A Framework to Approach Shared Use of Mining Related Infrastructure: Power

November 2013
## Background: Power in Africa

### Power Supply in Africa

- Generation capacity of the 48 Sub-Saharan African countries (pop. 800 million) ≈ Power generation capacity of Spain (pop. 45 million).
- Power consumption is only a tenth of the consumption in other developing countries.
- Level of power consumption is equal to each person using one 100Watt light bulb for three hours a day.

### Power Demand of Mines

- Power is a critical input to mining processes.
- The mining sector in Sub-Saharan Africa required 7,975MW in 2000 and 15,704MW in 2012.
- Mining demand for power could treble from the 2000 level and reach 23,192 MW by 2020.

Source: WB- VCC database
Infrastructure funding gap in power is the biggest of all infrastructure sectors

SSA Infrastructure Funding Gap by Sector (2008):

<table>
<thead>
<tr>
<th></th>
<th>Capital expenditure</th>
<th>Operations and maintenance</th>
<th>Total spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>0.8</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.7</td>
<td>--</td>
<td>0.7</td>
</tr>
<tr>
<td>Power</td>
<td>23.2</td>
<td>19.4</td>
<td>42.6</td>
</tr>
<tr>
<td>Transport</td>
<td>10.7</td>
<td>9.6</td>
<td>20.3</td>
</tr>
<tr>
<td>WSS</td>
<td>2.7</td>
<td>7.3</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38.1</strong></td>
<td><strong>37.4</strong></td>
<td><strong>75.5</strong></td>
</tr>
</tbody>
</table>

Source: ‘Overhauling the Engine of Growth: Infrastructure in Africa, AICD Sept 2008’
PURPOSE: Leveraging the mining industry’s power demand and its capital investments in power infrastructure for the development of the national power system

STEP 1: Assess the Current Situation – What is at Stake?

STEP 2: Identify Operational Synergies

STEP 3: Verify Necessary Pre-conditions

STEP 4: Negotiation Points
STEP 1: Assessing the current situation

What determines the mine’s power arrangement?

- **Adequacy of National Supply**
- **Reliability of Supply**
- **Cost of Grid Power**
- **Extent of Transmission Infrastructure**

- Depending on stage, commodity and type of operations, mines require a large amount of power.
- Power is crucial to mining operations - mines need reliable power access.
- Power intensity of mining operations means that profit margins are highly sensitive to power costs.
- Transmission network must extend to mines or cost of extending network must be economical.
STEP 1: Assessing the current situation

- The power sourcing arrangement will depend on the commodity and level of processing

- Power costs will often constitute between 10% and 25% of operating costs

- The more power-intensive the operation, the more it will look for cheap power sources

Source: Power of the Mine, VCC-WB report
STEP 2: Identifying Power-Mine Synergies

Benefit for country:
- Develop the national power generation facilities and electricity transmission systems
- Strengthen the utility
- Increase access to electricity in remote areas.

Benefit for mine:
- Effective coordination results in cost-savings
- Maintain social licence to operate
### Power-Mine Arrangement

<table>
<thead>
<tr>
<th>Power-Mine Arrangement</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Mine generates power for its own needs</td>
<td>Sierra Leone, Liberia</td>
</tr>
<tr>
<td>b. Mine provides power to communities</td>
<td>Sierra Leone, Guinea</td>
</tr>
<tr>
<td>c. Mine sells excess power to grid</td>
<td>Mozambique</td>
</tr>
<tr>
<td>d. Mine serves as anchor customer for Independent Power Producer (IPP)</td>
<td>Sierra Leone, Mauritania</td>
</tr>
<tr>
<td>e. Mine sources power from grid</td>
<td>Mozambique, Zambia</td>
</tr>
</tbody>
</table>
Mine supplies power to communities

- Where the distance to the grid is too large to warrant investment in transmission infrastructure

### Off-Grid Solutions

**Example: Sierra Leone**
Sierra Rutile has installed solar street lights in the townships of Moriba and Mogbwemo near its mining site

### RES - based Mini-Grid

**Example: Guinea**
Rio Tinto and Infraco initiative near the Simandou mine:
- 1 MW hydro power plant on the Cessou river
- 20 km 20kV transmission to Beyla
- Upgrade of existing distribution system

- Assists the government in meeting rural electrification goals
- Helps the mining company’s social license to operate
Where mining companies generate their own power, extra power could be sold back into the grid.

**Example** - Mozambique:
- Low quality thermal coal in Moatize
- High transportation costs to market
- Domestic and regional power demand

Commercial incentive for mines to build thermal coal power plants both for their own consumption and to sell excess power to grid

e.g. **Vale’s Moatize plant:**
- Initial phase net 270MW plant capacity. Mine will consume 220MW, with the remainder to be sold to EDM, transmitted via the Northern Grid.

Source: The Guardian
Mines sell excess power to grid: Coordination

- Economies of scale in coordinating investment among mines
- World Bank analysis of Liberian power sector:

**Individual Thermal Plants**
- Mines generate power through coal-fired plants
- 700MW generated to serve the mines, and 160MW of excess supply to the grid
- Average cost of power for the country = **$0.12/kWh** by 2030, compared to a base scenario without mine supply of $0.15/kWh

**Coordinated Thermal Plant**
- Average cost of power in Liberia by 2030 would fall to **$0.08/kWh**.
- **Saving to Mines:** $1.4 billion over a 20 year period (or US $70 million annually)
- **Saving to LEC:** $0.2 billion over a 20 year period (or US $10 million annually).
Mines serve as anchor for IPPs

- Given their large power needs, mines can also be used as anchor customers for IPP generation investments.
Mines serve as anchor for IPP: Sierra Leone

- Current plans for Joule Africa (IPP) to carry out expansion phase of Bumbuna Dam from 50 MW to 372MW.

- Projected cost post-transmission to be between $0.08-0.14/kWh.

- London Mining interested as a power off-taker. Current marginal cost of HFO power ($0.18/kWh)

Source: Renewbl.com (Top)  
Renewable-Technology.com (Bottom)
Mines serve as anchor for IPPs

- Depending on the situation, mines may choose to play a more active role in the IPP investment as part of a joint venture.

Example: Mauritania
- PPP between government, utility, state-owned mining company (SNIM) and Kinross Gold Corp to develop 350MW gas power plant
Mines source power from grid

- Mine extends transmission infrastructure
- Mine contributes to additional generation capacity and gets priority access
- Mine pays higher tariff to finance utility investment
### Mines source power from grid

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Example</th>
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<tbody>
<tr>
<td>Mine extends transmission</td>
<td>• Ownership of infrastructure transferred to utility, and mine is compensated through repayment by utility, in cash (often with interest) or through discounted power tariffs&lt;br&gt;• <em>When economically feasibility, mining companies of the same mining basin should share the transmission infrastructure to improve the utility’s financial health</em></td>
<td>• Extension of <strong>Burkina Faso’s</strong> transmission infrastructure to Semafo’s Mana gold mine.&lt;br&gt;• Sonabel, the national power utility company repays it over 8 years following commissioning.</td>
</tr>
<tr>
<td>infrastructure</td>
<td></td>
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<tr>
<td>Mine invests in generation</td>
<td>• Mines get priority access in exchange for investment in emergency power infrastructure</td>
<td>• In <strong>Ghana</strong>, four mining companies built a 80MW thermal power plant in Tema.&lt;br&gt;• Ownership transferred to public utility company VRA&lt;br&gt;• Plant serves as a back-up for the mines in case of energy shortage</td>
</tr>
<tr>
<td>Mine pays higher tariff</td>
<td>• Mine pays higher tariff for investment to be carried out by the utility company</td>
<td>• In <strong>Zambia</strong>, Zesco (electrical supply company) has increased its industrial/bulk supply tariffs by 30% to support new investments in generation</td>
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</tbody>
</table>
## STEP 2 Summary: Power-Mine Synergies

<table>
<thead>
<tr>
<th>Scenario</th>
<th>How can the power sector leverage the mining energy demand?</th>
<th>Benefit for the mine</th>
<th>Increased welfare for the host state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid : Too remote</td>
<td><strong>Mine: Builds its own generation</strong></td>
<td>Social license to operate</td>
<td>Rural electrification</td>
</tr>
<tr>
<td>Mine supplies power to communities</td>
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<tr>
<td>Grid: Too expensive or unstable</td>
<td><strong>Mine: Builds its own generation</strong></td>
<td>Additional revenues</td>
<td>Additional sources of generation</td>
</tr>
<tr>
<td>Mine sells excess power to the grid</td>
<td>Mines build bigger collective power plant</td>
<td>Diminished costs of energy</td>
<td>Fall in cost of generation</td>
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<tr>
<td>Mine serves as anchor for IPPs</td>
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<tr>
<td>Grid : Hydro-based (gas-based) and cheap</td>
<td><strong>Mine: sources power from the grid</strong></td>
<td>Stable access to cheap electricity</td>
<td>Utility company can gain efficiency</td>
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<tr>
<td>Mines participate in upgrading power generation and transmission infrastructure</td>
<td></td>
<td>Opportunity for additional revenues</td>
<td>Infrastructure upgrading</td>
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<td>Avoid saturation of the grid</td>
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</table>
STEP 3: Verify the Preconditions

- Sufficiently liberalised market with trusted legal framework and regulatory oversight
- Public utility company as a credit-worthy partner
- Comprehensive planning framework that incorporates mining power demand and investment
## STEP 3: Pre-conditions for Power-Mine Synergies

<table>
<thead>
<tr>
<th>Power-Mine Synergy Category</th>
<th>Pre-Conditions</th>
<th>Policy Instruments</th>
</tr>
</thead>
</table>
| Mine supplies power to communities | Trusted and stable legal framework | • Well-drafted contractual requirement  
• Government and company coordination  
• Reorienting of social tariff subsidies to support to RES mini-grid |
| Mine sells excess power to the grid | Public Utility as a viable and credit-worthy Partner | • Strong and efficient mutually beneficial PPA and IPP framework  
• Efficient regulatory system adapted to the country |
| Mines build bigger collective power plant | Integrating mining growth and plans into the power master plan | • Suitable commercial arrangements between the utility and the mining partner  
• Supply-side and demand-side management |
| Mine serves as anchor for IPPs | | |
| Mines participate in upgrading the grid (generation and transmission) | | |
### STEP 4: Negotiating Points

| Mines Supplies Communities | • Parties to be involved (government, utility, donors, NGOs)?  
|                          | • Responsibilities of each party?  
|                          | • Provisions for post-mine closure? |
| Mine Sells Excess Power to Grid | • Scope for coordination among mines?  
|                                | • Terms of the PPA between mine and utility company?  
|                                | • Quality of the utility? Are extra guarantees necessary?  
|                                | • Responsibility for transmission? |
| Mine Serves as Anchor for IPP | • Role of mine i.e. off-taker or joint venture partner?  
|                               | • Alignment of timing? Provision for delays?  
|                               | • Terms of the PPA?  
|                               | • Quality of the utility/company? Extra guarantees necessary?  
|                               | • Responsibility for transmission of power? |
| Mine Sources Power from Grid  | • Commercial arrangement for transmission infrastructure?  
|                             | • Ownership of transmission infrastructure?  
|                             | • Design for smaller users to tap into grid supply?  
|                             | • How to avoid saturation of the grid? |