



# Biomass valorisation in the sugarcane processing industry

DST Science-meets-Industry Workshop:  
Organic waste

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# The SA Sugarcane Industry

## Sugarcane production

- 26 000 registered growers
- 372 000 ha under cane
- 20 Mt of cane per annum
- 17.4% of total SA field crop production

## Sugarcane processing

- 14 sugar mills
- 2 Mt of sugar produced

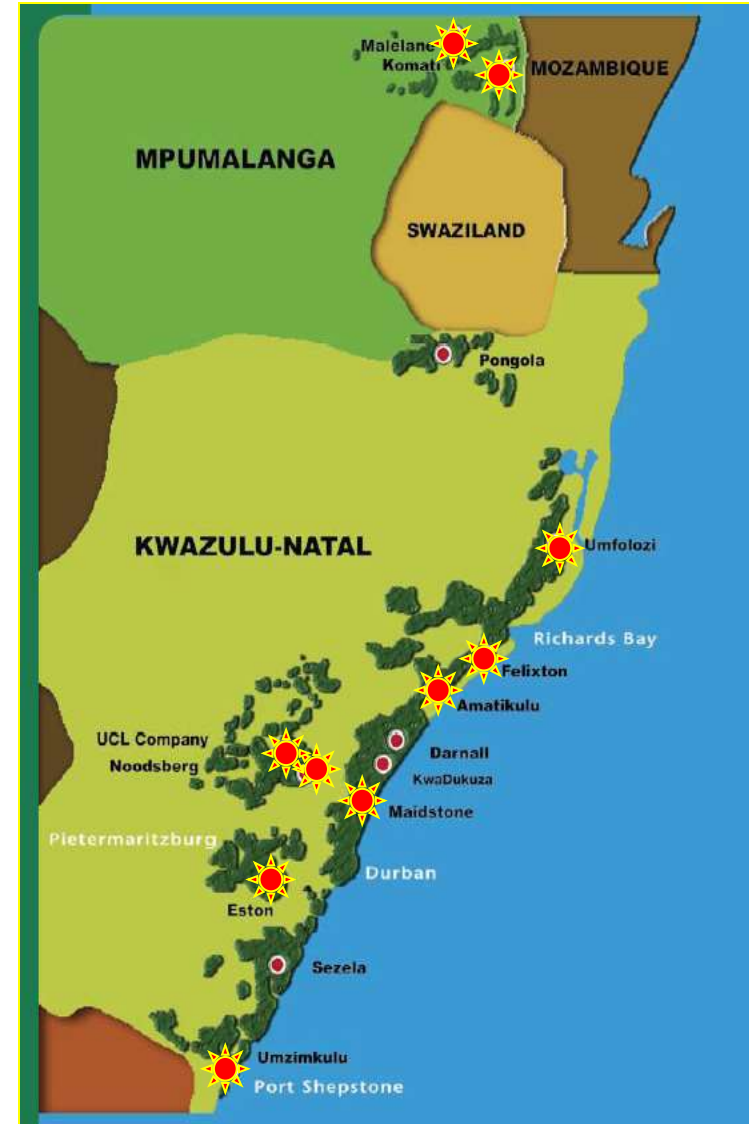
## Size of industry

- R12 billion pa
- Export earnings: R2 billion pa
- 60% of sugar marketed in SACU

## Major employer:

- Direct jobs: 79 000
- Indirect employment: 350 000
- Dependent on industry: ~ 1 million

- **Strategically important industry**



# The SA sugarcane industry

**Growers**

**Millers**

**South African Sugar Association**

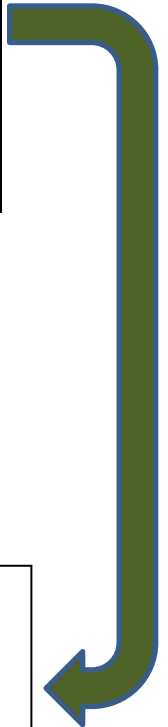


**SASRI**

- Mt Edgecombe
- Agriculture research

**SMRI**

- Glenwood
- Processing research





# SMRI



## SMRI

- ❑ Founded in 1949
- ❑ To service R&D and technical needs of the South African sugar milling industry
- ❑ Joint venture:
  - SA sugar milling industry
  - CSIR
  - University of Natal (now UKZN)
- ❑ Located: UKZN campus, Durban
- ❑ Funding
  - ❑ Membership fees
  - ❑ External funding – technical services
- ❑ Staff: ~60 people



# SMRI Membership



## ◆ Full members:

- ◆ SA sugar milling (14 raw sugar factories + central refinery)

## ◆ Affiliate members:

- ◆ 13 non-SA based mills (in Tanzania, Malawi, Zambia, Mozambique and Swaziland)

- Fully or partly by Tongaat-Hulett, Illovo and Tsb Sugar

## ◆ Associate member:

- ◆ The South African Sugar Association

## ◆ New membership classes



# What is Sugarcane?

- It is a grass
  - Extremely efficient converter of sunlight & CO<sub>2</sub>
- Cane stalk - composition (% dry mass):
  - Sugars: 14%
  - Fibre: 16%
  - Water 70%
- Other:
  - “Tops & trash” - growing tip and leaves :
    - ~ 25% of total crop
    - Either burned pre-harvest or left in the field
  - Sugarcane - an ideal Renewable Energy crop:
    - Solubles readily convertible into ethanol for fuel
    - Fibrous material readily usable as renewable fuel



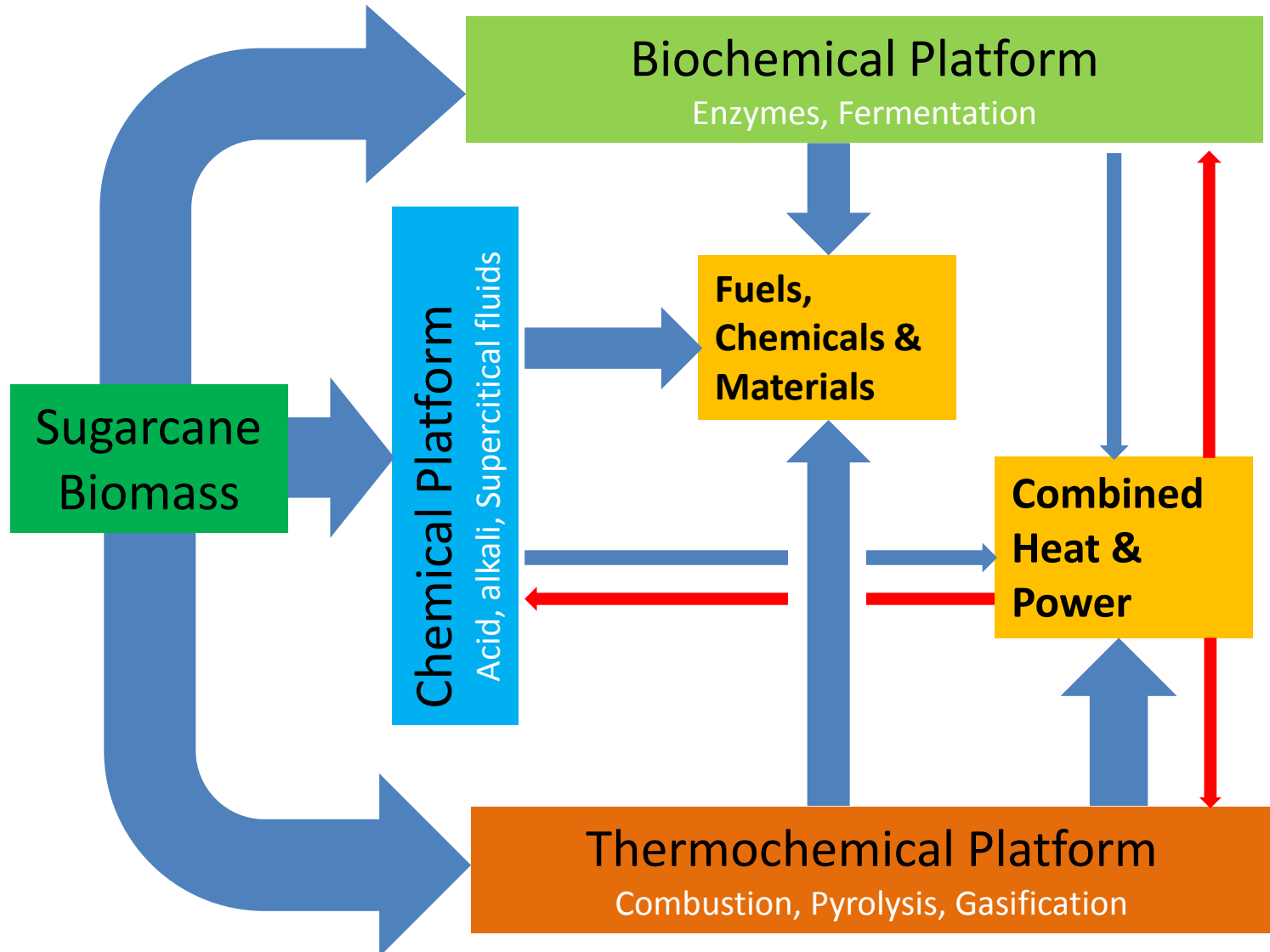


# Sugarcane products

- Currently:
  - Sugar
  - Molasses
  - Limited value addition (e.g. furfural and ethanol)
  - Limited energy products (co-gen)
- In the (not so distant) future:
  - Growth in bioethanol
  - Additional cogenerated power
  - Value addition to sucrose/ethanol/fibre

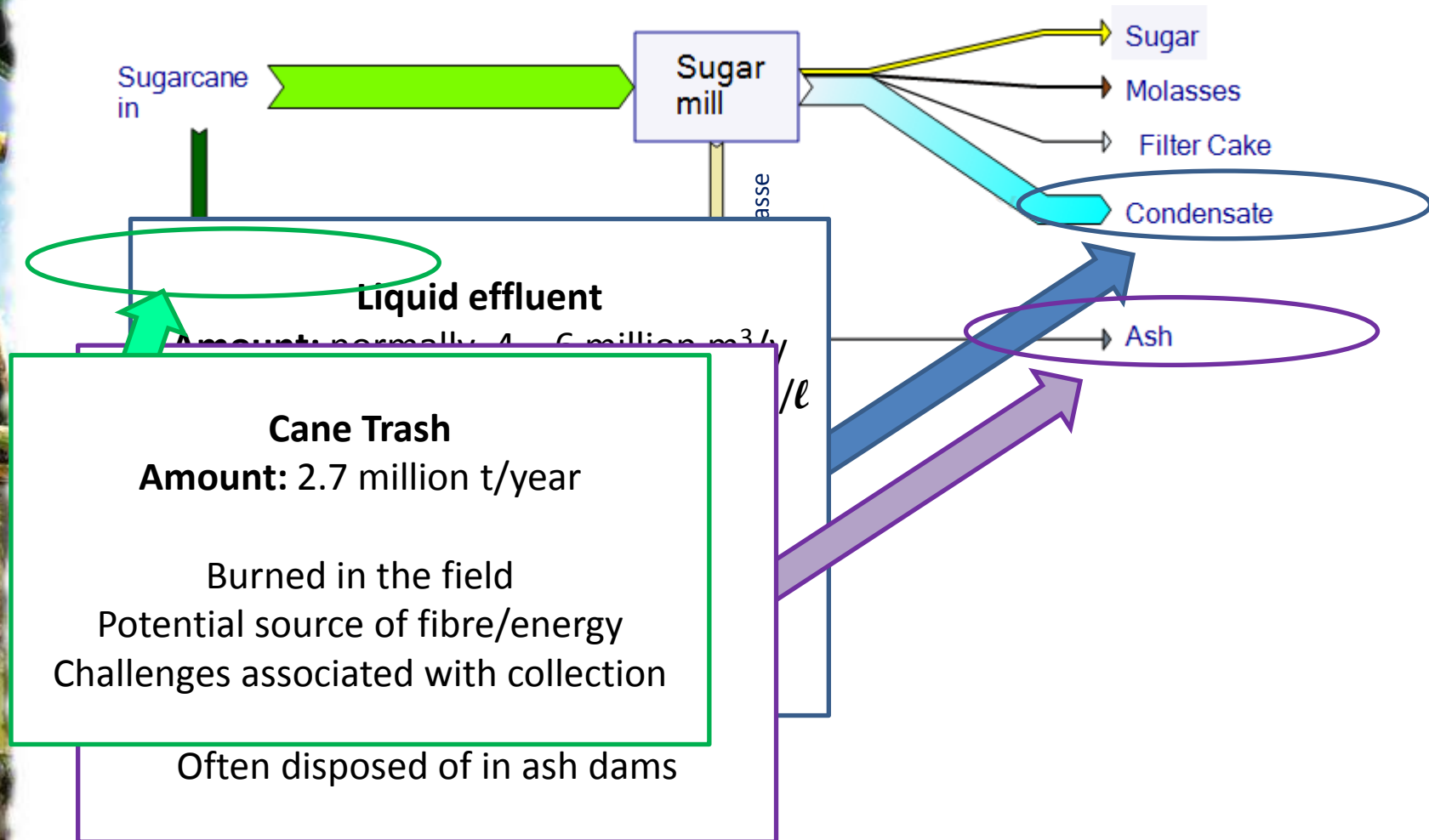


# Biorefinery Concept

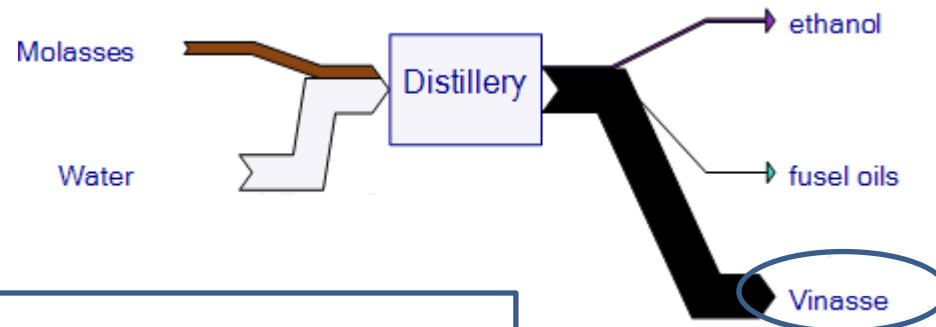




# Mass flows – sugar factory



# Mass flows distillery



**Vinsasse**  
**Volume:** 7-15 l/ l ethanol

**Concentration:** 9 – 200 g COD/l ethanol, acetic acid, phenolic compounds, carbohydrates  
 K (8g/l), Mg (0.2-1.5g/l), Ca (0.7-2.3g/l)

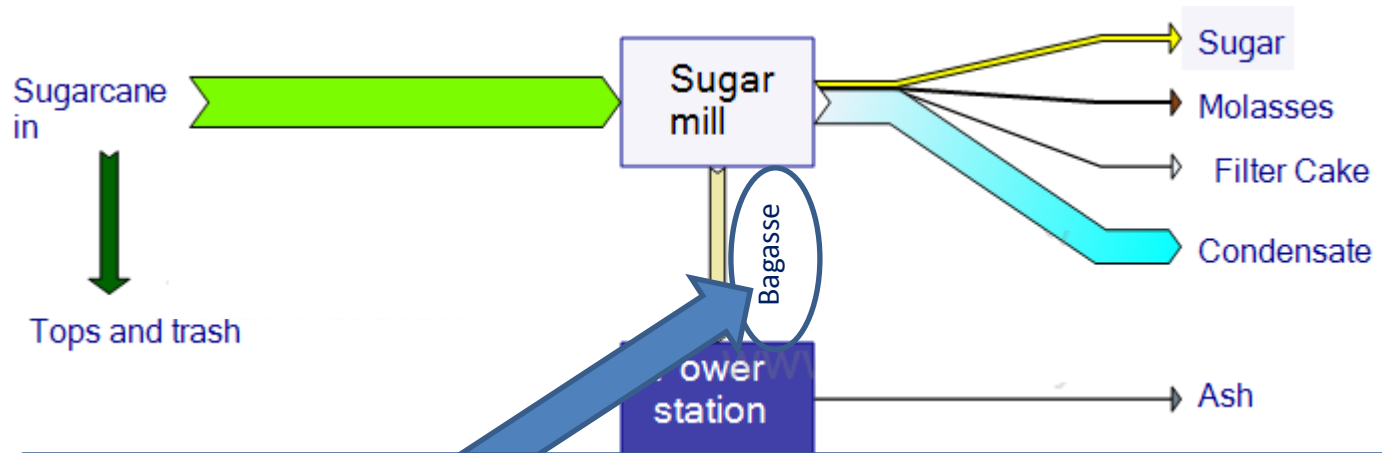
**Treatment:** evaporative concentration, anaerobic digestion, membrane filtration, incineration

**Vinsasse volumes**  
**Currently:** estimated at 4 700Mℓ  
**Potentially:** 7 500Mℓ

**CMS Concentrated molasses solubles**

- Fertiliser
- Animal feed additive

# Mass flows – sugar factory



**Bagasse**  
**NOT A WASTE!** (Usually)  
**Amount:** Approx 6 million t/y (wet mass)  
**Composition:** 50% water, fibre

**Currently:** burned to raise steam to power the factory  
 Furfural extraction and residue burned (1 factory)  
 Fibre board manufacture





# Challenges/potential opportunities

- Vinasse valorisation, treatment and disposal, potassium recovery

Risk to bioethanol opportunity

- Ash beneficiation

Small but persistent

- Bagasse valorisation – integrates with energy efficiency

Challenge: engineering processes for REAL bagasse

- Trash energy/fibre valorisation

Priority may rise – environmental issues

# STEP-Bio Programme

- DST: Industry-funded (public-private partnership)
  - *Sugarcane Technology Enabling Programme for Bioenergy*
- To enable and maximise Bioenergy opportunity:
  - **Theme 1: Risk-mitigation**
    - Project 1.1: Treatment of vinasse from bioethanol production
    - Project 1.2: Disposal or beneficiation of boiler ash
  - **Theme 2: Enabling of Opportunities**
    - Project 2.1: Options for biomass off-crop storage ←
    - Project 2.2: Value addition to sucrose
    - Project 2.3: Value addition to ethanol
  - **Theme 3: Strategic and decision-support projects**
    - Project 3.1: The techno-economics of sugar, ethanol and cogeneration in South Africa
    - Project 3.2: Optimising energy efficiency and integration in South African sugar mills
    - Project 3.3: Study of local market opportunities for bio-based chemicals from sugarcane

# Challenges/potential opportunities

- Vinasse valorisation, treatment and disposal

STEP-Bio

- Ash beneficiation

STEP-Bio

- Bagasse valorisation – integrates with energy efficiency

- Trash energy/fibre valorisation

Longer term focus



# Parting shots

- Bioethanol initiative important for KZN agro-industrial economy
- Vinasse management is a huge risk (effluent) and potential opportunity (potassium fertiliser)
- Integrated industry-appropriate solutions required
- Roles for innovation (HEI, science councils) and pragmatic technology transfer (industry research institute)

# *To the future sugarcane biorefineries...*

