JUNE 2022 REPORT

Milling Sector Bio-Energy Agenda

Prepared by the Australian Sugar Milling Council using data and findings from L.E.K. Consulting and BDO Projects.

AUSTRALIAN Sugar Milling COUNCIL

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Independent Engagement

L.E.K. Consulting was commissioned by ASMC in 2021 to assess which bio-energy plays are commercially prospective.

ASMCs Macro-Agenda

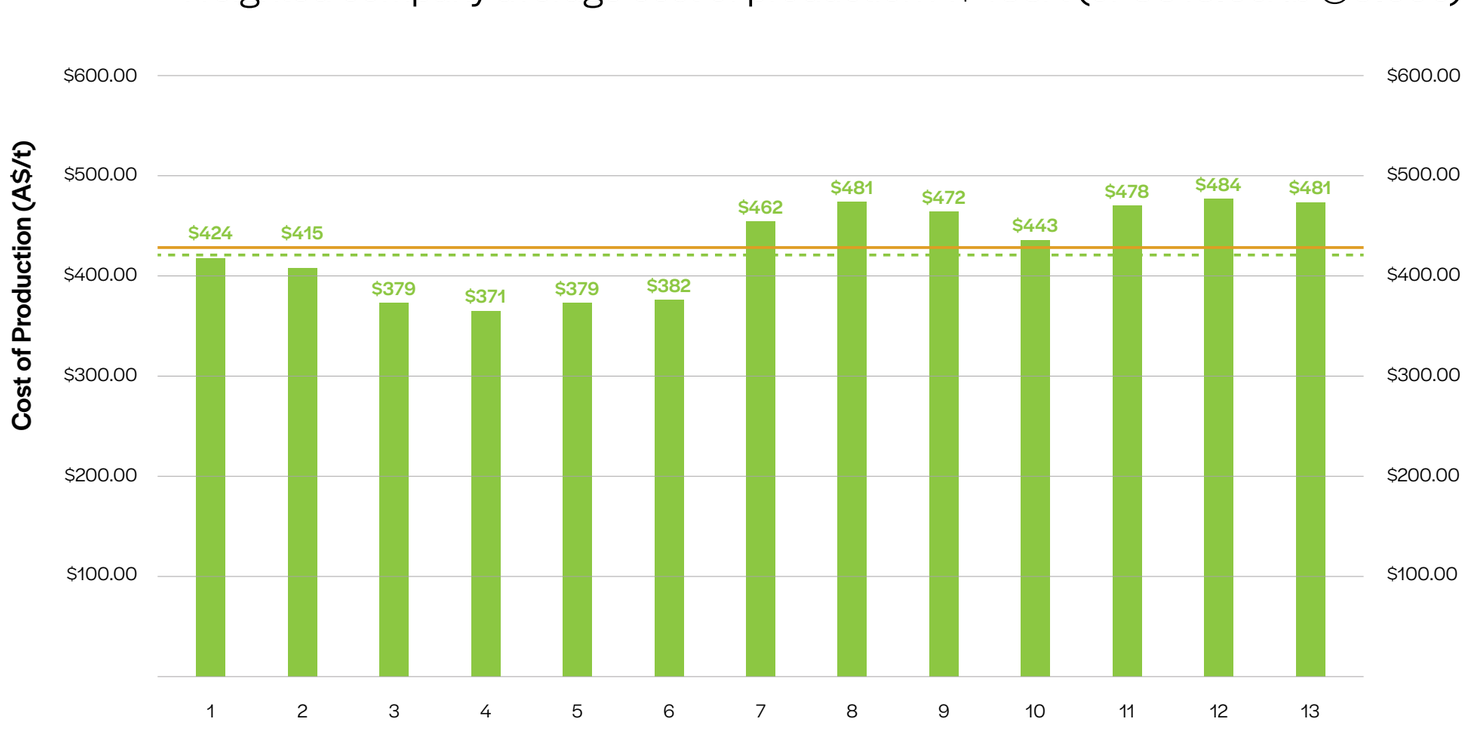
The Problem

Falling cane supply (in trend terms) is contributing to mill under-utilisation and high costs of production. In combination with limited value-add revenue diversification and additional revenue flows, the financial viability of milling operations is compromised.

CHART 1: RAW SUGAR PRODUCTION COSTS BY MILL

By-Product Revenues Not Assumed as a Cost Offset

(AVERAGE 2018-2020 • $AUD)



SOURCE: BDO PROJECTS, 2021 (UPDATED 7 JULY 2022)

ASMCs Macro-Agenda (Cont.)

What we need

34 million tonnes of consistent QLD cane production per annum

and...

A policy environment that supports value-add, revenue diversification opportunities.

Both are complimentary in the context of pursuing revenue diversification (i.e higher volumes will provide certainty of supply and additional revenues to help fund factory upgrades needed to liberate by-product feedstocks).

CHART 2: RAW SUGAR PRODUCTION COSTS BY MILL

By-Product Revenues Assumed as a Cost Offset

(AVERAGE 2018-2020 • $AUD AND USC/LB)

SOURCE: BDO PROJECTS, 2021 (UPDATED 7 JULY 2022)

ASMCs Bio-Energy Agenda

Option	Commercially prospective?	Is more govt help needed?	What type of govt help is required?*
MORE CO-GENERATION	**YES**	**YES**	▪ Provision of low cost investment capital (eg 2%), ▪ Long-term PPAs that reflects anticipated market failure for firming supply in the NEM ▪ Improvements in EQL and AEMO generation connection approvals processes
MORE BIO-FUELS	**YES** – especially Sustainable Aviation Fuel (SAF)	**YES**	▪ R&D incentives ▪ Fuel supply (eg low emissions fuel standard and/or mandates) ▪ Fuel demand (consumer) incentives
BAGASSE PELLETISATION (FOR EXPORT)	Not in the foreseeable future		
BIO-METHANE	**YES**	**YES**	▪ Low cost investment capital (eg 2%) ▪ ACCU's (Australian Credit Carbon Units) when gas is digested from bagasse or trash
GREEN OR TURQUOISE HYDROGEN	Not in the foreseeable future		

* In addition, for new investments to take place, milling companies and other investors will require a regulatory and policy environment that ensures that future returns, after an investment decision has been made, cannot be expropriated through pre-contract arbitration proceedings. Due to the uncertainty that currently exists from the pre-contract arbitration provisions in the *Federal Sugar Industry Code of Conduct (2017)* and similar provisions in the *Queensland Sugar Industry Act* exist, investment by sugar milling companies are likely to remain on hold until these provisions are reformed.

SUMMARY OF FINDINGS

More Co-Gen

COMMERCIALLY PROSPECTIVE

1. National Electricity Market (NEM) will require both a **significant quantum of renewable, firming and baseload power supply** of which the sugar industry is capable of supplying all – especially given the faster than anticipated retirement of coal fired generation;
2. Queensland mills could significantly increase Co-generation from bagasse from 438 MW of capacity (and 567 GWh's of export) to between **680 MW's** of capacity (2,120 GWh's of exported power) and **1,736 MW** of capacity (and 7,588 GWh's of exported power);
3. The range 680MW to 1,736 MW range reflects the extent of:
   - Upgrades to current plant and the amount of bagasse liberalisation that can occur and the
   - Type and rate of technology advances with the commissioning of new plant.

   These augmentations would allow co-generated electricity to be dispatched well beyond the June-Nov sugarcane crushing season;
4. Levelised cost of energy (LCOE) of new co-generation from **AUD$93 MWh to AUD$152 MWh** (assumes 60% capacity and discount rate ranging from 2% to 10%);
5. Compares favourably to LCOE estimates for other firming options – **gas** (AUD$95 MWh-$151 MWh), **lithium batteries** (4 hrs) (AUD$192 MWh) and **pumped hydro** (AUD$150 MWh);
6. The co-generated electricity **should primarily be dispatched during the evening peak and overnight (5pm-7am)** rather than during the day **and extended into the summer months** when prices may be higher. It could also be brought on quickly during other periods of the day as a firming option;
7. **$3-4 billion in potential new investment in regional Queensland** as mills electrify and modernise their factories (to liberate more bagasse supply) and for the installation of and commissioning of additional Co-generation capacity in Queensland regional communities from Bundaberg to Mossman;
8. A **strengthening of the milling sector's financial position** due to complementary renewal of critical factory equipment like boilers and additional revenue streams to help fund other essential factory upgrades and other diversification opportunities;
9. A **strengthening of the financial position of canegrowers** due to the improved financial position of the milling sector and the potential co-investment of growers in new cogeneration assets thereby providing access to additional revenue streams;
10. As the **supply is synchronous, electricity grid security and reliability is improved** therefore ensuring that Queensland's lights stay on as a renewable, baseload and/or firming energy generation alternative to when Queensland starts to retire its coal fired energy assets; and
11. Around **2.9 million tonnes of additional carbon abatement** per annum (under scenario of 1,054 MW installed capacity).

SUMMARY OF FINDINGS

More Biofuels

COMMERCIALLY PROSPECTIVE

1. Potential for the **Sustainable Aviation Fuel (SAF) production** from the sugar milling sector to be highly significant;
2. **Number of potential SAF pathways exist from our bagasse or cane trash** - including Ethanol-to-jet fuel (ETJ), Sugar-to-jet fuel (STJ), Gas-to jet fuel (GTJ); and pyrolysis to make the bio-crude for refining into SAF;
3. Domestic and international airlines are **looking for a way to decarbonise** and options such as batteries or hydrogen have limited applicability or are much further away;
4. Current uptake of SAF, both globally and in Australia, is relatively limited; while there are long-term government mandates (e.g. in the European Union) and independent targets within the aviation sector, current demand is mainly limited to trial use;
5. International **SAF usage is forecast to grow to c.19%** of total aviation fuels by 2040. If this usage were to be reached in Australia, and it were to be fulfilled entirely via an ethanol pathway, it could result in demand that is c.5-6x current levels;
6. Several SAFs have received certification for commercial use, with different underlying feedstocks and different airline backers. Ultimately, airlines will choose the SAF they can obtain at the lowest cost, provided it does not materially impact aircraft performance;
7. Currently, the levelised cost of making jet fuel from sugarcane via the ETJ and STJ pathways are c.4x more expensive than conventional jet fuel, and is also inferior to the oil based HEFA-SPK pathway that uses vegetable and soybean oil as a feedstock;
8. Ethanol yield from bagasse is comparable to HEFA feedstocks and could become an economic source of ETJ if capital costs were reduced; and
9. ETJ, GTJ and STJ are currently not economic without government mandates or subsidies, which do not currently exist in Australia.

SUMMARY OF FINDINGS

Bio-Methane

COMMERCIALLY PROSPECTIVE

1. Surplus bagasse and sugarcane trash can be used to produce biomethane via an anaerobic digestion (AD) process, which can ultimately produce gas which can be injected directly into transmission pipelines;
2. Biomethane production could be a potentially attractive opportunity because there is a **strong demand outlook for export natural gas which feeds through to domestic prices;**
3. AD is technologically mature and operating at scale (with substantial government incentives) in overseas markets like the US and Europe, but mainly produced from other feedstocks which have lower cost of production than sugarcane residues;
4. Analysis indicates that only with a low cost of capital (at 3% instead of 10%) as well as an increase in ACCU prices from c.$22 / tonne to c.$30 / tonne would enable biomethane from bagasse to become economic with the additional proviso that the project is located within 40 kms of a pipeline;
5. The Clean Energy Regulator (CER) is currently developing an approved method for determining the eligibility for credits from biomethane production from waste (likely to be bagasse or trash) and agricultural methods (the benefit of this for bagasse, given the additionality test is however unclear); and
6. The benefit of cane trash is that fugitive emissions are more likely to be awarded under the additionality test – but this would incur additional costs associated with collecting and transporting the cane trash.

SUMMARY OF FINDINGS

Green or Turquoise Hydrogen

NOT CURRENTLY COMMERCIALLY PROSPECTIVE

1. Hydrogen is forecast to play an important role as the world moves toward decarbonisation;
2. The two possible avenues for the sugar industry to commercially participate include:
   (1) the production of green hydrogen via electrolysis or
   (2) the production of turquoise hydrogen via pyrolysis.
3. Green hydrogen is more expensive to produce than hydrogen produced from fossil fuel energy sources. It is not expected to be competitive with grey hydrogen (from gas) until the middle of the century; and
4. Neither electrolysis nor pyrolysis appear to be viable pathways for the sugar industry;
   - Solar and wind are likely to be the most cost effective source of energy for the electrolysis process. Bagasse is likely to be uncompetitive. Moreover, electrolysis would require significant capital investment
   - Pyrolysis is a commercial unproven technology and it makes limited sense for the sugar industry to invest in generating biomethane, only to then use this as an input into producing hydrogen (rather than selling directly to the gas network).

SUMMARY OF FINDINGS

Bagasse Pelletisation

NOT CURRENTLY COMMERCIALLY PROSPECTIVE

1. Global consumption for wood pellets, a proxy for bagasse pellets, is attractive having grown materially over the last 5 years (c.18% p.a.) (mainly in the EU, China and Japan);
2. In order to investigate the economics of investing in capacity, L.E.K. considered a representative c.76 kt p.a. pellet plant in the Herbert region. Findings suggest that at a price of A$241/t, a c.$45M facility exporting to Japan is unlikely to generate an appropriate return on capital (in the absence of any policy support);
3. Bagasse pellets have several limitations compared to wood alternatives, limiting the potential for their uptake, including affordability, storage requirements and chemical composition; and
4. The supply of pellets (namely wood) is also becoming increasingly competitive in SE Asia, which is likely to make Australian-based pellets appear relatively more expensive to North Asian markets (particularly given additional shipping costs).

Next Steps

1. For more co-generation, seek government financial support for a full pre-feasibility study;
2. For more bio-fuels, and SAF specifically, seek government financial support for a full pre-feasibility study;
3. For bio-methane, work with Clean Energy Regulator to develop ERF methodologies that support ACCU creation for trash and bagasse feedstocks; and
4. Seek reform of the pre-contract arbitration provisions in the Federal Sugar Industry Code of Conduct (2017) and the Queensland Sugar Industry Act (1999) to ensure that future returns cannot be expropriated after an investment decision has been made.