Renewable Energy
Electricity from Sugar Cane Fibre
in South Africa and Region

NERSA Consultation Paper
Cogeneration Regulatory Rules and COFIT

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Sugarcane Agriculture & Processing
Contribution to South African Economy
Trends – Permanent Structural Change
Policy Priorities
Impact of Electricity on Sugar Industry
Renewable Cogeneration from Sugarcane Fibre
  Fuel Cost
  IRP 2010 - 2030
  Revision of Key Parameters
Recommendations
Sugarcane Agriculture & Processing

Sugarcane

Tops and trash
• 15% fibre
• No product
• Partially to electricity

Fibre

15% fibre

No product

Partially to electricity

Electricity and Steam (CHP)

• Present Situation
  • at low energy efficiency for own use

• New Power Island
  • Higher efficiency – 3 times more power
  • Higher energy efficient mill – less steam
  • Sugar mill procures electricity

Other Products

• Animal feeds
• Paper
• Chemicals

Future Products

• Cellulosic ethanol

Sugar Act defines Bagasse as “Product”

Sugars

80% as sugar

20% as molasses

Sugars to ethanol

Molasses - potable and industrial ethanol

fuel ethanol
## Contribution to the South African Economy

The Sugar Industry on average represents:

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total average industry income</td>
<td>R8 billion p.a.</td>
</tr>
<tr>
<td>Export earnings</td>
<td>R2.5 billion p.a.</td>
</tr>
<tr>
<td>Average value of sugarcane production</td>
<td>R5.1 billion p.a.</td>
</tr>
<tr>
<td></td>
<td>(more than 15% of total gross value of South African annual field crop production)</td>
</tr>
<tr>
<td>Direct jobs</td>
<td>77 000</td>
</tr>
<tr>
<td>Indirect employment</td>
<td>350 000</td>
</tr>
<tr>
<td>Support to domestic value chain</td>
<td>R300 million p.a.</td>
</tr>
</tbody>
</table>

Support to domestic value chain of R300 million p.a. refers to rebates paid to domestic manufacturers and value-added exports.
International – Permanent Structural Change

- World’s two largest cane producers, Brazil and India, have access to sugar, electricity and ethanol markets
- Number of sugar industries transforming to co-produce sugar, ethanol and electricity

Sugar-only industries are revenue uncompetitive
South African Sugarcane Internationally Competitive

Weighted World Average of Nominal Cane Sugar and Beet Sugar Production Costs, 2006/07-2008/09

Cumulative output, million tonnes

South Africa

India

Brazil C.S.

Source: LMC INTERNATIONAL Dec 2010
Sugar Industry Trends – South Africa

Annual South African Sugar Cane Production

- **Internationally Cost Competitive**
- **Declining sugarcane production** – presently sugar only industry
- **Small Scale Grower** declined from 29 000 to 14 000 since 2000
- **Declining milling capacity** to 75% utilisation (average across industry)
Few Industries fulfill aspirations of National Plans and Policies as well as a viable sugarcane processing industry

- Medium Term Strategic Framework (MTSF)
- Rural Development and Land Reform
- Climate Change – Low carbon
- New Growth Path
- Industrial Policy Action Plan 2011/12 – 2013/14
  - Economic Sectors and Employment Cluster

Most labour intensive energy supply option

Secures and expands rural sugarcane economy

Effective in terms of trade

Synergistic with fuel ethanol from sugarcane

Established base for substantial regional development
Impact of Electricity on Sugarcane Industry

- At stake – on the margin 57,500 direct and 262,000 indirect jobs
- Retention – 28,000 direct and 127,000 indirect jobs
- New – 29,500 direct and 135,000 indirect jobs
- Long-term sustains 21,300 direct and 97,000 indirect jobs (revenue split)
- Viable sugarcane agro-processing industry critical for success of estimated total investment of Rand 7 to 10 billion in land reform

- Substantial Investment in rural economy
  - Electricity Supply 15 to 23 Rand Billion
  - Sugarcane agriculture 5 to 7 Rand Billion
  - About 80% of capital equipment sourced in SA – IPAP

- Improved viability of sugarcane agro-processing
  - Sugarcane fibre 15% of sugarcane – electricity 30% of revenue.
  - Sugar constitutes 12% of sugarcane – sugar 70% of revenue
  - Ethanol and sugar reform required for new plants – further 20% revenue
Sugar Revenue insufficient to secure Sugarcane Supply

Implicit Risk Assumptions in NERSA REFIT and COFIT

• No market risk (volume and price)
• No input risk (volume and cost of fuel)

One common raw material for both sugar and electricity

• Fuel only feedstock risks covered by tariff
• Fuel from a multi-product feedstock risk cannot be covered by tariff
• Sugar is a volatile agricultural commodity
• Agricultural risks such as weather, drought and pests
• Exogenous financial parameters

Inherent risk to secure supply of sugarcane fibre

• Risk to be partially covered by sugarcane fibre value
Fuel Cost – New Investment Scenario

- One common raw material processed to multiple products
- Based on new investment principle inherent in NERSA tariffs
- Generic mill at full capacity and high energy efficiency
- Representative season consistent with long-term costs and revenues
- Full cost of capital and operating costs across the total value chain

Fuel Cost

5.93 $/GJ (GCV)
IRP 2010-2030
• IRP adjusted fuel value to 19 Rand/GJ (2.6 $/GJ) for modeling purposes
• Presently own electricity generation similar to this value
• No investment feasible at this sugarcane fibre fuel cost
• IRP 2010-2030 sugarcane value based on EPRI forest residue
  • EPRI clearly states “assumed value”
  • Not based on cost analysis of sugarcane fibre
• NERSA defined sugarcane fibre as a co-product
• SASA concurs with NERSA – all bagasse is currently utilised
• Sugar Act defines bagasse as a product

Renewable Cogeneration of Sugarcane Fibre
• Step change from low to high energy efficiency
Proposed Revisions of Sugarcane Fibre Parameters

- Consistent with new investment scenario model
- Adjusted Heat Rate based on:
  - Change from LCV to GCV – 50% moisture content of bagasse
  - Medium pressure boilers
  - Distribution of steam to backpressure and condensing turbines

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>COFIT Type 3 Sugarcane Fibre 1 New</th>
<th>COFIT Type 3 Sugarcane Fibre 2 Upgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Energy Content</td>
<td>kJ (GCV)/kg</td>
<td>8 897</td>
<td>8 897</td>
</tr>
<tr>
<td>Heat rate</td>
<td>kJ (GCV)/kWh</td>
<td>24 043</td>
<td>33 432</td>
</tr>
<tr>
<td>Fuel Cost</td>
<td>$/GJ (GCV)</td>
<td>5.93</td>
<td>5.93</td>
</tr>
<tr>
<td>Fixed O&amp;M</td>
<td>$/kW/Year</td>
<td>47.8</td>
<td>15.54</td>
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<tr>
<td>Load Factor</td>
<td></td>
<td>55.9%</td>
<td>55%</td>
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</table>
SASA supports the Sugarcane Fibre Tariffs based on NERSA Consultation Paper COFIT (19 January 2011)

Adjustments based on sugar industry submission

Industry submission based on extensive cost analysis

Secures sugarcane fibre fuel supply for electricity investment

Enables turn-around and growth of sugarcane industry

Supply renewable low carbon electricity in the medium term

During expected period of supply shortage 2012 to 2016
- Potential option for industry members
- Published heat rate better than for large scale coal based power station
  - 100% condensing turbine at high energy efficiency and integration
  - Low quality and low value coal
- Proposed heat rate based on
  - 100% backpressure turbine
  - Medium pressure boiler
  - Lower energy efficiency of small scale power plant (100 MW)
- Export parity and quality coal at the KwaZulu-Natal coast

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>IRP Large Scale Coal</th>
<th>COFIT Type 2 CHP Coal NERSA Consultation</th>
<th>COFIT Type 2 CHP Coal Proposed Parameters</th>
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<tr>
<td>Heat rate</td>
<td>kJ (GCV)/kWh</td>
<td>10 081</td>
<td>9 769</td>
<td>18 840</td>
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<tr>
<td>Fuel Cost</td>
<td>$/GJ (GCV)</td>
<td>2.02</td>
<td>2.02</td>
<td>4.0</td>
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