Renewable Energy from Sugarcane - Potential in SADC

IEP Colloquium : 30 MARCH

Wolfgang Fechter : Bioenergy Executive

Tongaat Hulett
Presentation Themes

• Sugarcane Agriculture and Processing
• Industry Model Developed for Renewable Energy
• Potential within SADC
• SADC has Similar Cane Energy Potential as Brazil
• Ethanol Production Costs
• Relative Oil and Sugar Pricing
• Renewable Fuel Policy
• Conclusion
• Additional Slides
Sugarcane agriculture and processing

- **Tops and leaves**
  - 15% fibre

- **Fibre**

- **Sugars**
  - 80% as sugar
  - 20% as molasses

- **Sugars to ethanol**
  - Molasses - potable and industrial ethanol
  - Fuel ethanol

- **Electricity and Steam**
  - **Current**
    - Fuel supply matched to own energy use
  - **New Power Island**
    - At high efficiency 2 to 5 times more power
    - Less steam to higher energy efficient mill
    - Sugar mill procures electricity

- **Other Products**
  - Animal feeds
  - Paper
  - Chemicals

Sugar Act defines Bagasse as Product

**Sugarcane** – one of most efficient plant to convert sunlight into energy

**Season** - April to December

**Tongaat Hulett**
Industry Model developed - SA Renewable Energy

• **Electricity – 1 000 MW**
  • 14 existing mills at full capacity
  • 2 new ethanol mills
  • 70% condensing – “base load during peak demand”

• **Ethanol – 600 to 900 million liter**
  • Returns based Petroleum Industry Framework
  • Export Raw Sugar to Ethanol 600 million liter
  • New estates 300 million liter
  • Sugar and Ethanol pricing linked

• **Sugarcane Agriculture Existing Mills**
  – 90% of jobs
  • 20 000 new jobs alone
  • New area under sugarcane
  • Re-establish yields through re-planting

• **Sugarcane costs**
  • Oil pricing
  • Electricity Pricing
  • Sugar pricing
  • Currency

*Tongaat Hulett*
Potential within SADC

Key Issues

• Land
• Water
• Human Capacity
Land Comparison

<table>
<thead>
<tr>
<th></th>
<th>South Africa</th>
<th>SADC</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Million hectares</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest area</td>
<td>10</td>
<td>370</td>
<td>480</td>
</tr>
<tr>
<td>Pasture</td>
<td>40</td>
<td>340</td>
<td>190</td>
</tr>
<tr>
<td>Cropland Potential</td>
<td>&lt;10</td>
<td>60 - 120</td>
<td>60-100</td>
</tr>
<tr>
<td>Other</td>
<td>60</td>
<td>200</td>
<td>110</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>970</td>
<td>850</td>
</tr>
</tbody>
</table>

Source: FAOSTAT 2008
Rainfall and Water Supply Comparison

Regional Rainfall Pattern:

Southern SADC
- Limited additional potential
- Low rainfall, limited water for irrigation and land
- Focus on next generation – ethanol from cellulose

Northern SADC
- Substantial potential
- Suitable rainfall, extensive water for irrigation and land
- Limited infrastructure
- Small markets

<table>
<thead>
<tr>
<th></th>
<th>Billion liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>SADC</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>
SADC has similar cane energy potential as Brazil

- Combine competitive advantages of SADC
  - 2% – 4% of SADC cropland required
  - Water suitable – rain and irrigation
  - Market - Economies of scale
  - SA - 70% of SADC fuel market
  - SA - 80% of SADC electricity market
  - Equivalent to 13 SA sugar industries

- Electricity generation
  - 6 500 MW (bagasse and leaves)
  - Annual increase in supply - 500 MW
  - Medupi power station = 4800 MW

- 20 billion litres of ethanol
  - 10% of Angola Oil Industry

- Over 15 years to E50 – Brazil 2010 at E60
  - Fuel growth 5% - future petrol demand
  - Blend E20-25 – anhydrous ethanol
  - Flex Fuel Vehicle E85 – hydrous ethanol
  - No light diesel vehicles

- >1 million new jobs
  - 5 million indirect employment

- Very high localisation for SA
- Meets 15 to 25% of UNFCCC CO₂ reduction commitment by South Africa

- Rateable investment reduces cost
- $ 20 - 25 billion annual turnover
Impact on Livelihood

- **SADC ethanol and electricity from sugarcane**
  - Over 10 - 15 years can create 3 million direct jobs (1.8 million permanent)
  - 24 million dependants
  - R70 billion per annum earned by the “rural economy” of SADC

- **Experience in Zimbabwe – 2 mills**
  - 19 schools
  - 2 Hospitals serving 200 000 patients per annum
  - Cattle farming and only abattoir in the region
  - Large scale maize farming
  - Local services – refuse removal, water supply

- **Experience in Mozambique**
  - Only Hospital in Beira area serving community of 50 000

- **Experience in South Africa**
  - Initially created all services
  - Now towns in own right - Tongaat
  - Many leaders and professionals from sugarcane agro-processing workers

*Most development journeys started with sustainable agriculture*
## Ethanol Production Cost

<table>
<thead>
<tr>
<th>Type of Investment</th>
<th>Sugar</th>
<th>Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Greenfields</td>
<td>Greenfields</td>
</tr>
<tr>
<td><strong>Unit</strong></td>
<td>US c/lb</td>
<td>US c/l</td>
</tr>
<tr>
<td><strong>Capital Cost @ 15% = EBITDA</strong></td>
<td>18.6</td>
<td>71</td>
</tr>
<tr>
<td><strong>Operating Cost</strong></td>
<td>19.4</td>
<td>62</td>
</tr>
<tr>
<td>Agriculture</td>
<td>15.4</td>
<td>49</td>
</tr>
<tr>
<td>Industrial</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Raw Material</td>
<td></td>
<td>92</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>38</td>
<td>132</td>
</tr>
<tr>
<td><strong>Total Revenue</strong></td>
<td>38</td>
<td>132</td>
</tr>
<tr>
<td>Ethanol</td>
<td></td>
<td>95</td>
</tr>
<tr>
<td>Sugar</td>
<td>25.7</td>
<td></td>
</tr>
<tr>
<td>Molasses</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Electricity</td>
<td>10.9</td>
<td>37</td>
</tr>
</tbody>
</table>

**Tongaat Hulett**
## Relative Oil and Sugar Pricing

<table>
<thead>
<tr>
<th>Fuel Ethanol</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>Pump price</td>
</tr>
<tr>
<td>petrol energy equivalent</td>
<td>BFP + Tax</td>
</tr>
<tr>
<td>Ethanol</td>
<td>BFP</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Oil price</td>
</tr>
<tr>
<td>Sugar price</td>
<td>(April 2011)</td>
</tr>
<tr>
<td>Renewable electricity at 171c/kWh</td>
<td></td>
</tr>
</tbody>
</table>

### Cost Structure
- Capital cost for ethanol lower than petrol
- Operating cost for ethanol higher than petrol

### Pricing structure
- Linked to ethanol costs and oil price
- Ethanol is labour intensive and cannot withstand high oil volatility

### Brazil
- Gasoline price managed between viable ethanol and oil price
- Gasoline produce price about 673 SA c/l over 75 to 90 $/bbl

### SA fuel taxes low
- Brazil fuel taxes about double SA
Renewable Fuel Policy

Energy
• Develop two ethanol markets
  • Blend – anhydrous ethanol
  • Fuel for Flexible Fuel Vehicles (FFV) – hydrous ethanol
• Incremental expansion consistent with demand growth
• Diversify fuel supply and feedstock risk

Automotive
• Introduce flexible fuel vehicles
• Prohibit small diesel vehicles

Trade
• Support of electricity more effective option than fuel ethanol
• Duty structure on fuel ethanol

Climate change and Carbon emission reduction
• Combination of ethanol and electricity maximises potential
• Sustainable farming practices
• SADC ethanol and electricity about 30% of South Africa’s carbon reduction requirements
Conclusion

Optimal value chain - Combine best of Brazil and India

- Fuel ethanol
- High efficiency electricity generation

SADC has agriculture potential

- 2 to 4% of available cropland
- Facilitate infrastructure and services
- Enables food production

South Africa key to open up SADC market

Enable investments

- Pricing competitive
- Support substantial infrastructure development
- Development finance

Massive Impact

- Over 1 million direct jobs
- Some SADC countries doubling of GDP
- Growth in trade and investment between SADC
- Meets 15 to 25% of SA carbon emission reduction targets
Thank You
ADDITIONAL SLIDES
## Current Bioethanol Policy Summary

<table>
<thead>
<tr>
<th>Policy</th>
<th>Brazil</th>
<th>South Africa/SADC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market:</strong></td>
<td>60% of fuel pool ethanol</td>
<td>&lt;1% of fuel pool ethanol</td>
</tr>
<tr>
<td>1) anhydrous ethanol for existing petrol cars</td>
<td>E20-25</td>
<td>SA – E2 in 2010 ? SA – E10 when ?</td>
</tr>
<tr>
<td>2) hydrous ethanol for flex-fuel petrol cars</td>
<td>&gt;90% of new cars FFV</td>
<td>SA – not part of policy Malawi – implemented</td>
</tr>
<tr>
<td>3) Diesel cars</td>
<td>No light diesel vehicles</td>
<td>SA – growing market share</td>
</tr>
<tr>
<td><strong>Pricing</strong></td>
<td>Controlled fuel pump prices consistent with ethanol</td>
<td>Still to be determined</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
<td>BNDES – low real rates</td>
<td>Commercial rates - IPAP</td>
</tr>
<tr>
<td><strong>Agriculture Support</strong></td>
<td>Extensive</td>
<td>Limited</td>
</tr>
<tr>
<td><strong>Policy co-ordination</strong></td>
<td>Extensive and consistent</td>
<td>Starting – IPAP</td>
</tr>
<tr>
<td>(energy, agriculture, industrial, funding, rural, environmental)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Incubation Support</strong></td>
<td>Extensive and largely phased out</td>
<td>Recognised – to be developed</td>
</tr>
</tbody>
</table>
Transport Fuels Supply Curve

- US advantaged LC ethanol
- Brazil Sugar Cane ethanol

Net Supply Costs under a $40/te CO2e Carbon price

- Average SC Ethanol mill (70)
- OPEC Middle East
- Other OPEC
- Other Conventional Oil
- FSU
- Venezuela
- Heavy Oil
- Arctic
- Deep Water
- EOR

- US Corn Ethanol 2020 Demand (0.7mmboe/d)
- GTL and CTL
- Oil Shale
- Oil Sands (in situ)
- Oil Sands (Mining)
- Marginal Conventional Oil
- Algae
- US Other LC (Wood based and FT)
- Veg Oil Biodiesel
- Sugar To Diesel
# Ethanol - Competitiveness with Petrol

<table>
<thead>
<tr>
<th></th>
<th>South Africa</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fuel Price in Rand per litre (2009)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Pump</td>
<td>4.35</td>
<td>8.00</td>
</tr>
<tr>
<td>Petrol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anhydrous ethanol</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Hydrous ethanol</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>South Africa</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas To Liquids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Refinery</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Ethanol Plant</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capital Cost in Rand per litre</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refinery or Processing</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Exploration</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total costs</td>
<td>50</td>
<td>30</td>
</tr>
</tbody>
</table>

- Fuel tax in Brazil higher than South Africa
- Ethanol has lowest capital cost requirement.
  - Higher cash costs
  - needs protection against volatility
- Reducing ethanol costs
  - Learning curve principle/cellulosic
- Increasing petrol costs
  - Increasing supply cost
- Ethanol (E85) requires own distribution network