Energy for Sustainable Development in the Caribbean

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# Power Generation in the Caribbean

<table>
<thead>
<tr>
<th>Country</th>
<th>Thermal</th>
<th>Hydro</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua and Barbuda</td>
<td>51</td>
<td>0</td>
<td>51</td>
</tr>
<tr>
<td>Barbados</td>
<td>210</td>
<td>0</td>
<td>210</td>
</tr>
<tr>
<td>Cuba</td>
<td>3,901</td>
<td>57</td>
<td>3959</td>
</tr>
<tr>
<td>Dominica</td>
<td>14</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>4,184</td>
<td>542</td>
<td>4726</td>
</tr>
<tr>
<td>Grenada</td>
<td>32</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Haiti</td>
<td>181</td>
<td>63</td>
<td>244</td>
</tr>
<tr>
<td>Jamaica*</td>
<td>1,325</td>
<td>24</td>
<td>1349</td>
</tr>
<tr>
<td>Saint Lucia</td>
<td>57</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Saint Kitts &amp; Nevis</td>
<td>47</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>St. Vincent and the Grenadines</td>
<td>18</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>1,416</td>
<td>0</td>
<td>1416</td>
</tr>
</tbody>
</table>

Source: Energy Information Administration (EIA), 2004

*Wind: Jamaica accounts for 20 MW.*
Electricity Sector Organizational Arrangements

• Vertical Monopolies Dominate:
  – Generally operate with long-term agreement, with fixed percentage ROI
  – Limited options for IPPs
  – Small systems create big challenges for competition
  – Private: LUCELEC, GRENLEC, DOMLEC
  – Public: St. Kitts Electricity Dept., NEVLEC, APUA, MONLEC, VINLEC, BL&P
Recent Energy Sector Trends/Developments in the Eastern Caribbean

- Push to open electricity markets to competition
- Accept oil discounting arrangements (i.e. PetroCaribe)
- Establish policies, plans, strategies, laws, etc. that favor sustainable energy
- Promote the development and use of biofuels and bio-electricity
- Promote the development and use of other renewable energy alternatives
On-Going Sustainable Energy Programs/Initiatives in the Region

- **Regional Initiatives:**
  - Caribbean Renewable Energy Development Programme (CREDP) [CARICOM, GTZ, UNEP/GEF]
  - Global Sustainable Energy Islands Initiative (GSEII) [OAS, The Climate Institute, ESG, UNIDO]
  - Proposed establishment of Caribbean Renewable Energy, Energy Efficiency, and Bioenergy Action Program (CREBAP) [OAS, IICA, IADB, CARICOM, Countries]
  - Proposed development of CARICOM Regional Energy Policy
  - US-Brazil Biofuels Partnership [Dominican Republic, Haiti, St. Kitts and Nevis, El Salvador]
On-Going Sustainable Energy Programs/Initiatives in the Region

- Preparing launch of the **Caribbean-EUEI Sustainable Energy Assistance Programme**
  - Funding from the European Commission (EUEI)
  - Implementation by the OAS with CARILEC, and CARICOM
  - Project Countries: The Bahamas, St. Vincent and the Grenadines, Antigua and Barbuda, St. Lucia, Dominica, St. Kitts & Nevis, Grenada
  - Key Goals:
    - Develop institutional and human capacity
    - Prepare plans, policies, regulations, laws, ... for sustainable energy
    - Identify and assess project opportunities
    - Establish regional and national sustainable energy support offices
National Sustainable Energy Programs/Initiatives in the Region

- St. Kitts & Nevis Bio-Energy Feasibility and Development Program
  - SKN sugar industry closed in 2005
  - OAS/GSEII team assessing biomass to energy alternatives (sugar and municipal waste)
  - Options may include ethanol, electricity, other byproducts
  - On-going analysis including TA from Dr. Al Binger, and soil/crop analysis by the Fundacao Getulio Vargas (FGV)

- SKN included in USA-Brazil Biofuels Bilateral Agreement
On-Going Sustainable Energy Programs/Initiatives in the Region

- Eastern Caribbean Geothermal Development Project (Geo-Caraïbes) – GEF+ Funded
  - St. Lucia, St. Kitts & Nevis, Dominica
  - Partners: OAS, AfD/FFEM, UNEP
  - PDF-B Project Components:
    - Resource Exploration (Surface Studies)
    - Policy Preparation (Regional and National)
    - Design Drilling Risk/Feasibility Financing Tool
  - Catalyze multiple commercial geothermal projects and inter-island electricity transmission
Background/History

- Serious geothermal resource exploration began in the mid-70s by the British Geological Survey.
- After dozens of investigations and nine drilled holes, no real geothermal development has resulted to date.
Geo-Caraïbes PDF-B Findings and Next Steps: St. Lucia

Time Line

1951  British start formal investigation (Willmore)
1964  Tomblin performs detailed geology survey
1974  Institute of Geological Sciences (IGS) U.K. resistivity survey
1975-76 Seven wells drilled by IGS (Wells 1-7)
1976  Aspinall et al. perform seismic monitoring
1982  Aquater (Italy): Magnetotellurics, gravity, well data evaluation.
1983-84 Los Alamos (USA): Geology, geochemistry, geophysics
1987-88 USAID/UN: Drill two deep wells (SL1 & SL2)
1992  Geothermal Energy New Zealand: Gravity, resistivity, audio magnetotelluric resistivity
1998-2006 M.I.T.: Reinterpretation of British resistivity data, self potential geophysics, decision analysis
Geo-Caraïbes PDF-B Findings and Next Steps: St. Lucia

- **Synopsis of Four MIT Studies**
  - Reinterpretation of the British Line 9 resistivity data
  - 3D rendering of 2D resistivity inversions
  - Self Potential surveying
  - Geological/Geophysical data integration using a decision analysis method

- **Eleven datasets were used**: Seismics, self potentials, fault structure, deep resistivity, shallow resistivity, geology, topography, wells/springs/geochemistry, shallow AMT, deep AMT, and residual gravity
Summary/Conclusions

- Good geothermal development potential, but...
- Very complex geology and hydrogeology
- The chemistry of the geothermal waters beneath the Sulphur Springs is quite severe
- The geothermal reservoir cap rocks are weak
- Exploration may be best optimized by exploring for less hot – but less corrosive – waters away from the Sulphur Springs
- Challenge created by designation of World Heritage Site
- Private company holds MOU (from 2004) for exploration/development, but minimal activity
Geo-Caraïbes Activities

- BRGM/CFG work concentrated on geochemistry and structural geology
- Geochemistry used to characterize the resource at depth, especially in terms of temperature of resource and hydrothermal regime
- Structural geology (also GeoSy and G. Huttner) important in identifying subsurface porosity/permeability characteristics and ultimately in helping to find the best subsurface flow rates
Geo-Caraïbes PDF-B Findings and Next Steps: Dominica

Current Status

- AfD/FFEM currently supporting expanded geophysics and geochemistry – setting up for exploratory drilling
- EUEI funding feasibility study focused on potential for interconnection with French Islands
- Multiple private sector companies have approached the Government of Dominica with proposals for development
Geo-Caraïbes PDF-B Findings and Next Steps: St. Kitts & Nevis

**Background/History**

- The islands are two of eleven Caribbean islands of volcanic origin.
- The dome within Mt. Nevis is ~60,000 years old.
- Earthquakes are common, with a notable swarm in 1950-1951.
- Dominant regional fault orientations are NE-SW and NW-SE.
- No geothermal wells drilled until current exercise.

[Map of St. Kitts and Nevis]
Geo-Caraïbes PDF-B Activities

- Geological reconnaissance mapping of western Nevis
- Geochemical sampling and evaluations of thermal waters, on and offshore, with emphasis on the western side of Nevis
- Gravity and geographic positioning surveys in the SW part of the island
- A Self-Potential ("SP") survey in the SW part of the island
- Geo-Sciences by: GeoSy, G. Huttrrer, GeothermEx, MIT, SP International, University of the West Indies – SRU

Geo-Caraïbes PDF-B Findings and Next Steps: St. Kitts & Nevis

• Current Status
  – Recent MOU/Contract between Nevis Island Administration (NIA) and West Indies Power for Exploration and Development
  – Additional Geo-Physics, Geo-Chemistry and Geology Completed
  – Exploratory well drilling currently underway
  – OAS legal team advising Federation and NIA on contracts, PPA, geothermal policy
  – Plan to develop geothermal power for use in Nevis, St. Kitts, and export to neighboring islands
New Opportunities to Further Geothermal Development in the Caribbean

- Expansion of “mature” opportunities: Those countries with considerable exploration and research completed: Dominica, St. Kitts & Nevis, St. Lucia, Guadeloupe, Martinique, Montserrat
- Launch of early-stage investigation: St. Vincent & the Grenadines, Grenada, Saba, St. Eustatius
- Partner with regional institutions involved with Energy/Geothermal Development: OAS, CCCCC, UWI, CARILEC...
Thank you!

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