Producing Ethanol, Electricity and Heat from Sugar Crops in Southern Africa - Policies Status and Prospects in a Rapidly Changing Global Environment

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Introduction:

CARENSA is supported by the European Commission and has the primary objective of evaluating the potential for the southern African sugar industry to become a significant supplier of low-carbon bioenergy within the SADC region. The network (see below for details) is now at the mid-stage of the project and is developing preliminary scenarios to help understand how the sugar resources (land, people, technology, water and climate) can best be used for the sustainable and equitable development of the region.
Early results show that there is a significant potential to produce both ethanol (as a petroleum extender and replacement), electricity and heat (cogen). However, this potential will be constrained by global trade policies, local economic development and the depth of commitment of both local and international policies on climate change mitigation.
In summary, without any changes to the existing sugarcane area, milling capacity and local consumption of sugar the industry could:

- Produce sufficient ethanol for 5% ethanol:petrol blend (energy basis).
- Produce between 0.27 and 1.37% of regional electricity consumption.
- Some countries could produce significantly more.
- South Africa dominates existing supplies but Mozambique is expanding production rapidly
- Future agreements on global trade and preferential sugar tariffs / markets will be a key driver in convincing the local industry that a biofuels market could be attractive.

The CARENSA Network:

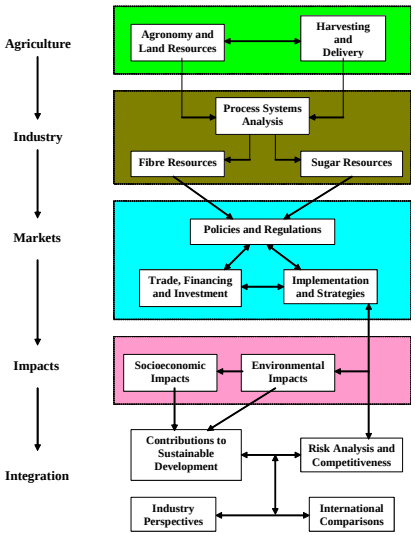
This thematic network is supported by the European Commission's Directorate General for Research **(DG-RES)** . There are three other principal contractors responsible for the Network and nine members. The project team was designed to place the key issues in their proper regional and global context, while also promoting north-south and south-south cooperation on cane resource development. There are four European organisations, four African organisations, three international or regional organisations, and two organisations based outside of Africa in the world's two largest cane-producing countries (Brazil and India), as listed below:

1. SEI, Stockholm Environment Institute (Coordinator)
2. ICL, Imperial College London, Env. Sci. and Tech., London, UK (Principal Contractor)
3. UM, University of Mauritius, Chemical and Sugar Eng. Dept. (Principal Contractor)
4. UND, University of Natal, Durban, South Africa (Principal Contractor)
5. AUA, Agricultural University of Athens, Greece (Member)
6. CIRPS, Interuniversity Research Centre on Developing Countries, Italy (Member)
7. BUN, Biomass Users Network, Zimbabwe (Member)
8. CEEEZ, Centre for Energy, Environment, and Engineering, Zambia (Member)
9. ISO, International Sugar Organisation (Member)
10. FAO, Food and Agricultural Organisation (FAO), United Nations (Member)
11. WII, Winrock International India (Member)
12. CENBIO, National Reference Centre for Biomass, Brazil (Member)
13. SADC, Southern African Development Community (Member)

Developing Scenarios to Understand the Potential for Bioenergy Production in the Sugar Industry of Southern Africa:

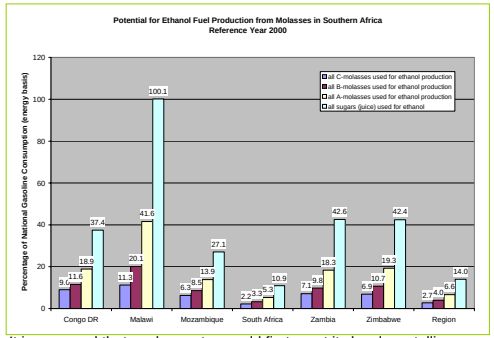
Understanding the potential for the sugar industry in southern Africa to become a major supplier of bioenergy to the region requires a detailed understanding of the total sugarcane system. CARENSA has therefore developed a detailed multi-disciplinary approach to evaluating each stage of the cane production, conversion and final product supply system with international expertise in each of the sub-sectors (see Figure 1).

Figure 1: Sub-Sectors of the Sugar Industry

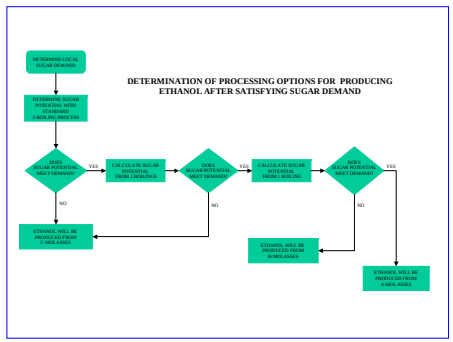


As a first phase of the scenario development process, the potential production of ethanol from the C-molasses produced in the countries under consideration was determined. The quantity of ethanol produced in this case would be equivalent to 2.7% of the total gasoline used in all six countries in that year. To assess the impact of diverting more of the sucrose in the cane from production of crystalline sugar to ethanol, the potential for ethanol production from B and C molasses and from cane juice were determined.

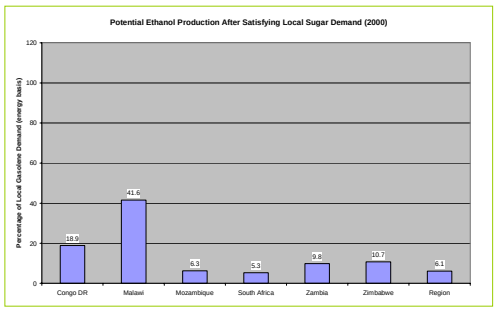
The Potential for Bioethanol Production:



•It is assumed that each country would first meet its local crystalline sugar demand before using remaining sugars for ethanol.
•Each mill would then use that ethanol feedstock stream which allows for maximum production of ethanol while meeting its sugar demand, as shown in the flowchart below.



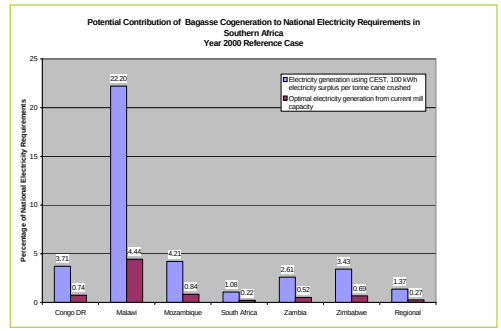
•After satisfying local demand for crystalline sugar, the ethanol production for the six countries would be as shown below



The Potential for Bioelectricity Production:

The reference case for cogeneration uses the existing mill set in the six countries with representative energy efficiencies in the factories and optimized combustion in the boilers. These conditions produce an average of 20 kWh of surplus electricity per tonne of cane crushed.

Based on experience in Mauritius and other countries, a representative surplus electricity production of 100 kWh per tonne of cane crushed is used for the scenario based on the use of Condensing Extraction Steam Turbine (CEST) technology



Conclusions:

- The sugar industry in Southern Africa has the potential to produce large quantities of ethanol from the available sugarcane resource, while still satisfying local demand for crystalline sugar.
- The potential ethanol production could make a significant contribution to the liquid fuel demand in these countries, substituting for imported petrol.
- Using conventional technologies, it is possible for the sugar industry in Southern Africa to generate surplus electricity for export to the grid.
- Significant amounts of electricity generation will only occur when enabling policies encourage the adoption of advanced high-pressure technologies, as is already occurring in Mauritius, Brazil and India.
- Future Carensa work is aimed at establishing the relative costs and environmental benefits of accelerated introduction of bioenergy-friendly policies and practices in the region's sugar industry.

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