DETERMINATION OF OPTIONS TO GENERATE SURPLUS BAGASSE – TWO CASE STUDIES

Seek practical cost effective options

By

R. BROADFOOT, F. PLAZA and G. KENT

Queensland University of Technology, Brisbane

r.broadfoot@qut.edu.au

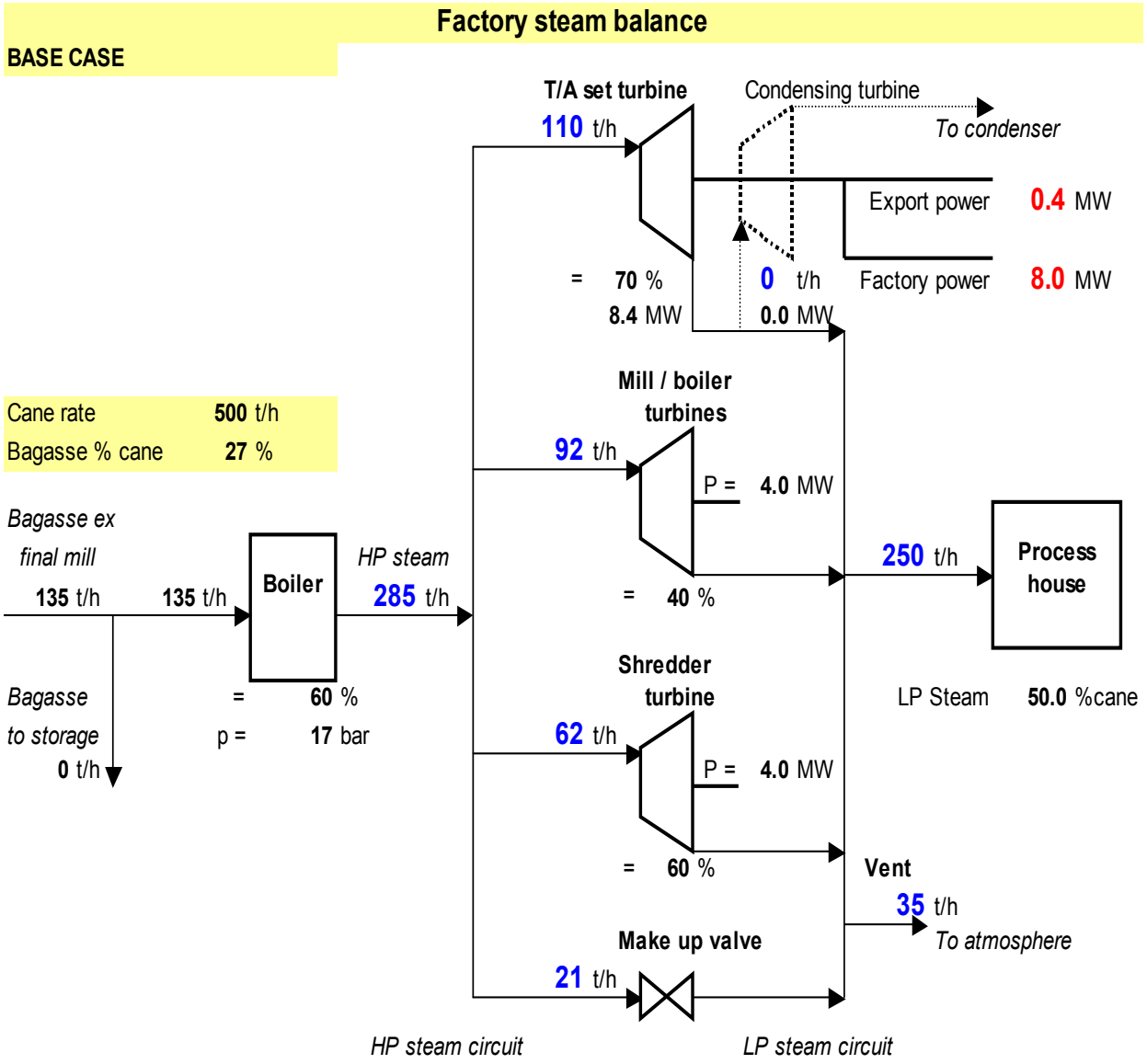
The two scenarios

Common features for existing plant

- Turbines on all mills, shredder, boiler pumps and fans
- Low boiler efficiency (~60%)
- Boilers at ~1700 kPag
- High steam consumption%cane (>55% on cane)

Require surplus bagasse for off season use or for sale to an adjacent factory

Typical steam balance for Australian factories



Case A – Surplus bagasse for off season steam generation

- HP steam pressure 1710 kPag
- STGs have surplus capacity of 3.2 MW
- Turbine exhausts:150 and 100 kPag
- Quintuple evaporator set (on 150 kPag)
- Minimal juice heating on vapour bleed
- Pan stage uses LP steam at 100 kPag
- Steam % cane > 55

Case B – Surplus bagasse for sale to an adjacent factory

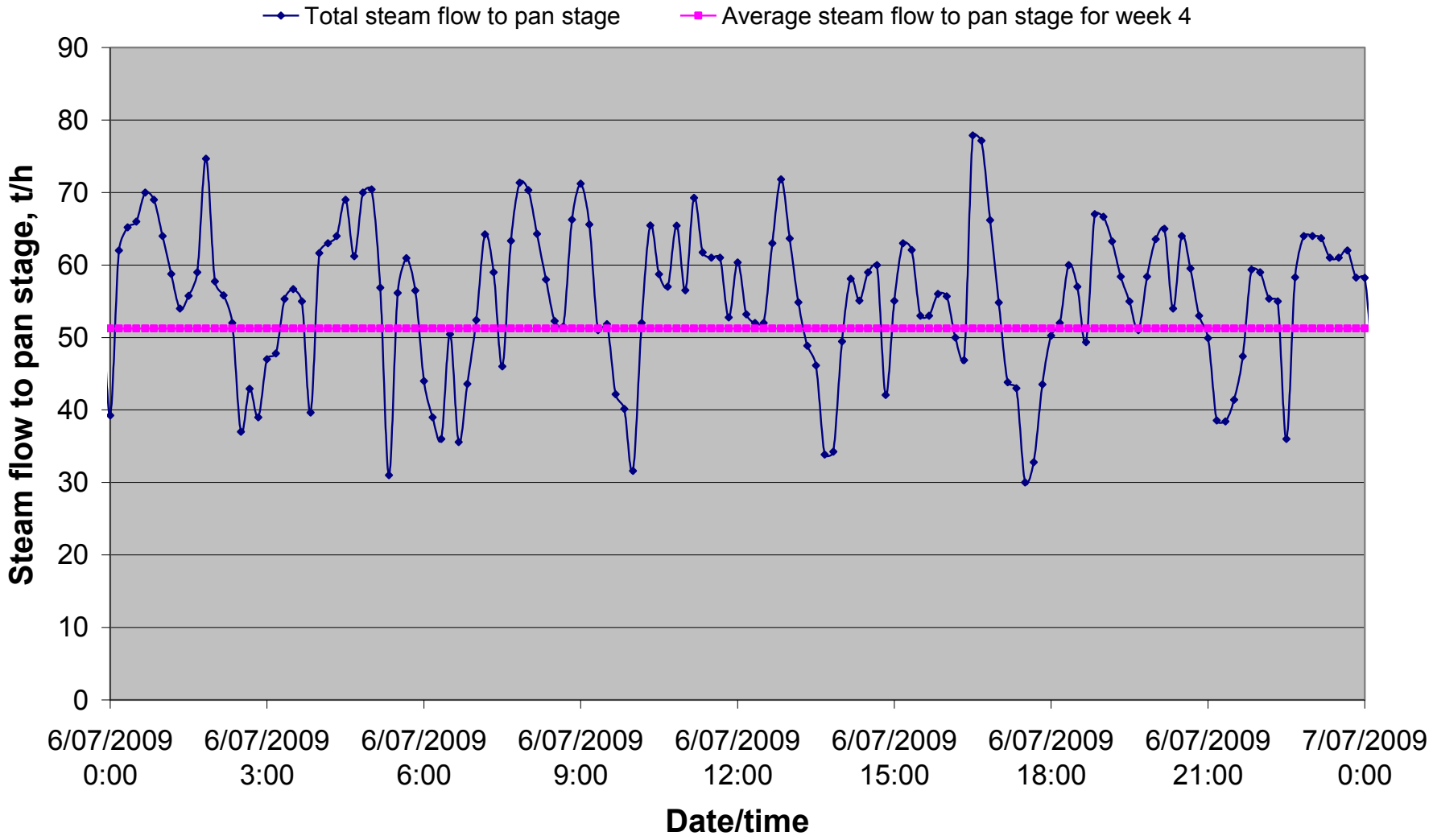
- HP steam pressure 1720 kPag
- STG has surplus capacity of only 0.3 MW
- LP steam pressure 100 kPag
- Quadruple evaporator set with no vapour bleeding
- Pan stage uses LP steam (100 kPag)
- Steam % cane > 58

Pan stages – impact on LP steam options

Australian pan stages use mostly large batch pans

- » Large cyclic variations in steam/vapour use
- » Large loss of productivity when low pressure vapour replaces LP steam
- » High capital cost of pans makes replacement with continuous pans not attractive

Typical cyclic variation in pan stage steam usage



Strategy for selecting HP steam options

- Increasing the efficiency of the boilers.
  Install or upgrade economisers, air heaters and supply feedwater with greater enthalpy (higher temperature, greater quantity).

  » Little impact on HP-LP steam balance

- Reducing the HP steam demand. Replace inefficient turbines on the mills and shredder and on the boiler feedwater pumps and fans with electric drives.

  » Impact on HP-LP steam balance

Strategy for managing HP and LP steam balance

- No condensing STG (not financially viable) → Need to balance HP and LP steam rates to avoid excessive LP steam venting or make up HP to LP steam
- Strategy for balance of HP and LP steam
  - Establish so vent of LP steam at 'near zero' when at average LP steam rate
  - When LP steam consumption rate < average → vent excess LP steam
  - When LP steam consumption rate > average → increase HP steam generation and increase power generation (if STG capacity available)

Allocations of bagasse in excess of boiler requirements

- Stoppages during season
  - Planned maintenance stops
  - Unscheduled stops (wet weather, breakdown)
- Stockpile for restart next season
  - 24 h supply at nominal crushing rate
- Surplus bagasse
  - Store for off season
  - Sell for off site use

Approach to modelling

1. For a selected HP steam scenario use HP steam model to calculate:
    - Changes to the HP steam consumption rate including for electrical power generation (to avoid import power)
    - Changes to the LP steam production rate
    - Changes to HP steam generation rate; bagasse consumption rate by boiler and the bagasse surplus
2. Investigate several LP steam options to match the available LP steam rate. Use LP steam model.

Strategy for selecting LP steam options

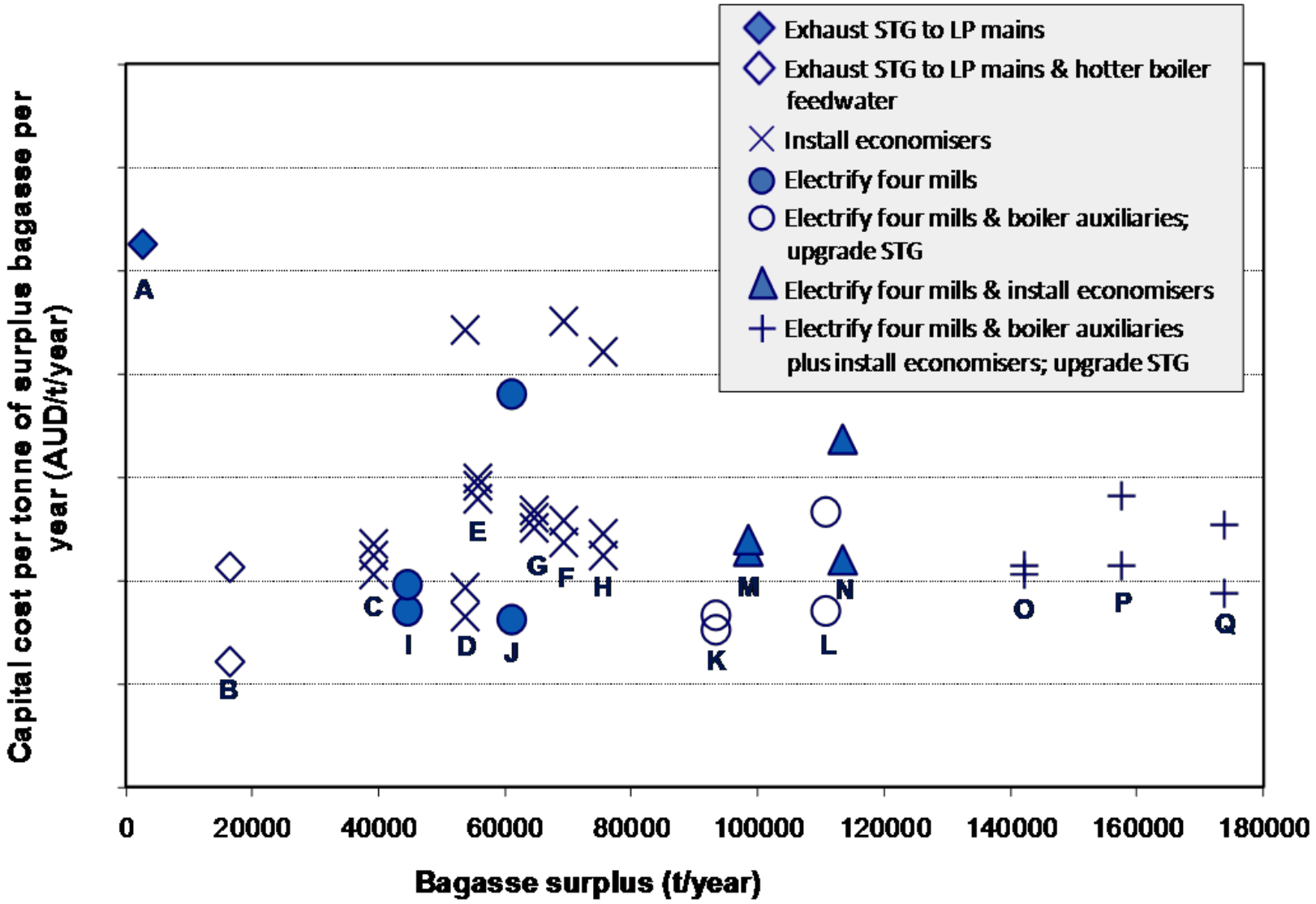
- Practical considerations for the evaporators (reserve capacity, vapour loading on individual effects, scaling propensity)
- LP steam consumption match LP steam production (avoid excessive venting)
- Suitable for subsequent plans for higher efficiency targets
- Ease of incorporating changes into factory
- Investment cost

Options to reduce LP steam consumption

- Use of condensate for heating juice
  - Increase in juice temperature up to 14 °C
- Use of bleed vapour to juice heaters
  - Vapour from first effect to final effect
  - Non contact and direct contact heaters
- Pan stage retained on LP steam

Limit to LP steam consumption ~40% on cane

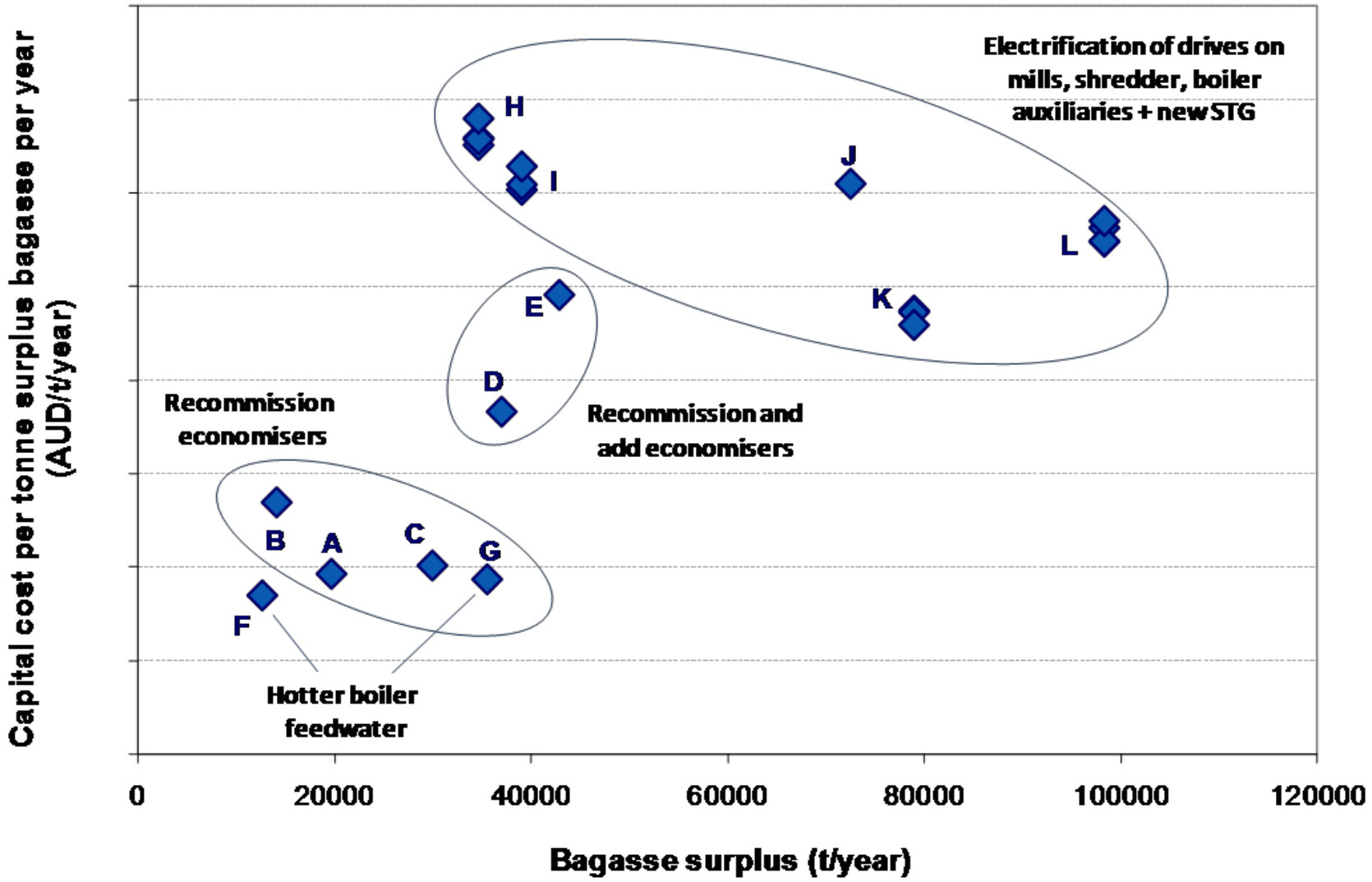
Results for Case A



Scenario for maximum bagasse generation – Case A

- Install economisers on boilers
- Electric drives on feedwater pumps and ID fans
- Electric drives on 4 mills
- Upgrade STG for higher power output
- Reconfigured quintuple set with primary heaters on vapour 4 and 3; secondary heaters on vapour 2 and 1; ESJ heaters on vapour 1
- HP steam%cane 44.2
- Bagasse surplus 173 kt per year

Results for Case B



Scenario for maximum bagasse generation – Case B

- Electric drives on feedwater pumps and ID fans
- Electric drives on shredder and 5 mills
- Install additional STG of 6 MW
- Install additional evaporator and convert to quintuple set with primary heaters on condensate, vapour 4 and 3; secondary heaters on vapour 2 and 1 plus direct contact heater on vapour 1; ESJ heater on vapour 1
- HP steam%cane 41.1
- Bagasse surplus 98 kt per year

Conclusions

- The assessments are site specific both in terms of the preferred solution, the cost of generating surplus bagasse and the quantity of surplus bagasse that can be generated.
- Result depends on existing plant in the HP and LP stations of the factory

Acknowledgements

QUT thanks the SRL clients for permission to present the work