Ministry of Power

Renewable Energy Resources and Potentials in Ghana

By
Wisdom Ahiaataku -Togobo
(Director, Renewable & Alternative Energy)
Ministry of Power, Ghana

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OVERVIEW OF GHANA

Land Area: **238,500 km²**


Electricity Access: **80.5%** (2015 estimates)

Rural Access: **57%** (2015 Estimates)

Consumption/Capita: **451.5KWh** (2013)

Ave. GDP Growth Rate: **6%** (2015)

Major Export: **Cocoa, Gold, Timber, Bauxite, Oil and Electricity**
Medium Term Policy Focus for the Energy Sector

• Increase access to adequate, reliable and economically priced modern forms of energy supply
• Diversify the national energy mix including the use of environmentally friendly indigenous sources of energy
• Ensure efficient production, management and use of energy
• Promote Private Sector Participation in the energy sector
• Ensure productive and efficient use of energy
Ghana’s Energy Policy Focus

- Reducing indoor air pollution
- Achieve universal access to electricity by 2030
- Modernize Transport
## EXISTING POWER GENERATION PLANTS IN GHANA

<table>
<thead>
<tr>
<th>Energy Resource</th>
<th>No. of Plants</th>
<th>Total Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>3</td>
<td>1,580</td>
</tr>
<tr>
<td>Solar</td>
<td>2</td>
<td>22.5</td>
</tr>
<tr>
<td>Biogas</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>3</td>
<td>218</td>
</tr>
<tr>
<td>Natural Gas: LCO</td>
<td>4</td>
<td>1028</td>
</tr>
<tr>
<td>Natural Gas: DFO</td>
<td>3</td>
<td>570</td>
</tr>
<tr>
<td>HFO; Natural Gas</td>
<td>2</td>
<td>475</td>
</tr>
<tr>
<td>Diesel</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>20</strong></td>
<td><strong>3,933.6</strong></td>
</tr>
</tbody>
</table>
Renewable Energy Resource Potential

Ghana has high potential for energy crops, forest and crop residue for electricity generation.

High solar irradiation 4-6 kWh/m²/day to support grid and off-grid electrification.

Ghana has over 14 potential hydro sites with total capacity of 740 MW yet to be exploited.

High Wind power potential along coast. Data collection at 60m & 80m height underway in 13 sites.
Renewable Energy Policy Focus

To contribute to climate change mitigation and reduce poverty by increasing access to renewable energy solutions

Objective

• Increase the contribution of RE source (including hydro, solar, biomass and wind) by 10% for grid, mini grid and off-grid applications; by 2020.

• Reduce the dependence on woodfuels for thermal energy (cooking and heating)
  • Use of clean cooking fuel alternatives (LPG etc) and efficient woodfuel cookstoves.

• Support production and use of biofuel as blend to improve quality of fossil fuel consumption where economically feasible.
• Provide the fiscal incentives and regulatory framework to encourage private sector investment.

• Key Provisions includes:
  • **Feed-in-Tariff Scheme** under which electricity generated from renewable energy sources would be offered a guaranteed price.
  • **Purchase Obligation** under which power distribution utilities and bulk electricity consumers would be obliged to purchase a certain percentage of their energy required from electricity generated from renewable energy sources
  • **Net Metering (distributed generation)** under which RE generated on site may be delivered to the local utility to offset the cost of electricity provided by the utility.
Key Provisions in Act 832

- **Off-grid Electrification** – promote Mini-grid and stand-alone RE systems for remote off-grid locations
- **Woodfuels** – Promote efficient production and utilization of woodfuel for cooking
- **Renewable Energy Fund** to provide incentives for the promotion, development and utilization of renewable energy resources
- **Establishment of Renewable Energy Authority** to own, implement and manage renewable energy assets on behalf of the State. (particularly for off grid electrification)
Institutional Framework in Place with Clear Roles and Mandates

• **Energy Commission**: Technical regulation and licensing for RE electricity generation, transmission and distribution

• **PURC**: Economic regulation and setting tariffs for electricity including the Renewable Energy Feed-in-Tariff

• **Environmental Protection Agency**: environmental regulation and permitting

• **Ghana Investment Promotion Centre**: Assist and facilitate incentive for private sector investments (IPPs)
## Priority Areas for Renewable Energy Investments (Grid Connected)

<table>
<thead>
<tr>
<th>Programme</th>
<th>Preliminary Target by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility study and the development of medium hydro potential sites</td>
<td>3-6 potential sites (200-300MW)</td>
</tr>
<tr>
<td>Utility Scale Biomass &amp; W2E (Waste to Energy) Power Plants</td>
<td>70-150MW</td>
</tr>
<tr>
<td>Utility Scale Wind Park</td>
<td>150-500MW</td>
</tr>
<tr>
<td>Distributed grid connected RE generation through Net-metering (solar, wind, biomass, hydro)</td>
<td>40-200MW</td>
</tr>
<tr>
<td>Utility Scale Solar Farms</td>
<td>150-300 MW</td>
</tr>
<tr>
<td>Tidal Wave &amp; other Clean technologies</td>
<td>?????</td>
</tr>
</tbody>
</table>
Progress Since Passage of RE Law

- Grid Code for utility scale RE grid interconnection
- Net metering Code
- Draft Standardized Power Purchase Agreement (PPA)
- Guidelines on Renewable Energy Purchase Obligation
- Licensing framework developed

- Ongoing activities
  - Wind resource assessment in 13 potential sites at 60m and 80m height.
  - Biomass resource assessment for power generation.
  - Feasibility studies for three potential hydro sites with total estimated capacity of 200MW
Progress Since Passage of RE Law

• Investment interest for utility scale RE grid integration is high due to the very attractive RE-FIT.

• About 66 Provisional Licenses; 17 sitting and 2 Construction permits issued by the EC to date.
  • Solar – 44
  • Wind – 7
  • Biomass/WTE – 11
  • Hydro - 3
  • Tidal Wave - 1
Progress Since Passage of RE Law in December 2011

• Feed-in-tariff scheme
  • 1st RE-FIT gazette – Oct. 2013
    ❖ Limited to 10 years, no provision for investment in energy storage for grid stabilization for variable RE (wind & Solar)
  • 2nd RE-FIT gazette - Oct. 2014.
    • 10 years with capacity limit for variable RE (wind & Solar) and provision for grid stabilization and storage.
    • Provision for 10 and 20 years and capacity limit subject to grid impact studies
  • Acknowledged the support of the World Bank through GEDAP for building capacity of PURC, EC and MOP for the development of the RE-FIT Methodology.
<table>
<thead>
<tr>
<th>TYPE OF TECHNOLOGY</th>
<th>(1 - 10 years) Guaranteed FIT</th>
<th>20 years Indicative FIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USCents per Kwh</td>
<td>USCents / Kwh</td>
</tr>
<tr>
<td>Wind</td>
<td>16.6</td>
<td>14.5</td>
</tr>
<tr>
<td>Solar PV</td>
<td>15.1</td>
<td>13.0</td>
</tr>
<tr>
<td>Hydro &lt;= 10 MW</td>
<td>13.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Hydro (&gt;10 MW and &lt;=100 MW)</td>
<td>14.3</td>
<td>12.3</td>
</tr>
<tr>
<td>Tidal Wave (Ocean Wave)</td>
<td>13.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Run off River</td>
<td>13.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Biomass</td>
<td>17.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Biomass (Enhanced Technology)</td>
<td>18.5</td>
<td>15.9</td>
</tr>
<tr>
<td>Biomass (Plantation as Feed Stock)</td>
<td>19.8</td>
<td>17.0</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>17.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Sewage Gas</td>
<td>17.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Geoplutonic (Geothermal)</td>
<td>11.8</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Gazette in Ghana Cedis at GHS3.9476/USD, 31 Aug 2016 Interbank Exchange rate - (GAB)

Please note that the FIT is payable only in local currency at the above exchange rate.
Development of Utility Scale RE projects

- Ghana’s largest Solar farm - 20MW Near Winneba Central Region
- 2.5MW Solar Farm at Navorongo
- 20MW tender under negotiations
- 50MW Bui tender under negotiation
Renewable Energy Purchase Obligation (REPO)

• The Act obliges PURC to allocate a certain percentage of electricity purchased by all electricity distribution utilities and bulk consumers to come from electricity generated from RE sources or pay a fine.

• Ghana currently has 3 distribution utilities (ECG, NEDCo & Power Enclave) and 32 bulk consumers.

• For now, all RE developers are moving to ECG to sign PPAs and this could have negative impact on ECG financials if not done early.

• The PURC is currently developing the modalities to establish the percentage required for each of these bulk electricity purchasers.
## Priority Areas for Mini & Off Grid Renewable Energy Investments

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<tr>
<td>Mini Grid Renewable Energy based electrification in isolated communities</td>
</tr>
<tr>
<td>Deploy Solar Home Systems (SHS) in isolated off-grid households</td>
</tr>
<tr>
<td>Deploy Solar Lanterns (SL) with mobile phone charging facilities through local assembling and partial subsidy</td>
</tr>
<tr>
<td>Solar electrification in off-grid public facilities (schools, clinics, security outposts)</td>
</tr>
<tr>
<td>Solar Community Lighting Systems (Solar Street lights) for isolated communities</td>
</tr>
<tr>
<td>Pilot Wind &amp; solar water pumps, Biogas, Solar crop dryers etc to support SMEs in Agric</td>
</tr>
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</table>
Renewable Energy Net-Metering Scheme

- 200,000 Solar Roof Top programme being implemented by the Energy Commission.
- Government providing capital subsidy of 500W panel per installation.
Net Metering (Distributed Generation) - MOP

50KWp Solar Park, Ministry of Power

- 500x100Wp Solar panels
- 7x8kW SMA Invertors

Average daily generation from Solar from Jan-Jun is about 156KWh. Translates to a savings (15% of total consumption)
Scale-Up Renewable Energy Programme (SREP)

• Developed and obtained approval for $230m Ghana SREP Investment Plan
  ➢ 4 projects under SREP
    • 55 Mini-Grid & 38,000 SHS
    • 15,000 Net-metering
    • 20-30MW utility scale Solar/wind Project
    • Technical Assistance
• Secured $40m financing from the Climate Investment Fund of which $30m is grant to finance the above 4 projects.
• Additional $1.5m project preparation Grant has been approved by CIF to develop the above project.
Mini-Grid Electrification Project

KUDORKOPE

ATIGAGORME

Wayokorpe

AGLAKOPE

PEDIATORKOPE
Mini-Grid Renewable Energy Electrification Programme

• Hybrid Mini-grids developed in 5 island communities on the Volta lake to provided electricity services for over 6000 inhabitants.

• Policy developed to mainstream Mini-grids into National Electrification Programme.
  • Public sector led investment with VRA and ECG/NEDCo responsible for generation and distribution respectively.
  • Uniform prizing tariff, zero connection fee for mini grid customers

• Launched socio-economic studies for 3 additional mini-grids under SECO grant financing for Island Communities in the Ada East District.
Off-grid Stand Alone Electrification Programme

- Solar Streetlights installed in remote off-grid communities.
- Solar systems installed in remote clinics, security outpost and schools.
- Energy service centers established in remote un-electrified communities for charging mobile phones, batteries etc.
Kerosene Lantern Replacement Program

• 70,000 solar lanterns sold under 70% subsidy to replace kerosene lanterns.

• The target is 2,000,000 by 2030.

• Private sector has taken up the challenge to deploy both solar and battery operated lanterns to power LED lamps.

• Kerosene consumption has drastically reduced.
1. Monitored Cookstove initiatives (total improved woodstoves disseminated by private sector – 22,856 stoves as of June 30, 2016).
2. 32 Institutional Stoves constructed in 5 Districts for Gari Processors through a 50% grant facility from SNV/GIZ
3. Rehabilitation works of Appolonia Renewable Energy Centre has commenced - 30% work done to date.
4. Completed market assessment for solar pumps for irrigation
Tiptop Farms, Anloga

• Renewable Energy demonstration farm located in Anloga in the Keta District.

• Farm started with a 1.6m diameter wind pump irrigating 0.5 acres daily

• Currently the farm has a total of 20 acres under all year irrigation from solar, wind, biogas and electricity.
Biogas

- Biogas has potential of producing:
  - gas for power generation and direct heat
  - Organic manure
  - Improved sanitation.
Solar

- Solar 1.6KW solar pump capable of irrigating 2-3 acres.
Key Programme initiatives

• World Bank
• AfDB – funding secured for S/M Hydro power pre-feasibility studies for 10 sites
• SECO – Funding secured for 2 minigrids and other RE related initiatives
• GIZ - Supporting implementation of RE law and productive use of RE.
• SREP/AFDB – Funding secured for the development of framework for establishment of RE Authority.
• China, Japan Israel, India – Human resource capacity development in the RE Sector.
• USAID / Power Africa Initiative support to the RE Sector
• EU – Support study for RE Fund Operationalization – Low Outcome
• Ghana China UNDP Renewable Energy Technology Transfer Project with support from Denmark. Transfer of RE knowhow NOT Products
Conclusion

• Ghana has made significant progress in the deployment of RE since the enactment of the RE Act.

• Mini-grid and stand alone RE system will accelerate the attainment of Universal access.

• Pricing policy framework to address challenges in the off-grid RE market is being developed.

• Efforts underway to consolidate various plans and actions into a renewable energy master plan.

• Issues regarding regulatory framework and financing for the off-grid sector still remain a major challenges

• Appreciate the continuous support of the donor partners and the private sector in advancing RE development in Ghana.

• THANK YOU