The energy sector of Angola:

Vision, Action Plan and Investment Opportunities

AEMP Round 3
25 – 26 June, 2019
Section 1

Country Energy Sector Overview
Angola believes that access to electricity is key to economic growth and country development, benefiting the overall population's standard of living and welfare.

Electricity and Income Correlation

Angola aims to double its electrification rate until 2025 and equal that of reference countries.

- **Middle East and North Africa**: 2600 KWh per capita
- **Latin America and the Caribbean**: 1900 KWh per capita
- **World**: 2900 KWh per capita
- **Angola 2010**: 247 KWh per capita
- **Angola 2025**: Increase electrification to 60%

GDP per capita ($)

Legend:
- The diameter indicates average energy consumption per capita.

Source: World Bank, 2010
Long term Vision & Objectives
Angola’s strategy to Light up and power Africa by 2025

Milestones

- Electrification rate of 50%
- Up to US$ 3 billion of private investments mobilized.
- Electrification rate of 60%
- Up to US$ 9 billion of private investments mobilized.

Policy
- Restructuring and strengthening power sector operations
- Tariff review and economic/financial sustainability
- Promotion of private capital and know/how
- Electrification (urban and rural) and grid expansion
- Use of renewable energy
- Increase generation capacity

Generation, Transmission & Distribution

2018 – 2022: US$ 13.6 billion budget
7.5 GW Target for 2022

2022 – 2025: US$ 23.1 billion budget
9.9 GW Target for 2025

Installed Capacity Target

Transmission & Distribution

Angola Power Sector Long Term Vision 2025

Technical Assistance

2018 2019 2020 2021 2022 2023 2024 2025
Key pillars

Ensure and Increase Electricity Supply

- Increase the electricity access rate from 30% to 60%
- Quadruple generation capacity from current ~2.000 MW to ~9.500 MW in 2025
- Extend more than 2.500 km of lines and substations in the transmission grid, and establish international interconnections
- Rehabilitate distribution networks, adding more than 1,5 million consumers

Industry Competitiveness

- Improve the efficiency of public companies
- Implement a new market model that allows for cost reductions
- Develop a new regulatory model encouraging efficiency

System Sustainability

- Reduce tariff subsidization
- Develop an optimal generation mix, making better use of Angola’s natural resources
- Develop the capabilities of the local workforce
## Angola Energy Sector Snapshot

### Potential

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>6.400</td>
</tr>
<tr>
<td>Thermal</td>
<td>82</td>
</tr>
<tr>
<td>Residential</td>
<td>1650</td>
</tr>
</tbody>
</table>

- Angola has a solar potential of 17.3GW distributed over 368 projects.
- PV systems are the most appropriate technology to harness the solar potential.
- This potential for electricity generation is spread over 42 projects.
- 3.3 GW of projects are forestry related.

### Production

- **6,400 MW** Total Installed Capacity
- **82 MW** Of supply is generated by IPPs

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>53%</td>
</tr>
<tr>
<td>Thermal</td>
<td>47%</td>
</tr>
</tbody>
</table>

### Key Indicators

- **3.4 M** Households without power
- **1650 MW** Peak energy consumption (reached in 2014)
- **36%** Access Rate (Population electrified localities / Total Population)
- **15.5%** Average consumption growth rate (2008-2014)

**Energy consumption per client (2014):**

- **Residential:** 45%
- **Industry:** 9%
- **Services:** 32%
- **Losses:** 14%

**Electricity production by source (2014):**

- **15.5%** Hydro
- **47%** Thermal
- **32%** Services
- **9%** Industry
i. Angola Energy Programs, Policy & Reforms

Energy Sector Stakeholders

- The Ministry of Energy and Water of Angola (MINEA)
- IRSEA – Regulator
- PRODEL – Generation Company
- RNT – Transmission Company
- ENDE – Distribution Company
- GAMEK – Project Development

*On a local level, Provincial Governments (18 in total) have their own Directions of Energy and Water

Country generation programs/Expansion plans

- More than 6,000 km of very high voltage transmission lines and over 40 substations are planned.
- Plans exist to link the grids through a north-central south backbone and expand the grid from 3,354 km to 16,350 km by 2025 and to connect to the Southern Africa Power Pool (SAPP) through Namibia (ANNA) and the Democratic Republic of Congo (Inga).

Country’s Priorities

The Angolan Government has an ambitious Action Plan for the period up to 2025 with around US $18 billion worth of investments into renewables underway, and it has a long-term vision for the power sector with a clear roadmap to provide modern electricity services to 60% of the population by 2025.

Energy Policies and Reforms

- The AfDB jointly with JICA supported the Government with US$ 1.2 billion through its Power Sector Reform Support Program to support the energy sector reforms undertaken by Angola between 2014 and 2017.
- Order no. 11/17: to review and extend the Angola’s National Vision of 2025 to 2050.
To successfully achieve the proposed goals in the energy sector a large amount of investment is necessary in generation assets and grid infrastructures.

Quadrupling generation capacity is a key pillar for electrification and supply security.

Source: Data 2012 – MINEA Expanded Council Board; Financial Reports ENE e EDEL; Estimated data PSEA, 2009, Data 2019 - MINEA

A significant investment extending transmission lines to connect the new generation and unify the four transmission systems.

The expected growth in generation is followed by the extension of the distribution network and consumer base.
Angola is managing large, concurrent infrastructure developments, carefully planned to take advantage of Angola's unique national resources – natural gas, hydro, wind and solar.

How to take advantage of Angolan natural resources

- Benefit from the hydro potential of Kwanza river – Laúca and Caculo-Cabaça
- Install combined cycle gas turbines, partnering with Sonangol/ Angola LNG
- National integration of transmission systems
- International interconnection with Namibia and Congo
- Rural electrification with distributed renewables sources
The Electricity Sector Transformation Program (PTSE) sought to improve efficiency by unbundling activities and a new market regulation that allows private participation.

I. The Electricity Sector Transformation Program (PTSE) sought to improve efficiency by unbundling activities and a new market regulation that allows private participation.

### Value Chain

<table>
<thead>
<tr>
<th>Public Companies Restructuring</th>
<th>Market and Regulation Models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation</strong></td>
<td>▪ Allow Private Generation</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>▪ Establish a Single Buyer to purchase all energy generated</td>
</tr>
<tr>
<td><strong>Distribution and Customer Operations</strong></td>
<td>▪ Power Purchase Agreements negotiated by Single Buyers with generation companies</td>
</tr>
<tr>
<td><strong>Regulator</strong></td>
<td>▪ Incentives and liberalization in generation and distribution, with private players</td>
</tr>
<tr>
<td><strong>Engineering</strong></td>
<td>▪ Tariff model design to promote energy efficiency to project poorer consumers</td>
</tr>
</tbody>
</table>

#### Until 2015
- Generation: Private Investors
- Transmission: Private Investors
- Distribution and Customer Operations: Municipalities
- Regulator: IRSEA
- Engineering: GEMEK

#### Current Status
- Generation: Private Investors (GAMEK)
- Transmission: Private Investors (ENDE)
- Distribution: Private Concessions (EDEL)
- Regulator: IRSEA (INstituto Regulador dos Serviços de Electricidade e de Água)
- Engineering Office (for strategic projects) (GAMEK)
Section 2

Investment Opportunities
II. Project #1: Hydroelectric Power Plant – CHICAPA II

**IMPACT**

- **31.2 MW**
- **20,800 Households Electrified**
- **1.25 CO₂ kton/yr Emissions Savings**

**Deal Snapshot**

- Financing the construction and operation of the Hydroelectric Power Plant of Chicapa II, in Lunda Sul, which will increase the energy generation of Chicapa I, from 86.9 GWh/year to 135 GWh/year and improve the power supply to Saurimo, a growing city, to local mining industries as well as support the expansion of the transport network in the Eastern Region.
- Indicative Investment Amount: USD 180 million

**Alignment with Action Plan**

- Expansion on Electricity Access on urban areas, capitals of Municipalities and rural areas;
- Construction of the new water supply system from the river Chicapa, one of the weaker provinces in access to drinking water;
II. Project #2: Hydroelectric Power Plant – LUACANO

**IMPACT**

- **36 MW**
- **25,000 Households Electrified**
- **37.2 CO₂ kton/yr Emissions Savings**

**Deal Snapshot**

- Financing the construction and operation of the Hydroelectric Power Plant of Luacano, which will benefit the municipalities of Lucano, Luau and those located at border of the Upper Zambezi region;
- Indicative Annual Production: 140.2 GWh
- Indicative Investment amount: USD 390 million

**Alignment with Action Plan**

- Increase generation capacity in the East System;
- Rural electrification;
- Link with the rehabilitation and expansion of water supply system in Luacano;
Project #3. Hydroelectric Power Plant – Vuka

**IMPACT**

- **43.6 MW**
- **29,000 Households Electrified**
- **1.2 CO₂ kton/yr Emissions Savings**

**Deal Snapshot**

- Financing the construction and operation of the Hydroelectric Power Plant of Vuka, which will benefit the municipalities of Cuango e Luzamba, Cafunfo, Luremo, Xá Muteba, Capenda Camulemba. In the future will support and stabilize the connection in Very High Tension between the North and the East Systems;
- Indicative annual production: 209 GWh
- Indicative Investment Amount: USD 320 million

**Alignment with Action Plan**

- Increase generation capacity in the East System;
- Interconnectivity of the transmission systems;
- Rural Electrification.
### Investment Opportunities in Solar Energy

**IMPACT**

- **100 MW**
- **66,000 Households Electrified**
- **21.9 CO₂ kton/yr Emissions Savings**

<table>
<thead>
<tr>
<th>Region</th>
<th>Capacity (in MW)</th>
<th>Annual Production (MWh/yr)</th>
<th>Emission savings (CO₂ ton/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>30</td>
<td>57.51</td>
<td>36.61</td>
</tr>
<tr>
<td>South</td>
<td>70</td>
<td>136.33</td>
<td>86.79</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>193.84</td>
<td>123.40</td>
</tr>
</tbody>
</table>

**Alignment with Action Plan**

- Expansion on Electricity Access on urban areas, capitals of Municipalities and rural areas;
- Rural Electrification;
- Priority projects include: Namacunde (10 MW), Camongue (10 MW) and Caraculo (10 MW).
II. Investment Opportunities in Wind Energy

### IMPACT

<table>
<thead>
<tr>
<th>Capacity (in MW)</th>
<th>Annual Production (MWh/yr)</th>
<th>Emission savings (CO₂ ton/ Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>168</td>
<td>414.62</td>
</tr>
<tr>
<td>North</td>
<td>134</td>
<td>373.63</td>
</tr>
<tr>
<td>South</td>
<td>350</td>
<td>747.69</td>
</tr>
<tr>
<td>Total</td>
<td>652</td>
<td>1535.94</td>
</tr>
</tbody>
</table>

**Alignment with Action Plan**

- Expansion on Electricity Access on urban areas, capitals of Municipalities and rural areas;
- Rural Electrification;
- Priority projects include: Chibia (78 MW) and Cacula (88 MW).
II.

The social, economic and environmental sustainability is the third building block for development in the Angolan electricity sector.

- Establish **new electricity market conditions**
- Reduce governmental tariff subsidization
- Develop regulation capabilities to promote efficiency
- Management professionalization

- Expand rural electrification, boosting growth and development in these regions
- Ensure **long-term sustainability** and independence of local capabilities
- Deliver results to society in the short term

- Adopt a **better installed capacity mix** focused on Angola’s natural resources
- Choose **thermal powerplant technologies with reduced CO2 emissions**
- Develop pilot projects to expand renewable energies
- Promote electricity efficiency with mass **installation of prepayment meters**
Thank you for your attention.
### Public Investment Programme For 2018-2022

#### Generation
- Rehabilitation and relocation of Thermal plants;
- Optimization of thermal plants
- Installation of Ocean thermal plants in the North, Centre and South with reconversion to gas
- New regulation Hydro at the East for 2025/2030
- Rehabilitation of Large hydropower Plants

#### Transmission
- Laúca and Caculo Cabaça Hydro power evacuation
- Interconnection of North – Central grids Interconnection
- Capacity building of RNT
- Interconnection of South-Central grids
- Eastern grid connection at 220 KV
- Support to Municipal and rural Electrification at 110 kv Dembos and Malanje

#### Distribution & Rural Electrification
- Conversion to Pre-paid meters and tele metering in MT universal
- Electrification of Provincial Capital cities
- Rural and Municipal Electrification (northern, central, southern and eastern grids)
- Rural Electrification with Renewable energy
Projects Open For Private Investors’ Participation

**Conventional Large & Medium-Size Power Plants**
- NGCCPP Soyo 2 (750 MW);
- NGCPP Malembo 2 (100 MW);
- NGCPP Ocean Terminal Lobito 1 & 2 (750 MW)
- Large & Medium size Hydro - Catumbela River;
- Large & Medium size Hydro - Queue River;
- Medium Hydro in the East.

**New & Renewable Energy**
- Solar Energy Programme (200MW);
- Hybrid solar-Diesel Power Plants (58 MW);
- Biomass Thermal Plants and Urban solid waste thermal plants (Luanda & Benguela);
- First Wind park in Angola (100 MW);
- Studies for the relaunching of the Mini-Hydro programme.

**Municipal & Rural Areas Distribution**
- Management Contracts for municipal networks connected to the grid;
- Licencing of Municipal off-grid networks and creation of managing entities through partnership;
- Rent of individual solar units for isolated areas.