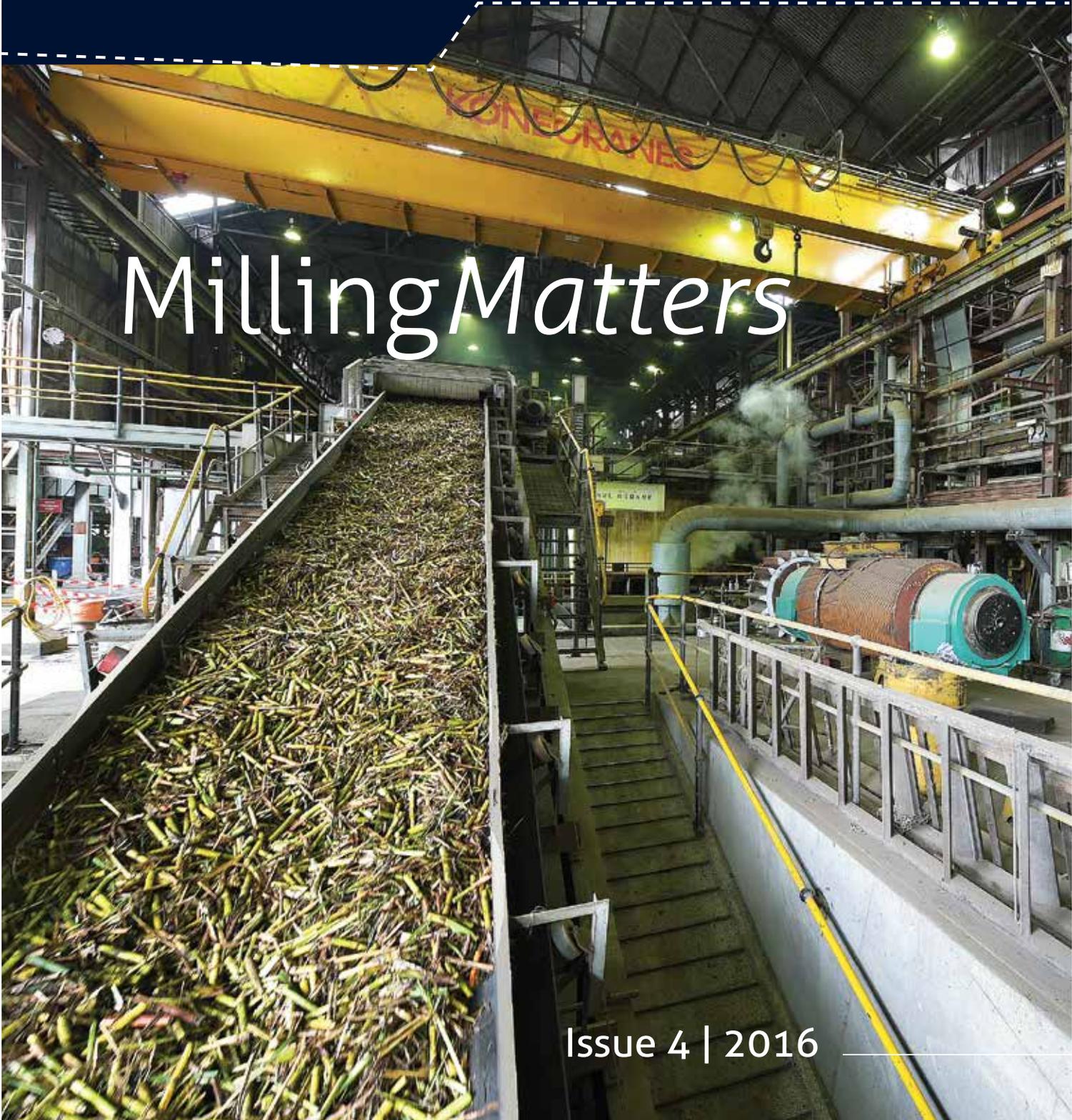


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Sugar Research
Australia™



MillingMatters

Issue 4 | 2016

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Welcome to MillingMatters



Welcome to the fourth edition of Milling Matters magazine. The purpose of this magazine is to provide updates on milling research activity for SRA's milling investors. SRA invests in a range of milling research projects, including projects that are internal (conducted by SRA researchers), and those that are external (conducted by other researchers).

This investment comes as part of SRA's focus on eight Key Focus Areas of research that were developed as part of SRA's strategic plan.

In this edition, we look at a new research project that has been commissioned to contribute toward improving harvest best practice (page 10), an issue that has been estimated to cost the industry over \$50 million annually.

While a strong focus of harvest losses research occurs in the paddock, the outcomes of improving harvesting efficiency flow all the way to the mill. Improvements in this space would help generate greater cane supply to the mill, and cleaner cane. The new project is looking at real-time or rapid sensors in the harvesting environment.

In that theme, a current research project being conducted at QUT is looking at new cane cleaning technology, which you can also read about in this magazine. The project has potential implications throughout the value chain.

We also look at research into the degradation of bagasse stockpiles, and look at some of the lessons that QUT researchers have learned from overseas sugar mills and how these lessons could be applied to Australian mills.

Much of this research was also discussed at milling research workshops held throughout the industry earlier this year (pictured above, and also featured on page five). SRA thanks all those who attended and we look forward to continue to keeping you informed of SRA's milling research investments throughout 2016.

Brad Pfeffer

Executive Manager, Communications



Overseas factories share options for efficiency

It is well known that farmers like to look over the fence to see what innovations their neighbours are up to. And while it is nowhere near as easy for millers to “look over the fence”, a current project looking inside several overseas sugar factories is unearthing potential efficiencies that could be incorporated into Australian sugar mills.

Researchers from the Queensland University of Technology (QUT) are in the midst of a project that is unearthing valuable experience and lessons from overseas sugar mills.

Their aim is to provide a blueprint that defines some technologies that are being used in overseas mills that could be suitable to Australian sugar mills now.

In December 2015 and February 2016, researchers Dr Ross Broadfoot and Dr Darryn Rackemann visited overseas factories in South Africa, Reunion, Mauritius, India and Germany.

A major component of their project was to study overseas Kestner and falling film tube evaporators and compare them to Robert evaporators, which are standard in Australia.

They are comparing their overseas observations with experiences in several Australian factories as a reference point.

The project had been identified as it was recognised that overall Australian factories are among the least energy efficient in the world with process steam consumption levels being for most Australian factories about 50 percent on cane.

Some of the technologies being used in these overseas energy efficient factories (where steam consumption levels as low as 30 percent on cane are being achieved) could be introduced into Australian factories to provide capacity and operational benefits.

These technologies would then suit any transformation of Australian factories to more energy efficient configurations.

Examples of the technologies which are being used in overseas factories and could have immediate application into Australian factories include:

- falling film tube evaporators and Kestner evaporators
- in-line juice heaters using the vapour from the final effect,
- direct contact pan feed conditioning systems, and
- vapour recovery systems such as in condensate cigars.

In most cases, these technologies also boost plant capacity and processing efficiency such as sucrose recovery and reduce heat loads on cooling water systems.

“The next phase of the project is bringing all that data together,” Dr Broadfoot said. “We will model four Australian factories where we focus on the implications of implementing and integrating these technologies.”



Key Focus Area

Milling efficiency and technology

Project name

Develop a blueprint for the introduction of new processing technologies for Australian factories

Project number

2015/043

Project leaders

Ross Broadfoot, Darryn Rackemann

Project end date

September 2017

Above: Darryn Rackemann with QUT in front of two falling film tube evaporators and a semi-Kestner evaporator at Le Gol factory, Reunion.

Research looks at cane cleaning options that could reduce the need for cane fires in NSW

New research is hoping to provide innovative solutions that could greatly reduce the need for sugarcane burning in NSW, which is still commonly needed immediately before harvest in this region of the sugarcane industry.

Currently, the high-yielding sugarcane crops in the NSW region are burnt because of their size, because of the two-year crop cycle, and because the soils and climate do not allow the sugarcane trash to break-down into the soil. Also, sending the trash to the mill can greatly reduce sugar quality.

But according to Sunshine Sugar CEO, Chris Connors, the industry is looking for proactive solutions for what to do with that sugarcane trash and reduce the need to burn.



Above: Sunshine Sugar CEO Chris Connors.

“We don’t want to burn, the growers don’t want to burn and we know that the community does not want us to burn. But at the moment we have no choice,” Mr Connors said.

The new research, being conducted by the Queensland University of Technology (QUT) and funded by Sugar Research Australia (SRA), is looking at ways that the whole crop could be brought to the mill.

The research is looking at a new method of cleaning the cane by removing the trash and other impurities after harvest but before it enters the mill.

Existing cane cleaning methods such as on the harvester have served the industry well, and are still required. However, financial pressure is resulting in harvesting operations where increased levels of extraneous matter and cane loss are the result.

The new research is looking at a method that uses less energy, has less cane loss, and can work in wet or dry conditions, and is working to scale up a concept previously developed at QUT.

Key Focus Area

Farming systems and production management

Project name

A non-pneumatic cane cleaning system with no cane loss

Project number

2014/035

Project providers

QUT

Primary investigator

Floren Plaza

Project end date

01/12/2017

Mr Connors said that this research was an important piece of a broader puzzle that needed to be solved.

The next step would require a look at the logistics of moving cane around that had much more trash, as this was a lighter and less efficient load.

There was also the important step of harnessing the best value from the trash.

“Sunshine Sugar has a keen interest in that side of it, because we are still of the view that we want to take all of the crop in. There is this crop sitting out there where we are throwing so much away and only taking the stalk in the middle,” Mr Connors said.

“There is another 25% of material there that we can do something with.”

SRA CEO Neil Fisher said that this research formed part of SRA’s strategic plan, which focused on eight Key Focus Areas of research investment for the Australian sugarcane industry.

“This research has useful implications for both growers and millers. It has positive implications for the farming system and its efficiency, and also for product diversification and value-adding,” Mr Fisher said.

“It has strong collaborations between QUT and Sunshine Sugar in NSW, and it also will deliver practical and useful outcomes for the entire Australian sugarcane industry.”

The project is being led by Floren Plaza at QUT and it builds a concept developed in a PhD study by Chris Henderson. The PhD study involved a relatively small design, and this new project has an objective of scaling-up the technology.

Details of the process are not identified as there is an intent to patent the concept.

“Trash in cane supply has a lot of negative impacts such as wear and tear, less quality, and sugar loss,”

QUT's Dr Geoff Kent explained at recent milling research workshops.

“The fibre is also gaining in value. Yes, there is value for it in the field, but there is more there than there is needed for that purpose.”

Opposite: An investigation into a new cane-cleaning system could eventually lead to a reduced need for cane fires in some situations.

Milling research delivered direct to industry

Milling researchers have hit the road in early 2016 to bring the latest research findings and information to the millers of the Australian sugarcane industry.

The forums were a collaboration between Sugar Research Australia and the Queensland University of Technology, which is one of SRA's main research partners into milling efficiency and technology and also product diversification and value addition.

Researchers from QUT and SRA spoke at the events held in Mackay, Innisfail, Townsville, Bundaberg and Broadwater. Speakers included Eloise Keeffe and Jo Stringer from SRA and Geoff Kent and Ross Broadfoot from QUT.

The aim of the seminars was to communicate some of the research that is currently being conducted in the milling sector. SRA thanks all of those who attended the events.



Above: Wilmar staff at the event in Townsville hear from Dr Geoff Kent from QUT. This was one of five events held recently.

Improving mill efficiency through rapid analysis methods

This project has sought to develop turn-key, diode array benchtop NIR spectroscopy systems for the rapid analysis of sugar factory products. By Eloise Keeffe, Senior Researcher, SRA

Key Focus Area

Milling efficiency and technology

Project name

Improving mill efficiency through rapid analysis technologies

Project number

2014/051

Investigators

Eloise Keeffe, Steve Staunton, Joel Simpson (SRA), Dr Wayne Martens (QUT)

Project end date

2017

Near infra-red spectroscopy is a well utilised tool in the Australian sugar industry, however adoption of bench-top systems in the mill laboratory has been low.

The cause for this is two-fold: the high capital cost of benchtop instruments and the excessive resource investment required to develop local calibrations at mill level.

The advent of diode array systems has solved the first problem. The second is more challenging.

This project has sought to develop turn-key, diode array benchtop NIR spectroscopy systems for the rapid analysis of sugar factory products.

This has been achieved through the development of global calibration models that comprise data from 14 different mills across multiple seasons.

Global calibration models of varying performance (qualitative to quantitative and ready for use) exist for all factory products, including: prepared cane, bagasse, juice, syrup, magma, massecuites, molasses, raw sugar and mud. Performance statistics are available.

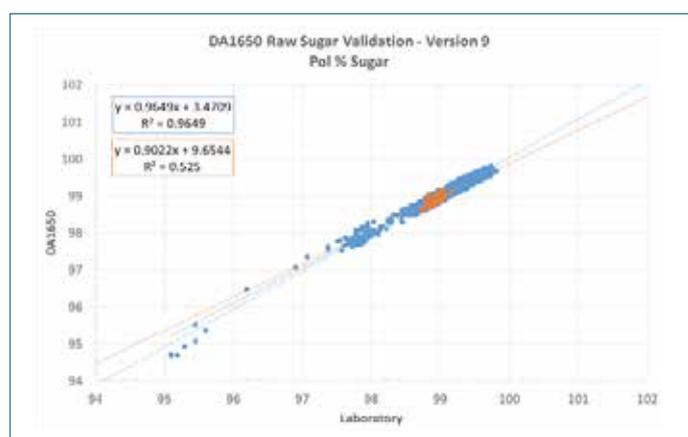
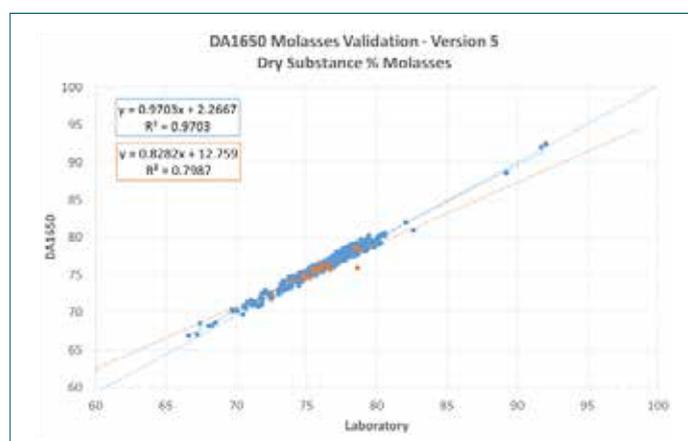
Mill trials during last year's crush indicated that most calibration models were performing across multiple sites better than expected. Little to no localisation is required.

Characterisation of the mill products is also ongoing and will be used to better understand the chemical mechanisms defining each calibration model.

Additional trials have been planned for this year to expand the dataset and finalise the global models. If you wish to host a trial, please contact one of the investigators.

For more information contact Eloise Keeffe ekeeffe@sugarresearch.com.au or (07) 3331 3351.

Product	Constituent	Range	N	SEP
Bagasse	Pol (Mills 1-4)	0.90–13.1	3505	0.65
Molasses	Sucrose	31.4–77.4	1356	1.08
Raw sugar	Pol	95.1–99.82	4821	0.06



The project demonstrated the yield benefits for growers who regularly obtained clean seed.

Mill data analysis identifies key productivity drivers

A research project is using mill data to help inform and improve on-farm productivity, delivering benefit along the value chain for both growers and millers.

Key Focus Area

Optimally-adapted varieties, plant breeding and release

Project name

Optimising productivity and variety recommendations through analysis of mill data

Project number

2014/054

Project collaborators

SRA, HCPSL, Wilmar

Project end date

2016

A joint research project between Sugar Research Australia, Herbert Cane Productivity Services Ltd (HCPSL) and Wilmar Sugar Australia has quantified the impact of cane farms using modern farming systems and technologies for the industry.

Researchers have analysed the Herbert River mill rake data using innovative techniques to identify key drivers of productivity.

Dr Jo Stringer from SRA said the project was borne out of a need to identify the reasons behind productivity declining in the Herbert River mills after 2005.

"Analysis of mill data in the Herbert successfully identified groups of farms with similar productivity trends over time and the major

factors associated with these groupings," Dr Stringer said.

Results showed growers who adopted new farming systems had significantly higher productivity than those who continued to use traditional practices.

The impact of the Pachymetra resistance of previous varieties on yield of the current crop was also significant, suggesting this may be a major factor contributing to poor ratooning in the Herbert.

Growers who regularly obtained clean seed had more than 10% higher yields than growers who infrequently obtained clean seed and greater than 6% higher yields than growers who only obtained clean seed in 3 or 4 years out of 6.

Points of focus included the correlation between farm size, age of manager running the farm, yield, and those who regularly obtained clean seed.

Overall the study identified factors improving farm performance, including obtaining clean seed, adoption of new varieties and new farming systems.

Manager of HCPSL Lawrence Di Bella said the research has allowed HCPSL to design targeted extension strategies with growers, with the view to influence better variety choices and increase productivity.

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

New tool to deliver informed harvest decisions

Harvesting is a very large part of the total cost of production of sugarcane, and if not done well, the loss of value through the harvest and transport operation can exceed the 'visible' costs of harvesting.

SRA has recently invested in a new project to address this issue, as part of SRA's focus on reducing harvest losses as a priority impact area. The R&D provider of the project is Norris ECT, and is based around a program called SCHLOT.

SCHLOT, a program built by Norris ECT, allows growers, harvesting operators and millers to assess the cost of harvesting and where gains can be made to implement a payment scheme that increases the profitability of all three sectors, through finding the ideal compromise between harvesting costs and losses. This type of tool promises to allow growers and contractors to achieve the Harvest Best Outcome under any conditions.

For more information on harvest losses research, contact Adoption Officer Phil Patane (07) 4776 8202.

Research looks to improve shelf-life of bagasse stockpiles

A recently completed project has looked closely at what is happening inside bagasse stockpiles in order to provide information that would allow millers to more efficiently and sustainably store this important resource.

The approach in this study was to further develop QUT's existing stockpile model and to build equipment that would enable key characteristics of bagasse (or any other biomass) to be measured and used to increase the accuracy of the model predictions.

The project made a number of important findings in relation to factors that influence the temperature of a bagasse stockpile, which in turn is a factor that influences its degradation. Researchers from QUT working on the project also gathered important information on managing spontaneous combustion.

The project was led by QUT researcher Dr Phil Hobson, with support from other researchers at QUT. Some of their results were presented at recent milling research workshops held by QUT and Sugar Research Australia across the Australian sugar industry.

At these workshops, Dr Geoff Kent with QUT told the audience that the research found that the maximum temperature inside a bagasse stockpile occurred not far below the surface, which meant that increasing the stockpile higher elevated that maximum temperature point higher in the stockpile.

"All of the degradation is predicted to happen near the surface," he said. "As the stockpile gets bigger, the proportion of degraded material gets lower."

He said temperature was largely related to the amount of oxygen that could enter the stockpile and the moisture content of the stockpile.

Tarpping is sometimes used over stockpiles. Dr Kent said that the effect of tarping was not pinned down mathematically, but preliminary modelling of covered stockpiles indicated that tarping could reduce the maximum temperature by a notable amount.

Project name

Biomass characterisation facility for extended stockpile model accuracy and capability

Project leader

Dr Phil Hobson, Queensland University of Technology

Project supporters

Mr Neil McKenzie, Dr Floren Plaza, Dr Laleh Moghaddam, Dr Chris East and Mr Adrian Baker

Research provider

Queensland University of Technology

Increasing density of the stockpile reduces the rate at which oxygen is able to enter and travel through the stockpile, which can also result in lower temperatures.

The project also revealed findings around moisture content that require further investigation. Common assumption would be that increased moisture content risks higher temperatures, as is the case for most stockpiles of other organic matter. However, there were some findings that might suggest that high levels of moisture in bagasse inhibit the rate of transport of oxygen through the stockpile, which could mean a lower temperature.



Above: Tarping was found to be the single most effective means of controlling stockpile heating.

Top: Research at QUT has studied degradation in bagasse stockpiles.

A number of factors can be considered to help reduce degradation in a bagasse stockpile.



In summary, the project's four main recommendations were to:

1. Increase bagasse bulk density

The adoption or increased use of bagasse moving equipment during construction of the stockpile could typically increase bulk density, resulting in a reduction in maximum untarped stockpile temperature.

2. Increase stockpile height

The depth of bagasse below the stockpile surface affected by degradation is independent of the stockpile height. Increased stockpile height will therefore result in a reduced mean loss of dry matter. The greatest gains are for small untarped stockpiles. Increasing stockpile height has no impact on maximum stockpile temperature.

3. Tarp open stockpiles and improve sealing of tarped stockpiles

Tarping was found to be the single most effective means of controlling stockpile heating. A stockpile fitted with a reasonably well sealed tarp has predicted maximum temperatures which are below those in the equivalent untarped stockpile.

4. Stockpiling bagasse at elevated moisture contents reduces the risk of spontaneous combustion and dry matter loss

Further experimental proof of this effect is required before this recommendation can be adopted with any confidence.

Biofuels mandate powers sustainable future

The Queensland Parliament has passed legislation requiring fuel sellers to meet targets for the sale of ethanol-blended petrol and bio-based diesel.

The mandate has been established under the *Liquid Fuel Supply (Ethanol and Other Biofuels Mandate) Amendment Act 2015* and is hoped to grow the biofuels and bio-manufacturing sectors.

The Bill includes an initial three per cent ethanol mandate for petrol and a half a per cent bio-based diesel mandate with both due to start on 1 January 2017.

In practical terms, the mandate will require E10 to make up 30 per cent of regular petrol sales in Queensland in 2017.

A joint Deloitte Access Economics/QUT study predicts bio-refining in all its forms could contribute more than \$1.8 billion in gross state product to Queensland and create up to 6640 jobs over the next 20 years.

"New types of bio-based fuels that may be developed in the future will also count toward the mandate, further helping to stimulate investment and innovations in Queensland's biotechnology sector," the State Government said.

Further information about the biofuels mandate is available on the Department of Energy and Water Supply website: www.dews.qld.gov.au.



Better data to help inform harvest best practice

A new research project is looking at real-time harvesting sensors, in a bid to drive improvements in harvest best practice across the industry. By Eloise Keeffe, Senior Researcher, SRA

Key Focus Area

Farming systems and production management

Project name

Sensors for improved harvesting feedback: a feasibility study

Project number

2015/080

Investigators

Eloise Keeffe, Phil Patane, Steve Staunton, Leigh Clement (SRA), Peter Larsen (Wilmar), Brian Robotham (SCAN Consulting)

Project end date

2017

Lack of incentives for key parties in the sugarcane supply chain has resulted in low adoption of harvesting best practice (HBP) strategies.

Poor harvest quality is estimated to cost the industry over \$50m annually. A revision of the payment structure is critical to driving practice change; however, there is currently no measurement mechanism available to facilitate a quality-based payment system.

Real-time or rapid sensors in the harvesting environment will improve harvest quality across the board by allowing contractors to adjust harvester settings based on loss and quality indicators in real-time.

It would also allow growers to monitor contractors' performance and adherence to HBP, allow mills to receive feed-forward information on the quality of incoming feedstock, and provide the data for a quality-based payment system.

Sensing technology must provide meaningful information about actionable issues on-the-go, be easy to implement and use, and have potential to improve productivity by recovering existing losses.

Resource and time constraints prevent real-world evaluation of all sensing options for suitability.

Instead, our feasibility study will identify those sensors and arrangements with the greatest likelihood of delivering and identify strategies for further research in field-based efficacy testing.

This feasibility study will be broken down into six parts:

1. **The Project Scope**, which will define the problem and opportunity to be addressed;
2. **The Current Analysis**, which will be used to define and understand the current harvesting systems and environment;
3. **The Requirements**, which will specify the needs of the end users, who include, contractors, growers, millers, harvester manufacturers and sensor manufacturers;
4. **The Approach**, which evaluates each of the sensors available in the market at the moment, as well as technologies capable of being used as a sensor, against the Requirements;
5. **The Evaluation**, which will identify a subset of systems presented in the Approach with the greatest likelihood of being efficacious in proof-of-concept; and
6. **The Review**, which will be a rigorous assessment of the feasibility study and its recommendations by an independent panel.

Much of the required information will be collected through consultation with industry, harvesting manufacturers, sensor manufacturers and method specialists. This consultation will occur via workshops, face-to-face meetings, and teleconferences.

This project will undertake a feasibility study to identify the sensing opportunities most effective in the harvesting environment. Specific objectives to achieve this include:

- (a) Investigate the current practices and processes of the harvesting community, including the present use of sensors.
- (b) Isolate the cause and effect of harvest quality and loss and the drivers currently preventing change.
- (c) Identify what contractors, growers and millers need and/or wish to achieve from the addition of sensors on harvesters.
- (d) Identify and evaluate commercially available sensors and other measurement systems for their suitability to measure certain parameters in the harvesting environment.
- (e) Identify a small sub-set of systems (4 or less) most likely to succeed in future efficacy testing and develop a research strategy to support this development.

Total Research Investment for the Milling Sector

Project Title	Project Number	Principal R&D Provider	Chief Investigator	End Date
Key Focus Area 5 (Milling efficiency and technology)				
Determine the optimum tube dimensions for Robert evaporators through experimental investigations and CFD modelling	2012/054	QUT	Ross Broadfoot	01/09/2016
Improved modelling of wet scrubbers	2012/055	QUT	Anthony Mann	01/05/2017
Determination of factory processing procedures to better manage sugar quality issues	2012/057	QUT	Ross Broadfoot	Closed
A retrofit to a mill to reduce its operational and maintenance costs	2013/059	QUT	Geoff Kent	02/08/2017
Reducing the maintenance costs of mill rolls	2013/060	QUT	Geoff Kent	01/08/2019
Real time harvest and transport system (under contract)	2014/037	QUT	Geoff Kent	01/09/2017
Improving mill efficiency through rapid analysis methodologies	2014/051	SRA	Eloise Keeffe	01/08/2017
Managing aspects of raw sugar quality in the Australian sugar industry	2014/052	SRA	Eloise Keeffe	01/08/2017
Investigation into modifying pan boiling techniques to improve sugar quality	2015/013	QUT	David Moller	01/06/2017
Increasing capacity to undertake cane preparation research through modelling and experimentation	2015/018	QUT	Geoff Kent	01/05/2017
Develop a blueprint for the introduction of new processing technologies for Australian factories	2015/043	QUT	Ross Broadfoot	01/09/2017
Key Focus Area 6 (Product diversification and value addition)				
Process for making bagasse paper pulp	2012/053	QUT	Thomas Rainey	01/04/2018
A profitable future for Australian agriculture: biorefineries for higher-value animal feeds, chemicals and fuels	2015/902	QUT	Ian O'Hara	01/04/2019
Key Focus Area 8 (Capability development, attraction and retention)				
Modification of lignin biosynthesis in sugarcane for the production of cellulosic ethanol	2010/068	QUT	Patrick Bewg Heather Coleman	Closed
Biodegradable polymer nanocomposites derived from natural fibre and starch	2011/071	QUT	William Gilfillan William Doherty	Closed
Enhancing sugarcane for decreased water content and increased sugar content at harvest	2011/072	QUT	Anthony Brinnin Mark Kinkema	01/05/2016
Production of furanics and chemicals from bagasse and molasses	2012/074	QUT	Joshua Howard William Doherty	01/04/2016
Investigating the utility of mill mud for soil health conditioning and nutrient use efficiency on sodic soils within the Burdekin	2013/077	USQ	John Bennett	01/09/2016



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