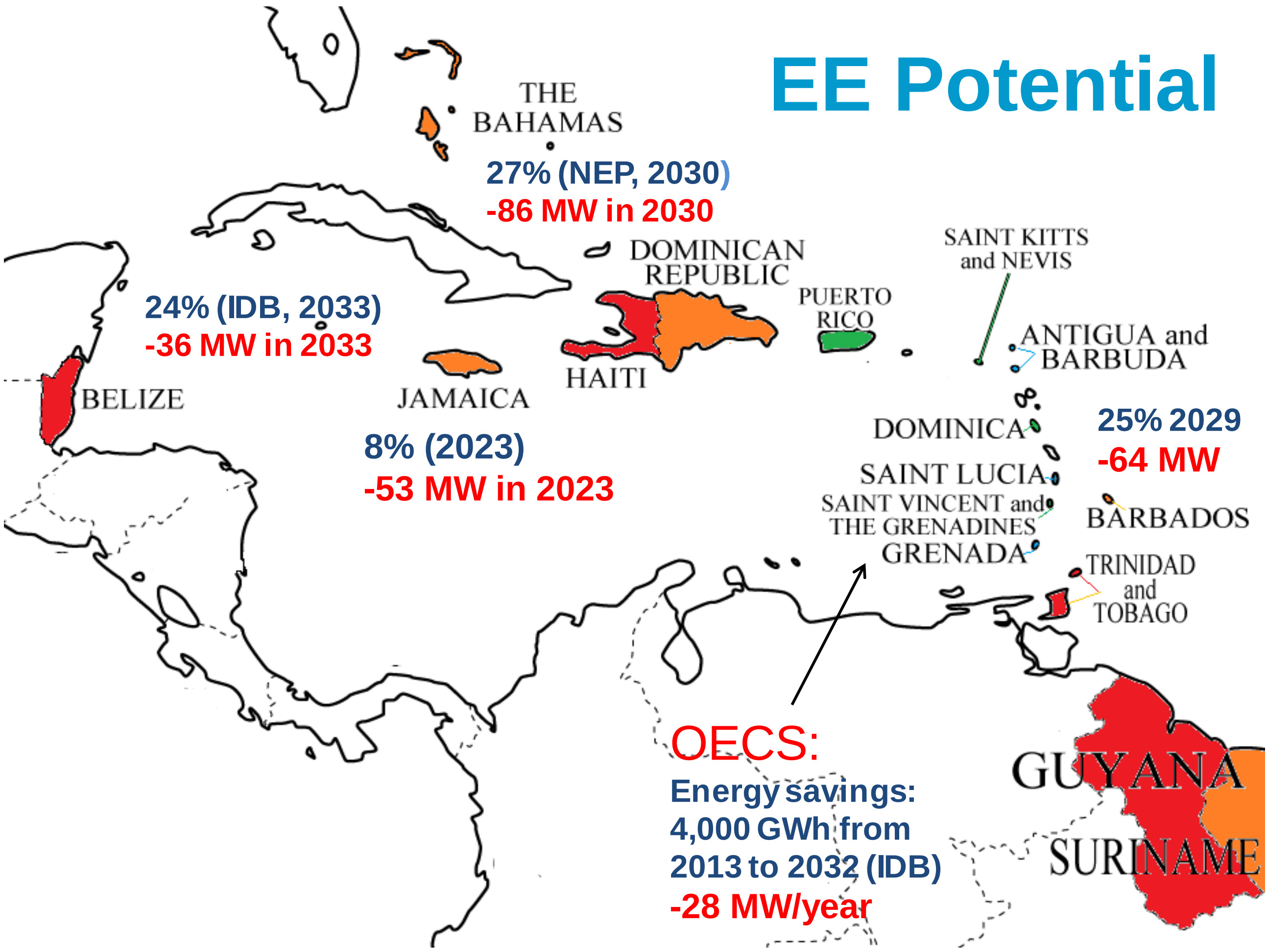
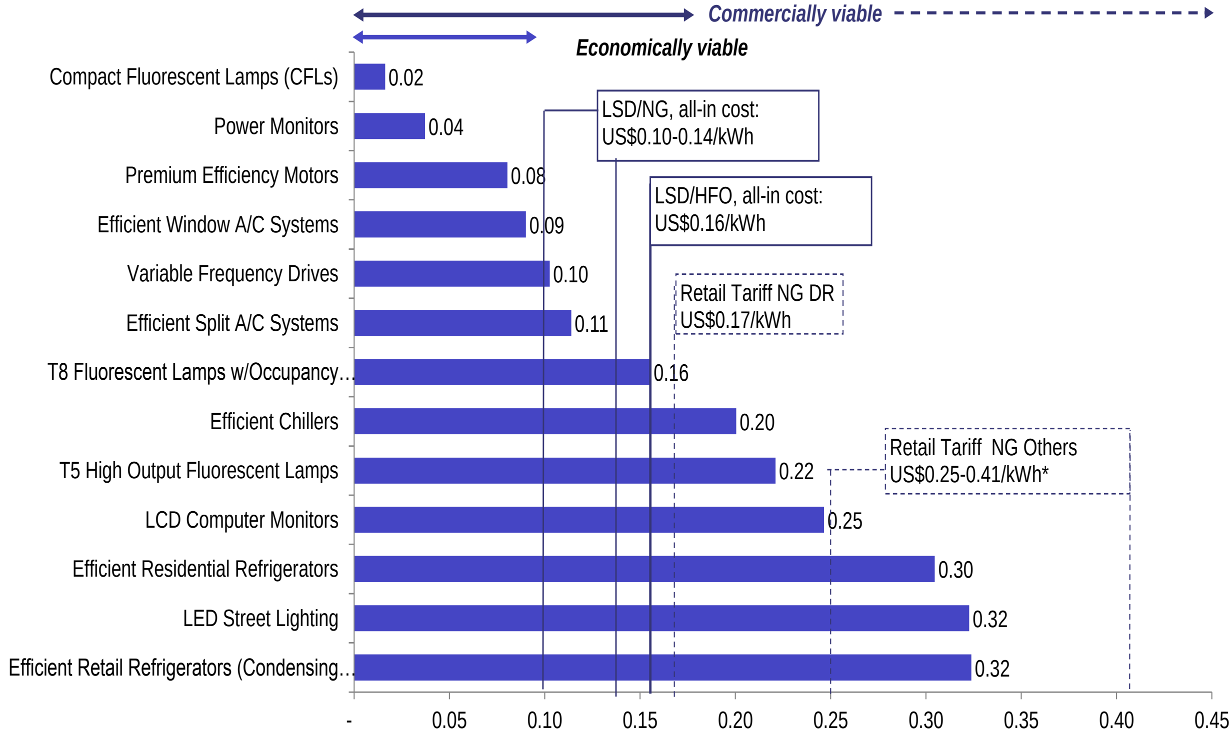
EE Potential



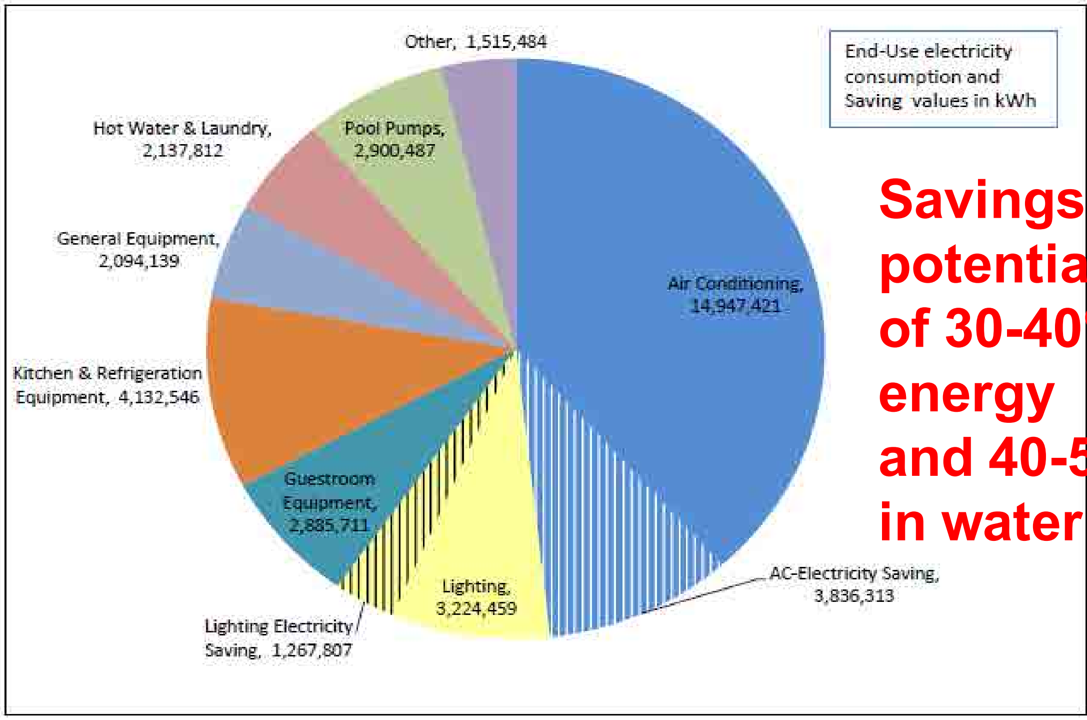
Energy Efficiency potential

EE Cost Curve in Scenario with Natural Gas



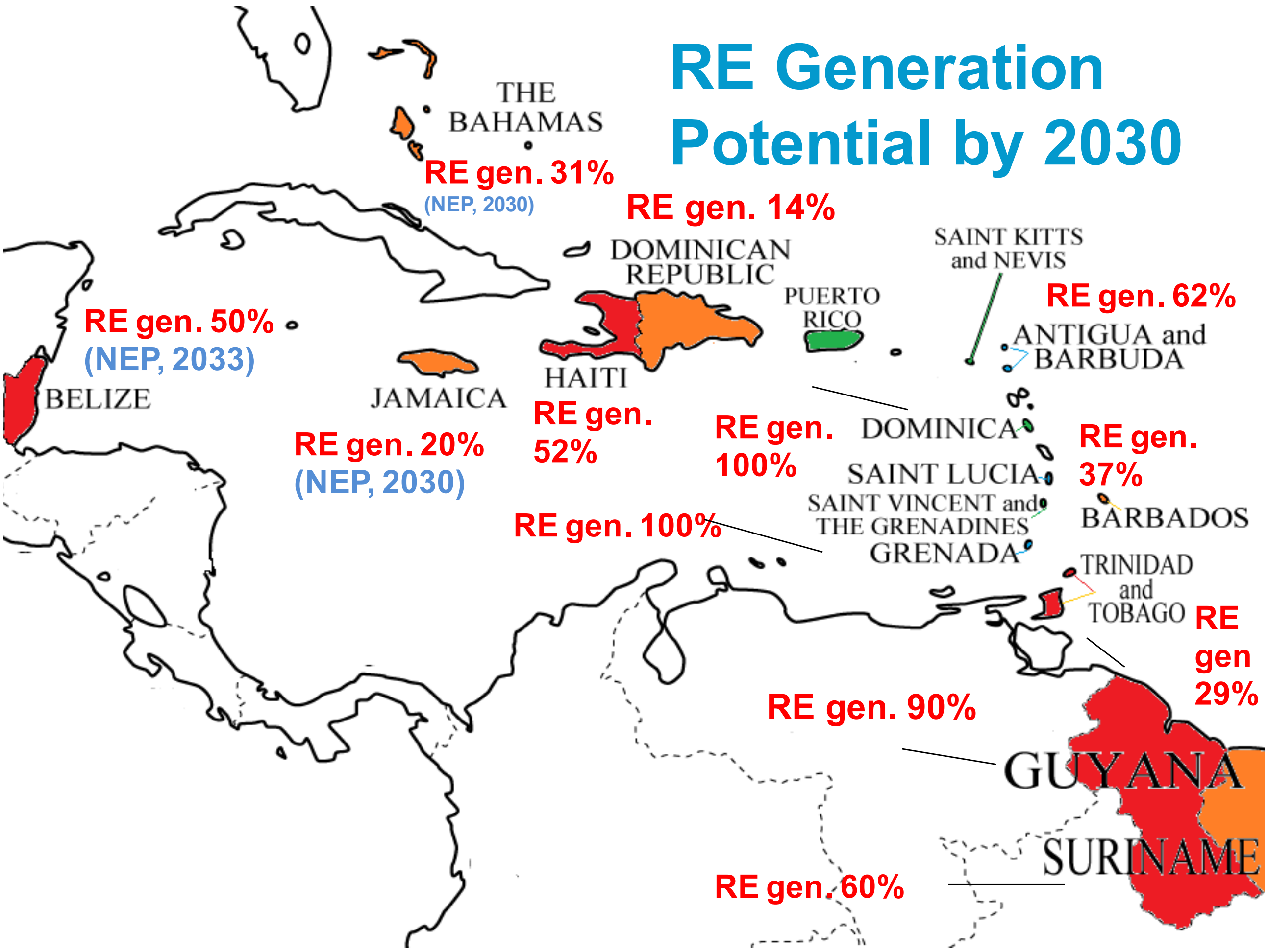
Energy usage by hotels (Results from CHENACT)

Air conditioning and lighting together account for nearly two-thirds of all the electricity consumed in the hotel sector.

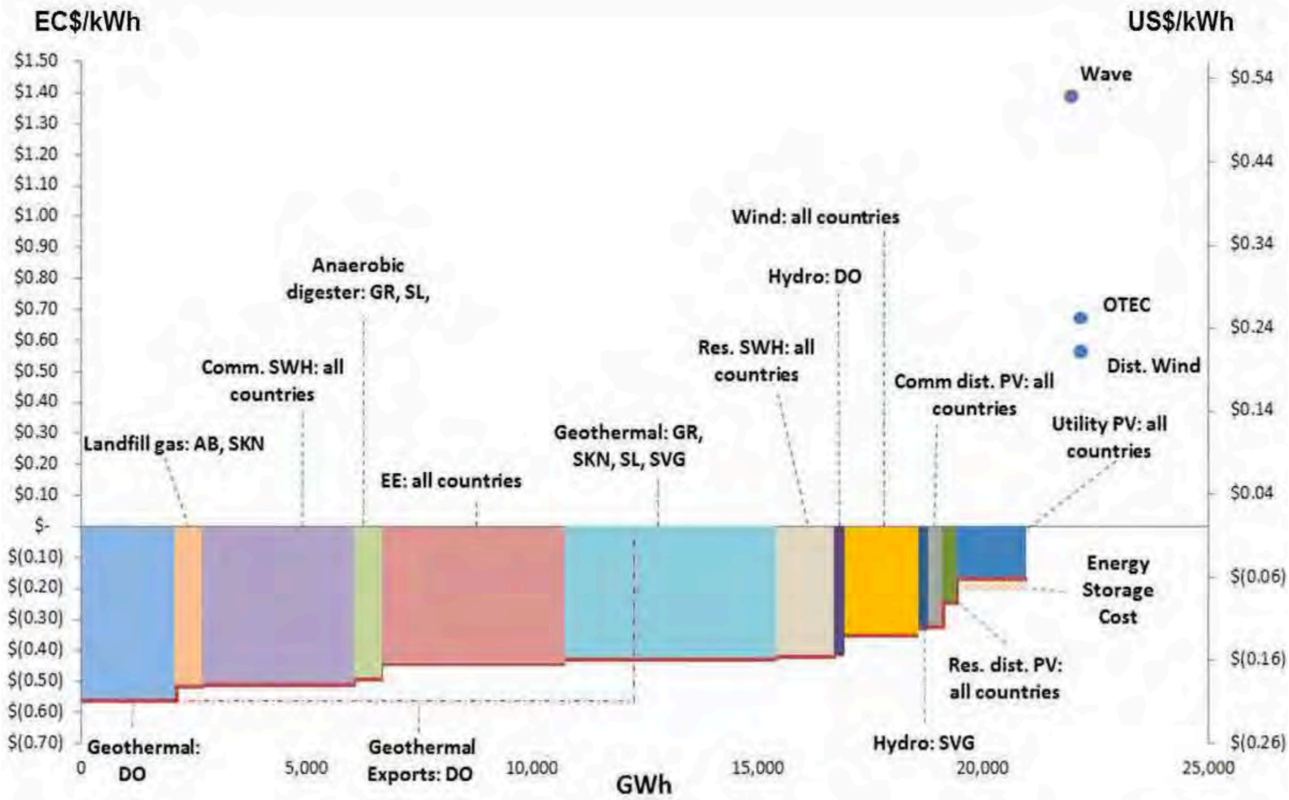


Savings potential of 30-40% in energy and 40-50% in water

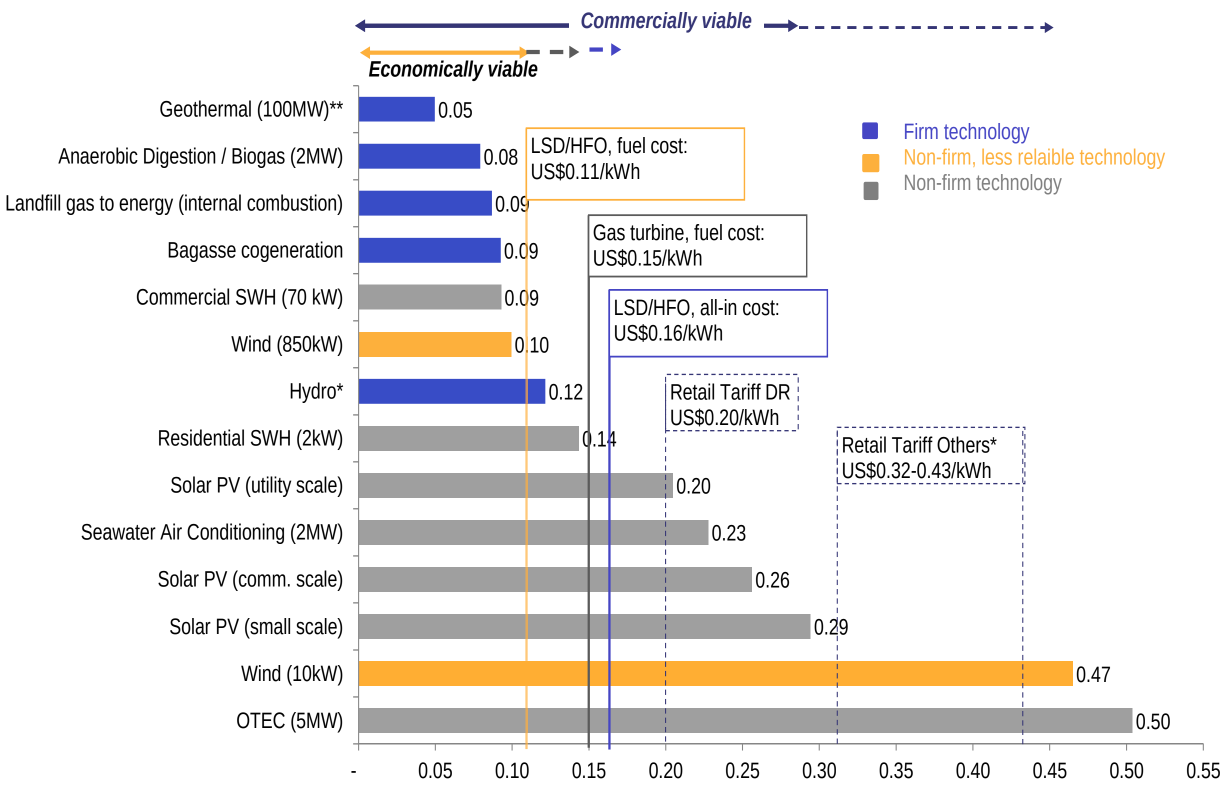
RE Generation Potential by 2030



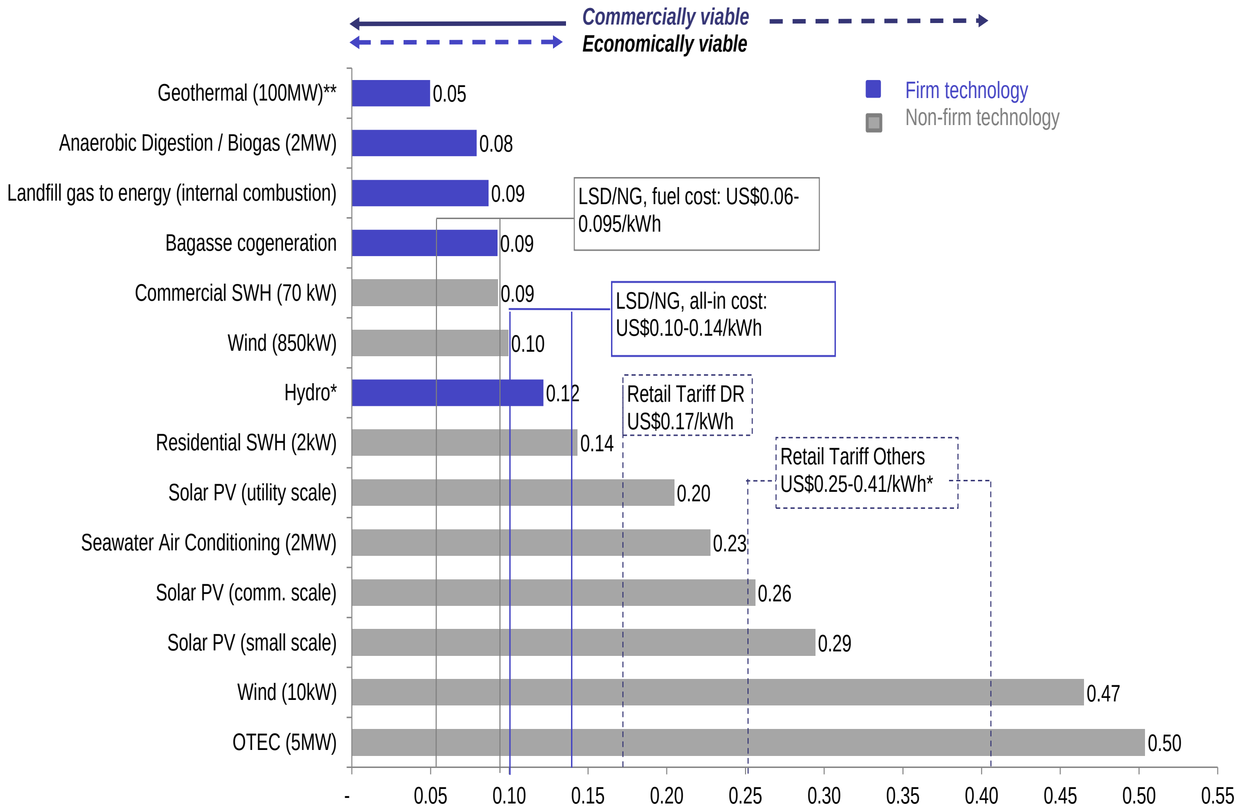
Eastern Caribbean EE and RE potential



Renewable Energy with Fuel Oil



Renewable Energy with Natural Gas

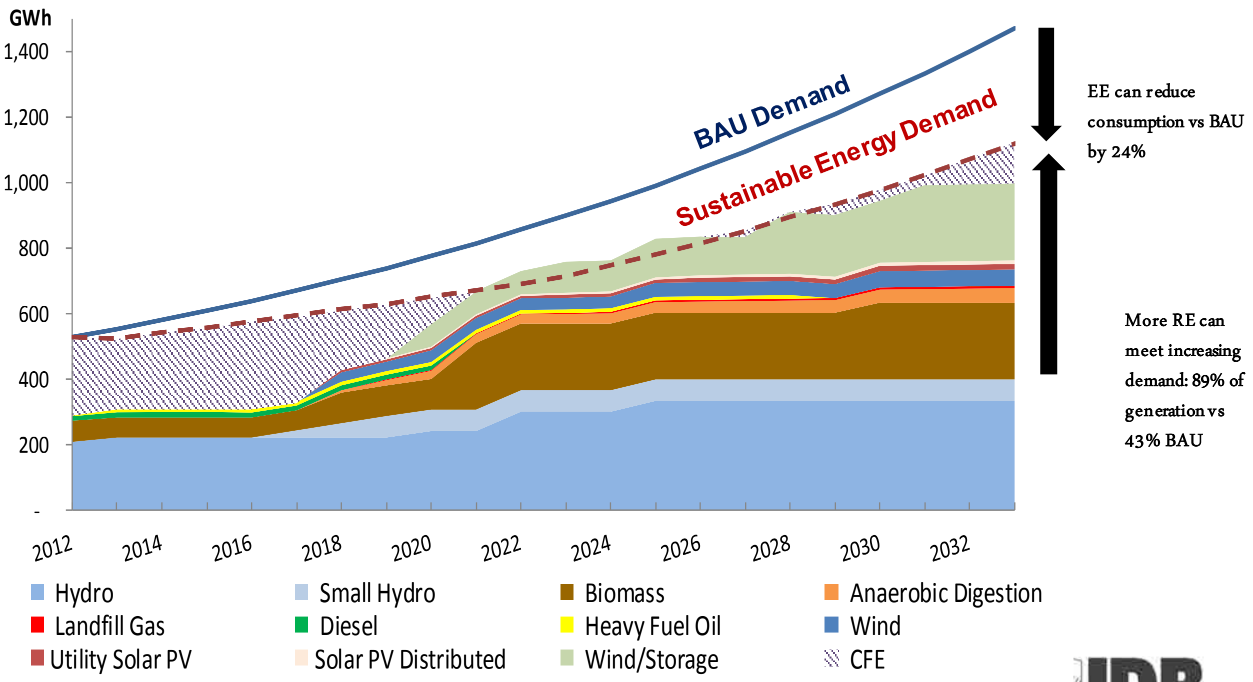


Case Studies

- **Belize**
  - – Interconnection with Mexico
  - – Base load RE (hydro)
- **Barbados**
  - – No interconnection
  - – Limited RE Base load
  - – Intermittent RE available
- **Grenada**
  - – No interconnection
  - – Geothermal Potential
- **Haiti**
  - – 30% access to energy

IDB

Evolution of Belize's energy matrix: EE saves money and increases competitiveness



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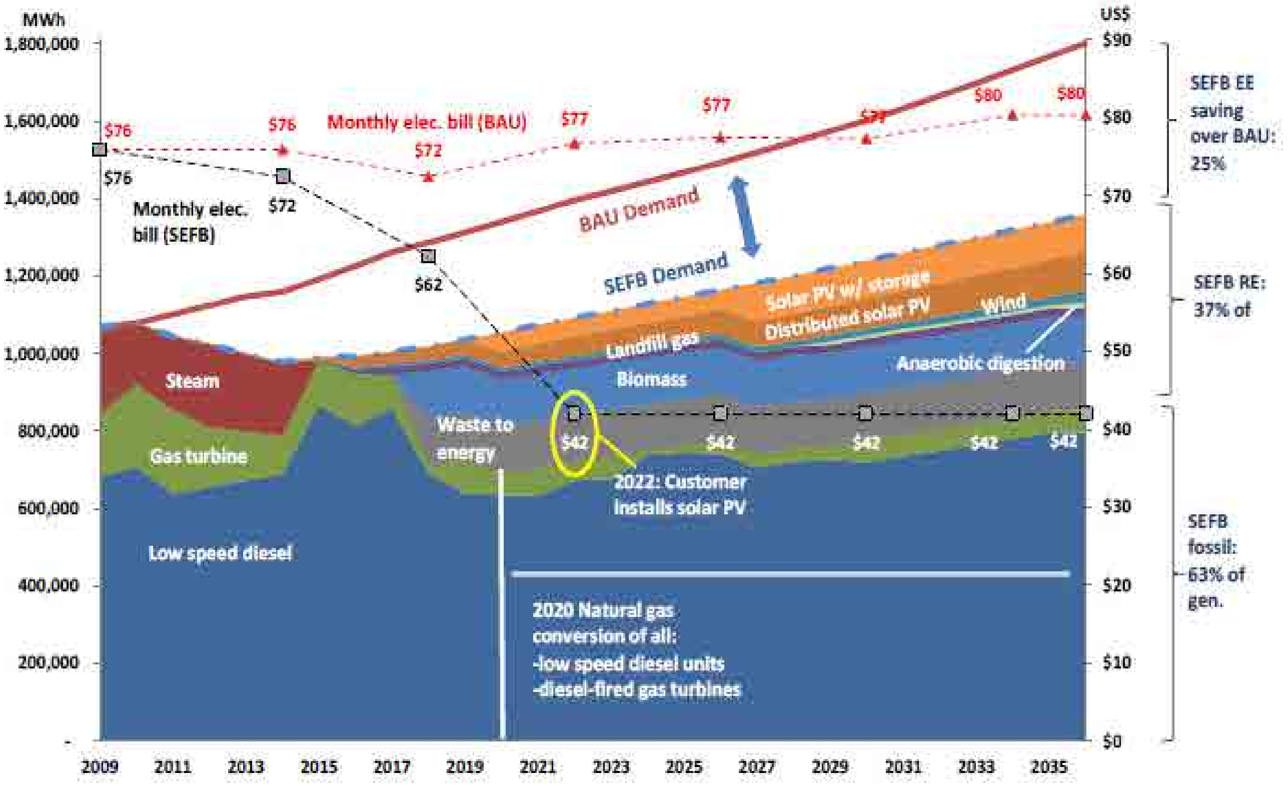
The Case of Barbados

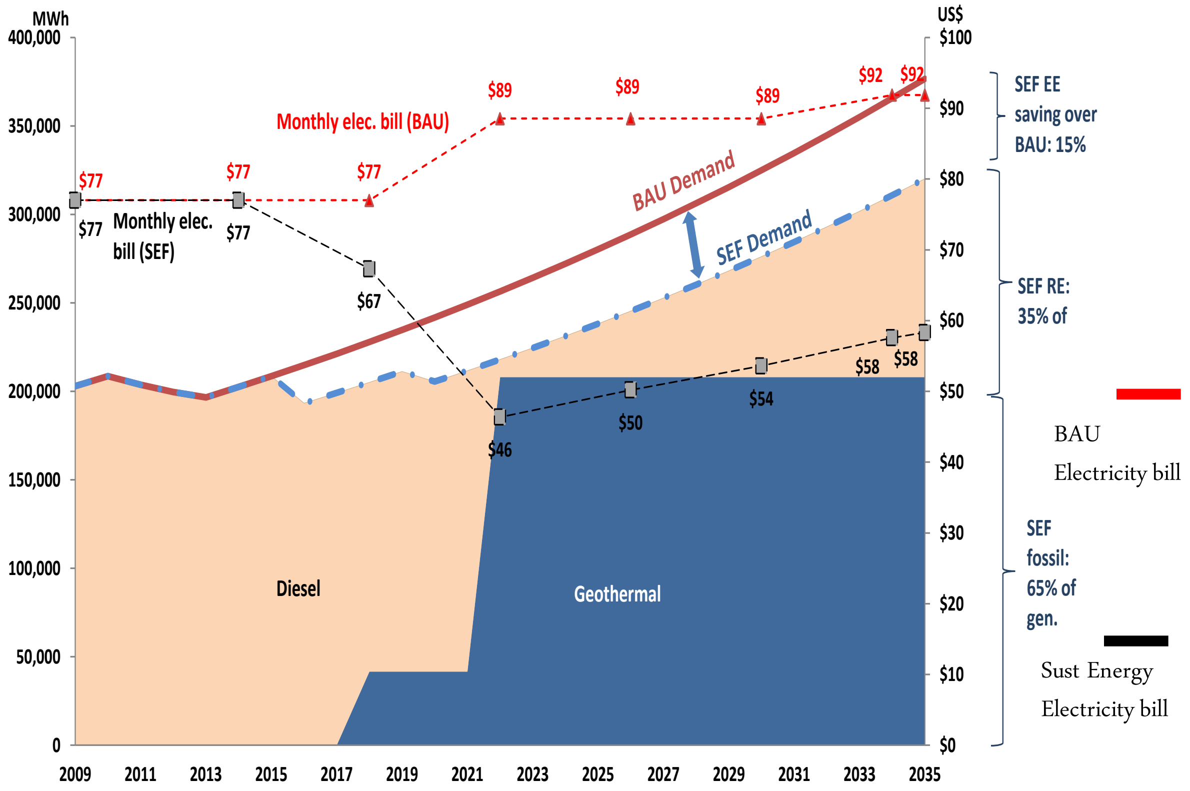
- Studies on RE and EE potential
- Policies and legislation to promote RE and EE (National Sustainable Energy Policy)
- Plans to support RE and EE (i.e. phase-out plan for incandescent lights, safe disposal CFLs, ACs)
- Pilot projects
- Energy Smart Fund (technical assistance and low interest loans to implement RE and EE projects in SMEs)
- Public Sector Smart Energy Program (100% of street light replaced with LEDs, government buildings retrofitted)
- Studies on Ocean Studies and RE in transport

IDB

Barbados



Grenada



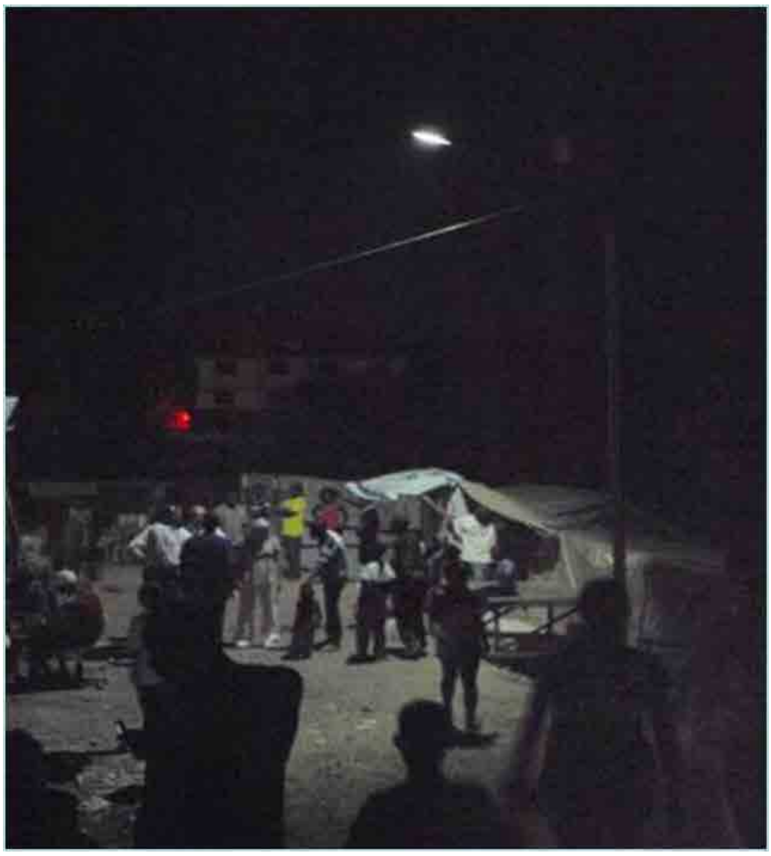
Geothermal potential in the Eastern Caribbean and development status

	Dominica (no export)	Dominica (export)	Nevis (Nevis + St. Kitts)	Grenada (no export)	Saint Lucia (no export)	Saint Vincent (no export)
Plant size* (Realistic potential)	16MW	100-120MW	31 MW	29 MW	51 MW	26 MW
Development status	Production well drilling completed	Exploratory drilling confirmed resource	Exploratory drilling confirmed resource	Surface exploration needed to prove resource	Some exploratory drilling carried out	Surface exploration ongoing

Note: ***=**Plant size that would supply baseload electricity demand in 2023 based on demand estimates. The size of the export project from Dominica is based on media reports on the proposed project size.
Estimated costs do not include costs for any ongoing steps.

Challenges in Haiti's Energy Sector

- Electricity access in Haiti is the lowest in the Latin American and Caribbean (LAC)
  - Over **70% of population** lacks access to electricity
  - 100 solar-powered street lamps in two of the largest camps, Carradeux and Petionville Club



Haiti's Refugee camps Retrofitted with solar PV street lights

Opportunities for the Caribbean part 1

- Review Regulatory and legislative changes to promote diversification
- Promote smart grids in combination with Natural Gas, RE, EE and Energy Storage
- If geothermal is available, develop it!
- Public sector programs to retrofit buildings, street lights and other public dependencies
- Develop Smart Fund programs to promote RE and EE in SMEs

Opportunities for the Caribbean part 2

- Develop Interconnection programs where they may make economic sense
  - St Kitts – Nevis
  - Guadeloupe - Dominica- Martinique
- Explore and pilot RE in transportation - electric vehicles powered by RE sources
- Develop ocean studies and pilot programs, particularly OTEC

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Opportunities for the Caribbean part 3

- Bundling of procurement
  – What would the price obtained per Watt of PV for a regional RFP?
  – Aggregate purchases of common basis energy technologies (i.e. solar, lighting, and A/C)
- Harmonize standards & customs duties to provide preferential treatment to energy related products
- Bundling of carbon emission
  – Example in the tourism sector through the CHENACT program (+1 million tons of CO_2 could be sold)

IDB

Technical & Financial assistance, Training & Capacity Building for the Caribbean energy sector

- CORE Cofinancing program to promote RE and EE in Central America and the Caribbean Funded y JICA (US$ 1 B) and IDB (US$ 300m)
- BRIDGE in Sustainable Energy and ICT Program (Trinidad and Tobago, Jamaica and Barbados), partnering with Gov. of New Zealand, Scotland, GE, and Phillips
- Expand the CHENACT program
- Contribute to achieve the RE CARICOM targets (national and regional)
- Develop EE regional and national targets

IDB

Thank you!

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JAPAN・CARICOM FRIENDSHIP YEAR 2014

Ministerial Joint Statement between Japan and CARICOM

(Tokyo, 15 November, 2014)

1. The Fourth Japan-CARICOM Ministerial-Level Conference was held in Tokyo on 15th November 2014 with the participation of the Minister for Foreign Affairs of Japan and the Ministers of Foreign Affairs and other Heads of Delegations of the Member States of the Caribbean Community (CARICOM). The Minister for Foreign Affairs of Japan, Fumio Kishida and the Minister of Foreign Affairs of Guyana, The Honourable Carolyn Rodrigues-Birkett, served as Co-chairs.

2. On the occasion of the celebration of the commemoration of the Japan-CARICOM Friendship Year 2014, which marks the Twentieth Anniversary of relations between CARICOM and Japan, the Foreign Ministers reaffirmed their global partnership and mutual interests as island nations and low-lying coastal states, which face common challenges, and uphold shared basic values such as freedom, democracy, respect for basic human rights, and the rule of law, and committed to their countries' continued contribution to betterment of the international community. They welcomed the increased level of exchanges in recent years and expressed their intention to keep up the momentum attained during the Friendship Year.

3. The Foreign Ministers also decided to actively follow up the successful First Japan-CARICOM Summit held in Trinidad and Tobago on 28th July 2014, which was co-chaired by H.E. Mr. Shinzo Abe, Prime Minister of Japan, and H.E. Mr. Gaston Browne, Prime Minister of Antigua and Barbuda and Chairman of the CARICOM

Conference of Heads of Government. The Foreign Ministers resolved to strengthen the bond between Japan and CARICOM Member States and to cooperate in various areas related to three pillars: (1) cooperation towards sustainable development including overcoming vulnerabilities particular to Small Island Developing States (SIDS); (2) deepening and expanding bonds founded on exchanges and friendship; (3) cooperation in addressing challenges confronting the international community.

< First Pillar: Cooperation towards sustainable development including overcoming vulnerabilities particular to Small Island Developing States >

4. Recognising that CARICOM Member States, as small islands and low lying coastal developing states, remain a special case for sustainable development in view of their unique and particular vulnerabilities and that they remain constrained in meeting their goals in achieving sustainable development, Foreign Minister Kishida reaffirmed Japan’s intention to actively engage in international discussions concerning vulnerabilities particular to Small Island Developing States. CARICOM Foreign Ministers expressed their concerns over the issue of graduation from concessionary funding based on the narrow measurement of GDP per capita and underlined the importance of expanding this measurement to include a vulnerability index. Foreign Minister Kishida noted that Japan will give utmost consideration to the concerns of CARICOM. The Foreign Minister also indicated that Japan will continue to extend its cooperation towards overcoming such vulnerabilities particular to CARICOM Member States utilising Japanese technologies and expertise nurtured through its similar experience in the fields of disaster risk reduction, countermeasures against environmental degradation, climate change, energy, waste management and fisheries amongst others.

5. CARICOM Foreign Ministers expressed appreciation for Japan’s solidarity and welcomed the fact that Japan has started a field survey in the area of renewable energy and energy efficiency, which is one of the key sectors to overcome inherent vulnerabilities particular to CARICOM Member States, such as their dependence on

imported fossil fuels. They also welcomed other ongoing projects and field surveys to be conducted in priority areas for the Community. CARICOM Foreign Ministers also expressed appreciation for Japan's recognition of the importance of assisting their countries from perspectives other than those based on per capita income, and expressed their expectation for close cooperation in that regard.

6. Reaffirming the importance of assistance through the Japan-CARICOM Friendship Fund, which is Japan's public and private initiative since 2000, the Foreign Ministers decided to continue cooperation by further enhancing the effectiveness of the Fund, mindful of its flexible operation and possible synergy with other assistance programs.

＜Second Pillar: Deepening and expanding bonds founded on exchanges and friendship＞

7. Appreciating the efforts undertaken by public and private sectors during this Friendship Year to promote cultural understanding and realise exchanges at various levels, the Foreign Ministers affirmed their intention to maintain this momentum and to enhance mutual understanding and strengthen the bonds of friendship.

8. Recognising the successful achievement of exchange programmes such as the "Japan Exchange and Teaching (JET) Programme" and the "Invitation Program for Young Officials of the Caribbean Community", the Foreign Ministers reaffirmed the intention to continue people-to-people exchanges including through these programmes.

9. Foreign Minister Kishida affirmed his intention to promote assistance for Japanese language education at the University of the West Indies (UWI), which plays a central role in promoting Japanese language education in CARICOM Member

States, through strengthening cooperation with the Japan Foundation and through the use of Information and Communication Technologies (ICT).

10. The Foreign Ministers welcomed the hosting of the 2020 Olympic and Paralympic Games in Tokyo and expressed their best wishes to the athletes of Japan and CARICOM Member States at the Games. They also welcomed Japan's efforts for the international cooperation scheme "Sport for Tomorrow" programme and affirmed that Japan and CARICOM will work together in fostering friendship and mutual understanding through sports.

11. Highlighting the rich tourism resources that exist in Japan and the significance of this sector to CARICOM Member States, the Foreign Ministers welcomed the participation of CARICOM Member States in the "Tourism EXPO JAPAN" in September 2014 utilising the Japan-CARICOM Friendship Fund, and called for promotion and cooperation in this area in order to increase tourism on both sides.

12. The Foreign Ministers recognised the importance of a mutually beneficial economic relationship. Bearing in mind that stable energy supply and clean energy, as well as Information Communication Technologies are key to economic development in CARICOM Member States, they welcomed investment and interest by Japanese enterprises in such fields. They also recognised that it is important to improve the business environment including infrastructure, capacity building, and affiliated industries in order to enhance trade and investment.

＜Third Pillar: Cooperation in addressing challenges of the international community＞

13. The Foreign Ministers emphasised the need to reform the United Nations Security Council (UNSC) in a way that reflects the geopolitical realities of the 21st Century. In particular, they stressed the need for the UNSC to increase its representativeness,

effectiveness and transparency. Recognising that the positions of Japan and CARICOM on UNSC reform have much in common, they shared the view that they will strengthen their collaboration with a view to converging their positions to achieve concrete outcomes during the 70th anniversary of the UN in 2015.

14. Noting that Japan and CARICOM face common challenges pertaining to natural disasters, the Foreign Ministers reaffirmed the importance of mainstreaming disaster risk reduction in development planning and international cooperation initiatives. They affirmed their active participation in and close cooperation for the Third UN World Conference on Disaster Risk Reduction to be held in Sendai-City, Japan, in March 2015.

15. The Foreign Ministers reaffirmed their continuous cooperation for the achievement of the UN Millennium Development Goals (MDGs) by 2015 and shared the common recognition that the Post-2015 Development Agenda should be, based on the principle of human security, an effective framework to address challenges including disaster risk reduction, universal health coverage and gender equality and women's empowerment. The Foreign Ministers also recognised that it is important to take into account not only elements such as per-capita income, but also inherent vulnerabilities particular to SIDS, including CARICOM Member States, in drawing up the new framework.

16. The Foreign Ministers reaffirmed their intention to continue close cooperation in the field of climate change, including cooperation to develop a Post-2020 framework applicable to all Parties under the UN Framework Convention on Climate Change. In that context, they reaffirmed their determination to achieve a successful outcome at the COP20 which will be held in Lima, Peru, in December 2014. Japan stressed the importance of Climate Change, Disaster Risk Reduction and Health and announced its support to SIDS by training 5,000 'actors' over the next three years at the Third International Conference on Small Island Developing States (SIDS) in

September 2014. CARICOM welcomed Japan's Initiative to address the vulnerabilities of SIDS. Foreign Minister Kishida explained Japan's position to place much value on assistance to SIDS, especially those vulnerable to climate change, and highlighted this position by announcing Japan's Adaptation Initiative at the UN Climate Change Summit in September 2014.

17. The Foreign Ministers shared the recognition that the seas and oceans should be open, free and secure, in accordance with international law including the United Nations Convention on the Law of the Sea (UNCLOS). They further reaffirmed that maritime order must be maintained and that common principles such as the freedom and safety of navigation and overflight, the renouncement of the threat or the use of force, and the peaceful settlement of disputes must be adhered to in accordance with the international law.

18. The Foreign Ministers affirmed, as countries surrounded by seas and oceans and enjoying their resources, the importance of the sustainable use of marine living resources based on the best scientific evidence available and proper management, and they will cooperate to gain wider support in this area.

19. The Foreign Ministers reaffirmed their commitment to nuclear disarmament, nuclear non-proliferation, and peaceful uses of nuclear energy, as well as the success of the Review Conference of the Parties to the Treaty on the Non-proliferation of Nuclear Weapons in 2015. They welcomed the entry into force of the Convention on Cluster Munitions in 2010 and the imminent entry into force of the Arms Trade Treaty, and affirmed the importance of their cooperation towards the universalisation of these treaties.

20. Foreign Minister Kishida explained Japan's determination to contribute even more actively to ensuring peace, stability and prosperity in the international community from the policy of "Proactive Contribution to Peace" based on the principle of

international cooperation, and explained its recent efforts. CARICOM Foreign Ministers welcomed and supported Japan's efforts to contribute to the peace and stability of the world and reiterated their support for the renouncement of the threat or use of force as prohibited in the UN Charter and for the peaceful settlement of disputes. CARICOM Foreign Ministers also reaffirmed the Community's commitment to regional peace through the CELAC Declaration on 29th January 2014, which designates the Caribbean and Latin America as a Zone of Peace, as well as to the Treaty of Tlatelolco, which established a nuclear weapon free zones in Latin America and the Caribbean.

21. The Foreign Ministers, recalling the concerns of the international community over North Korea's continued development of nuclear weapons and ballistic missile programs, strongly urged North Korea to take concrete actions towards its denuclearization and to fully comply with its obligations under all relevant UN Security Council resolutions, and stressed the need for it to abide by the commitments made in the Joint Statement of the Fourth Round of the Six-Party Talks of the September 2005. They also urged North Korea to address the human rights and humanitarian concerns, including the abductions issue.

22. The Foreign Ministers reiterated their commitment to continue working towards the achievement of the objectives mentioned above and to further strengthen their coordination as global partners on issues of mutual concern within the international community. They also stressed the significance of high-level policy dialogues between Japan and CARICOM and reaffirmed their continued efforts to strengthen ties through enhanced communications and improved diplomatic channels.

23. CARICOM Foreign Ministers expressed their appreciation for the warm hospitality and excellent arrangements provided by the Government of Japan for the Fourth Japan-CARICOM Ministerial-Level Conference and their gratitude for the assistance given to date by Japan.