COGENERATION AT SUCROGEN AUSTRALIA

ISSCT Factory Workshop
Techniques for profitable cogeneration
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Brian Edwards and Paul Trayner



Outline of presentation

Outline:

- Brief overview of installations
- How to be profitable?

Sucrogen

- Formerly CSR Sugar, 150 year old company in Australia

- Acquired by Wilmar International Limited in 2010
- Sucrogen cane products is one of the businesses of Sucrogen
  - Generally harvests about 13Mt of cane per year
  - Owns and operates some farms – 2,500 hectares producing 210,000 tonnes of cane
  - Owns a harvesting business harvesting 300,000tonnes of cane each year

- Sister businesses of sugar refining and ethanol

Cogeneration at Sucrogen

- Sucrogen is Australia's largest renewable electricity producer from biomass
- Sucrogen is the largest Renewable energy producer in Queensland and the 8th largest in Australia in 2009
- Sucrogen has seven sites with generators (including a new 19MW generator to be installed this year) with a total
  - Installed capacity of 184MW
  - Export capacity of 117MW
- Sucrogen
  - generates over 510GWh pa
  - Exports 285GWh pa

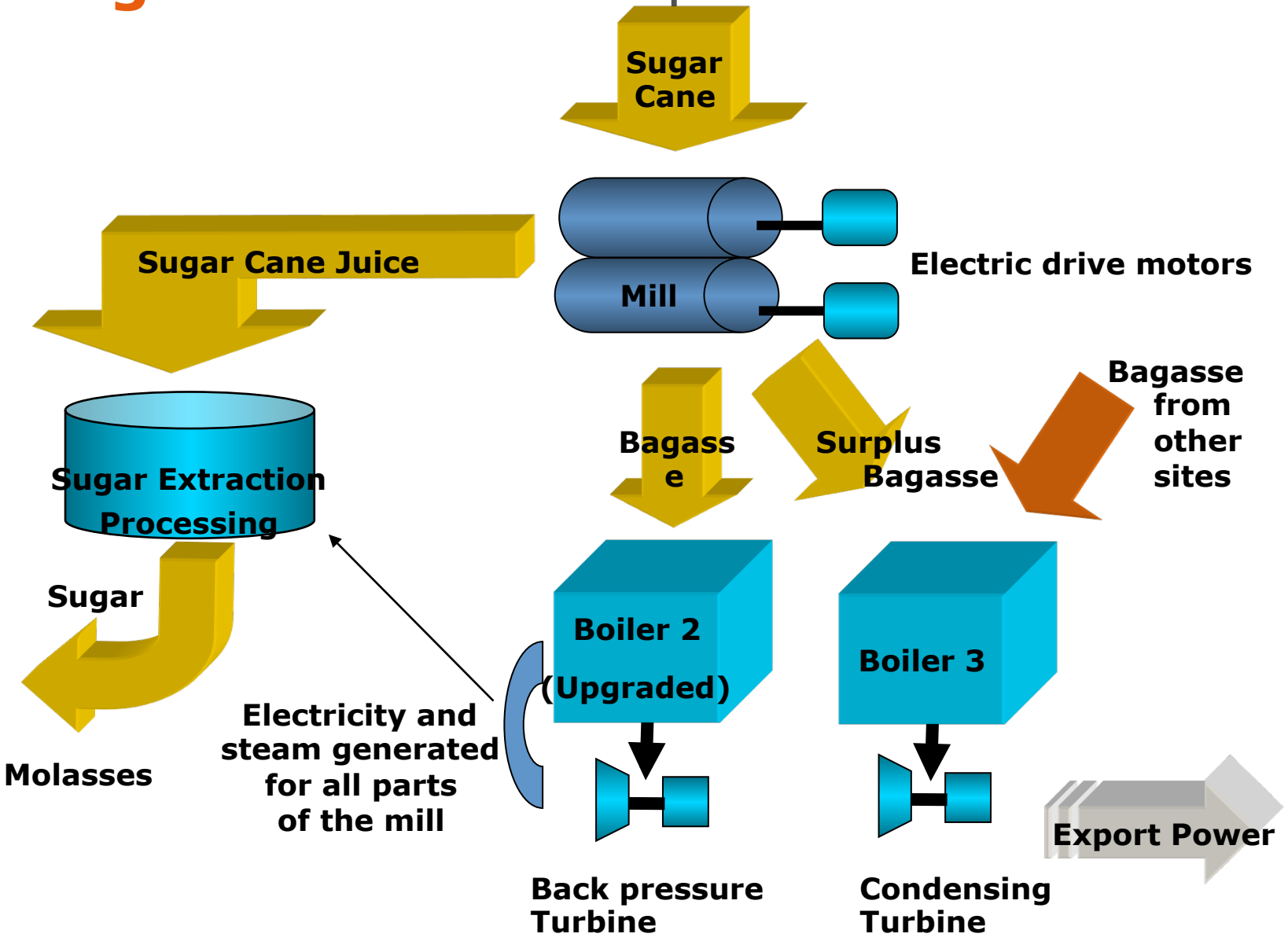


Cogeneration at Sucrogen (continued)

- The two largest generators in the Sucrogen group are located in the Burdekin region;
  - Invicta Mill upgraded to 50MW in 1996 (prior to the current green energy scheme)
  - Pioneer Mill upgraded to 68MW in 2005



Cogeneration concept at Pioneer



Boiler and TA details at Pioneer Mill

- New Boiler 3 plus a condensing turbine unit
    - 130 t/hr, 65 bar, 480^{o}C,
    - Exhaust steam @ -0.9 barg, 42°C
    - 36MW, 60 t bag/hr, 0.6MWh/t bag
- Upgraded **(inexpensive)** Boiler 2 plus new back pressure turbine unit
    - Initially at 210 t/hr, 17 bar
    - Upgraded to 240 t/hr, 31 bar, 380^{o}C
    - Exhaust steam @ 135kpa
    - 31MW, 110 t bag/hr, 0.3MWh/t bag

Bagasse basics at Pioneer

Pioneer is located centrally in the region providing natural transport efficiencies (and savings).

Over 110,000 tonnes of bagasse is transferred within the Burdekin region using walking floor trucks (20t/load).

Stockpiling occurs in the "crush" Jun – Nov

Reclamation during the "generation" (more profitable) season from December to March

Over 110,000 tonnes of bagasse is stockpiled in the crush and used during the generation season (typically 16 weeks)

Stockpile design

- Stockpiles are designed to reduce financial risks due to spoilage or destruction with long narrow piles to:
  - facilitate covering and secure access during wet weather
  - To make firefighting simple if required
- Stockpiles are built using two methods:
    - Pusher-bar on front end loader
    - Dozer (355 Komatsu) modified with wings




MAXWELL





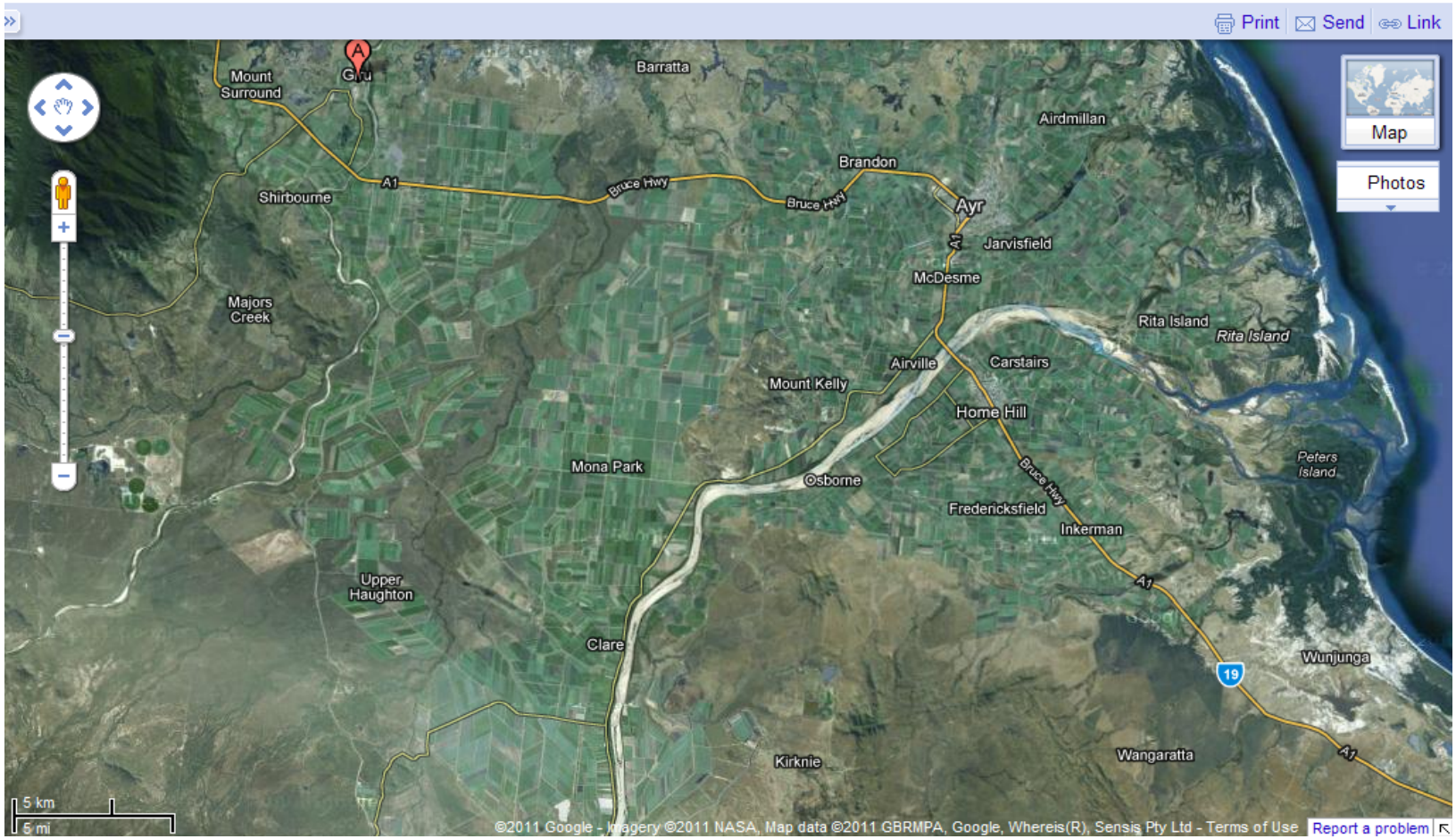
Economics

- Cogeneration is generally difficult to justify in Australia unless you are a bit ‘different’
- Optimistically revenue could be $100/MWh but there have been some notable exceptions at various times
- With only 3000 hours of operation within the season, generation from 1MW of export can give at best $300,000 per year.
- Yet installation costs can be $3M/MW installed (and often not all those MW are export MW)
- This cost can easily get larger if
  - brown field installations increase costs,
  - export capability to the grid is not available and must be installed
- So returns are slim and not guaranteed

Economics (continued)

- For profitability the installation needs an additional angle or incentive, for example:
  - Year round operation with a refinery on the same site, or
  - A dramatic increase in fuel supply (collect trash), or
  - A green field site or
  - requirements to replace boiler or turbine assets where the costs of cogeneration are absorbed into the costs of the sugar factory, or
  - In Pioneer's case, adjacent factories with spare bagasse

Location

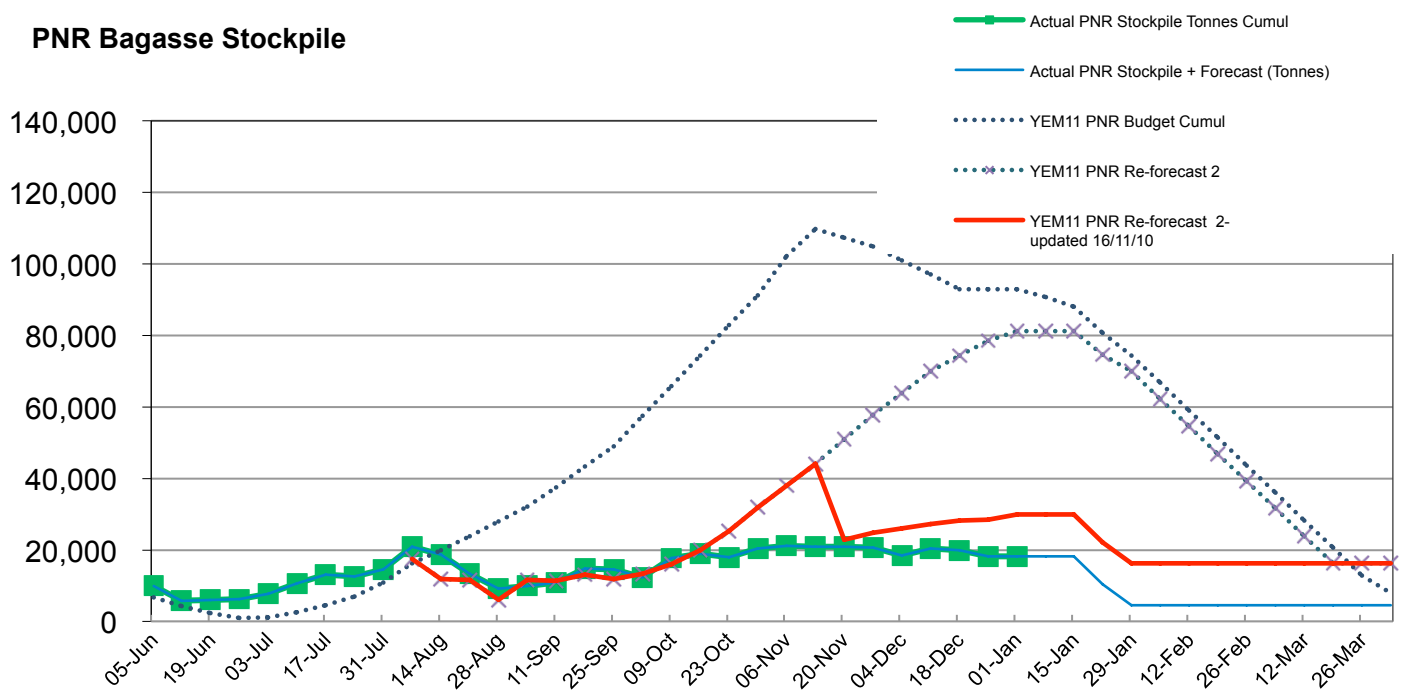

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Generally except last year

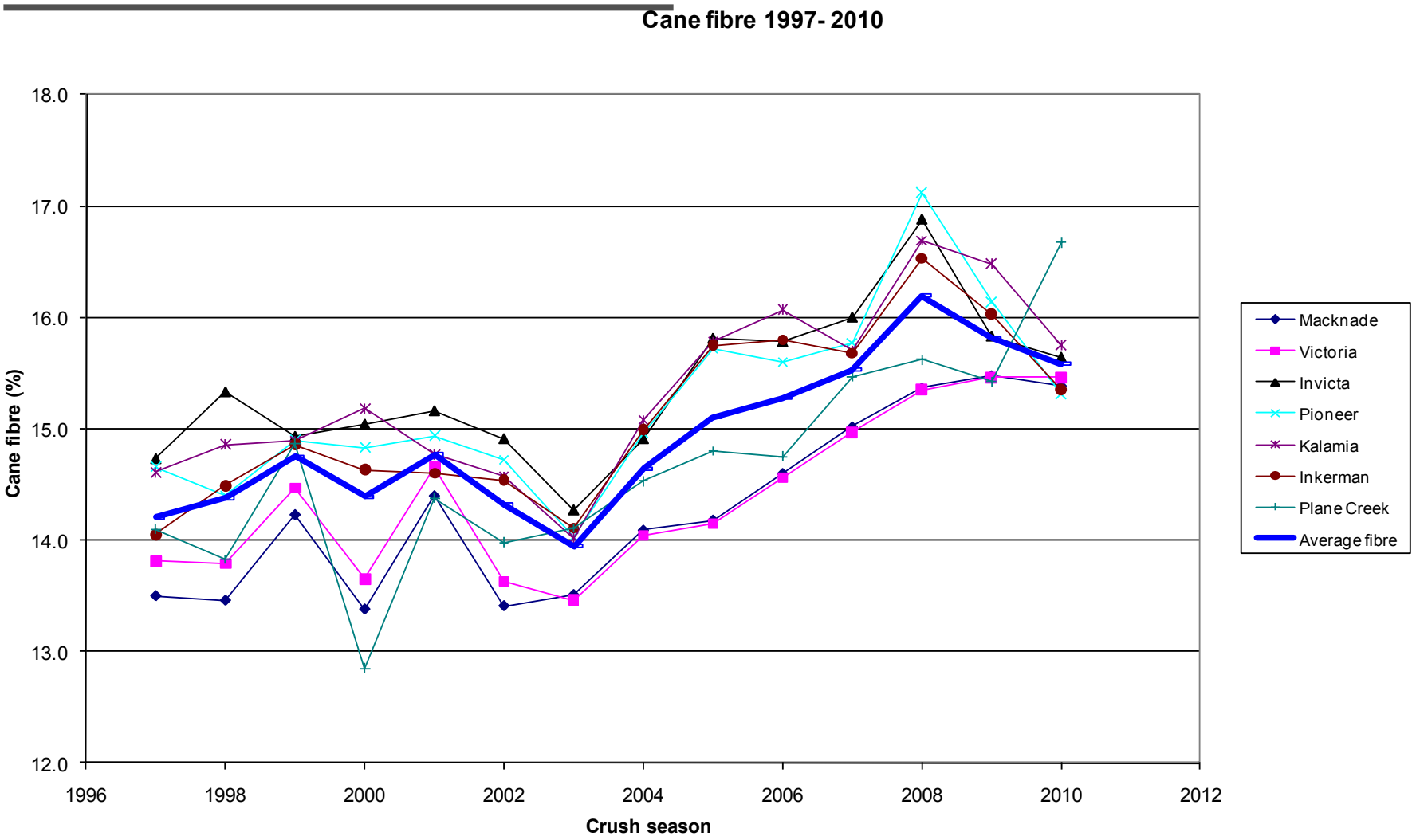
- Very unusual season 2010 - rain
- Pioneer – 2600 hours crushing, 1900 hours waiting for cane.
- Other bagasse contributing mills had similar problems
- A large quantity of cane was unharvested at the end of the season as the wet season set in.
- Fuel and cogeneration was sacrificed in an attempt to harvest as many tonnes as possible
- Cogeneration is the #2 business

The **importance** of fuel

- Fuel availability – 2010 impact on Pioneer Mill



Luck can be involved…



Management of installed equipment

Fuel use

- Steam-on-cane (SOC)
- Factory operations can have a major impact
  - Factory reliability and crush rate
  - Start-up and shut down procedures
  - Boiler operations (Oxygen %)
  - Milling performance – poor fuel
  - Added water – ESJ
- Poor fuel handling can have a major impact on fuel use
  - Contamination can impede boiler operations
  - Water ingress or degradation of the bagasse can reduce GCV

Minimising fuel use

Fuel use in Cogen

- Cogen fuel use is a more direct measurement
  - MWh/tonne of steam
  - Tonne of steam/tonne of bagasse

- Overall efficiency is about
  - Fuel quality
  - Boiler performance
  - Turbine performance
    - Condenser performance

- Fuel quality
  - Degradation (GCV rate)
  - Damage – water ingress
  - Contamination



Questions?