Assessing Opportunities and Challenges for Utilizing Coal in Botswana

M.T. Oladiran and C. Kiravu, University of Botswana
O.A. Plumb, University of Wyoming
Overview of Talk

- Background on Botswana
- Energy consumption in Botswana and region
- Coal reserves and production in Botswana and region
- Current plans and future vision for coal in Botswana
- Conclusion
Industries in Botswana

- Wild Life and Bird Sanctuaries
- Tourism and Development
- Processing and Export of Beef
- Mining and Export of Diamonds
Wild Life in Botswana
Okavango Delta in Botswana
Energy Consumption by Sectors in Botswana

- Residential: 38%
- Industry: 27%
- Transportation: 25%
- Government: 8%
- Agriculture: 2%
Energy Utilization for S. African Region
Heat and Electric (GWH)

![Energy Utilization Chart for S. African Region](chart.png)
Coal Consumption in South African Region (kt)
Per Capita Primary Energy Consumption (million BTU, 2008)

- Botswana  
  33.1
- Zambia  
  11.1
- Zimbabwe  
  15.0
- Namibia  
  29.3
- South Africa  
  117.2
- USA  
  334.6
- China  
  56.2
### 2008 Production, Thousands of Short Tons

<table>
<thead>
<tr>
<th>Country</th>
<th>Production</th>
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<tbody>
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<td>Botswana</td>
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<td>Namibia</td>
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<td>Zambia</td>
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<td>Zimbabwe</td>
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</tbody>
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Coal Reserves (IEA 2005, Millions of Short Tons)

- Botswana (IEA) 44
- Botswana (Recent Internal Report) 212000
- Namibia 0
- South Africa 52911
- Zambia 11
- Zimbabwe 553
Recoverable Reserves (Cairncross, JAES, 2001, tons)

- Botswana 4754
- South Africa 60,994
- Namibia -
- Zambia 61
- Zimbabwe 809
Properties of Botswana Coal (Morupule)

- 21.1% ash
- 24.3% matter
- 24.4 MJ/kg
- 1.44% sulfur
- 0.5 – 9.5 m seam thickness
- Medium volatile, high ash bituminous
Botswana’s Current Status

- Electricity – 70% imported from South Africa
- 55% of the population is connected to the grid
- 100% of transportation fuel is imported
- Significant % of home heating is provided by biomass (wood) which may not be sustainable
Botswana’s Goals

• Move from 55% to 80% connectivity by 2016
• 200 MW CBM by 2020 (the resource is estimated to be 196 tcf with 40 tcf recoverable)
• Expand existing 132 MW coal-fired power generating unit at Morupule by 600 MW by 2012
• Explore potential for UCG and production of transportation fuels from coal
• Add 200 MW of solar thermal by 2020
Current Projects and Studies

- Exploration of Jatropha as a potential biomass energy resource
- Village distributed electrification via photovoltaics
- Potential for solar/coal hybrid power generation
- Feasibility for production of 20,000 l/day of biodiesel from animal fat
Future Potential

• In addition to coal resource, the solar resource is significant, 6.5-7.0 kWh/m²/day on flat plate tilted at latitude over most of the country
Fig. Variation of global radiation.
Integrated Solar Combined Cycle System
Feedwater heating utilizing solar
Solar input at boiler
Coal Export Opportunities and Challenges

• Immense coal reserves & relatively cheap.
• Coal to be washed to improve quality i.e. remove some of the ash content
• Botswana is land locked but stable government
• No current rail systems to possible markets.
  – New rail to Durban – for market in the East
  – New rail to Cape Town for market in the West
  – Activate rail to Zimbabwe to supply countries in the North
• Bilateral agreement to be designed.
• New Energy Policy to include export.
• New Guidelines e.g. to curb environmental pollution
Conclusions

• Botswana has a significant coal resource that is not completely characterized
• Using the coal and solar resource the country can easily supply its long term electrical needs
• In the longer term coal plus CBM could supply transportation fuel needs
• Potential to export coal through Durban, SA, and elsewhere exists but infrastructure needs development
• Botswana could supply coal generated electricity to neighboring Zambia and Namibia if transmission lines can be built