Ghana Integrated Power Sector Master Plan

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GHANA MASTER PLAN OVERVIEW

• Builds on existing sub-sector plans to guide future investment
• 2016-2019 USAID-funded Integrated Resource and Resilience Planning (IRRP) Project, implemented by ICF, worked with Ghana power stakeholders to develop the Integrated Power Sector Master Plan (IPSMP)
• 2018 version of the IPSMP is available at Ghana Energy Commission website http://www.energycom.gov.gh/ (scroll to “Planning” for drop-down menu)
• 2019 update of IPSMP is currently underway

**IPSMP vision:**
Develop a resilient power system to reliably meet Ghana’s growing power demand in a cost-effective manner that supports the country’s sustainable development
MASTER PLAN FRAMEWORK

Integrated Resource and Resilience Planning

Supply Side
- **Existing & New Sources**
  - Hydropower, Natural Gas
  - Coal, Oil, Nuclear
  - Renewables, Imports

- **Transmission**
  - **Existing and New Lines**
    - HV Transmission Lines
    - New line build options

Demand Side
- **Electricity Demand**
  - Industrial, Commercial, Residential
  - EE, DSM

Performance and Cost Characteristics

Least-Cost Planning Model
- Scenario Modeling

Resilience Assessment and Planning
- Environmental, Social, Financial Impact Analysis, Risk Analysis
  - (Regulatory, Financial, Environmental, Climate Change, Political)

Integrated Power Sector Master Plan
LEAST REGRETS PLANNING

• Develop policy/technology “strategies”
• Explicitly model various risks & uncertainties through “sensitivities”
• Consider a range of metrics, in addition to least cost
• Least Regrets Strategy performs the best under a broad range of potential techno-economic futures, under several metrics
ZONAL MODELLING

- Ghana divided in four zones
- Zones determined by transmission constraints
- Exports zones to neighbours
- Allows for location-specific generation and transmission builds
DEMAND GROWTH (2019 VERSION)

Reference Case

- **2019**: 2.83 GW, 18 TWh
- **2025**: 3.71 GW, 24.4 TWh
- **2035**: 5.83 GW, 38.1 TWh

High Case

- **2019**: 7.89 GW, 52.2 GWh
- **2025**:
- **2035**:

Low Case

- **2019**: 4.45 GW, 29.2 GWh
- **2025**:
- **2035**:

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DEMAND GROWTH PROJECTIONS

Annual Ghana Utility Projections (various year vintages)
DEMAND GROWTH PROJECTIONS

- **Key Risk Factors**
  - **VALCO**: New investments needed
  - **Exports**: Growth & Competition
  - **EE/DPV**: Cost-effective EE & Solar-PV can reduce grid demand
SUPPLY STATUS & PROJECTIONS

- **2018**: 4 GW installed capacity
- 900 MW of new gas plants under construction
- Several PPAs signed, but not yet financially closed
- Committed volumes of gas contracts and price of gas limits Ghana’s options
- Older thermal plants could retire
- Low RE costs attractive, but RE economics linked to gas price and competitive bidding

~900 MW Under Construction

<table>
<thead>
<tr>
<th>Plant</th>
<th>MW</th>
<th>Expected COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenpower</td>
<td>340</td>
<td>Q2 2019</td>
</tr>
<tr>
<td>Amandi</td>
<td>190</td>
<td>Q4 2019</td>
</tr>
<tr>
<td>Early Power Simple Cycle</td>
<td>140</td>
<td>Q3 2019</td>
</tr>
<tr>
<td>Early Power CC</td>
<td>190</td>
<td>Q1 2021</td>
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<tr>
<td>Early Power Phase 2</td>
<td>390</td>
<td>Q4 2023</td>
</tr>
<tr>
<td>AKSA</td>
<td>350</td>
<td>Retires 2023</td>
</tr>
<tr>
<td>Karpower</td>
<td>450</td>
<td>Retires 2027</td>
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</tbody>
</table>
## STRATEGIES & METRICS

### Strategic Options

<table>
<thead>
<tr>
<th>Strategic Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S1 Unconstrained (BAU)</strong></td>
<td>No technology-specific constraints</td>
</tr>
<tr>
<td><strong>S2 Indigenous Resources</strong></td>
<td>Utilize indigenous resources as a high priority</td>
</tr>
<tr>
<td><strong>S3 Diversified Resources</strong></td>
<td>Diversify fuels by building coal &amp; nuclear power</td>
</tr>
<tr>
<td><strong>S4 Reduced CO₂ growth</strong></td>
<td>Constrain CO₂ emissions to half of BAU emissions</td>
</tr>
<tr>
<td><strong>S5 Export Oriented</strong></td>
<td>Increase exports to neighbouring countries</td>
</tr>
</tbody>
</table>

### Metrics

- Cost
- Reliability
- Resilience
- Local Environment
- Land Use
- Climate Change
<table>
<thead>
<tr>
<th>Strategy</th>
<th>10-year INVESTMENT COST*</th>
<th>10-year SYSTEM COST**</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2</td>
<td>$1,075M</td>
<td>$7,771M</td>
</tr>
<tr>
<td>S1</td>
<td>$1,363M</td>
<td>$7,780M</td>
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<tr>
<td></td>
<td>+288M</td>
<td>+9M</td>
</tr>
<tr>
<td>S5</td>
<td>$1,404M</td>
<td>$7,814M</td>
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<tr>
<td></td>
<td>+329M</td>
<td>+43M</td>
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<tr>
<td>S3</td>
<td>$1,415M</td>
<td>$7,869M</td>
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<td></td>
<td>+340M</td>
<td>+98M</td>
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<tr>
<td>S4</td>
<td>$1,945M</td>
<td>$7,849M</td>
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<tr>
<td></td>
<td>+870M</td>
<td>+78M</td>
</tr>
</tbody>
</table>

*Costs averaged across 14 sensitivities for each strategy
** System cost does not include capacity charges for existing plants
KEY RECOMMENDATIONS (1)

• Prioritise the use of indigenous resources

• Competitively procure solar PV and wind projects connected to the transmission network in the range of 20-75 MW
  – Lower end-user tariffs and increase know-how on grid integration

• Do not build additional conventional plants beyond the ones under construction until the mid-2020s
  – Timing depends on retirements and demand growth (and tariffs)

• Expedite implementation of wholesale electricity market to increase dispatch efficiency and lower generation costs
KEY RECOMMENDATIONS (2)

• Establish a standing *Power Planning Technical Committee* to be a one-stop shop for power sector planning in Ghana
  – Core and non-core members – inputs & feedback

• **Regularly update IPSMP** (2019, and at least every 3 years)

• Competitively procure all future grid-connected plants and transmission based on IPSMP recommendations
  – Use licensing and financial incentives to adhere to plans
  – Transmission and distribution master plans should align with IPSMP
  – Harmonize Ghanaian and Regional plans
CHALLENGES REMAIN…

- Political drivers could lock-in additional generation and fuel contracts
  - GoG continues to be lobbied on projects (political aspirations vs. reality)
  - **Key Metric**: Provision of low-cost reliable electricity to consumers, not just capacity additions

- Institutional (individual) tussles, combined with lack of clarity on mandates, allows for non-economic decisions
  - Utility business decisions vs. Regulatory independence vs. Politics

- Ongoing poor financial health of utilities can derail good planning
  - Success of ECG concession? Greater transparency in tariff setting?

- Will training and built-capacity in planning be used in the long term?
  - Needs strong, motivated, and independent leadership (regulators & utilities)
MEDAASE! (THANK YOU)

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