Sugar Cane Biomass

Current and potential use for heat & power cogeneration in Cuban sugar cane industry

Photosynthesis Potential of Sugar Cane

Energy Production Balance

Agricultural Yield: 64 t/hectare p.a.
8 kg (fuel oil equivalent) consumed as fuel and fertilizers + Solar Energy + CO₂ + H₂O
= 0.22 t Dry Matter (88 Kg fuel oil equiv)
Products & by-products from 70 million mt. of milling cane

- Sugar 7,0 MM mt
- Bagasse (50% humidity) 19,0 MM mt
- Trash at Cleaning Centre 5,0 MM mt
- Trash in field (70% humidity) 15,0 MM mt
- Molasses 2,8 MM mt
- Filter Mud 2,1 MM mt
- Water 35,0 MM m³

CURRENT SITUATION

- Satisfy total raw sugar production demand for heating (2500 Kcal/Kg raw sugar)
- Partial supply of the electricity demand of raw sugar production process (95%)

(Trash consumed today is 5% of total availability at the cleaning centres)
ELECTRICITY BALANCE
SUGAR AGRO - INDUSTRY SECTOR

(Sugar and By-Products Production equivalent to 64 million mt. of cane)
(1992)

◆ Consumption  2,140  GW.h / pa
◆ Production    1,600  GW.h / pa
◆ Supply from grid  730  GW.h / pa

ENERGY DEVELOPMENT PROGRAMME

PRINCIPAL TARGETS

MEDIUM TERM
Co-generation equals Sugar Sector demand

LONG TERM:
Co-generation exceeds sector demand
Sales to national grid
STRATEGIC COMPONENTS

◆ Increase efficiency of energy use in the industry
◆ Increase energy production during crushing season with new boilers (efficiency 85-90%) and steam turbines at steam pressure higher than 28 bar
◆ New power plant, connected to sugar mill, running all year round fueled by sugar cane biomass

FUEL SOURCES

<table>
<thead>
<tr>
<th></th>
<th>Agricultural Yield mtc/ha-a</th>
<th>Bagasse %</th>
<th>Trash %</th>
<th>TOTAL Biomass %</th>
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</thead>
<tbody>
<tr>
<td>SUGAR CANE</td>
<td>60</td>
<td>27</td>
<td>6</td>
<td>33</td>
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<tr>
<td>ENERGY CANE</td>
<td>100</td>
<td>58</td>
<td>6</td>
<td>64</td>
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CANE TRASH AT CANE CLEANING CENTRE

CANE TRASH AT CANE CLEANING CENTRE
INTEGRATED SUGAR MILL
POWER PLANTS

TECHNOLOGY

◆ Biomass-fired boiler, extraction condensing steam turbine
◆ Biomass gasification - gas turbine - combined cycle
◆ Biomass pyrolysis
◆ Process Steam Consumption =/< 320 kg/tc

Power Plant

- Steam Pressure 60 - 80 atm
- Extraction-Condensing Steam Turbine
- Operation 8000 hrs/a

Sugar Mill

Sugar Cane

Bagasse
Steam
Electricity
Condensed

Cane Trash

Cleaning Center

Grid
NEW CAPACITY
(Phase 1)

Consumption
2,230 GWh
(Base Year 1992)

Production
1,726.4 GWh
(Efficiency factor = 26 kWhtc)

National Grid Consumption 503,6 GWh

Installed capacity all-year generation projects 100 MW

LONG TERM PROJECTION

39 sugar mills have been selected for investment

24 with adjoining power generation plants

15 with existing installed capacity to be expanded / upgraded

Result: installed capacity could increase about 1,015 MW
GLOBAL CLIMATIC CHANGE IMPACT

◆ Medium Term
  - CO₂ abatement 385 MMT/pa

◆ Long Term
  - CO₂ abatement > 6,175MMT/pa