The South African Electricity Sector: challenges and options

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http://www.electricitypolicy.org.uk
South Africa supplies 70% of sub-Saharan Africa’s electricity generation.
Eskom – a VI monopoly SOE

- Until 1994 unregulated
- Could borrow at low rates of interest
- In 1970s embarked on large investment in G
  - 4,000 MW UK stations, unsuited to local coal
  - Low availability => increase investment
  - Borrow, raise prices, then improve performance
⇒ Surplus capacity, inflation erodes real debt
⇒ Prices can fall in real terms, debt paid off
Historical growth in maximum demand and capacity at Eskom

Installed capacity/Max demand (MW)

Reserve margin

Net maximum installed capacity

Maximum demand

Over-investment led to increasing reserve margin

Historical growth in maximum demand and capacity at Eskom
Eskom’s successes

- Commission of inquiry replaces management
- Eskom recruits/trains excellent black managers
- Surplus cash poured into electrification
  - Complete change of priorities despite apartheid
- 1994: Eskom darling of rainbow nation
  - Despite continued low prices to the old heavy export-oriented industry
Reform pressures post 1994

- SOEs increasingly criticised for inefficiency
  - Particularly for investment
- Anticipate need for new capacity 2006+
- Municipal discos inefficient, need reform
- Consensus model – liberalise, unbundle, encourage new IPPs, privatise, regulate …
- Debate on reform starts – conferences, reports, models,…..
Eskom Productivity 1979-2006

GWh produced/employee
GWh sold/employee
Customers/Employee RHS

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Eskom's average selling price deflated by CPI
Electrification: Impressive success but dodgy data

Source: NER, Stats SA, Eskom
Where are we now?

- Little progress, privatisation abandoned but IPPs still to have at least 30% of (new?) capacity
- Regulator created, but prices still based on historic AC
- Demand has (predictably) outstripped capacity
  - reliability falling, new build delayed, costs rising
- Challenges:
  - Security of supply needs to be restored in G, T & D
  - Prices are below LRMC and need to be raised
  - Reconsider restructuring options?
- How should prices be set?
Reserve margins are below desired 15-20% level
And reserve margins could deteriorate further

If Eskom stations delayed by one year
If IPPs delayed by one year and less cogen
If energy savings targets not realised
Eskom Generation Unplanned Capacity Loss Factors
# Eskom transmission performance benchmarked against 25 utilities

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Substation Composite</td>
<td>Below Average</td>
<td>Below Average</td>
<td>Poor</td>
<td>Above Average</td>
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<tr>
<td>Line Composite</td>
<td>Above Average</td>
<td>Good</td>
<td>Below Average</td>
<td>Poor</td>
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<tr>
<td>Field Switching Operations</td>
<td>Good</td>
<td>Good</td>
<td>Above Average</td>
<td>Above Average</td>
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<tr>
<td>Transformers</td>
<td>Good</td>
<td>Below Average</td>
<td>Average</td>
<td>Very Poor</td>
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<tr>
<td>Breakers</td>
<td>Good</td>
<td>Above Average</td>
<td>Above Average</td>
<td>Average</td>
</tr>
<tr>
<td>Compensation Equipment</td>
<td>Average</td>
<td>Below Average</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Instrument Transformers</td>
<td>Good</td>
<td>Above Average</td>
<td>Good</td>
<td>Above Average</td>
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<tr>
<td>Disconnectors</td>
<td>Above Average</td>
<td>Good</td>
<td>Below Average</td>
<td>Good</td>
</tr>
<tr>
<td>Site and Aux Equipment</td>
<td>Below Average</td>
<td>Poor</td>
<td>Average</td>
<td>Average</td>
</tr>
<tr>
<td>Relay</td>
<td>Above Average</td>
<td>Poor</td>
<td>Below Average</td>
<td>Good</td>
</tr>
<tr>
<td>Line Maintenance</td>
<td>Good</td>
<td>Good</td>
<td>Average</td>
<td>Below Average</td>
</tr>
<tr>
<td>Patrol and Inspect</td>
<td>Good</td>
<td>Good</td>
<td>Average</td>
<td>Below Average</td>
</tr>
<tr>
<td>Right of Way</td>
<td>Below Average</td>
<td>Excellent</td>
<td>Below Average</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>
South Africa's Carbon Dioxide emissions
About two-third of Sub-Saharan Africa's total

million tonnes


petroleum
natural gas
other coal
Eskom
At 10 US$/tonne = +$10/MWh, +40% price
Eskom's average selling price deflated by CPI

![Graph showing the average selling price of Eskom's electricity from 1979 to 2005, with prices deflated by the Consumer Price Index (CPI). The graph compares the South African (ZA) cents per kWh and the US (2005) cents per kWh.](image-url)
World industrial electricity prices from a representative utility in each country

US cents per kWh

The survey is based on prices at 1 April 2007 for the supply of 1 000kW for an organisation with a monthly usage of 450 000kWh. All prices are in US cents per
Demand patterns

MW in thousands

00:00 – 24:00

Typical winter day
Typical summer day
Peak day 29 June 2006
Eskom’s prices and costs

- Eskom delivered rapid productivity growth
- Eskom’s sales price is low and falling
- Coal costs are low by international standards
- But capital costs of new coal are high
- Efficient pricing when investment needed:
  - annual cost = LRMC > current price

*Current underpricing is inefficient, and short-changes owners = the people*
Coal costs to Eskom and delivered NW Europe

Coal prices (US$2000)

- EU import price
- Eskom cost
- NW Europe (BP)
- NIRP2 new PF

Newbery and Eberhard
E&E Feb 2008
Energy and capital costs

Variable costs: Coal  US$1-5/MWhe
LNG: $56/MWhe, distillate in CCGT $77/Mwhe, in OCGT = $130/MWhe (at $7/mmBTU for gas)
Peak price (Megaflex) = $63/MWh

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Coal vs other fuels

• gas was costly in 2003 at $3.50/mmBTU
• since then price has doubled
  – as has oil and distillate
• coal capex is rising fast
  – demand growth world-wide
• nuclear costs are unknown
  – PBMR not proven, EPWR costs rising
But assets are heavily written down
Eskom’s pricing

• Based on average historic cost
• Forward price projections based on need to finance new investment
• Gradual price rise reflects undervaluation of current capacity - share of new capex only slowly rises
• Scarcity pricing (SRMC>LRMC) generates huge price rise
Table 1 Estimates of Eskom’s asset values, \(ZAR\) (2006) billion

<table>
<thead>
<tr>
<th></th>
<th>CCA original cost 2003 at 2006 prices</th>
<th>CCA current value 2003 at 2006 prices</th>
<th>HC carrying value 2006 March</th>
<th>HCA depreciation</th>
<th>estimated ODV</th>
<th>Depreciation on CCA cost</th>
<th>ODV/CCA</th>
<th>ODA/HC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation</strong></td>
<td>197.6</td>
<td>76.5</td>
<td>26.4</td>
<td>2.2</td>
<td><strong>200.0</strong></td>
<td>4.9</td>
<td>2.6</td>
<td>7.6</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>49.0</td>
<td>12.5</td>
<td>7.2</td>
<td>0.5</td>
<td>32.8</td>
<td>1.2</td>
<td>2.6</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
<td>78.1</td>
<td>31.4</td>
<td>19.7</td>
<td>1.5</td>
<td>80.0</td>
<td>2.0</td>
<td>2.5</td>
<td>4.1</td>
</tr>
<tr>
<td>land and building</td>
<td>21.5</td>
<td>6.6</td>
<td>1.8</td>
<td>0.0</td>
<td>17.2</td>
<td>0.4</td>
<td>2.6</td>
<td>9.4</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>8.4</td>
<td>1.9</td>
<td>1.9</td>
<td>0.4</td>
<td>4.9</td>
<td>0.6</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>total in commission</strong></td>
<td>354.6</td>
<td>128.9</td>
<td>57.0</td>
<td>4.6</td>
<td><strong>334.9</strong></td>
<td>9.1</td>
<td>2.6</td>
<td>5.9</td>
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<tr>
<td><strong>Mothballed plant</strong></td>
<td>15.6</td>
<td>3.9</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>work under construction</td>
<td>3.6</td>
<td>3.6</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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Source: Eskom’s accounts 2003, 2006 and calculations
Eskom’s asset values

= 57 ZAR bn historic cost in 2006
= 129 ZAR bn inflation adjusted to 2006
Optimal deprival value = 335 ZAR bn (2006)
    of which generation = 200 ZAR bn
Economic return = 2.3% on ODV

*Suggests serious underpricing*
NERSA on pricing electricity

- Tariffs should enhance *economic efficiency*
- Structure and level should be *cost reflective*
  - with possible exceptions:
    - to ease transition, for distributional reasons
- Cross-subsidies should be levied *transparently*
  - licensees should publicise average level of cross subsidy between customer categories
Approaches to pricing

• ODV value + WACC of 8% prices should increase 60% from 170 to 270 ZAR/MWh
  – Still 3\textsuperscript{rd} cheapest of 14 countries at $40/MWh
  – and this excludes any CO\textsubscript{2} cost

• Generation LRMC = 250 ZAR/MWh
  + current T&D = 320 ZAR/MWh ($48)
  + revalued T&D might be 370 ZAR/MWh ($55)

\textit{What is the right price to set?}
Pricing in liberalised markets

• for private investment wholesale price must satisfy investors
  – they must expect prices at or above LRMC
  – future risks (cheaper alternatives) => higher discount rate

• test: does the market price reward PPAs?
• Would energy consumers sign PPAs?
Pricing

• Efficient pricing most important for marginal increments of demand
  => LRMC most important for new energy-intensive users (Aluminium?)
    – benchmark against IPP PPAs
    – Target price increases on larger customers?
  => raise peak prices, energy prices relative to fixed charges?

Eskom should be a cash cow, not a hungry dog
Institutional reform options

• Reform has been successfully delayed
• Investment now requires Eskom’s full attention, deflecting early restructuring
  – but Eskom will be under close scrutiny given large financial requirements, price rises
  – timely decisions about IPPs required
• Longer term: the single buyer model?
Conclusions (1)

• Eskom has been adept during the transition
  – in electrification, securing political support, improving performance
  – in setting challenging standards for Muni Discos

• Challenge: financing and delivering efficient investment and performance in all segments
  – starting from a low price but with valuable assets

• Regulation & governance:
  – clarify responsibilities for investment, pricing, IPPs
Conclusions (2)

• Restoring supply security requires not only an accelerated investment programme but an enabling policy and institutional framework
  – Planning and approval processes need rationalisation
  – Need more transparent allocation of IPP opportunities
  – Need more efficient procurement of IPPs
• Distribution restructuring not yet a reality: need Plan B
• Need a more realistic, achievable universal coverage programme
• NERSA needs to move prices to economic levels
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