ETHIOPIAN ELECTRIC POWER
THE ETHIOPIAN ENERGY SECTOR – INVESTMENT OPPORTUNITIES

UK-ETHIOPIA TRADE & INVESTMENT FORUM 2015
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LONDON, UK

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1. Institutional & Regulatory Framework

- Ministry of Water Irrigation & Energy (MoWIE) is the lead institution for the Energy Sector.
- It supervises Three Institutions:
  - Ethiopian Electric Utility (EEU): Distribution, Sales
  - Ethiopian Energy Authority: Regulatory body for electricity and energy efficiency
- Its responsibilities fall into Three Broad Categories:
  - Resource assessment and development,
  - Policy and regulatory, and
  - R&D
2. ENERGY SECTOR POLICY

The Energy policy envisages to meet the following broad objectives:

- Giving high priority to RE Development and follows climate resilient green economy strategy
- Considers Hydropower as the backbone of the country’s energy generation and maximize its utilization;
- Promoting and enhance other renewable energy sources development such as solar, wind, geothermal and bio-mass to increase RE mix there by Improving security and reliability of energy supply and be a regional hub for renewable energy.
- Enhancing regional and global cooperation in the energy sector to ensure exchange of know-how, information and transfer of technologies
- Strengthening cross borderer energy trade.
- Increasing access to affordable and adequate modern energy.
- Promoting efficient, clean, and appropriate energy technologies and conservation measure.
- Improving the energy efficiency of systems and operations.
- Strengthening energy sector governance and build strong energy institution (EEPCo’s Transformation)
- Ensuring environmental and social safety and sustainability of energy supply and utilization, and gender mainstreaming.
- Ensuring Capacity building and technology transfer
- Strengthening Energy Sector Financing.
- Exploring for natural gas and other hydrocarbon fuels
- Encourages Public-Private Partnership in energy generation
3. PRIVATE SECTOR PARTICIPATION

Based on the Energy policy, enabling environment is created for both Public and Private investors.

- In any RE generation projects, **private sector can participate either in partnership with Public or independently** without any limitation of generation capacity.
- The **public sector plays significant role** in power sector development.
- On the basis of the enabling environment for investment, **many private developers showed keen interest to participate as an IPP for generation from hydro, wind, solar, and Geothermal**.
- Accordingly, PPA is signed for the **first Geothermal IPP** for 1000 MW generation at Corbetti with Icelandic- Reykjavik Geothermal Company.
## 4. Indigenous Energy Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Unit</th>
<th>Exploitable Reserve</th>
<th>Exploited Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower</td>
<td>MW</td>
<td>45,000</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Solar/day</td>
<td>kWh/m²</td>
<td>Avg. 5.5</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Wind: Power Speed</td>
<td>GW m/s</td>
<td>1,350</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>MW</td>
<td>7000</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Wood</td>
<td>Million tons</td>
<td>1120</td>
<td>50%</td>
</tr>
<tr>
<td>Agricultural waste</td>
<td>Million tons</td>
<td>15-20</td>
<td>30%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>Billion m³</td>
<td>113</td>
<td>0%</td>
</tr>
<tr>
<td>Coal</td>
<td>Million tons</td>
<td>300</td>
<td>0%</td>
</tr>
<tr>
<td>Oil shale</td>
<td>Million tons</td>
<td>253</td>
<td>0%</td>
</tr>
</tbody>
</table>
5. RENEWABLE ENERGY POTENTIALS AND THEIR GEOGRAPHICAL DISTRIBUTION

Hydro
- Ethiopia’s plentiful hydropower resources are distributed in nine major river basins and their innumerable tributaries is estimated to generate an economically affordable energy of about 260 TWH.
- However, less than 5% of the potential has been exploited so far.

Wind
- Ethiopia has total wind energy resource reserve of 3,030 Giga Watt and the potential exploitable quantity of is 1,350 Giga Watt.
- For technical and economic reasons appropriate wind regions for grid-based electricity generation are those with wind density of 300W/m² (wind speed 6.5 m/s) and above. Ayisha in the Eastern part of the country has good potential.

Solar
According to the revised Master Plan, Ethiopia’s average solar energy potential is 5.5 KWh/m²/day and mainly centralized in the north part of the country in Tigray and Afar regions.

Geothermal
- The best perspective areas are distributed along the Ethiopian Rift valley system which runs for more than 1000 km from the Afar depression, at Red Sea to the Turkana depression southwards (NE-SW to N-S direction).
- A total of 16 geothermal resource areas have been identified by various studies. These resource zones are all located within the rift valley system. (Aluto Langano, Tullu Moye Tendaho, Danakil Depression....)
6. DEVELOPED HYDRO RESOURCE

- Ethiopia’s Hydro potential (45,000 MW) constitutes 20% of the total technically feasible potential in Africa.
- With this potential Ethiopia is usually referred as the power house of Africa.
- However Ethiopia has utilized less than 5% of its potential so far.
- Currently, Access to electricity in Ethiopia is ~ 55%.
7. CURRENT STATUS OF ENERGY DEVELOPMENT IN ETHIOPIA

Hydro

Potential 45,000 MW

Developed 2,360 MW (4228 MW)

Access to electricity 55%

Annual Demand growth 25-30%

No. of Customers 2,450,000

Substations 145

Distribution 189,000 Km

Transmission 12,825Km

Generation 2,360 MW (9018 GWh)

8,000 – 10,000 MW GTP I

Gibe III =1,870 MW
GERD = 6,000 MW
GD3 = 254 MW

Hydro, Wind, Geothermal, Biomass
8. GENERATION PROJECTS UNDER CONSTRUCTION

Grand Ethiopian Renaissance Dam Project:
- 6000 MW installed capacity
- 48% Completed
- Fully Public Financed Project
- RCC & Rock fill Saddle Dam
8. GENERATION PROJECTS UNDER CONSTRUCTION (...continued)

Gibe III Hydropower Project

- 1900 MW Installed Capacity
- 93% Completed
- RCC Dam
- 246 m High

Dam & Reservoir: General View
Gibe III: U/S & D/S Views
8. GENERATION PROJECTS UNDER CONSTRUCTION (....continued)

Genale Dawa Hydropower Project
- 254 MW Installed Capacity
- 78% Completed

Rockfill Dam – Upstream Face

Spillway Concreting Works
Adama II Wind Power Project:
- 153 MW Installed Capacity
- 96% Completed
- 1.5 MW Turbines
8. GENERATION PROJECTS UNDER CONSTRUCTION (....continued)

Aluto Geothermal
8. GENERATION PROJECTS UNDER CONSTRUCTION (.....continued)

Reppi Waste to Energy Project:
- 50 MW Installed Capacity
- Municipal Solid waste (Addis Ababa)
- The first W to E Plant in Africa
- 68% completed

Tipping Hall, Waste Bunker Area and Boiler Hall Under Construction
## 9. Transmission Projects Under Construction (Major)

<table>
<thead>
<tr>
<th>Capacity (KV)</th>
<th>Length (KM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1,700</td>
</tr>
<tr>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td>230</td>
<td>1,100</td>
</tr>
<tr>
<td>132</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>~4,260 KM</strong></td>
</tr>
</tbody>
</table>
10. Power System Demand Forecast

Major Consumers include:
1. Transport Sector (Railway)
2. Agriculture Sector
3. Industrial Sector
4. Large-scale Housing Programs
5. Universal Electricity Access Program
6. Electricity Export Market

2014 Internal Demand Composition:
- Domestic (Dom.) 39%
- Commercial (Com.) 24%
- Industrial (Ind.) 36%

2037 Internal Demand Composition:
- Domestic (Dom.) 18%
- Services (Serv.) 14%
- Agri. 14%
- Trans. 8%
- Ind. 46%
11. Over View of Existing and Planned Interconnection

- Ethiopia is already connected to Sudan, Djibouti and the Border towns of Kenya.

- Ethiopia – Kenya 500 KV D.C. line under construction (up to 2000 MW);

- Exports to Egypt 2000 MW and additional 1200 MW to Sudan are planned for implementation soon.

- MoUs signed to Exports to Tanzania, Rwanda, Burundi, South Sudan and Yemen
Over View of Existing and Planned Interconnection
12. GTPII : UPCOMING PROJECTS (2016-2020)

Planned Generation Projects
- Hydro = 11,015 MW
- Wind = 1,520 MW
- Geothermal = 1,270 MW
- Solar = 300 MW
- Biomass = 420 MW

Total = 14,615 MW

Planned Transmission Projects
- 500 KV = 1,229 km
- 400 KV = 2,137 km
- 230 KV = 3,343 km
- 132 KV = 3,041 km
- < 132 KV = 250 km

Total = 10,000 km

Planned Substation Construction
- 115 New
- 63 Rehabilitation/Upgrading

Total = 178

<table>
<thead>
<tr>
<th>No.</th>
<th>RE Source</th>
<th>Project</th>
<th>Installed Capacity (MW)</th>
<th>Energy (GWh)</th>
<th>Indicative Cost (MUSD)</th>
<th>Planned Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HYDRO</td>
<td>Geba I &amp; II</td>
<td>372</td>
<td>1709</td>
<td>572</td>
<td>2020</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Genale Dawa VI</td>
<td>256</td>
<td>1532</td>
<td>588</td>
<td>2020</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Werabesa + Halele</td>
<td>422</td>
<td>1873</td>
<td>886</td>
<td>2020</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Yeda 1 + Yeda 2</td>
<td>280</td>
<td>1089</td>
<td>540</td>
<td>2020</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Gibe IV</td>
<td>2000</td>
<td>6200</td>
<td>2000</td>
<td>2020</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Tams</td>
<td>1700</td>
<td>5760</td>
<td>4214</td>
<td>2020</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Upper Dabus</td>
<td>326</td>
<td>1460</td>
<td>628</td>
<td>2020</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Wabi Shebele</td>
<td>88</td>
<td>691</td>
<td>1100</td>
<td>2020</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Karadobi</td>
<td>1600</td>
<td>7857</td>
<td>2576</td>
<td>2021</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Beko Abo</td>
<td>935</td>
<td>6632</td>
<td>1260</td>
<td>2022</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Upper Mendaya</td>
<td>1700</td>
<td>8582</td>
<td>2436</td>
<td>2023</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Birbir River</td>
<td>467</td>
<td>2724</td>
<td>1231</td>
<td>2023</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Baro 1 + Baro 2 + Genji</td>
<td>859</td>
<td>3524</td>
<td>1794</td>
<td>2024</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Genale V</td>
<td>100</td>
<td>575</td>
<td>298</td>
<td>2025</td>
</tr>
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</table>

Total HYDRO = 11,105 MW

<table>
<thead>
<tr>
<th>No.</th>
<th>Wind</th>
<th>Project</th>
<th>Installed Capacity (MW)</th>
<th>Energy (GWh)</th>
<th>Indicative Cost (MUSD)</th>
<th>Planned Year of Completion</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Iteya I</td>
<td>200</td>
<td>613</td>
<td>380</td>
<td>2016</td>
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<tr>
<td>2</td>
<td></td>
<td>Iteya II</td>
<td>200</td>
<td>312</td>
<td>420</td>
<td>2016</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Dila</td>
<td>100</td>
<td>306</td>
<td>210</td>
<td>2018</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Iteya II</td>
<td>200</td>
<td>613</td>
<td>380</td>
<td>2017</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Assela</td>
<td>100</td>
<td>307</td>
<td>190</td>
<td>2018</td>
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<tr>
<td>6</td>
<td></td>
<td>Debire Birhan</td>
<td>100</td>
<td>613</td>
<td>380</td>
<td>2017</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Ayisha I &amp; II</td>
<td>420</td>
<td>1577</td>
<td>760</td>
<td>2017</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Sululta</td>
<td>100</td>
<td>306</td>
<td>210</td>
<td>2019</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Mega Maji</td>
<td>100</td>
<td>306</td>
<td>210</td>
<td>2019</td>
</tr>
</tbody>
</table>

Total Wind = 1520 MW

<table>
<thead>
<tr>
<th>No.</th>
<th>Solar</th>
<th>Project</th>
<th>Installed Capacity (MW)</th>
<th>Energy (GWh)</th>
<th>Indicative Cost (MUSD)</th>
<th>Planned Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Different Sites</td>
<td>100</td>
<td>175</td>
<td>180</td>
<td>2016</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>100</td>
<td>175</td>
<td>180</td>
<td>2016</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>100</td>
<td>175</td>
<td>180</td>
<td>2016</td>
</tr>
</tbody>
</table>

Total Solar = 300 MW

<table>
<thead>
<tr>
<th>No.</th>
<th>Geothermal</th>
<th>Project</th>
<th>Installed Capacity (MW)</th>
<th>Energy (GWh)</th>
<th>Indicative Cost (MUSD)</th>
<th>Planned Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Corbetti</td>
<td>1000</td>
<td>7096</td>
<td>4000</td>
<td>2017 - 2022</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Aluto Langano II</td>
<td>70</td>
<td>552</td>
<td>280</td>
<td>2018</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Aluto Langano III</td>
<td>100</td>
<td>788</td>
<td>364</td>
<td>2017</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Tendaho</td>
<td>100</td>
<td>788</td>
<td>364</td>
<td>2016</td>
</tr>
</tbody>
</table>

Total Geothermal = 1270 MW

<table>
<thead>
<tr>
<th>No.</th>
<th>Biomass</th>
<th>Project</th>
<th>Installed Capacity (MW)</th>
<th>Energy (GWh)</th>
<th>Indicative Cost (MUSD)</th>
<th>Planned Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Any Resourceful site</td>
<td>420</td>
<td>2940</td>
<td>525</td>
<td>2009</td>
</tr>
</tbody>
</table>

Grand Total = 14,615 MW

*Inline with the 25 Years Power Sector Master Plan, the following projects are planned for implementation in the GTPII:*
13. Profile of GTP II Generation Projects Intended for IPP/PPP Modality

1. UPPER MENDAYA and BEKO ABO Hydropower Project
   - Installed Capacity: 2635 MW
   - Reconnaissance Study
   - Indicative Cost Estimate: USD 3.3 Billion
   - Located Third Cascade of Abay/Nile River, Western Ethiopia

2. TAMS Hydropower Project
   - Installed Capacity: 1700 MW
   - Prefeasibility Study Completed
   - Indicative Cost Estimate: USD 3.2 Billion
   - Located on Baro River, Western Ethiopia

3. KARADABI Hydropower Project
   - Installed Capacity: 1600 MW
   - Prefeasibility Study Completed
   - Indicative Cost Estimate: USD 3.5 Billion
   - First Cascade of Abay/Nile River

4. Baro I & II and Genji Hydropower Project
   - Installed Capacity: 859 MW
   - Prefeasibility Study
   - Indicative Cost Estimate: USD 1.8 Billion
   - Located Baro River, Western Ethiopia
13. Profile of GTP II Generation Projects Intended for IPP/PPP Modality (... Continued)

4. Birbir Hydropower Project
   - Installed Capacity: 467 MW
   - Reconnaissance Study
   - Indicative Cost Estimate: USD 1.6 Billion
   - Located on Birbir River South-West Ethiopia

5. HALELE WERABESSA Hydropower Project
   - Installed Capacity: 436 MW
   - Feasibility Study Completed
   - Indicative Cost Estimate: USD 1.1 Billion

6. UPPER DABUS Hydropower Project
   - Installed Capacity: 326 MW
   - Prefeasibility Study Completed
   - Indicative Cost Estimate: USD 848 Million
   - Located in Dabus River, Western Ethiopia

7. CHEMOGA YEDA Hydropower Project
   - Installed Capacity: 280 MW
   - Prefeasibility Study Completed
   - Indicative Cost Estimate: USD 729 Million

8. GENALE DAWA VI Hydropower Project
   - Installed Capacity: 256 MW
   - Prefeasibility Study Completed
   - Indicative Cost Estimate: USD 794 Million
   - Located in the Genale Dawa River Basin, Southern Ethiopia
Thank You!