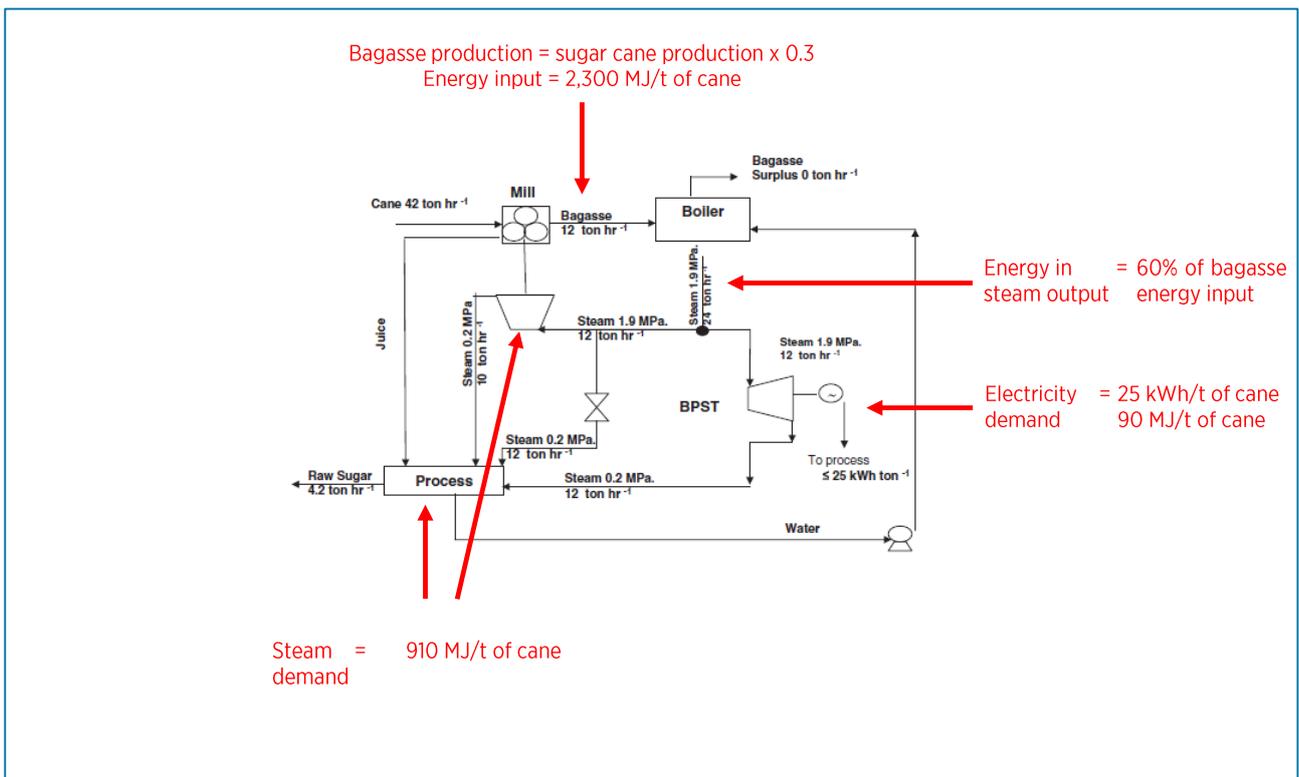


Renewable Energy Statistics Training

Exercise 5e: Energy balance bagasse energy (electricity and process heat)

Where survey information is not available, bagasse energy production and use can be derived from sugar cane processing statistics. The figure below shows the energy flow in a traditional sugar mill that burns bagasse to generate steam for electricity production, cane crushing and heat. This is a generally low efficiency system that is typical of many sugar mills found around the World today. If the mill is more modern and generates surplus electricity to sell to the grid, then the amount of electricity production may be several times higher than shown here.

Typical energy flow in a sugar mill with electricity production for own-use



Source: Derived from - Pippo, W A, and Luengo, C A, 2013, *Sugarcane energy use: accounting of feedstock energy considering current agro-industrial trends and their feasibility*, *International Journal of Energy and Environmental Engineering*, Vol 4:10.

To estimate bagasse energy production and use, the following points should be noted:

- Bagasse accounts for about 30% of the weight of sugar cane inputs (burnt cane).
- Electricity produced for own use = 25 kWh or 90 MJ per tonne of processed sugar cane.
- Steam energy used for crushing and heat amount to about 910 MJ per tonne of processed sugar cane.

In an energy balance, the amount of bagasse used in transformation (CHP) should be based on the share of electricity production in total final energy use (electricity and steam). The other share of bagasse should be recorded as final consumption in industry. In the above example, this split would be 10% electricity and 90% other uses.

The division of bagasse use between electricity and other uses is not based on how much steam from the boiler goes to the electricity generator (e.g. 50% in the above example).

Sugar cane production in 2014, as reported in FAOSTAT

Country	Sugar cane (in tonnes)
	Production
Cambodia	624,380
China	126,153,469
Indonesia	28,600,000
Lao PDR	1,840,465
Malaysia	9,147
Myanmar	11,128,400
Philippines	32,464,000
Thailand	103,697,005
Viet Nam	19,822,851

The table above shows the production of sugar cane in 2014, as reported by the Food and Agriculture Organisation (FAO – FAOSTAT). Use this data to estimate bagasse electricity production and complete the energy balance for bagasse in your country (or use your own data if available).

Answer sheet:

Supply and consumption 2014		Bagasse
		Tonnes
Production	(+)	
Imports	(+)	
Exports	(-)	
Stock changes	(+)	
International Bunkers	(-)	
Domestic supply	(=)	
Transfers		
Statistical Differences		
Power plants		
CHP plants		
Commercial heat plants		
Charcoal production		
Biomass pellet and briquette production		
Other transformation		
Energy sector and own use		
Distribution losses		
Total final consumption		
Industry sector		
Transport sector		
of which road transport		
Commercial and public services		
Residential		
of which traditional uses		
Other		
Net calorific value (MJ/t)		7,720

Electricity
Production
(in MWh)

Completed answer sheet (for Viet Nam):

Supply and consumption 2014		Bagasse
		Tonnes
Production	(+)	5,946,855
Imports	(+)	
Exports	(-)	
Stock changes	(+)	
International Bunkers	(-)	
Domestic supply	(=)	5,946,855
Transfers		
Statistical Differences		
Power plants		
CHP plants		594,686
Commercial heat plants		
Charcoal production		
Biomass pellet and briquette production		
Other transformation		
Energy sector and own use		
Distribution losses		
Total final consumption		5,352,170
Industry sector		5,352,170
Transport sector		
of which road transport		
Commercial and public services		
Residential		
of which traditional uses		
Other		
Net calorific value (MJ/t)		7,720

Electricity
Production
(in MWh)

495,571

1. Electricity production = 19,822,851 tonnes x 25 kWh/tonne = 495,571 MWh.
2. Bagasse production = 19,822,851 tonnes x 0.3 = 5,946,855 tonnes.
3. Electricity share of bagasse use = 90 MJ / (90 MJ + 910 MJ) = 10%
4. Bagasse used in transformation (CHP) = 5,946,855 tonnes x 0.1 = 594,685 tonnes.
5. Bagasse used in industry = 5,946,855 tonnes - 594,685 tonnes = 5,352,170 tonnes.

Note that in modern sugar mills, a higher amount of electricity may be produced, so the share of bagasse used in transformation may be higher. This is particularly true if the mill exports electricity to the grid.