AN OVERVIEW OF INVESTMENT OPPORTUNITIES IN THE ENERGY SECTOR OF LIBERIA

Presented By:
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Minister of Lands, Mines & Energy
Map of Liberia
## Liberia Population Trend
### 1962 – 2008

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Population</td>
<td>1,016,443</td>
<td>1,503,368</td>
<td>2,101,628</td>
<td>3,476,608</td>
</tr>
<tr>
<td>Population change</td>
<td>-</td>
<td>486,925</td>
<td>598,260</td>
<td>1,374,980</td>
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<tr>
<td>Average annual increase</td>
<td>-</td>
<td>40,577</td>
<td>59,826</td>
<td>57,291</td>
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<tr>
<td>Percentage increase</td>
<td>-</td>
<td>48%</td>
<td>40%</td>
<td>65.4%</td>
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<tr>
<td>Annual rate of growth</td>
<td>3.3%</td>
<td>3.4%</td>
<td>2.1%</td>
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</table>
Liberia is undergoing significant transformation as the country ‘recuperates’ from the impact of civil war; which destroyed basic service infrastructure and caused serious economic, financial and social difficulties.

The country’s economy is traditionally dependent on export of rubber, minerals (iron ore, diamond and gold), timber, agriculture (cocoa and coffee) and fishery.
As a result of War:

- There was accelerated social & economic decline
  - Agricultural production dropped as people fled their farms
  - Minerals and timber businesses were shut down
  - Rubber plantations were closed
  - Manufacturing stopped, and basic services came to a halt
  - Production of iron ore and timber were completely ceased
  - Rice production fell 76% between 1987 and 2005
  - Financial services fell 93%
  - Transportation and communication, trade and hotels, and construction all fell around 69%
  - Electricity generation and water supply services fell 85%, as the 64MW Mount Coffee Hydroelectric Dam was breeched and its Power Plant subsequently looted
Under the Emerging Recovery:

- The economy is rebounding; economic growth is showing
  - Iron ore, diamond and gold mines are reopening or set to soon be so; as at least 5 Mineral Development Agreements (MDAs) are now in effect
  - Commercial businesses are reopened and increasing in size and numbers; as commercial centers across the country – Monrovia, Ganta, Buchanan, Gbarnga, Kakata, etc. – are growing steadily
  - The rubber industry and other major agricultural, agro-forestry and forestry concessions have renewed their operations, or are set to do so; and new concessions are in the pipeline
  - However, a critical, common denominator of success for all these industries is the availability of Electric Power
Under the Emerging Recovery:

- Offshore Oil Exploration adds a new dimension of hope for enhanced socio-economic growth; and
  - With recent oil discovery in Sierra Leone and oil production recently started in the Jubilee Oil Field of Ghana,
    - West Africa is prospectively a new Total Petroleum System, and
  - There’s heightened attraction towards Liberia’s offshore waters
  - 12 out of Liberia’s 17 Offshore Blocks have been awarded to IOCs (International Oil Companies), and exploratory drilling is due to start this year (2011); Bid Awards for the last 5 blocks are pending
  - Layout and Delimitation work on the Ultra-Deepwater Blocks are ongoing, in preparing to extend the frontier into Liberia’s Exclusive Economic Zone (EEZ)
Under the Emerging Recovery:

- Liberia’s economy is highly dependent on fossil fuel; while global oil price is rising and the market is highly volatile
  - For transportation fuel, there are no viable alternatives to diesel and gasoline
  - Due to damaged and/or derelict power infrastructure, high-speed diesel thermal generating plants are the only sources of public electricity supply; available at a cost of approx. US$0.50 per kWh, which is inhibitive, esp. for small enterprises and poor households
  - Studies and designs for reconstruction of Mount Coffee Hydropower Facility are being done for the medium-term
  - HFO-fired power plants (and other technologies of competitive operational performance) are being considered under independent power production (IPP) and related power purchase agreement (PPA)
LIBERIA’S ENERGY CHALLENGE

It is a challenge that full economic recovery and sustainable development is impossible without an electric generating capacity commensurate with the energy demand from industries, commercial entities and households.

Two basic aspects of this challenge are:

1. Restoring installed capacity to at least the pre-war level of 412MW (against the current 23MW); and setting-up to surpass it (Primarily a funding issue)

2. Ensuring that the energy generated under the renewed system is dominantly ‘clean’ and conforms with the global efforts to control greenhouse gas GHG emissions that are responsible for climate change (Primarily a technology issue)
Evaluating the Needs

• The first need is to evaluate the domestic demand and resource potential for primary energy development, with emphasis on renewable sources

• The overriding need is for energy security
  • esp. against the background of widespread prevailing energy poverty and excessive reliance on externally sourced fossil fuels

• The strategic expectations point beyond mere sufficiency and in the direction of producing surpluses to
  • make Liberia a net energy exporting country
The World Bank has stratified the estimated electricity demand for Liberia over a 30-year period (2010 to 2040) and indicates the future need to supply **1,500 MW** of electrical power, to meet the domestic demand, by the year 2040.

Approx. 1,000 MW (or 66%) of this need will be potential industrial demand, primarily from international mining companies.
Spatial footprint of concessions in Liberia (2011)
[Source: World Bank]
Total Estimated Electricity Demand for Liberia, 2010–2040: High Growth Scenario
[Source: World Bank]

<table>
<thead>
<tr>
<th>Liberia Electricity Demand (MW) Scenario II – High Growth</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monrovia Electrical Grid</td>
<td>19.66</td>
<td>54.50</td>
<td>75.58</td>
<td>149.99</td>
<td>417.78</td>
</tr>
<tr>
<td>Other On-Grid (WAPP, Cote d'Ivoire Interconnection)</td>
<td>0.44</td>
<td>3.97</td>
<td>5.09</td>
<td>12.06</td>
<td>28.60</td>
</tr>
<tr>
<td>Urban and Rural Off-Grid</td>
<td>1.19</td>
<td>10.07</td>
<td>13.18</td>
<td>30.63</td>
<td>70.65</td>
</tr>
<tr>
<td>Non-Monrovia Industrial: Off-Grid (Mining, Agriculture and Forestry)</td>
<td>16.50</td>
<td>121.00</td>
<td>341.00</td>
<td>574.00</td>
<td>770.47</td>
</tr>
<tr>
<td>Non-Monrovia Industrial On-Grid (Mining, Agriculture and Forestry)</td>
<td>0.00</td>
<td>50.00</td>
<td>109.00</td>
<td>216.00</td>
<td>232.12</td>
</tr>
<tr>
<td>TOTAL ON-GRID</td>
<td>20.10</td>
<td>108.47</td>
<td>189.67</td>
<td>378.05</td>
<td>678.50</td>
</tr>
<tr>
<td>TOTAL OFF-GRID</td>
<td>17.69</td>
<td>131.07</td>
<td>354.18</td>
<td>604.63</td>
<td>841.12</td>
</tr>
<tr>
<td>TOTAL MEGAWATTS</td>
<td>37.79</td>
<td>239.54</td>
<td>543.86</td>
<td>982.68</td>
<td>1519.62</td>
</tr>
</tbody>
</table>
Finding the Resources to Match

- Is Liberia endowed with the energy resources potential required to meet the domestic?
- The investment opportunities (profit and non-profit alike) are found in the answer to this question
- Suffice it to mention that Liberia is blessed, by virtue of its tropical rainforest location, with sufficient solar radiation, hydro & biomass resources
Sunshine, Flora and Water: Liberia’s energy resource endowment
Liberia: Surface area = 111,370km²; Dry land covers 96,160km². 46% of the dry land or 43,900km² is covered by forests; evergreen forests in the more humid south and deciduous and mountain forests in the highlands of the north. This is a showcase of a natural biomass endowment.
There is a dearth of national data on solar radiation in Liberia. However, global weather data obtained from RETScreen International of Canada and the US National Renewable Energy Laboratory (NREL) show that monthly average daily solar radiation on horizontal surfaces in Liberia is between 4.0 and 6.0 kWh/m²/day (kWh per square meter per day).

- Wet season irradiation averages 4.0 - 5.0 kWh/m²/day
- Dry season it is higher, at 5.0 - 6.0 kWh/m²/day.
The annual solar radiation shows good prospects for the application of solar photovoltaic (PV) for power supply in remote off-grid locations.

If a 1kW PV system is considered, and module efficiency is assumed to be 12%, then a PV panel size of 100ft² (9.3m²) will be required: with a best suited rectangular dimension being approx. 4m x 2.3m.

Similarly, if a 1MW PV system is considered then the PV panel size would be 100,000ft² (or 9,300m²): with a best suited rectangular dimension being approx. 120m x 76m – the size of a football field.
• Limitations in the development of solar power in Liberia will come not with resource availability but with the high investment capital and land requirements and the size, economics and financials of specific projects.

• Notwithstanding, grid-based solar PV power applications should not be ruled out; as they are competitive with other options, when considered on a life-cycle costs basis.

• For now, however, it is safe to say that Liberia’s solar power potential lies firmly in standalone systems and distributed appliances.
Hydropower resources are the most studied and known renewable energy resources in Liberia. Five (5) of the country’s six major rivers are assessed to have a total hydropower potential of approx. 2,300MW.

<table>
<thead>
<tr>
<th>Potential Site /Project</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>St Paul River</td>
<td>1,200</td>
</tr>
<tr>
<td>Lofa – Mano Diversion</td>
<td>518</td>
</tr>
<tr>
<td>St. John River</td>
<td>225</td>
</tr>
<tr>
<td>Cavalla River (jointly with Cote d’Ivoire)</td>
<td>250</td>
</tr>
<tr>
<td>Mano River (jointly with Sierra Leone)</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,343</strong></td>
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</table>
St. Paul River has approx. 52% of Liberia’s large hydropower potential and, because of it being proximal to Monrovia and the location of the derelict Mount Coffee Hydropower Plant,

It is the now the focus of concerted attention; esp. in lieu of Mount Coffee Hydropower Facility reconstruction for renewed serviceability to the domestic energy demand.
St. Paul River has 12 hydropower sites including Mount Coffee, the Via Reservoir and diversion dams (V1 and SP4) and nine others.

The plan is to establish the St. Paul River Authority (SPRA) as the SPV, under public-private partnership (PPP), to harness this hydropower potential.

The ultimate objective is to have firm year-round power generation capacity through water storage for the New Mount Coffee, while gearing up to meet the power needs of Liberia’s renewed mining industry and looking beyond to the export of potential surplus power to WAPP.
There are numerous potential small hydropower sites with indicative capacities of less than 10MW; 24 of which are known to have a combined total capacity of 86MW. In Liberia there are hundreds of sites, if not more, with smaller hydropower capacities.
We have seen some visuals of the biomass endowment of Liberia, which in reality are the forest and agricultural resources. The US NREL estimates a potential biomass power output of 22,000GWh from crop and forest residue, if 30% of cropland in the country is used for expanded cash crop production.

This is associated with a biomass power generating capacity of at least 2.5GW; which is enormous, when compared with hydropower. There is also the potential for approx. 32,000GWh from sugar cane, palm oil and coconut residues.
• The case for rubber wood fired biomass power plants have been firmly established, with an estimated requirement of 30ha of trees and 13,000 tons of wood per year for each MW of plant capacity.

• Notwithstanding the very high potential, a salient precondition for sustainability is that biomass power resource development must go hand in hand with agricultural and agro-forestry development; especially an intensive rubber tree planting and replanting program.
Small Light Today
Big Light Tomorrow
More Light for All

THANK YOU
LIBERIA

Rural Energy Update

Rural & Renewable Energy Agency (RREA)

“Securing Modern Energy Access for All Liberians”

By:
Dr. Roosevelt G. Jayjay
Minister of Lands, Mines & Energy
Background

Rural and Renewable Energy Agency (RREA) Established

• January 2010 – Her Excellency the President issued Executive Order No. 23 establishing the RREA as called for by the National Energy Policy.

• The purpose of the RREA is to facilitate and accelerate the economic transformation of rural Liberia by promoting the commercial development and supply of modern energy services to rural areas with emphasis on locally available renewable resources.
Mandate of the RREA

• To provide modern energy services to rural Liberians through both the private sector and community initiatives
  – Micro-hydro power schemes, solar rural electrification schemes and distributed technologies, biomass plants, and where renewable energy is not the least-cost option, diesel mini-grids
  – Support for outreach and educational/training activities
  – Information clearinghouse
  – Investment and project development support facilities through the Rural Energy Fund (REFUND)
Institutional Development

Financial support of about US$1.4 million provided by the World Bank through the “Catalyzing New Renewable Energy in Rural Liberia” program has achieved the overall setting up of the RREA including the following:

- Recruited and hired a core team of 9 highly qualified staff for the RREA
- Acquired the LEC sub-station on Newport Street for use as RREA headquarters
- The LEC sub-station has been fully renovated, furnished and equipped for use as the RREA Headquarters
- Comprehensive RREA legislation drafted and submitted to the Office of the President for onward submission to the National Legislature for enactment
The headquarters Building of the RREA Was officially dedicated On Thursday, April 14, 2011 By His Excellency Joseph N. Boakai, Vice President of the Republic of Liberia.
Current Rural Energy Programs and Projects

- The World Bank and the GOL signed a 2 million USD grant agreement on March 15, 2011 for the implementation of two rural energy projects by the RREA in Bong and Lofa counties. (a micro-hydro power project in Lofa and solar project in Gbarnga and surrounding towns and villages).

- The EU has approved a grant of 1.5 million Euros for the RREA to develop a comprehensive rural energy master plan and implement a solar project in Zorzor and its surrounding villages and towns. The contract negotiation is nearing completion.
The RREA and the Department of Energy of the Ministry of Lands, Mines and Energy are jointly implementing a rural energy needs assessment project in five southeastern counties (Grand Gedeh, River Gee, Sinoe, Grand Kru and Maryland).

The Agency has received an assortment of 200 pieces of solar panels donated by the University of Arizona for education and outreach purposes. The RREA is in discussion with the Ministry of Education for deployment of some of the donated solar panels at 15 rural public schools and is in the process of installing some at its headquarters in order to practice what it preaches.
Current Rural Energy Programs and Projects

• The United States Agency for International Development (USAID), through the Liberian Energy Sector Support program (LESSP) is currently providing training support for the Agency’s staff.

• The Government of Norway, through its institutional cooperation with the Ministry of Lands, Mines and Energy is also providing some capacity building support to the RREA with emphasis on mainstreaming gender in energy programs and the setting up on the Rural Energy Fund.
The Way Forward

GOL Support for RREA Sustainability

To date the World Bank has financed the RREA 100%

The Government of Liberia has allocated US$600,000 in FY 2011-2012 budget for the RREA administrative and operational costs, to ensure the sustainability of this nascent Agency. The Government funding is expected to increased upon establishment of the Agency by statutes.
Thank You