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Economic Commission for Latin America and the Caribbean  
Subregional Headquarters for the Caribbean

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**A STUDY ON ENERGY ISSUES IN THE CARIBBEAN:  
POTENTIAL FOR MITIGATING CLIMATE CHANGE**

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## **ACKNOWLEDGEMENT**

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## ABSTRACT

The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) is seeking to provide support to the Governments of Guyana, Jamaica and Barbados in researching the potential for employing renewable energy technologies to mitigate climate change. This exercise involves the study of different types of renewable technologies and mitigative strategies, with the aim of making recommendations to the governments on the development of their renewable energy sector. The recommendations may also assist in achieving their long-term objectives of reducing poverty and promoting healthy economies and sustainable livelihoods in keeping with the Millennium Development Goals.

Guyana, Jamaica and Barbados each face common and specific challenges in their efforts to adequately define and implement their energy and climate policies, in a way that allows them to contribute to the mitigation effort against climate change, while promoting sustainable development within their countries. Each country has demonstrated an understanding of the global and national challenges pertaining to climate change. They have attempted to address these challenges through policies and various programmes implemented by local and international agencies. Documented and undocumented policies have sought to outline the directions to be taken by each territory as they seek to deploy new technologies to address issues related to energy and the environment. While all territories have sought to deploy multiple alternate and renewable technologies simultaneously, it is clear that, given their sizes and resource limitations, no one territory can achieve excellence in all these areas.

Guyana has demonstrated the greatest potential for hydro energy and should pursue it as their main area of expertise. The country also has an additional major strategy that includes forest credits and the Reduced Emissions from Deforestation and Degradation (REDD) programme. This approach will be brought to the negotiation table in the upcoming climate change meeting in Copenhagen in December 2009. Of the three countries, Jamaica has the only active significant wind farm deployment, while Barbados has a long tradition in solar energy. Each country might then supplement their energy and fuel mix with other energy and fuel sources and draw from the experience of other countries. Given the synergies that might accrue from adopting a regional approach, the Caribbean Community Climate Change Centre (CCCCC) might be well positioned to play a coordinating role.

This focus on renewable energy and biofuels should yield good, long-term results as it relates to mitigation against climate change, and good, short- and medium-term results as it relates to the development of sustainable economies. Each country might also achieve energy security, reduced oil dependence, significant reduction in harmful emissions and better foreign exchange management if they pursue good policies and implementation practices. Human and financial resources are critical to the success of planned interventions, and it will be necessary to successfully mobilize these resources in order to be effective in executing key plans.

## **I. OVERVIEW**

Energy has become central to the Caribbean subregion's existence. Its source may vary, but most of what is done is built around the power produced from it in one form or another. Electricity and transportation are the two most popular applications. Necessity, convenience and luxury have been the drivers of this dependency that does not seem to subside, even in the face of global climate change.

The subregion's response must, therefore, be made in this context. Potential use of alternate and renewable energies to address this challenge is well documented in many journals across knowledge networks, but actual application falls short.

Energy, like any other resource, is something of value with purpose and limitations. It has several costs associated with it, including generation, storage, distribution and ultimate delivery to its recipients. Over the course of history, the face of energy has remained the same, while its uses and sources have been slowly changing.

### **A. CLIMATE CHANGE**

The burning of fossil fuels for energy production, industry, transportation and other specialised applications has been a climate concern for many years. The emissions from these processes are the prime suspects responsible for current global warming trends. Various gases are also believed to be ozone depleting. The production of high levels of Carbon Dioxide (CO<sub>2</sub>) and the steady reduction of vegetation are the result of development and, in this regard, the world's principal economies are taking the lead. The effort to reverse the situation now requires similar leadership. While the major damage is caused by the practices of a few countries, such as the United States which consumes 30% of the world's oil resources, all countries are experiencing climate change and need to respond mainly through mitigation and adaptation.

Vulnerable Caribbean countries have been forced to focus on local adaptation measures to protect their people and develop sustainable economies. There is also the need to focus on the mitigation of climate change. This may address other critical issues such as energy security, oil dependence and foreign exchange management. Measures to address mitigation have started a movement away from non-renewable fossil fuels towards other fuels and sources of energy that are cleaner and more indigenous to the specific countries. The use of alternate and renewable energies is, therefore, critical to any effort to mitigate climate change.

### **B. NON-RENEWABLE ENERGY**

Non-renewable energy sources are those which have a life expectancy although this timeline has not been predicted accurately. This single fact has been the source of conflict and wars in the past and present. The fossil fuel group has certainly been linked to global warming and climate change.

### **C. RENEWABLE ENERGY**

Renewable energy sources are those which are self replenishing and natural, with no foreseeable end to their availability or supply. The non-fossil fuel groups are also referred to as alternate energies, and sources include solar, geothermal, hydro, wave and wind.

## **D. ENERGY SOLUTIONS**

There is a broad scope of energy sources available around the Caribbean. Various renewable and alternate energy technologies have been researched, and a number of them implemented over the years. An understanding of the range of energy solutions is necessary in order to understand their appropriateness for different locations and situations. The associated management processes necessary to fully integrate these technologies into existing systems also requires consideration. A brief description of most of these technologies found around the Caribbean is provided here. These technologies include:

- Biomass
- Biofuels
- Fuel cells
- Solar
- Geothermal
- Wind
- Hydro
- Nuclear
- Biomass

### **1. Biomass**

Biomass is biological material derived from living, or recently living organisms, such as wood, waste, and alcohol fuels. Biomass is commonly plant matter, grown to generate electricity or produce heat.

Wood has traditionally been used to create fire for various purposes, including space heating, material heating, cooking and waste disposal. The technology has moved from the fireplace to the power company. While it is not seen as a major source of power generation, biomass energy initiatives serve as a form of motivation and inspiration for countries to get involved in renewable energy projects.

### **2. Biofuels**

There has been the development of biofuels, which are capable of substituting traditional fuels such as diesel and gasoline. The production process may use different raw materials, such as:

- Crops used to feed humans and cattle
- Crops used to make food-related product, like butter
- Plants not used for food
- Plants not previously used in any significant way

Farmers now have the challenge of determining the purpose for which they are cultivating their plants in an environment where the cost of food is rising, world hunger has not significantly improved over the recent past, and the earth is experiencing more natural disasters and crop destruction than previously encountered. Rising food prices are likely to cause a similar increase in the cost of some biofuels, unless separate capacity and land is utilized to supply the required feedstock demand for energy generation.

The biogas production process harnesses the gases released from waste. On a small scale, it may be suitable for operations in the vicinity of a farm and, on a larger scale, when associated with a waste disposal operation. In the Caribbean, Cuba has advanced the furthest with plans to move from simply flaring methane gas to using it for energy generation. There are also plans for complete solid waste

management facilities in Barbados,<sup>1</sup> Jamaica and in the nearby South American countries of Brazil and Argentina.<sup>2</sup>

### 3. Fuel cells

Another recent technology is the use of the hydrogen fuel cells in vehicles. This has been done in cars, motorcycles and even buses.<sup>3</sup> The technology is very clean and shows great promise in terms of consumption efficiency. Europe is now looking at a wind-hydrogen strategy to determine the cost effectiveness of this hybrid power system.<sup>4</sup> Given the significance of transportation to Caribbean countries and the dependence of the transportation sector on fossil fuels, this advancement in fuels for vehicles would positively affect the current impacts on the environment.

### 4. Solar

The Caribbean is fortunate to have an abundance of sunlight, which translates readily into solar energy. Israel and Barbados have been two of the world leaders in solar water heating, which has been a success story. Many power companies still suffer from the end-of-day power peak, which Barbados has been able to overcome to a large extent. The solar water heater has certainly removed some capacity burden from the Barbados Light and Power (BL&P) and the penetration in homes is one of the highest in the world.

Further advancement is seen in the use of Photo Voltaic (PV) solar panels that may be used to generate electricity utilizing solar technology. The subregion has the capacity to generate solar electricity for its homes, with excess that may be supplied into the national grids. This is being implemented in Germany and other parts of the world.<sup>5</sup> There are also appliances in the business environment that may be operated using solar energy. This is not widespread in the subregion but has been talked about for many years. Solar power lacks the policy and framework support to push it forward. Cost has also been an inhibitor to the natural implementation process that is seen for solar water heaters.

The supply of solar energy greatly depends on location. Other factors, such as poor access to national grids, also increase its attractiveness. Rural areas that are very disconnected from many basic services have been using solar energy for lighting, cooling and pumping. While availability and appropriateness are important, implementation is maximized when it is supported by policy and incorporated into the country's national plan. This has been the experience in Botswana.<sup>6</sup> In Barbados, the BL&P has two implementations feeding into the grid and other Caribbean countries are also working towards their own types of implementations.

### 5. Geothermal

Geothermal is another promising technology, where the heat beneath the earth's surface is utilized.<sup>7</sup> A few Eastern Caribbean countries have invested in significant studies, including Saint Kitts and Nevis, Grenada,

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<sup>1</sup> Solid Waste Management, Project Document, Government of Barbados

<sup>2</sup> Renewable energy potential in Jamaica, ECLAC 2005

<sup>3</sup> INTERNATIONAL JOURNAL OF ENERGY RESEARCH, Volume: 32, Issue: 9, Pages: 783-792  
Published: JUL 2008

<sup>4</sup> INTERNATIONAL JOURNAL OF HYDROGEN ENERGY, Volume: 33, Issue: 13, Pages: 3249-3263  
Published: JUL 2008

<sup>5</sup> Invest in Germany; PVSEC Europe 2008: Germany Solidifies Leading Position in PV Energy Resource Week. Atlanta: Sep 14, 2008. pg. 129

<sup>6</sup> Renewable Energy, Volume 4, Issue 2, March 1994, Pages 179-188

<sup>7</sup> Sierra Pacific Resources; Sierra Pacific Resources CEO Michael Yackira Addresses Clean Energy Summit Energy Business Journal. Atlanta: Sep 5, 2008. pg. 34

Dominica and Saint Lucia. Of these, Nevis shows the greatest promise. Joint ventures are being formed between developers and utilities seeking to build geothermal plants. Heat recovery projects are also being designed.

## **6. Wind**

Wind is the fastest growing renewable energy technology in the world. Many countries in Europe and the United States have vast wind farms generating hundreds of mega watts of electricity. Europe has been a leader in this area with some of the best wind turbine technology resident in Denmark and Germany. Denmark was among the first European countries to support wind electricity in the 1980s. In Germany, the feed-in-tariffs were introduced in late 1990s,<sup>8</sup> and the country is leading the field with exports outstripping domestic implementations. Germany entered the wind power era later than Denmark, but with a much larger public effort. The German wind market grew to 37% of all installed wind capacity in the world during the period 2002 to 2003; however it has since decreased to 14% in 2007. Jamaica and Barbados have both produced wind power and are seeking to expand.

## **7. Hydro**

Hydro power is another available renewable source for the future but is clearly limited to those countries with rivers and waterfalls. The generation process seeks to trap the energy of moving water, using turbines to produce electricity. It is the most widely used form of renewable energy.

## **8. Nuclear**

In the more developed countries, nuclear energy has been a source with great potential. Early on, it proved to be less than efficient and with some risks, however, in recent times, particularly in the United States, it has become quite efficient, with fewer plants producing more energy than previously obtained from all the plants originally built. It continues to be a very efficient source of energy, but the much improved risks still remain a social concern. The process is also known to have harmful toxic and radioactive by-products that are far more dangerous and fast acting than environmental concerns resulting from burning oil. Popularity has, therefore, not rivalled that of oil since errors in dealing with nuclear energy are far more life impacting than with oil. The Caribbean, however, does not have any commercial nuclear capacity and has not shown any great interest. Jamaica has a small reactor at the University of the West Indies (UWI), Mona Campus.

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<sup>8</sup> Renewable Energy, Volume 34, Issue 1, January 2009, Pages 53-64

## II. GUYANA ASSESSMENT

### A. INTRODUCTION

Guyana is located on the South American coast east of Venezuela, north of Brazil and west of Suriname. It is 83,000 square miles (214,970 sq km) in area, 80% of which is tropical forest. Most of its 771,000 inhabitants live in Georgetown and along the east coast. Between 2003 and 2008 GDP grew by 8.8% from US\$27.55 million to US\$31.8 million. Agriculture represents a major part of its economy, with some contributions being made by mining, timber and textiles.

ECLAC is seeking to provide support to the Government of Guyana in researching the potential for employing renewable energy technologies to assist in its efforts to mitigate climate change. This study will examine the different types of renewable technologies and mitigation strategies, with the intention of making recommendations to the government on the development of its renewable energy sector.

The recommendations may also assist in achieving their long-term objectives of reducing poverty, promoting healthy economies and sustainable livelihoods, which is in keeping with the Millennium Development Goals.

### B. GOVERNANCE STRUCTURE

The Government of Guyana has retained the responsibility for energy in the portfolio of the President. He holds all the ministerial responsibilities for policy and national planning. The government has, however, created a quasi-government agency called the Guyana Energy Agency (GEA). This agency works with other ministries, the Office of the Prime Minister and the Public Utilities Commission (PUC) to coordinate the energy portfolio.

Ministries and agencies that play an important role in energy and climate changes are:

- GEA
- Office of the President
- Office of Prime Minister
- PUC

#### 1. GEA

The GEAs mission is:

*“To ensure the rational and efficient use of imported petroleum-based energy sources, while encouraging, where economically feasible and environmentally acceptable, increased utilization of indigenous new and renewable sources of energy.”<sup>9</sup>*

As part of its mandate, there is a specific focus on non-conventional energy management. The relevant published functions and responsibilities are to:

- (a) Research the various energy technologies, both locally and internationally
- (b) Develop a database of renewable energy technologies and disseminate the information, as deemed appropriate

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<sup>9</sup> Guyana Energy Agency, [www.gea.gov.gy](http://www.gea.gov.gy)

- (c) Develop energy conservation programmes
- (d) Conduct relevant renewable energy studies in order to compile information and to recommend appropriate project designs
- (e) Monitor government agencies and private sector renewable energy projects/activities for optimum use, efficiency and cost-effectiveness
- (f) Actively liaise with various agencies in order to promote renewable energy as a clean technology, that will aid in the reduction of greenhouse gas emissions
- (g) Work in collaboration with other agencies, to reduce the effects of climate change and to assist in the development of mitigation and adaptation plans
- (h) Develop renewable energy projects and briefs aimed at attracting financing and investors.<sup>10</sup>

## **2. Office of the President**

A senior advisory function in the Office of the President is to provide guidance at a national policy level, in the area of the environment and climate change. The policy decisions are supported by GEA work and individual ministries. This is true, in general, and specifically for matters relating to climate change.

## **3. Office of the Prime Minister**

The Office of the Prime Minister is responsible for a number of local issues in Guyana. It has principal policymaking and regulatory responsibility for the energy sector, which includes:

- Issuing licenses to public utilities and independent power producers
- Approval of development and expansion plans
- Establishing operating standards and performance targets for Guyana Power and Light (GP&L)
- Electrification of the hinterlands and other rural interior areas.

## **4. PUC**

The PUC is responsible for monitoring and enforcing operator compliance with standards and targets set by the Office of the Prime Minister. As a result, PUC advises the Office of the Prime Minister on these issues. It also determines and approves tariffs charged by public suppliers.

## **C. REPORTED STATUS**

### **1. Generation**

The national electricity utility, GP&L, currently has generation capacity of between 110 MW to 130 MW, and experiences severe problems with reliability. The customer demand often exceeds this capacity and causes several blackouts. In response to this, several businesses in Guyana now have self-generation, which is estimated to be 70 MW.

Over the past decade and a half, the electricity landscape of Guyana has seen some changes both in demand and supply. Table 1 and figure 1 give a view of this in GW hours used and generated in Guyana. Data for 2008 are estimated.

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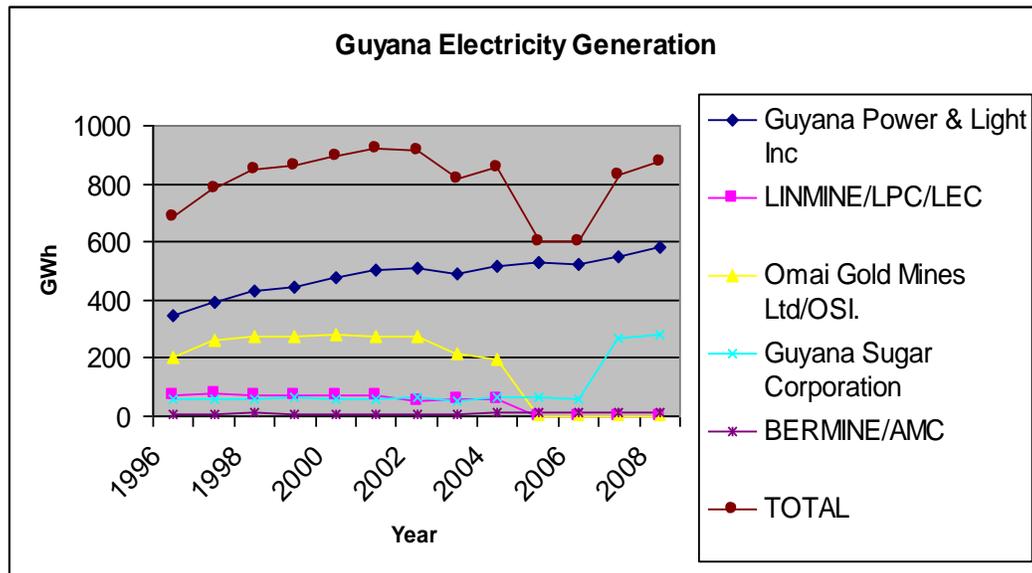
<sup>10</sup> Guyana Energy Agency, <http://www.gea.gov.gy/divisions.php>

**Table 1. Annual GWh used in Guyana**

SUPPLIERS	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Guyana Power & Light Inc	347	390	431	445	477	505	513	488	515	528	525	551	579
* LINMINE/LPC/LEC	74	75	75	69	73	72	54	60	62	0	0	0	0
Omai Gold Mines Ltd/OSI.	200	261	273	278	282	275	276	213	195	0	0	0	0
Guyana Sugar Corporation	57	57	59	64	59	58	67	52	68	62	62	267	280
** BERMINE/AMC	9	4	11	9	8	9	5	6	13	13	13	15	15
<b>TOTAL</b>	<b>688</b>	<b>788</b>	<b>849</b>	<b>865</b>	<b>898</b>	<b>919</b>	<b>914</b>	<b>820</b>	<b>854</b>	<b>603</b>	<b>600</b>	<b>833</b>	<b>875</b>

Source: Guyana Energy Agency and Self generating Companies

Note: \* Linden Mining Enterprise Limited; \*\* Berbice Mining Enterprise / Aroaima Mining Company

**Figure 1. Annual GWh used in Guyana**

Source: Guyana Energy Agency and Self generating Companies

Guyana has been trying to diversify its generation mix. However, there is still a lack of understanding of local needs, demands and potential for technological transfer, among other critical technical areas.<sup>11</sup> Unfortunately, this problem is compounded by a shortage of comprehensive information on new technologies.

## 2. Consumption

The reported composition of the 2008 annual figures for energy consumption in Guyana is shown in table 2.

<sup>11</sup> Guyana's 1<sup>st</sup> National Communication

**Table 2. Categorized 2008 GWh used in Guyana**

<b>Source</b>	<b>GWh</b>
Aviation Gas (AVGAS)	14.165
KEROSENE	271.572
GASOLENE	1234.569
FUEL OIL	1652.933
DIESEL	2705.407
Low Pressure Gas (LPG)	159.626
BIODIESEL	1.616
BAGASSE	2095.178
CHARCOAL	4.642
FUEL WOOD	33.770
RICE HUSK	377.693
SOLAR PV	0.047
WIND	0.000
BIOGAS	0.000
HYDRO	0.000
<b>Total</b>	<b>8551.218</b>

*Source: Guyana Energy Agency*

## **D. CURRENT POLICY**

### **1. Climate change policy**

Guyana has no climate change policy but there is a documented approach. The main strategy for dealing with climate change has been twofold in nature, adaptation and mitigation. With most of Guyana's population living in the capital, Georgetown, and along a 400 km stretch on the eastern coast, a major portion of its population will be seriously affected by climate change. Guyana's response has, therefore, been focused on adaptation and not mitigation.

### **2. Energy policy**

Energy experiences of the recent past, high oil prices and its potential unavailability, have heightened the need for energy security in Guyana. Another pressing factor has been the provision of basic electricity services to isolated and distant communities. Guyana has responded by implementing a number of measures and projects to address these concerns. Based on the energy policy of Guyana<sup>12</sup>, the national goals from 2004 are:

- To provide a stable, reliable and economic supply of energy
- To reduce dependency on imported fuels
- To promote, where possible, the increased utilization of domestic resources
- To ensure energy is used in an environmentally sound and sustainable manner

This led to several projects including, but not limited to:

- Rural electrification

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<sup>12</sup> Energy policy paper for Guyana

- Diversification of energy supply, with emphasis on local inputs
- Development of renewable energy
- Energy conservation and efficiency

These projects have led to the mitigation of climate change, by reducing energy consumption, while generating energy from cleaner sources.

### **3. Generation**

The areas relative to the supply side are:

- Petroleum-based sources
- Renewable and alternate energy sources

Since the emphasis is on reducing the use of imported fuels, replacing such fuels has led to reductions in harmful emissions. In many cases, there have been less harmful substitutes in the form of wood-waste, rice-husk and bagasse. In other cases, substitution has occurred by way of alternate energies and biofuels such as hydro, solar and biodiesel. Guyana's responses are well in line with the terms of reference for the Caribbean Renewable Energy Development Programme (CREDP) study presented to the Prime Minister in 2009.<sup>13</sup>

The existing policy is dated, with a strong bias towards indigenous resources and a reduced reliance on imported fuels. Since this represents a move away from hard fossil fuels, it does support reduced emissions and, by extension, mitigation against climate change. In 1998, the energy mix projected was: indigenous resources 53.7% and imported petroleum products 46.3%. A 26% reduction in the amount of imported petroleum products was forecasted for 2004. However, as of 2008, the use of imported fuels stood at 70% and indigenous resources at 30%. Given the changes in the energy industry and the governmental strategy over the last few years, it is critical that this policy be now updated.

### **4. Consumption**

The key areas relative to the demand side are:

- Electricity consumption
- The sugar industry

Education is being used as the primary tool to promote energy conservation and more energy-efficient equipment, however, there are no specific targets set for the reduction in consumption. Cogeneration is also being implemented in the sugar industry. In recent times, it has been primarily for internal use but additional capacity is being fed to the national grid.

## **E. INITIATIVES**

The Office of the President has recently launched a Low Carbon Development (LCD) strategy as part of its mitigation effort, which is an example of how Guyana is approaching its energy strategy. This effort is being led by the advisor to the president. This LCD strategy intends to use three components to deliver its objectives:

- Agriculture

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<sup>13</sup> Baseline study of energy policies & legislation in selected Caribbean countries 2009-09-07

- Forestry
- Alternate energy

## **1. Agriculture**

The coastal population of Guyana is highly vulnerable to flooding because the nearshore area is below sea level. Since much of the population is already involved in agriculture, the government is seeking to use this to encourage them to migrate further inland. The specific strategy is to link the population's safety to their livelihood.

In the agriculture component, the intention is to expand the boundaries of the useful land and diversify the crops being cultivated. This is expected to build resilience in the sector by targeting and building up small communities. While this is mostly adaptation, there is also a plan to target the efficient pumping of water for irrigation and the use of alternate energies to power the process. This will, therefore, result in mitigation since the plan seeks to implement a low carbon option.

## **2. Forestry**

Since 80% of Guyana is covered by forest and trees are known to be excellent retainers of CO<sub>2</sub>, Guyana is already making a global contribution to the world's emissions problem. Again, the specific strategy being used is to link Guyana's natural resources to the global climate change effort.

The forestry component of the LCD strategy is based on the scientific premise that the forest traps CO<sub>2</sub> and prevents its release into the atmosphere. By preserving forests and implementing sustainable forestry management, Guyana is mitigating further emissions into the atmosphere. Avoidance is, therefore, believed to be a valid strategy for mitigating climate change and has a commercial value, which is being pursued by the country. Support is being mobilized from Belize, Gabon, Congo, Suriname, central Africa, Malaysia and South East Asia. Like Guyana, these countries have vast forests that also trap CO<sub>2</sub> emissions.

Guyana's strategy, to request forest payments based on avoidance, is ambitious and has never been done before. The carbon credit market has not accepted this concept to the point of trading forest credits. It has, however, been accepted into the climate change framework by the United Nations Framework Convention on Climate Change (UNFCCC). The United Nations climate change conference in Copenhagen is seen as an ideal opportunity for Guyana to gain the necessary support at a political level, in order to benefit financially from their forests. Guyana's estimation of the value of its forests, based on avoided forestry and sacrificed economic development of the land post-deforestation, is also under question.

The execution of many of the LCD strategy components is dependent on payments from forest credits and the REDD programme. While the REDD programme focuses on the reduction of these potentially harmful activities, many countries are concerned about the mechanisms that may be deployed to monitor and verify such reductions<sup>14</sup>. With legal deforestation in Guyana already low, there is concern about the value that may be derived from even lower levels of deforestation, based on REDD monitoring.

There is also concern about the ongoing value of a forest that is not being replenished. Sequestration is considered to be of critical importance to forests. Environmental experts suggest that certain types of old trees do not retain their ability to trap and store large amounts of CO<sub>2</sub>. Old trees, thus, need to be harvested and replaced by new trees. As a result, the argument related to reducing deforestation

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<sup>14</sup> A Low Carbon Development strategy –Draft for Consultation

to low levels does not represent a financially sound position, and would fail to create the expected returns both under REDD and forest credits.

There is uncertainty about some components of the LCD programme. However, it is in draft form for consultation and may be refined to better achieve its objectives before December 2009, when the climate change meeting is held in Copenhagen to create a new framework to replace the Kyoto protocol.

### **3. Alternate energy**

The alternate energy component will seek to promote new options and create incentives for those who invest in them. Hydro, solar and wind have been identified as those with the greatest potential for generation in Guyana.

Unfortunately, a national thrust does not exist in the area of transportation. This is related to the view that total emissions from all forms of transportation in Guyana constitute less than 20% of what the forest will retain and, therefore, is not a top priority in the LCD programme. Region 1 is, however, pursuing this option.

The Office of the Prime Minister, GEA and the various line ministries have each embarked on their own strategies out of necessity. Responses include:

- Rural electrification
- Population education
- Use of alternate energy

#### **(a) Solar**

A number of the above-mentioned agencies/ministries have embarked on the electrification of homes and storage facilities in rural areas. These projects almost always sourced support from external agencies like the Canadian International Development Agency (CIDA), the United Nations Development Programme (UNDP) and the Latin American Energy Organization (OLADE).<sup>15</sup> Solar panels have been deployed to provide light by night for children needing to study and other general purposes. They have also been used by the ministries of health and agriculture to power cool storage for medicines and food, and pumping water from wells.

There is a visible 80 KW capacity installed, but the GEA is of the opinion that there may be up to five times that capacity. This assumption is based on everyday conversation and ad hoc informal reports, since there is no central recording point for all installations.

These local initiatives have also been accompanied by a proposal to the Japanese Government to build a 1MW PV farm behind Eccles Industrial Estate, at a cost between US\$5 million and US\$10 million. This project would move PV installations from being supplied individually to supplying a community and, eventually, the national grid.

#### **(b) Wind**

The Government of Guyana and DELTA Caribbean N.V. signed a Memorandum of Understanding (MOU) in March 2007 for the construction of a 13.5 MW Wind Farm at Hope Beach, East Coast

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<sup>15</sup> Wowetta business enterprise community project

Demerara. This project could supply power to the grid, and was expected to be commissioned in 2010. However, a final decision to discontinue the project has been announced by the President.

One study has been completed for the Guyana Water Inc (GWI) treatment plant by UWI, St. Augustine. The main objective was to see whether a hybrid (wind/diesel) power system was appropriate for the Better Hope Water Treatment Plant. The results of the study showed that the hybrid could deliver the required power requirement at US\$0.20 per kWh compared to the GP&L cost of US\$0.29 per kWh. The installed capacity is expected to be 750 MW. Table 3 also shows the summary of investment and operation and maintenance cost.<sup>16</sup>

**Table 3. Summary of investment and O&M Cost in Guyana**

Cost category	BTM Consultant (2008)	Guyana Wind Farm Inc (2008)	Wind Energy-The Facts (2002)	BH HPS
Turnkey Investment cost / kW installed	US\$2119	US\$2670	US\$1690	US\$2119
O & M cost for wind turbine		US\$0.012/kWh	US\$0.022/kWh	
O & M cost for diesel genset				US\$0.26/kWh
Cost of Wind power		US\$0.11/kWh	US\$0.085/kWh	US\$0.20/kWh

*Source:* An investigation into the appropriateness of a hybrid power system for the Better Hope Treatment Plant.

### (c) Hydro

One hydro power study in particular has attracted the main focus of the agencies. The Amaila Falls Hydroelectric project is being completed by Synergy Holdings/Sithe Global Power. Implementation is expected to commence in 2010 and completed in 2014, with a cost of between US\$400 million and US\$600 million. The 154MW plant is expected to feed its power directly into the grid.

The Moco Moco hydro plant was implemented by the Government of the People's Republic of China between 1994 and 1999, and generated 500 KW of power. It was damaged after that time and has not been returned to service because of prohibitive repair costs (US\$430 million).

Collectively, it is estimated that there is a capacity of 7000 MW of hydro power in Guyana. Other studies are shown in Table 4.

**Table 4. Location of other hydro studies in Guyana**

Location	Capacity (MW)
Kato, Region 8	3
Tumatumari, Region 8	1.5
Upper Mazaruni, Region 7	1320
Arisaru, Region 7	120
Devil's Hole, Region 7	62
Turtruba, Region 7	760
Eclipse Falls, Region 1	4

*Source:* Guyana Energy Agency, see <http://www.sdn.org.gy/gea/energydev-hydropower.php>

*Note:* See Appendix B for map of all potential sites.

<sup>16</sup> An investigation into the appropriateness of a hybrid power system for the Better Hope Treatment Plant

#### **(d) Biofuels**

Biodiesel from palm oil is also promoted as a viable option for transportation. An expansion in palm oil production in Region 1 is being implemented to increase the available volume of feedstock for biodiesel production. This plan will facilitate the use of biodiesel by a wider range of customers in that area. This initiative has been well supported by the Institute of Applied Sciences and Technology at the University of Guyana, where a fully functional station exists and rigorous quality assurance testing is executed to ensure a quality biodiesel. This project is a notable mitigative action, since it will reduce the dependence on fossil based diesel in Region 1. Further details may be obtained from a former biofuels report commissioned by ECLAC.<sup>17</sup>

#### **4. Energy efficiency**

The GEA, in its forward thinking, has embraced the notion that efficiency and energy conservation represent the new alternate energy. It has, therefore, embarked on a national education programme to enlighten the population of Guyana. Information may be viewed on the GEA web site at [www.gea.gov.gy](http://www.gea.gov.gy) or on one of their many brochures. They also offer advice on building, appliances, fixtures and vehicles, as related to energy efficiency and conservation.

#### **5. Other solutions**

The Guyana Sugar Company's cogeneration project at Skeldon is also worth mentioning as a mitigation effort. It is expected to provide most of its own electricity, thereby reducing its dependence on electricity from the fuel-based grid.

### **F. DEVELOPMENT REQUIREMENTS**

Guyana now has an overarching strategy that is guiding the path of energy development. As it relates to the use of alternate energies, the focus has been on hydro, solar, energy efficiency and wind energy, to a lesser extent. Several studies have been completed on hydro potential and one significant study on wind potential. Minimal data are available on wind in Georgetown.<sup>18</sup> Given Guyana's climate and physical location, there is little work required to determine the feasibility of solar energy, since it is more or less a certain contributor to any mitigation effort. Solar energy also plays a critical role in the country's adaptation strategy.

Based on the natural physical resources of Guyana, it seems wise to focus on hydro and solar, with wind playing a secondary role, mainly because they have been understudied and underdeveloped. Energy efficiency is an overarching principle that needs to be applied, both on the supply and demand side.

#### **1. Hydro**

The policy for hydro power must seek to:

- Ensure various size studies match specific criteria, for example, small hydro for specific communities
- Select the feasibility studies in a strategic manner
- Conclude studies and make decisions in a timely manner
- Provide appropriate resources to mobilize funding

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<sup>17</sup> Bio-fuels Potential in Guyana

<sup>18</sup> Study of new and renewable energies in Guyana, Chapter 2

- Implement projects with the best fit
- Ensure that training and skills transfer is built into all projects
- Provide institutional support for technical resources
- Develop a centre of excellence for hydro power in the Caribbean

## **2. Solar**

The policy for solar power must seek to:

- Define the strategic target sectors for PV systems
- Continue to progress the PV penetration in the hinterlands and remote areas
- Ensure that various size installations match individual and/or community needs
- Improve intelligence about the penetration of PV systems
- Define sustainable financing options for potential PV users
- Define specific incentives for target sectors
- Explore new areas to utilize solar technologies, for example, solar water heating
- Pursue appropriate solar training to match strategic plans
- Provide institutional support for technical resources
- Establish standards for installations and/or manufacturing
- Coordinate with the other centre(s) of excellence for solar power in the Caribbean

## **3. Wind**

The policy for wind power must seek to:

- Embark on a wider study of wind to assess country potential
- Explore hybrid opportunities with hydro and solar
- Create an environment that attracts key wind entrepreneurs
- Provide institutional support for technical resources
- Continuously assess wind potential in Guyana without any major local investment
- Coordinate with the other centre(s) of excellence for wind power

## **4. Energy efficiency**

The policy for energy efficiency must seek to:

- Continue to promote energy efficiency in the public arena
- Create more strategic target groups for efficiency
- Define sustainable financing options for potential retro-fits
- Define specific incentives for target sectors
- Pursue appropriate efficiency training to match promoted activity
- Provide institutional support for energy auditing and management
- Coordinate with other centre(s) of excellence for energy efficiency

## **5. Biofuels**

The policy for biofuels must seek to:

- Clearly define the sectors to be served
- Develop a long-term plan for feedstock
- Provide institutional support for technical resources
- Coordinate with other centre(s) of excellence for biofuels

## **6. Legal and regulatory**

The legal and policy framework with regards to climate change and energy needs to be further developed. The policy must seek to:

- Ensure responsibilities of a regulator to adequately cover a wide spectrum of energy and climate-related issues
- Provide strong support for the policies of the Government of Guyana
- Prohibit the importation of known inefficient equipment
- Mandate large consumers to do audits and become more energy efficient

## **7. Other areas**

Other fresh initiatives are likely to develop in the future and should be expected. The energy policy must seek to:

- Provide adequate incentives for investors
- Develop organizational structures to facilitate easy prototyping
- Quickly evaluate the feasibility of new proposals

The education effort is present, but needs to be enhanced to achieve its objectives. The energy policy must seek to:

- Deliver more targeted education to the varying levels in the population

### **III. JAMAICA ASSESSMENT**

#### **A. INTRODUCTION**

Jamaica is one of the larger islands in the Caribbean subregion located approximately 145 km south of the island of Cuba, and is roughly 230 km long and 80 km wide at its broadest point. About 60% of the island's bedrock is white limestone, 25% is volcanic and cretaceous, 10% is alluvial and 5% yellow limestone. More than 120 rivers flow from the mountains to the coast. The island has a population of approximately 2.6 million people residing in an area of 10,991 sq km and a coast line of about 1,022 km. The major economic earners in Jamaica are tourism, agriculture, manufacturing and the bauxite-alumina industry.

The spiralling cost of fuel along with burgeoning demand has dramatically increased the costs of fuel imports. The inflationary impacts of rising energy costs have been felt by all sectors of society. The government is, therefore, focused on implementing its national energy policy to mitigate the negative impacts of harmful emissions on the environment, and advance their use of renewable and alternate energies.

ECLAC is seeking to provide support to the Government of Jamaica in researching the potential for employment of renewable energy technologies to assist in its efforts to mitigate climate change. This study will examine the different types of renewable technologies and mitigative strategies, with the intention of making recommendations to the government on the development of its renewable energy sector.

The recommendations may also assist in achieving their long-term objectives of reducing poverty, promoting healthy economies and sustainable livelihoods in keeping with the Millennium Development Goals.

A fundamental element in Jamaica's long-term strategic vision is to have "an energy sector that is environmentally sustainable with significantly increased use of economically viable renewable energy resources while fully protecting the environment".<sup>19</sup> This confirms the country's commitment to take advantage of renewable resources, and promote conservation and efficiency in the use of energy resources amongst all sectors of the society.

#### **B. GOVERNANCE STRUCTURE**

The Government of Jamaica has set up a Ministry of Energy and Mining to retain the responsibility for energy. The work of this ministry supports its 2030 vision and national development plan, particularly national outcome ten which addresses energy security and efficiency.

The government has also recognized the importance of alternate energies and the planning of activities that may impact the country nationally. Key roles are performed by:

- Ministry of Energy and Mining
- Planning Institute of Jamaica (PIOJ)
- Petroleum Corporation of Jamaica (PCJ)
- Centre of Excellence for Renewable Energies (CERE)
- Meteorological Services Of Jamaica (MSOJ)

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<sup>19</sup> Jamaica National Energy Policy 2009-2030

- Office of the Prime Minister Environmental Management Division
- Office of Utilities Regulation

### 1. Ministry of Energy and Mining

The Ministry of Energy and Mining has the dual responsibility of articulating the energy policy and coordinating the monitoring of its implementation. It has as its vision:

*“To create and maintain a sustainable energy environment that encourages investment and competition in the energy sector; provides energy supplies in a safe, secure and cost effective way and facilitates the development and optimization of renewable and alternative energy sources.”<sup>20</sup>*

The mission of the Ministry of Energy and Mining is:

*“To formulate policies, systems and processes to effectively manage the sustainable development of the energy sector in support of economic development and improved standards of living.”<sup>21</sup>*

### 2. PIOJ

The PIOJ is the primary planning agency of the Government of Jamaica. Its role is central to the planning and strategic arm of the government. Its main functions that may impact Jamaica’s response to climate change include:

- Initiating and coordinating the development of policies, plans and programmes for the economic, financial, social, cultural and physical development of Jamaica
- Undertaking research on national development issues
- Collaborating with external funding agencies in the identification and implementation of development projects
- Interpreting decisions on economic and social policy and integrating them into the national development programme
- Assessing existing and projected social, economic and manpower resources, and formulating plans for the most effective use of such resources
- Coordinating national, regional and sectoral development planning and facilitating the consistent and efficient implementation of projects and programmes
- Determining the economic, financial and technical feasibility of new development projects, and coordinating the implementation of ongoing projects
- Being instrumental in conceptualizing investment projects for national development.<sup>22</sup>

The work of this agency often includes providing advice on project selection.

<sup>20</sup> Ministry of Energy and Mining, <http://www.men.gov.jm/vision.htm>

<sup>21</sup> Ministry of Energy and Mining, <http://www.men.gov.jm/mission.htm>

<sup>22</sup> Planning Institute of Jamaica, <http://pioj.gov.jm/StructureAndFunction.aspx>

### 3. PCJ

The PCJ was established by the Government of Jamaica as a statutory corporation, under the Ministry of Mining and Energy, with the exclusive rights to explore for oil, develop Jamaica's petroleum resources, and be involved in all stages of the petroleum industry. This includes the right to negotiate import contracts and the sale of petroleum and petroleum-based products, and the acceleration of the renewable energy agenda. In 1995, the PCJ was mandated to develop indigenous renewable energy resources to prevent adverse effects on the environment, and to assist the government in realizing the goals of the Jamaica Energy Sector Policy.

The PCJ has as its mission:

*To undertake the development and promotion of Jamaica's energy resources and seek, where necessary, business partners through joint ventures with the private sector.*<sup>23</sup>

The PCJ is committed to reducing Jamaica's heavy dependence on imported petroleum to meet their energy requirements. In seeking to diversify Jamaica's energy sources, the Corporation has undertaken a number of projects, some of which are mitigative. These include:

- The construction of hydropower plants
- Solar energy
- Biomass
- Wind energy
- The potential for Ocean Thermal Energy Conversion (OTEC)
- Biofuel research and development (2008 - present)

### 4. Centre of Excellence for Renewable Energies

The CERe is a division within the PCJ. Research and development has formed a major portion of its work since its mandate is to ensure that Jamaica regularly implements new ideas and methods in renewable energy, and to diversify Jamaica's energy base by encouraging a selection of indigenous energy options.

The mission of CERe is to enhance the contribution of renewable energy to Jamaica's energy mix by:

- (a) Bringing focus to the development and diversification of renewable energy sources and technologies;
- (b) Researching, educating, demonstrating new technologies and methods, and collaborating with various energy stakeholders, local and foreign investors and environmental stewards
- (c) Meeting the energy policy goal of 15% renewable energies in the energy supply mix by 2020.<sup>24</sup>

The centre aims to act as a one-stop agency of central coordination to aggressively seek and attract the best technologies and methods to be employed in Jamaica, and the financial and fiscal incentives to increase the levels of investment in renewable energy. The CERe has also become the contact point for the

<sup>23</sup> Petroleum Corporation of Jamaica, <http://www.pcj.com/dnn/AboutPCJ/CorporateProfile/tabid/154/Default.aspx>

<sup>24</sup> Petroleum Corporation of Jamaica, Information on the Centre of Excellence for Renewable Energy, <http://www.pcj.com/CERE.htm>

commercial sectors when they are experiencing energy-related problems. As a result, the organization is often researching practical solution for such queries.

## 5. MSOJ

The MSOJ is a scientific division of the Ministry of Land and Environment that works closely with the Environmental Management Division, particularly on issues dealing with climate change.

The mission of the MSOJ is:

*“To take full advantage of man's present knowledge of weather and climate; to take steps to improve significantly that knowledge and to foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity.”<sup>25</sup>”*

## 6. Office of the Prime Minister Environmental Management Division

The Office of the Prime Minister, Environmental Management Division, has developed a policy on environmental stewardship for government operations. It also has the direct responsibility for implementing this policy. As a result, there are a number of actions that provide mitigation against climate change.

It is hoped that this progressive move on the government’s part will in fact lead to the creation of similar initiatives to be implemented in the private sector, civil society organizations and private homes. The net contribution to the overall objectives can be very favourable if a good response is achieved.

The programmes of the Office of the Prime Minister, Environmental Management Division, promote energy management through energy conservation and efficiency, as well as activities that link environmental protection with economic development (for example, energy efficient lighting, low-flow toilets, etc.).<sup>26</sup>

## 7. Office of Utilities Regulation

The regulatory office has the responsibility for all utilities in Jamaica, including electricity. Their mandate is to provide an avenue of appeal for consumers who have grievances with the utility companies.

## C. REPORTED STATUS

### 1. Generation

The last reported annual figures for energy generation are for 2008 and are shown in table 5. Each source is converted to Barrel of Oil Equivalent (BOE) so that a proper comparison may be made.

<sup>25</sup> Meteorological Service of Jamaica, <http://www.metservice.gov.jm/aboutus.asp>

<sup>26</sup> Environmental Stewardship Policy for Government Operations

**Table 5. Energy generation by source in Jamaica**

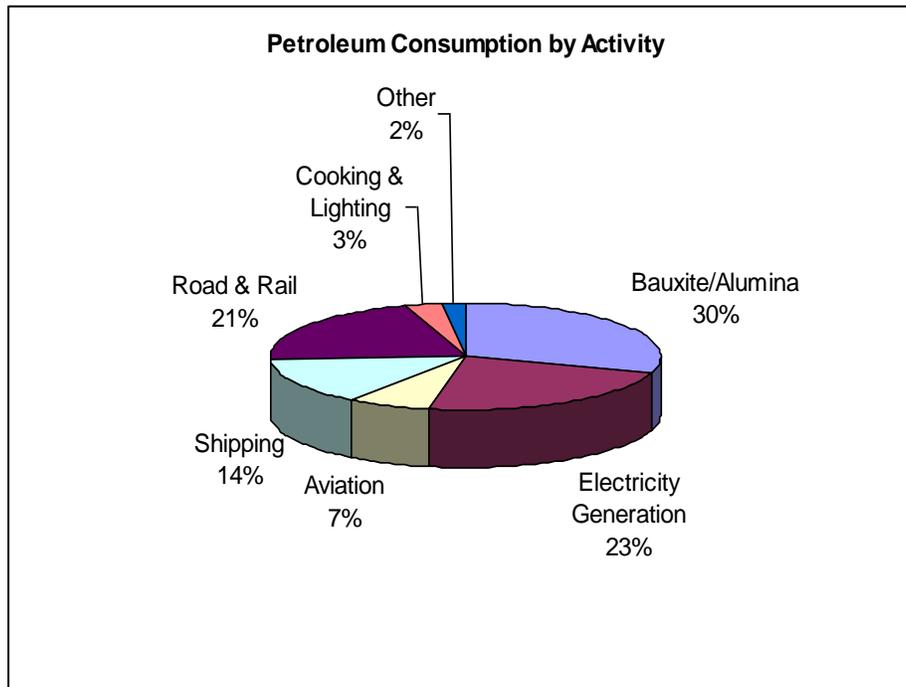
<b>Source</b>	<b>BOE (000)</b>
Turbo fuel	1,599.000
LPG	925.000
Kerosene	18.000
Gasoline	4,295.000
Automotive Diesel Oil (ADO)	3,661.000
Automotive Diesel Oil Bunker	247.000
Fuel Oil	16,372.000
Coal	233.000
Solar	0.000
Hydro	98.000
Wind	31.000
<b>Total</b>	<b>27,479.000</b>

*Source:* Jamaica's National Energy Policy (2009-2030), Ministry of Energy and Mining

The bias toward petroleum products is quite clear. These products provide 95% of the current energy mix, with hydro contributing 4% and wind 1%. This represents a regression, since in 2003 renewable sources represented 7.14% of the energy mix. This has negative implications for Jamaica's foreign oil dependence, energy security, foreign spending and environmental impact. Any strategy that seeks to address petroleum product consumption will, by default, contribute to the mitigation effort against harmful emissions and climate change. For the first time, Jamaica's oil import cost in 2007 surpassed their export earnings of US\$771.3 million. This has further increased the seriousness of the situation in a financial and economical way and requires prudent supply side management (SSM).

## **2. Consumption**

Consumption is dominated by three main sectors; bauxite/alumina, power generation and transportation. Any energy policy that seeks to also address climate change must, therefore, focus on the critical area of demand side management (DSM). Figure 4 gives a representation of energy consumption in Jamaica for 2008.

**Figure 2. Energy consumption by type in Jamaica**

Source: Jamaica's National Energy Policy (2009-2030), Ministry of Energy and Mining

The national electricity utility, Jamaica Public Service Company (JPSCO), currently supplies 90% of the households in Jamaica with electricity. This has replaced fuel wood over time, and significantly improved the standard of living for many Jamaicans. Jamaica produces about 860 MW of oil-based generation.

#### D. CURRENT POLICY

Jamaica has an energy vision of:

*"A modern, efficient, diversified and environmentally sustainable energy sector providing affordable and accessible energy supplies with long-term energy security and supported by informed public behaviour on energy issues and an appropriate policy, regulatory and institutional framework."*<sup>27</sup>

##### 1. Climate change policy

Jamaica has no stated policy on climate change. There are no specific climate change targets for Jamaica even though the country is a signatory to the Kyoto Protocol. Specific targets have been imposed only on developed countries, and their energy policies are linked to, or framed within, the context of climate change. After 2012 when the protocol ends, requirements for all countries are likely to have a different form.

Jamaica has implemented its strategy on climate change through the MSOJ, with contributors from a number of ministries and agencies. It may be possible to create a more focused approach to this critical

<sup>27</sup> Jamaica's National Energy Policy (2009-2030), Ministry of Energy and Mining

issue, however, the existing arrangement does work. The first communication to the UNFCCC has been completed and the second communication is currently being prepared.

## 2. Energy policy

Based on Jamaica's energy policy document, a timely impact on the efforts to mitigate climate change can be expected, as mitigative responses, such as energy conservation and development of renewable energy sources, have been incorporated. These are expected to have economic, social and environmental impacts. Much of this work will depend on a well-equipped functioning governance/regulatory framework. A regulator does exist in the body of the Office of Utilities Regulation, but its mandate and supporting legislation are not adequate.

The government's work is executed within a framework that covers 2009-2030. Seven specific goals have been set in order to guide the process and keep it on track. These are:

- Goal 1: Jamaicans use energy wisely and aggressively pursue opportunities for conservation and efficiency.
- Goal 2: Jamaica has a modernized and expanded energy infrastructure that enhances energy generation capacity and ensures that energy supplies are safely, reliably, and affordably transported to homes, communities and the productive sectors on a sustainable basis.
- Goal 3: Jamaica realizes its energy resource potential through the development of renewable energy sources and enhances its international competitiveness, energy security whilst reducing its carbon footprint.
- Goal 4: Jamaica's energy supply is secure and sufficient to support long-term economic and social development.
- Goal 5: Jamaica has well-defined and established governance, institutional, legal and regulatory framework for the energy sector that facilitates stakeholder involvement and engagement.
- Goal 6: Government ministries and agencies are models/leaders in energy conservation and environmental stewardship in Jamaica.
- Goal 7: Jamaica's industry structures embrace eco-efficiency for advancing international competitiveness and moves towards building a green economy.<sup>28</sup>

The main strategies for dealing with climate change has been based on the understanding that the Jamaican economy is characterized by high energy intensity, low efficiency and is almost completely dependent on imported oil.

The two national strategies employed to achieve the national outcome of "Energy Security and Efficiency" are:

- Diversification of the energy supply (representing SSM)
- Promotion of energy efficiency and conservation (representing DSM)

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<sup>28</sup> Jamaica's National Energy Policy (2009-2030), Ministry of Energy and Mining

The approach adopted to employ these strategies is wide in scope, but with emphasis on specific areas. It supports close collaboration among a number of ministries in order to achieve policy coherence and fulfil national energy goals. This strategy is sure to aid mitigation since it will bring together critical ministries, including those responsible for energy, agriculture, housing, land and environment, water, finance and climate change.

### **3. Shared responsibility**

The Ministry of Energy and Mining holds the primary responsibility for energy and has a number of challenges. There are limited resources available to adequately develop policy, and work with project selection and funding. It is felt that dedicated resources are required to complete, submit and follow up the required documentation to pursue international funds. Funding is available through a number of agencies including the Inter-American Development Bank (IDB), the German Society for Technical Cooperation (GTZ) and the Global Environment Facility (GEF).

The ministry is also challenged with project selection, as on many occasions, international agencies invite Jamaica to join a project instead of creating a project based on Jamaica's needs. The result is that minimum benefit is derived after committing already limited resources.

The ministries responsible for land, agriculture and energy need to make collective decisions about the use of land for growing food crops to be used for biofuels. Similarly, financial support needs to be in place to effect the decisions of the Ministry of Energy and Mining.

### **4. Generation**

The areas relative to the supply side are:

- Petroleum-based sources
- Renewable energy sources

The diversification strategy seeks to reduce use of petroleum products from 95% to 30%, and increase use of renewable sources from 5% to 20% by 2030. Natural gas is expected to enter the energy mix by 2015 and become the major energy source.

### **5. Consumption**

The areas relative to the demand side are:

- Transportation
- Agriculture
- Construction, housing, office, hotels and factories
- Bauxite industry
- Electricity consumption
- Finance

Jamaica's National Energy Policy discourages the use of inefficient and large vehicles, and encourages conscientious use of transportation and the use of clean fuels. It also seeks to reduce water consumption from well-pumping by conservation and the better use of treated water from industrial and other operations. Agriculture currently uses 75% of the country's pumped well water.

Compliance to energy codes and implementation of efficient designs and equipment, along with proper practices, are also proposed. Co-generation is encouraged in the bauxite and sugar industries, to reduce grid dependence and sell excess capacity to the grid, thereby enhancing the availability of clean power.

Education and efficient equipment have been proven to yield some results. There are no specific targets set for savings from efficiency and conservation, however, results from previous programmes show that average household consumption has declined by 18%, from 200 kWh/month to 164 kWh/month.

Financial incentives and fiscal measures are to be used to enable and support investment and development in the energy sector.

## **E. INITIATIVES**

In pursuit of its goals, Jamaica has embarked on a number of projects. These projects help to indicate where Jamaica has been focusing its limited resources and to what extent success has been achieved. Listed below are some key projects. These include projects that target:

- Community-based electrification
- Diversification of energy supply, with emphasis on local inputs
- Developing renewable energy
- Energy conservation and efficiency
- Forestry

These projects have all potentially led to mitigation, either by the use of alternative energy sources with emphasis on renewable energy, or energy efficiency and conservation. Emphasis has been on reducing the use of imported fuels and replacing petroleum-based fuels with energy sources that are less harmful to the environment. However, in some cases projects were in operation only temporarily because of technical problems. In other cases, electricity supplies were pulled out of production for grid use, because of internal demand.<sup>29</sup>

All efforts that move away from using fossil fuels do support reduced emissions and, by extension, mitigation against climate change. Despite a regression in the output from renewable sources and co-generation in recent years, current initiatives and policy seek to rectify the situation and set Jamaica back on track.

### **1. Financing**

The Development Bank of Jamaica initiated a fund for investors and entrepreneurs to develop renewable energy in Jamaica. The intention was to spark interest in renewable energy and encourage persons to start-up commercial operations. While having funds is a necessary step, it is equally important to provide the necessary incentives and wholesale price guarantees to ensure profitability. The government has also offered additional financial incentives, by way of the reduction of duties from 30% to 5% and a zero rating for general consumption tax on renewable energy equipment.

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<sup>29</sup> Jamaica Energy Policy –Annex 1

## 2. Energy efficiency

The PCJ constructed an energy efficient office complex called the PCJ Resource Centre, in Kingston. This centre serves as a model in the national effort to reduce energy costs in buildings. It is a demonstration of efficient building design and efficient equipment.

Demand side projects can often show immediate results with moderate investment. Government has provided exemptions on a number of items, like fluorescent lamps and solar panels, which are geared towards reducing energy demand from the national grid. The research reported in Annex 1 of the Energy Policy has indicated an annual reduction of 28 MWh due to a lighting project which included the replacement of inefficient lamps. A reduction in peak demand by 6 MW to 8 MW was also realized.

Jamaica has also taken the bold decision to take energy education to the primary, secondary and tertiary levels.

## 3. Forestry

Jamaica is also seeking to participate in the REDD programme. While constructing a recent highway, it was necessary to redevelop a mangrove area to accommodate the road. There is a planned project to restore an equivalent amount of mangrove to compensate for what was utilized.

The Forestry Department in the Ministry of Agriculture seeks to manage, protect and conserve their forest resources on a sustainable basis in order to protect watersheds, conserve biodiversity, and to maintain and increase the economic benefits that forests provide. However, there is no focus on the REDD programme as it relates to forests.

## 4. Biofuels

The PCJ commenced a biodiesel experiment at its Fonthill Farm, cultivating a 0.7 acre plot with castor. The reaped seeds are currently being used to plant additional acreages. The PCJ is in the process of sourcing additional feedstock and procuring biodiesel production equipment. Meanwhile its US\$10 million ethanol plant uses Brazilian feedstock and exports to the United States. Further details on biofuels in Jamaica may be obtained from a former biofuels report commissioned by ECLAC.<sup>30</sup>

Jamaica's 10% Ethanol program (E10) was introduced on 1 November 2008 to reduce the usage of Methyl Tertiary Butyl Ether (MTBE) in gasoline. The full-scale rollout of locally produced E10 in gasoline is estimated to save US\$52 million per annum and also reduce harmful emissions.<sup>31</sup>

## 5. Solar

The National Housing Trust provided loans to customers for the installation of solar energy systems. Solar water heater loans were also offered by the Jamaica Public Service and were later discontinued. However, in 2009 there were an estimated 5,000 solar water heaters in Jamaica. Two demonstration systems were installed to service 45 homes in two rural communities.

## 6. Wind

The Government of Jamaica, in partnership with the Kingdom of the Netherlands, has installed a wind farm at Wigton, Manchester, that currently generates an average of 7 MW. It has the unique feature

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<sup>30</sup> Bio-fuels Potential in Jamaica

<sup>31</sup> CERÉ Corporate Plan

of having generated EUR 425K through the Clean Development Mechanism (CDM) process, and another EUR 251K awaiting verification. A smaller 225 KW wind system at Munro College came online in 2006, but has since developed technical problems.

## **7. Hydro**

Six small hydro plants were rehabilitated and now provide 22 MW of capacity to the grid and an additional 82 MW was identified for future projects. When compared to existing generating systems, hydro power projects have traditionally been relatively expensive and, as a result, have been rejected. In more recent times, however, these projects tend to be more attractive. While the capital cost of hydro equipment is still high, higher oil prices now position the hydro operating cost closer to the operating cost of oil-based energy generation, while emitting no harmful gases from the electricity conversion processes.

## **8. Other solutions**

The sugar industry is a prime target for cogeneration. This was actually implemented at Jamaica Boiler's and Jamaico. Baggase was utilized by both companies to produce 12.2 MW and 11 MW, respectively. Of this 23.2 MW, only 6 MW is currently available to the national grid because of discontinuation by Jamaica Boiler's and increased internal demand of Jamaico.

## **F. DEVELOPMENT REQUIREMENTS**

The investment cost to install renewable energy technology is high. The fuel equivalent for the life cycle of the system is essentially purchased at one time. The result is that capacity cost or the fixed sunk costs are high in comparison to a traditional electricity generation system, whilst the marginal costs are negligible as compared with the high marginal costs of traditional electricity systems.

Marginal costs are directly impacted by the volatility in imported fuel costs. Access to low cost capital, in particular foreign investment capital, will be crucial to achieving critical take-up of renewable energy projects.

Jamaica now has a comprehensive policy and strategy for achieving its energy goals. As it relates to the use of alternate energies, it clearly intends to focus on hydro, solar, wind, biomass including bagasse in co-generation, and energy efficiency and conservation.

One of the more visible challenges facing Jamaica is the gap between policy and implementation. There is a framework and strategy that provides a clear path from policy to action plans and implementation. Jamaica has had a number of challenges that mitigate against their efforts, including natural disaster and, most noticeably, financial and human resources.

### **1. Project resources**

Jamaica's response to disaster in recent years has resulted in redirected funds and this has negatively impacted national growth and funds available for the implementation of projects. Its inability to secure adequate funding from international agencies such as the IDB and GEF is due to a dire shortage of human capacity to pursue these funds. It has, therefore, suffered from not having adequate funds to implement projects.

The policy for project selection must seek to:

- Propose a means of securing the required financial resources to implement the project

- Propose a means of securing the required human resources to plan and execute all the various project phases

## **2. Project selection**

The Ministry of Energy and Mining and related agencies are invited from time to time, to participate in externally-funded projects. This invariably requires the commitment of resources for some period of time and may distract from other tasks. Unfortunately, these projects do not always deliver an output of value to Jamaica.

The policy for project selection must seek to:

- Setup specific conditions for resource involvement for any proposed project
- Actively formulate or select projects that deliver against the goals of Jamaica's energy sectors

## **3. Project sustainability**

There have been a number of high potential projects that started in the past, including cogeneration projects, many hydro projects, financing and efficiency schemes. Unfortunately, several were discontinued for different reasons. Cogeneration was discontinued in one case and partially redirected towards internal demand, in another case. Loan schemes were not utilized due to a lack of education, and hydro plants went offline because of technical and maintenance reasons resulting in loss of productive MW power. While six of these were privatized and re-commissioned, there is the threat of losing further capacity.

The policy for project sustainability must seek to:

- Propose systems to keep active MW power up and running
- Propose systems to restore lost capacity
- Maintain databases to record and monitor installed capacity and performance

## **4. Solar**

The policy for solar power must seek to:

- Define the strategic target sectors for PV systems
- Promote PV solutions for the priority un-served 10% of the population
- Improve intelligence about installed PV systems
- Develop sustainable financing options for potential PV users
- Propose more aggressive government incentives
- Explore new areas to utilize solar technologies, such as solar water heating
- Pursue appropriate solar training to match strategic plans
- Provide institutional support for technical resources
- Coordinate with other centres of excellence for solar power in the Caribbean

## **5. Wind**

The policy for wind power must seek to:

- Further explore hybrid opportunities with other energy sources

- Provide institutional support for technical resources
- Create an environment that attracts key wind entrepreneurs
- Develop a centre of excellence for wind power in the Caribbean

## **6. Biofuels**

The policy for biofuels must seek to:

- Clearly define the sectors to be served
- Develop a long-term plan for feed stock or other source
- Provide institutional support for technical resources
- Coordinate with other centres of excellence for biofuels in the Caribbean

## **7. Energy efficiency**

The policy for energy efficiency must seek to:

- Engage utilities in active DSM to promote energy efficiency
- Promote and develop local companies to implement residential and commercial efficiency systems
- Propose more aggressive incentives for target sectors
- Provide institutional support for energy auditing and energy management
- Coordinate with other centres of excellence for energy efficiency in the Caribbean

## **8. Hydro**

The policy for hydro power must seek to:

- Provide appropriate resources to mobilize funding
- Ensure training and skills transfer is built into all projects
- Provide institutional support for technical resources
- Develop a centre of excellence for hydro power in the Caribbean

## **9. Legal and regulatory**

The legal and policy framework with regards to climate change needs to be analyzed effectively.<sup>32</sup> While many actions are being taken, they need the support of not only documented policy but also legislation. Where legislation does exist, there is sometimes the need for enforcement.

While there is no separate climate change policy, at least the energy policy does address the critical issues related to mitigation, using renewable energy sources as substitutes for traditional sources.

The Office of Utilities Regulation currently has responsibility for utilities, but needs to be expanded to adequately cover the wide spectrum of issues that are new or contentious in the emerging energy environment. There is, therefore, a clear need for capacity-building in this area to support the policies of the Government of Jamaica.

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<sup>32</sup> Jamaica 1<sup>st</sup> National Communications

## 10. Other areas

Water conservation needs to be promoted to all end users and within the water utility sector. It is quite common for more water to be lost from leakages in the distribution system than that actually consumed by the end users. This is important to note since the water utility sector is a major consumer of electricity. Their energy requirements are critical to the operation of JPSCO and will impact national planning for the national electricity grid and generation capacity. An anti-leak programme is, therefore, of great importance. According to the energy policy document, agriculture uses 75% of the pumped well water. With such a major portion of the energy consumption being used in this sector, some additional measures are necessary.

The energy policy must seek to:

- Address the water company's distribution inefficiencies
- Make provisions for the use of renewable energies to significantly contribute to the water pumping energy requirement

Jamaica is seeking to install a Waste to Energy (WtE) facility. Interested investors have been invited to partner with the PCJ and the National Solid Waste Management Authority. Such initiatives have the potential to deliver a continuous energy supply to the grid while making waste management more effective and safer. Other fresh initiatives are likely to develop in the future and should be expected.

The energy policy must seek to:

- Provide adequate incentives for investors
- Develop organizational structures to facilitate easy prototyping
- Quickly evaluate the feasibility of new proposals

## IV. BARBADOS ASSESSMENT

### A. INTRODUCTION

Barbados is the most easterly island in the Caribbean subregion. It has a population of approximately 272,000 people and is located in an area of 432 km<sup>2</sup> (166 m<sup>2</sup>). It has limited on-shore resources and only potential untapped offshore resources. Barbados may be defined as a middle-income country with an average annual per capita income of US\$8,500.

The country has transitioned from an agrarian to a service-based economy. Tourism has become the single largest foreign exchange earner, and the sugar cane industry is undergoing fundamental restructuring to survive in a post-preferential market environment.

GDP has increased steadily over the last decade and, concomitant with this, economic growth, energy consumption has increased, exceeding 1,500 kilograms of oil equivalent per capita per year. The spiralling cost of fuel, along with increasing demand, has dramatically increased the costs of fuel imports. The inflationary impacts of rising energy costs have been felt by all sectors of society. The government is, therefore, focused on implementing its national energy policy to mitigate the negative impacts of oil prices and advance its use of renewable and alternate energy.

ECLAC is seeking to provide support to the Government of Barbados in researching the potential for employing renewable energy technologies to assist in their efforts to mitigate climate change. This study will examine the different types of renewable technologies and mitigative strategies, with the intention of making recommendations to the government on the development of its renewable energy sector.

The recommendations may also assist in the achievements of their long-term objectives of reducing poverty, promoting healthy economies and sustainable livelihoods in keeping with the Millennium Development Goals. The energy policy is consistent with the sustainable development policy and the objectives are:

- (a) Ensuring security and stability of supply
- (b) Maximising energy efficiency
- (c) Creating a competitive market
- (d) Achieving environmental sustainability
- (e) Ensuring timely and effective implementation

Objectives (b) and (d) confirm the country's commitment to mitigating climate change.

### B. GOVERNANCE STRUCTURE

The Government of Barbados has retained the responsibility for energy in the portfolio of the Prime Minister and a Minister of State. The minister, who also manages other portfolios, has ministerial responsibilities for policy and national planning. There is, however, a permanent secretary assigned to the minister and a deputy permanent secretary who heads the energy division. The energy division was once a "sister" division to the environment division within a common ministry. They are, however, separate ministries today.

The energy sector in Barbados places emphasis on principles, policies and strategies which encourage development. It is for this reason, that environmental sustainability assumes major significance

in the division's programmes. The government has also recognized the importance of alternate and renewable energy sources. The climate change issue crosses many sectors and, therefore, calls for coordination between multiple ministries and divisions. Key roles are performed by:

- Ministry of Finance, Economic Affairs and Energy
- National Petroleum Corporation (NPC)
- Fair Trading Commission (FTC)

### **1. Ministry of Finance, Economic Affairs and Energy**

The Energy Division in the Ministry of Finance Economic Affairs and Energy has the responsibility for natural resources development, renewable energy and energy conservation, having amalgamated with the Energy Conservation Unit. It is charged with the mandate of:

- Monitoring energy price movements
- Liaising with the Caribbean Community (CARICOM) Secretariat and OLADE on regional energy issues
- Providing geological and earth science-related services to public and private sector
- Monitoring the Barbados National Terminal Company Ltd (BNTCL), the NPC and the Barbados National Oil Company Limited (BNOCL)<sup>33</sup>

### **2. NPC**

The Barbados NPC was established as a statutory corporation with responsibility for the management of the distribution of natural gas in Barbados for domestic, commercial and industrial use. Their mission is:

*To provide and maintain a safe, reliable, efficient and competitive gas service to consumers and be instrumental in carrying out Government's energy policy to improve the quality of life in the community which it serves.*<sup>34</sup>

### **3. FTC**

The FTC is the independent regulator of the supply and distribution of electricity, as well as domestic and international telecommunications services and natural gas. Its Utility Regulation Department currently oversees two utility companies – the BL&P and Cable & Wireless (C&W).

One of the prime functions of the division, in respect of utilities regulation, is establishing principles for arriving at the rates to be charged. The commission is guided by sector policy and seeks to:

- Protect consumers by setting fair and reasonable rates
- Encourage investment by allowing efficient operators to earn a reasonable return on capital
- Promote efficiency in the provision of the utility services

The FTC is also obligated to formulate the policy of market liberalisation and competitive pricing. This involves setting interconnection guidelines, approving interconnection agreements, and resolving disputes among providers of telecommunications services.

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<sup>33</sup> Ministry of Finance, Economic Affairs and Energy, [http://www.energy.gov.bb/\(S\(r55pzbfd4qkcskne5x3rawrg\)\)/Info.aspx?type=energyOverview](http://www.energy.gov.bb/(S(r55pzbfd4qkcskne5x3rawrg))/Info.aspx?type=energyOverview)

<sup>34</sup> National Petroleum Corporation of Barbados, <http://npc.com.bb/aboutus.htm>

It also sets the standards of service that utility providers should offer to the public, and monitors the companies to see whether or not they are maintaining or exceeding these standards. The purpose of identifying standards of service is to create conditions for customer satisfaction by making known the quality of service which the service provider is required to provide, and which the user has a right to expect.<sup>35</sup>

## C. REPORTED STATUS

### 1. Generation

The current annual generation levels of energy are estimated around 1,000 million kWh. This represents an annual increase of about 4% over the past few years. Energy generation is close to 100% fuel oil based. Only 4 KW of energy is generated from solar PV cells. Barbados has a capacity of around 250 MW, with a peak load demand around 166 MW and a base load factor of approximately 75%. There is also a natural gas reserve of 141.4 million cubic metres, with an annual consumption of 29.17 million cubic metres.

The dependence on petroleum products is almost complete. In a country with very limited fossil-based resources, this has serious and negative implications for foreign oil dependence, energy security, foreign spending and environmental impact. Any strategy that seeks to address petroleum product consumption will, by default, contribute to the sustainability of Barbados and its mitigation efforts against harmful emissions and climate change.

### 2. Consumption

Fuel oil consumption is dominated by two main sectors: power generation and transportation. Any energy policy will need to focus on the DSM along with SSM. Table 6 shows the energy demand or consumption distribution by sector.

**Table 6. Energy consumption by sector in Barbados**

<b>Users</b>	<b>% Consumption</b>
Transportation	50%
Electricity Generation	33%
Manufacturing	5%
Other	12%

*Source: Author*

Of the electricity generated (33%), domestic consumption is the major sector at 34% while the commercial sector is the second largest consumer with 23%. The BL&P national electricity utility is responsible for 74% of the CO<sub>2</sub> emissions and transportation accounts for 14%.

The BL&P services almost 100% of the households in Barbados. There are a few small communities of Rastafarians who live in more remote areas and do not wish, or are unable to acquire, a BL&P electricity service. There are less than 10 individual households that engage in micro-generation using primarily solar technology. These households have a positive effect on the environment and certainly are mitigating climate change. A few commercial properties also do micro-generation, using diesel generators. In these cases, there may be only minimal financial savings initially and most likely a negative impact on the environment.

<sup>35</sup> Fair Trading Commission of Barbados, <http://www.ftc.gov.bb/>

## **D. CURRENT POLICY**

Barbados is aiming to have renewable energy account for 30% of the island's primary electricity by 2012. However, due to the high price of fuel imports, it is trying to achieve this target earlier by expanding the number of sources of renewable energy, which will include wind energy and biofuel from sugar cane.

While electricity generation is close to 100% fuel-based, bagasse and solar water heaters contribute 15% of the island's primary energy supply, and are used for heating and cogeneration for internal purposes.

### **1. Climate change policy**

There is no official policy document on climate change. There is also no specific climate change target for Barbados even though the country is a signatory to the Kyoto Protocol. There is, however, a dated draft policy document that has not been improved. Further work and consultation is expected when resources become available.

The Ministry of the Environment is the lead ministry with responsibility for climate change responses, however, the process depends on inputs from various agencies. It may be possible to create a more focused approach to this critical issue if committed staff is provided. The first communication to the UNFCCC has been completed and the second communication is yet to commence.

### **2. Energy policy**

The Barbados energy policy document is set in a framework of sustainable development and seeks to maintain perfect alignment with its strategy. It is expected to impact climate change since it has incorporated mitigative responses, such as energy conservation and development of renewable energy sources. The policy is also expected to impact Barbados economically, socially and environmentally. It reflects the inputs of the major stakeholders and is accessible to all.

The following energy policy objectives have been adapted from these principles:

- (a) The provision of adequate and affordable energy to all sectors of society, as a prerequisite for a decent quality of life
- (b) Maximising the efficiency of energy use in production, conversion, storage, distribution and end-use
- (c) Reduced dependence on fossil fuels, with more emphasis on renewable energy technologies as the primary energy sources
- (d) Use of an integrated mix of regulation and economic and market-oriented approaches to promote competition within both the petroleum and electricity sectors, and to promote best industrial and environmental practices
- (e) Promotion of research and development in energy efficiency, oil and gas exploration and renewable energy technology
- (f) Increased exploration for oil and gas resources, and usage of found resources in such a manner as to ensure at least 50% transfer of known reserves of fossil fuels to the next generation
- (g) Increased private sector participation in a competitive energy sector.

Energy efficiency is being promoted by encouraging the purchase, and use, of energy efficient technologies and conservation. The government's vision of "Green Economics" is being promoted in hotels, businesses and larger institutions. Initiatives in these sectors include incentives to:

- Manage/minimize solid waste - promote recycling and separation
- Promote "Green" building techniques and standards
- Use alternative fuels/renewable energy
- Purchase "Green" products i.e. solar pumps, solar lights, composters; water-storage/ saving devices
- Effect energy conservation in the public sector

The government has also committed to:

- Implementing economic incentives to promote energy conservation, efficient energy use and promoting renewable energy sources
- Introducing standards for efficient energy use in technologies
- Encouraging the large-scale generation of energy using renewable sources
- Promoting research and development into renewable energy
- Implementing disaster management initiatives to mitigate against climate change.

An essential aspect of the efforts to achieve other goals, particularly the reduction in poverty, is increasing the availability of energy that is affordable, economically viable, socially acceptable and environmentally friendly. Under the reform of the sugar industry there was a plan to produce approximately 14.7 million litres of ethanol annually to meet that requirement. This would significantly reduce the emissions from vehicles and further mitigate climate change.

Lead as a fuel additive was phased out in 1999 and replaced by MTBE. This is now to be replaced by ethanol. The level of ethanol content in the gasoline is proposed to start at 10%, which requires no modification to engines, and will be progressively increased over the 20-year design period. Recognizing that ethanol can be used in the production of biodiesel, the government has pledged to encourage further investment in ethanol production. The government also supports the introduction of Ultra Low Sulphur Diesel (ULSD) into the local market. This will hopefully lead to the development of a local biodiesel industry. Given the changes the energy sector has undergone, it may be necessary to revisit the energy policy to revise the national targets.

### **3. Shared responsibility**

The shared responsibility approach has been adopted to deliver a climate change policy document. This will promote closer collaboration among a number of ministries in order to develop a sound document, with a foundation on which to develop strategies and plans to fulfil national goals and global obligations.

The Division of Energy has, for the past few years, developed its own energy policy. However, the Ministry of Environment has had some challenges in delivering a climate change policy that adequately addresses all the issues related to Barbados.

### **4. Generation**

The areas relative to the supply side are:

- Petroleum-based sources

- Renewable energy sources

The diversification strategy seeks to reduce petroleum products used in electricity generation from almost 100%. Renewable energy sources are expected to form 10% of the primary generation mix by 2010 and 20% by 2026. Diversification of the fuel mix will be further achieved by a transition to natural gas as the primary fuel. It is anticipated that the fuel mix will be 70% natural gas by 2026.

The government is leading the way with public sector installations of renewable energy projects involving wind and solar energy. It is expected that proving the technology and displaying it to the public will result in a greater confidence in these new technologies and an increase in private installations.

## 5. Consumption

The areas relative to the demand side are:

- Transportation;
- Productive sectors;
- Water consumption;
- Finance

The energy policy seeks to develop a more effective transportation system and introduce vehicles that use cleaner fuels, such as ethanol and natural gas.

The energy policy has also identified a study of DSM, which estimates potential saving between 14% and 17%, if it is applied. This is supposed to be achieved through education and the use of energy-efficient equipment. The government has done several audits and is hoping that the private sector does likewise. This will establish a foundation for improving energy consumption and creating energy efficiency.

The government has also recognized the importance of water distribution to energy use in Barbados. As the primary user of electricity, the Barbados Water Authority (BWA) is central to any future planning on the national electricity grid. The BWA is, therefore, focused on reducing water wastage through leaks in the water distribution network, and encouraging home owners to conserve water.

Financial incentives and fiscal measures are in place to encourage residential and commercial users to invest in renewable energy and energy efficiency. Tax allowances and reduced duties and import taxes have been offered.

## E. INITIATIVES

Barbados has pursued a number of projects in its quest to achieve its goals. These projects help to indicate where Barbados has been focusing, and to what extent success has been achieved. Listed below are some key projects. These include projects that target:

- Diversification of energy supply
- Developing renewable energies
- Energy conservation and efficiency
- Transportation fuel efficiency

All of the areas targeted above contribute to the release of harmful emissions because Barbados is almost 100% fossil-based in its electricity generation. Efforts have, therefore, supported the reduction of emissions and, by extension, mitigation against climate change. Despite some regression in the output from renewable energy sources, current initiatives and policies demonstrate a commitment towards achieving national objectives.

### **1. Financing**

The Government of Barbados has implemented a number of initiatives over the past years to stimulate the use of renewable energy. For many years, residents were granted a tax allowance on the purchase cost of a solar water heater. This has led to one of the highest solar water heater penetrations in the world. In recent years, commercial businesses have also been given a 150% tax break on retrofit work on their offices. However, this has not yielded the desired results. Tax allowances have now been extended to energy audits.

A special fund of Bds\$10 million was made available to the tourism sector to conduct audits, but was, unfortunately, not utilized by the industry. Most government ministries have also been allocated funds to install retrofits and implement other cost-saving measures. The government has also offered additional financial incentives by way of the reduction of duties, to as low as 5%, on renewable energy equipment. There needs to be improved communication with the commercial sector if a better response is to be achieved in the future.

### **2. Energy efficiency**

The government has commissioned audits on many of its major buildings, both government owned and leased. As a result, those ministries and others have undertaken measures to reduce energy consumption.

Two IDB projects are currently underway to examine efficiency in the tourism sector and energy sustainability in Barbados. It is also to the government's credit that a few of their recently built properties have a high level of energy efficiency built into their design and fixtures.

The local utility, BL&P, has been promoting conservation and efficiency in homes for over two decades and it has reported that residential consumption decreased in the last year by a fraction of 1%. Even though this is not significant, it is hoped that this decline represents a trend that holds for the future. There are, however, no direct interventions being made by the utility company in this area.

There is a clear acknowledgement that the most efficient watt is, indeed, the one not used. DSM projects are, therefore, seen as critical to the multifaceted approach that has become a hallmark of the mitigation effort. This area also promises the most immediate results from only moderate investment.

### **3. Biofuels**

The Division of Energy has just recently requested bids to set up small biodiesel systems as prototypes. There is no intended capacity to make a difference to the transportation mix, but it represents entry into this area and is, therefore, seen as useful.

The production of ethanol is reported in the Barbados policy document as critical to the transportation industry and with great potential to replace MTBE in gasoline, thereby reducing the amount of fossil-based and harmful fuels in vehicles. To this end, there was a plan to build a sugar cane factory that would produce ethanol and energy, along with the usual sugar cane products like sugar and molasses. This project was subsequently put on hold due to lack of funding.

There was also a joint local and foreign ethanol venture proposed last year. Its construction was, however, not approved by Town and Country Planning for the requested location.

#### **4. Solar**

The solar industry continues to be the most interesting one in Barbados. Solar water heaters have continued to feature prominently with steadily increasing penetration into the market. It is a characteristic of almost every new residence, however, many existing households still need to convert. Financing was identified as one issue, but competition has become quite fierce in the last few years with new entrants into the market. The reduction in peak demand continues to be a benefit to BL&P. While a number of hotels use solar water heaters, there are still quite a few which do not. Again capital cost has been a key factor since it is widely accepted that solar water heaters yield significant monthly savings.

Some local residents have used PVs with good results. Cost, however, continues to be the greatest barrier to PV penetration. The Barbados climate, with year-round sun, supports the use of PVs. BL&P has installed two small 2 KW systems that feed into the grid. The government has also installed a few systems in the past to provide ice for fishermen but failed to adequately maintain them. However, a model solar house in Queen's Park, Bridgetown, was successfully built. This house effectively demonstrates the use of PVs and the effectiveness of energy efficient designs. There is an ongoing project to install 16 KW of capacity at the Ministry of Transport and Works, and an existing request for another 11 PV systems to be installed this year.

The rate of growth in this area is dependent on falling market prices for PVs. Given the pioneering experience of Barbados with solar water heaters, the local available skills and the climate, there is likely to be a sustainable push in this direction.

#### **5. Wind**

A feasibility study was carried out to build a wind farm in the north of the island. The BL&P has indicated that it would have the capability to generate as much as 26 million kWh annually. Given the current price of fuel imports, the installation could save close to Bds\$5 million a year. Despite BL&P's efforts, the project was not continued because of social hindrances. As a result, an agreement is being sought with the surrounding residents. Government has issued a tender for 11 wind systems to be installed this year.

#### **6. Hydro**

There is no hydro potential in Barbados since there are no suitable sources such as rivers and waterfalls.

#### **7. Other solutions**

A major WtE project is being undertaken. It will effectively extract methane from the landfill and burn it to produce energy. It is expected to feed 1000 KW to 2000 KW of power into the grid. BL&P also plans to construct an 80 MW generation plant at Trents, St. Lucy, capable of using natural gas.

The BWA has, for the last few years, been searching for leakages in order to save water and energy. Success has been achieved but it is an ongoing process. The BWA has also been partnering with the IDB to perform energy audits on their pumping operation, with a view to making it more efficient. Government is also keen to examine the feasibility of using alternative energy sources for its pumping requirements.

## **F. DEVELOPMENT REQUIREMENTS**

Investment costs remain high for the installation of renewable energy technology in Barbados. However, because of its almost 100% dependence on oil for electricity generation and its lack of fossil-based resources, it is imperative that it embarks on a progressive programme to utilize other sources of energy. This creates the added value of reducing the national carbon footprint and mitigates climate change. Barbados has assessed its situation accurately and has developed a comprehensive policy and strategy for achieving its energy goals. As it relates to the use of renewable energies, it clearly intends to focus on solar, wind, WtE and energy efficiency.

While there is no approved climate change policy, the energy policy does address critical issues related to mitigation using alternate and renewable energy sources as substitutes for traditional sources.

### **1. Project resources**

The gap between policy and implementation is also large. There is neither framework nor strategy that provides a clear path from policy to action plans and implementation. One limitation is the lack of resources assigned to execute the energy mandate. Barbados has managed to mobilize funding for projects, but lacks the manpower to fully utilize it.

### **2. Financing**

Foreign investment capital could potentially provide the capital necessary to achieve critical take-up of renewable energy projects. Policy needs to create an investment climate that would specifically target investors in the energy sector.

While a number of incentives exist for corporate entities to execute audits and purchase energy efficient equipment, there has been little response. There needs to be better communication of these benefits, and the possible introduction of penalties for consumers, above a consumption threshold, who do not at least have an energy audit done and demonstrate some intention of becoming more efficient.

### **3. Solar**

The policy for solar power must seek to:

- Define the strategic sector applications for PV systems
- Develop sustainable financing options for potential PV users and low income residents
- Propose more aggressive government incentives
- Pursue appropriate solar training to match strategic plans
- Provide institutional support for technical resources
- Develop a centre of excellence for solar power in the Caribbean

### **4. Wind**

The policy for wind power must seek to:

- Embark on a wider study of wind to assess country potential
- Explore hybrid opportunities with other energy sources

- Provide institutional support for technical resources
- Create an environment that attracts key wind entrepreneurs
- Coordinate with other centres of excellence for wind in the Caribbean

## **5. Biofuels**

The policy for biofuels must seek to:

- Clearly define the sectors to be served
- Develop a long-term plan for feed stock or other sources
- Provide institutional support for technical resources
- Coordinate with other centres of excellence for biofuels in the Caribbean

## **6. Energy efficiency**

The policy for energy efficiency must seek to:

- Engage utilities in active DSM to promote energy efficiency
- Promote and develop local companies to implement residential and commercial efficiency systems
- Propose more aggressive incentives for target sectors
- Provide institutional support for energy auditing and energy management
- Coordinate with other centres of excellence for energy efficiency in the Caribbean

## **7. Legal and regulatory**

The legal and policy framework with regards to climate change and energy needs to be developed. The policy for legal and regulatory must seek to:

- Mandate large consumers to commission audits and engage in energy efficiency
- Expand the capacity of FTC to adequately cover the wide spectrum of issues that are new or contentious in the emerging energy environment
- Provide stronger support for the related policies of the Government of Barbados
- Develop legislation to force hotels to convert to solar water heaters for room use at least
- Prohibit the importation of known inefficient equipment

## **8. Other areas**

Other related policies must seek to:

- Target education for all levels of society and schools
- Focus on energy efficiency in other productive sectors besides tourism
- Focus on the development of an appropriate transportation system

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## Annex II

### DOCUMENTS REVIEWED

#### Guyana

- Baseline study of energy policies and legislation in selected Caribbean countries
- Energy policy of Guyana
- Study of New Renewable energies in Guyana
- Guyana's 1<sup>st</sup> Communication
- Energy efficiency brochures
- Bio-fuel Potential in Guyana
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- Enabling Activities for the Preparation of Jamaica's Second National communication to the UNFCCC: Vulnerability and Adaptation in Human Health
- Jamaica's 1<sup>st</sup> Communication
- CERE Corporate Plan 2009-2012
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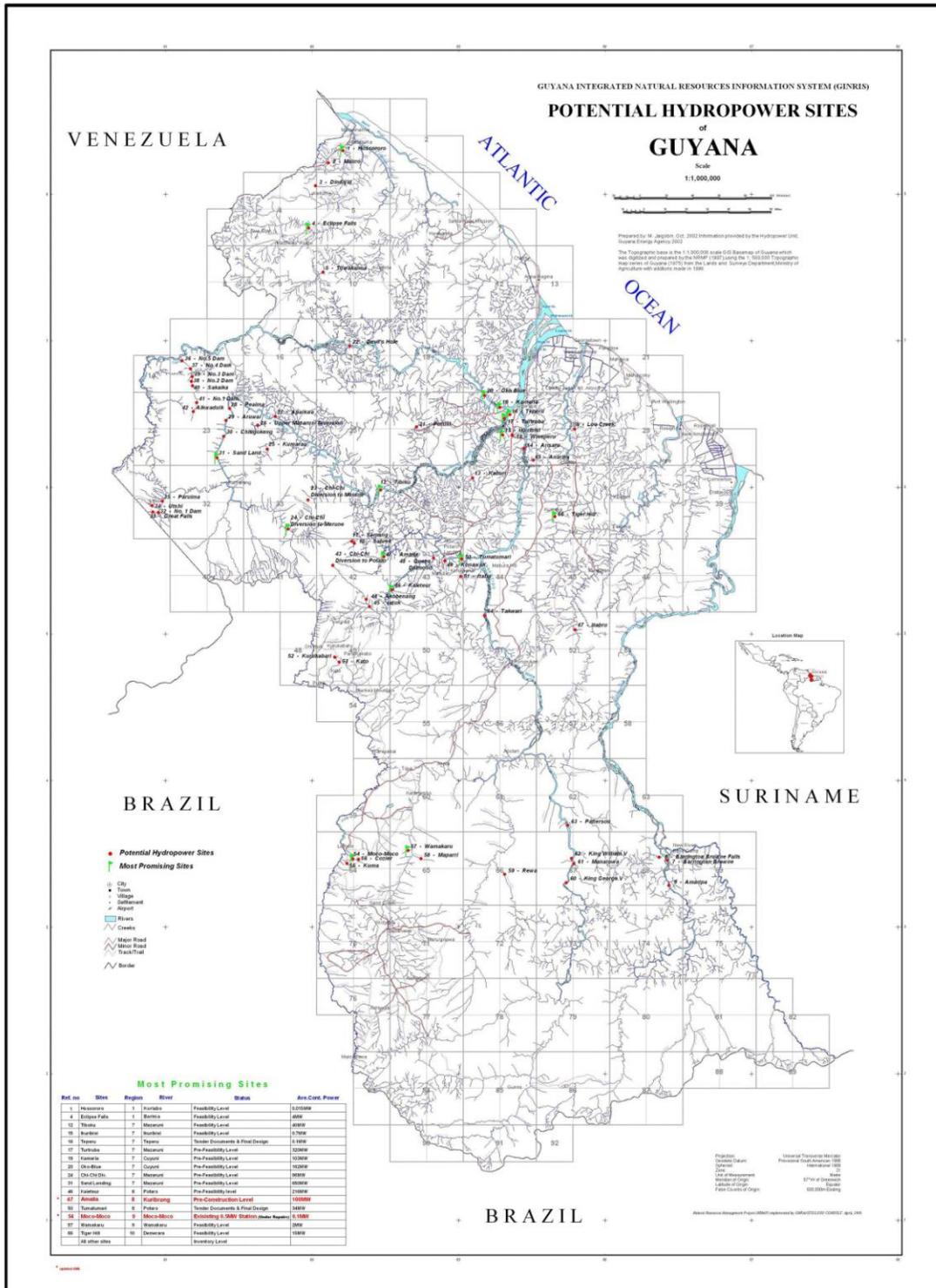
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Annex III

POTENTIAL HYDROPOWER SITES IN GUYANA



Source: Guyana Energy Agency, see <http://www.sdpn.org.gy/gea/energydev-hydropower.php>