RADICAL CHANGE IN THE SUGARCANE PROCESSING INDUSTRY

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Benefit: Cost Ratios for Research

During 1998, the Australian sugar industry R&D leaders undertook an evaluation of the costs and benefits of the industry's R&D program over the preceding five years. Funded by the Sugar Research & Development Corporation (SRDC), the Bureau of Sugar Experiment Stations (BSES) and the Sugar Research Institute (SRI), an independent economist (Agtrans Research) evaluated two core activities (one each from BSES and SRI) and a random selection of 41 projects, 14 in detail.

The evaluated core activity of SRI was the development of skills in, and applications of, computational fluid dynamics.This powerful analytical and simulation methodology has been applied by SRI in diverse ways:

- the aerodynamics of cane cleaning in harvesters
- the modelling of clarifier performance
- modelling of bagasse, ash and gas flows in boilers

The budget devoted to this work within SRI has been significant, nearly AUD 0.5m per year for the 5-year period under review. The following table demonstrates, on a very conservative basis, the value of the outcomes achieved.

Table 1. Investment Criteria; CFD activities 1994 - 1998.

Investment Criteria	No Discount Rate	5% Discount Rate	10% Discount Rate
Net Present Value ($m)	65	43	30
Benefit-Cost Ratio	21:1	12:1	7:1
Internal Rate of Return (%)		27	

Source: Agtrans Research 1998

The 14 specific projects which were analysed in detail tended to be dominated by field related work, since this reflects the expenditure bias in sugar industry R&D in Australia.The aggregated investment criteria for these projects is shown in Table 2.

Table 2. Investment criteria; 14 projects.

Investment Criteria	5% Discount Rate	10% Discount Rate
Net Present Value ($m)	134	73
Benefit-Cost Ratio	15:1	8:1

Source: Agtrans Research 1998

Clearly, the industry received quantifiable benefits from this R&D program which are many times their cost. Agtrans concluded that the present value of *benefits* from the 14 projects were five times greater than the present value of *costs* for the random sample of 41 projects. This multiple can therefore be assumed to apply to the full portfolio of projects undertaken over the 5 years, which had an aggregate cost of AUD66m.

It is hoped that this leads to the conclusion that even in straitened economic times, the commitment to R&D expenditure should be maintained because of the future value it creates.At the very least, it is evidence of the capability that the science and technology arm of the sugar industry has for innovation and change.

Future Challenges

Prices for free-trade sugar are generally forecast to remain at the current low levels for at least the next couple of years, before recovering slowly. At US6¢/lb, survival may depend upon three major strategies:

1. cutting costs with a brutality not previously contemplated;
2. producing superior quality sugar at least cost;
3. extracting more revenue/ profit from the total biomass processed.

This can be re-stated in terms of three obvious economic drivers:

1. price (now at historically low levels)
2. quality (the demand is for higher quality)
3. crop utilisation (historically sub-optimal)

Looking forwards 5 to 10 years, it is likely that sugar industries operating in an unprotected environment will have different characteristics to today.

1. Co-generation

Cogeneration of electricity from bagasse is regarded as renewable energy and carbon neutral, since sugarcane consumes carbon dioxide to grow.In Australia, a renewable energy industry is evolving, and sugarcane bagasse is easily the most cost-effective and abundant fuel source.

The following table demonstrates the revenue potential for a range of scenarios.

Cogeneration Scenario	Maximum export capacity MWe	Install cost AUD Millions	Annual export energy GWhe	Gross revenue AUD Millions
Seasonal (6 mths) cogen based on bagasse only. Low pressure boiler typical of current mill technology.	29	30	106	6.4
Seasonal (6 mths) cogen based on bagasse only. High pressure boiler.	52	60	191	11.5
Year-round cogen based on bagasse and trash. High pressure boiler.	91	105	474	28.4
Year-round cogen based on bagasse and trash. Gasification BIGCC technology.	175	245+	1000	60

ASSUMPTIONS

Crushing rate: 600 tcph
Power selling price: AUD 0.06¢/kWh
Process steam-on-cane consumption: 35%

This compares with the gross revenue from sugar production of about AUD 72 million.

Process steam-on-cane consumption characteristically is in the range from 42 to 55% in sugarcane factories. Historically, there has been no need to invest in energy efficiency because the bagasse provides abundant fuel, and payments for power delivered to the public grid were not attractive. The drive to reduce steam consumption to 30 - 35% on cane now has a serious economic driver, in the form of a price premium for renewable energy.

2.Energy efficiency

As energy efficiency becomes more critical to overall factory economics, the designs of process equipment, and the energy flows in the process end of factories will change, becoming closer to beet sugar layouts and designs.Thus some of the changes will include:

- steam turbines on mills and shredders will be replaced by electric drives;
- Roberts evaporators may be replaced in some stages by falling film type evaporators capable of operating on low temperature differentials;
- forced circulation may be necessary to improve the thermal efficiency of pans;
- centrifuge stations will be based on continuous designs;
- condenser designs will be revisited to improve efficiency;
- greater use will be made of 4th and 5th effect vapour.

3. Capacity and quality

Reducing costs inevitably means, on the capital side, doing more with less.Enhanced clarification technologies, resulting in cleaner juice, may enable technologies such as ultrafiltration to become cost-effective. This in turn has the potential to increase evaporator and pan stage efficiency/capacity while simultaneously producing higher purity sugar without the need for sulphitation.

4. Automation

The drive to reduce costs will place more pressure on labour levels. Full automation of cane handling, and the entire juice to crystal process are feasible now, and will inevitably occur in the next few years. New or improved process control instrumentation is being developed, in several locations, as a means to this end.

5. Molasses

The value of molasses has declined dramatically in recent years. It is likely that two uses will dominate:

- fermentation to produce fuel alcohol, which is also regarded as renewable energy under international protocols relating to greenhouse gas abatement;
- chromatographic extraction of sugar, already viable in protected beet-sugar industries, may eventually be applied to sugarcane molasses.

Gasification of molasses to produce combustible fuel is also feasible.

It is estimated that Brazil's alcohol fuel program displaced about 140 x 10^6 tonnes of CO_2 (equivalent), 1990 - 1994 aggregate (Copersucar/MCT). In Australia, alcohol-based fuel incentives are part of the greenhouse gas abatement program, but the incentives are not yet defined. Both renewable energy premiums and carbon emission credits are likely.

Chromatographic extraction of sugar from sugarcane molasses probably needs higher sugar prices *and* low molasses prices for it to become economically feasible. The residue has little value other than as a component in fertilisers.

In contrast, the dunder or distillery waste can be used to produce methane in anaerobic digesters, and the effluent from methanisation plants is suitable for increasing the nitrogen content of composted mill mud. This approach to integrated by-product utilisation is already demonstrated in several sugar mills in India and has much to commend it.Environmental sustainability is an important issue for the Australian sugar industry, and one to which the industry has demonstrated a serious commitment.

Conclusion

The sugar mill of the future will probably have several characteristics which, while demonstrated in isolation at various locations around the world, will become *integrated* in their application. These include:

- significant cogeneration of electricity using high pressure boiler or gasification technology;
- energy efficiency of 35% steam-on-cane or better;
- improved sugar quality characteristics such as colour, pol, ash etc, and processing standards to food grade;
- further reduction in labour costs;
- significantly increased integration of by-product utilisation, leading to improved revenue and zero effluent factories.