Adapting Renewable Energy Concepts to Irrigated Sugarcane Production at Bundaberg

Milestone Report No: 5

Australian Government
Australian Renewable Energy Agency

ADAPTING RENEWABLE ENERGY CONCEPTS TO IRRIGATED SUGARCANE PRODUCTION AT BUNDABERG

MILESTONE REPORT No: 5

Funding Agreement Details

Recipient Name	Bundaberg Regional Irrigators Group (BRIG)
Project Commencement Date	02/01/2017
Project Completion Date	15/09/2020
Project Partners/ Participants/ Sub-contractors	*Bundaberg CANEGROWERS Ltd* *Bundaberg Sugar Services Ltd* *Killer Family Holdings Pty Ltd.*
Primary Contact Name	Dale Holliss
Contact Telephone Number	0417 009 236
Contact Email	Dale_Holliss@bdbcanegrowers.com.au

Milestone Summary

Milestone Number	5		
Report Dates	Due: 12/07/19	Submitted: 12/07/19	Reporting period: 11/01/2019
Comments if report is late			

Technical Delivery of Milestone

1. Provide a technical report of the milestone activities.

The solar pumping trial located on the Killer Family farm provided 1437 hrs of irrigation operation during the period from 1 July 2019 to 30 June 2019. During this period comparative analysis of the running cost for the previous all grid powered system to the solar trial shows a reduction in operational cost of $11,657 which comprised $7,571 attributable to the solar array and $4,130 to the motor and pump efficiency improvements which included the Variable Frequency Drive (VFD).

The period in review was notable for very low annual rainfall but particularly for the lack of normal summer season rainfall which adversely affected crop growth during the critical summer months (January - February - March) when only 93 mm (21%) of the average 440 mm was recorded.

During the summer, subsoil moisture remained very low due to lack of rain and irrigation was only able to replenish the surface layers of the soil sufficiently to prevent crop death with very slow growth recorded.

This situation placed significant strain on the capacity of the irrigation system to deliver the required amount of water to the farm within an appropriately timed schedule. This outcome has demonstrated clearly that efficiency and capacity factors associated with delivery of pumped water have a direct link to the economic viability of solar pumping especially where the solar energy is directly linked to a cropping situation.

The most important issue was that the farm irrigation layout which was essentially designed in the 1970's for a supplementary irrigation system to enhance crop production in average seasonal conditions or a tool to ensure that crop root stock was not lost in drought. This is opposed to a system with capacity to produce potential yield in all seasons which is design methodology normally used today. There are too many short run sections which require an operational period per day that is less than a full day which results in time lost for set up which causes too much down time and loss of pumping hours. The trial has the capability to provide a dual reduction of energy options; reduced energy during daylight hours from solar and VFD and reduction in energy due to VFD in the nighttime hours.

The solar technology has so far worked above expectation in terms of reducing grid energy use per megalitre of water pumped, but the lesson that is unfolding in this trial is that for future solar investment to achieve cost recovery within a reasonable time period there will be a need to formulate guidelines that take into account farm infrastructure capacity when developing the size and design of solar system.

The issue of farm layout was considered during the trial site selection process and the current site was selected because the Killer site would pose challenges considered useful to a more extensive evaluation of solar in the cropping environment.

Important observations from the trial so far:

- Trial outcomes so far indicate that it is very difficult for a stand-alone solar array to maintain the specific energy demands of pumps linked to irrigation systems providing water directly to crops with specific seasonal moisture demands. These circumstances will require some form of integrated energy back up (Grid, battery or diesel generation equipment) to ensure that a 24 hour operation is possible when required.

- Sugarcane is a highly water dependant and timing dependant crop; it requires the right amount of water at the right time of the year to achieve its potential production so the design capacity of the solar array will be mostly influenced by individual farm characteristics.

- All avenues of available energy need to be utilised. In the case of Bundaberg farms within the SunWater water supply scheme most will receive their water supply at some level of incoming pressure (head). This head is effectively stored energy that should be utilised in the pumping process. Variable Frequency Drives can ensure that this incoming energy can be utilised as well as managing the friction head on the delivery side of the pump which in the case of this trial has the combined effect of lowering energy demand by 27%.

- From the information gathered so far it is evident that solar may need to become the second step in the process of reducing grid energy reliance for irrigation in some instances. The first step is likely to be upgrading of pumping and delivery systems to more efficient low pressure technology.

Technical delivery (Table 1)

Milestone (5) activity / deliverable	Completed
D5.1 Provide a report to ARENA clearly outlining the Data recording 2018-19 (last 6 months) crop including the: Irrigation program Attachment A	<u>Irrigation Program</u> The irrigation trial area for the July 2018- June 2019 period is 55 ha which is irrigated by the solar trial pumping system. A combination of the inadequacies of the farm irrigation distribution system noted in milestone 4 became an issue when relief rainfall failed to eventuate. Evaluation of potential crop irrigation demand for the 2018-2019 drought compared to average seasonal conditions including a review period from January to June 2019 is provided in Attachment A. This data illustrates potential monthly reference evapotranspiration (ET_0) determined from the onsite weather station.

	Calculated daily crop evapotranspiration (ET_C) is determined from potential crop size factors relative to the recorded $ET_{0.}$ When daily crop data is referenced against rainfall an irrigation demand for 2018-2019 and the historical average demand it is apparent that the irrigation requirement for the current season was much greater than the average. The Bundaberg region has a water supply allocation that varies across properties from about 2.5 ML/ha to 4.5 ML/ha. The application to the trial site 2018-2019 was 2.9ML/ha.
Climate data (rain, solar radiation, reference evapotranspiration (ET_0) and temperature (Attachment B)	<u>Climate data</u> Rain, solar radiation, reference evapotranspiration (ET_0) and temperature data for January 2019 to June 2019 is provided in attachment B This information contains the full daily data provided by the weather station at the trial site for each month of the review period. Weather conditions fluctuated significantly throughout the review period; solar radiation was often interrupted by cloudy weather which is an issue also evident in the corresponding temperature and ET_0 data however in most instances it is evident that these cloudy periods were not associated with significant rainfall events. The net effect of this weather pattern was that crop growth potential from irrigation applied was reduced significantly.
Irrigation/crop growth response data (Attachment C)	<u>Irrigation/crop growth response data</u> The soil moisture graph showing the impact of rain, irrigation and crop growth rate for the summer and autumn period is illustrated in Attachment C.

	The low sub soil moisture at 100 cm depth during January to June 2019 is evidence of the irrigation system's inability to compensate for the substantial lack of rain. The optimism expressed in December for a successful 2019 harvest was dashed by the record low summer rainfall which overwhelmed the irrigation system capacity to deliver the required water.
Energy availability verses consumption data (solar verses mains supply) and water applied (ML/ha) Attachment D Attachment E	<u>Energy availability verses consumption data (solar verses mains supply)</u> Solar energy data from the onsite weather station indicates that during the review period January to June 2019 (181 days) there were 2134 of sunshine with 896 hrs with sufficient radiation to maintain the threshold required to provide full power to the pumping system. Pump daytime hours were 589 which is 66% of the available hours within the pump operating threshold. Utilisation of solar energy and water data are shown in Attachment D. A chart illustrating the relationship between the daily solar intensity and the pump operational threshold is also included. It is noticeable that during a summer that with extremely low rainfall there was regular occurrence of cloud that reduced solar radiation below the pumping system threshold on many occasions resulting in an almost daily need for contribution from the mains energy supply.
D 5.2 Provide a report on crop production Attachment F	<u>Crop Production</u> A progressive estimate in Attachment F indicated in December 2018 that the crop for 2019 harvest was in good condition and prospects for successful crop were high. Early season irrigation had made a significant contribution to this optimistic view. However, the final harvest estimate for 2019 was influenced by an extended dry summer and

	autumn period which dashed all hopes of achieving the previous expectation. The situation that was encountered has not diminished the performance of the solar equipment, but it has highlighted the need for including irrigation distribution capacity when designing hybrid solar systems such as the current trial.
D 5 3 Provide evidence – energy efficiency relationship between monitored irrigation crop data and energy consumption solar/grid Attachment F	<u>Evidence of energy efficiency</u> Data illustrated in Attachment F shows that the average hourly energy use of the previous all grid system was 39 kW/h and for the new solar/grid pumping system the average hourly grid demand for the annual crop production period (July 2018 to June 2019) was 8.22 kw/h. This saving can be attributed to a reduction in grid demand as a result of the VFD and pump/motor upgrade (-10.86 kW/h) and the solar array (-19.92 kW/h). The annual value of the savings for the July 2018 to June 2019 period which shows that to produce the crop for 2019 harvest the total cost reduction $11,656 which equates to a reduction in irrigation cost over the period from the original pumping system of $5.19 per tonne cane to the current system $1.08 per tonne cane.

2. Provide a statement as to whether the timeframes for the project are being met and an explanation of any delays that have occurred.
Project timeframes are being met. Future delays are not anticipated.

3. Are there any proposed changes to the project, including to scope, personnel or partners?
No

4. Have there been any changes to the risk management plan (including changes to actual risk & risk ratings)?

If yes, please provide a copy of the updated risk management plan.
No

5. Comment on progress toward achieving each of the project outcomes listed in Schedule 3.	
Project Outcomes	**Achieved / Not achieved (comment)**
D5.1 Update the Milestone 4 (D4.1 report) clearly outlining the Data recording 2018-19 (last 6 months) crop including the: • irrigation program • climate data (rain, solar radiation, ET) • irrigation/crop growth response data energy availability versus consumption data (solar versus grid) and water applied (ML/ha)	Achieved
D5.2 Provide a report on crop production – estimated 2019 crop yield (tonnes cane/ha)	Achieved
D5.3 Provide evidence of energy efficiency (relationship between monitored irrigation/crop data and energy consumption solar/grid) in a format agreed with ARENA.	Achieved
D5.4 Provide a Milestone Report and associated items in accordance with item 1 of Schedule 3 and Schedule 5 (Knowledge sharing)	Achieved

6. Provide details of any published patents that have arisen out of or been contributed to by the project.
Not Applicable

7. Provide confirmation of the number of researchers (calculated on a full time equivalent basis) that are involved in the utilisation of the Grant Funds.

Not Applicable

Knowledge Sharing

8. Provide details of any knowledge sharing activities, including published reports, promotional material, media publicity or other documentation relevant to the project.

The objective of this project is to pave the way for adoption of technologies that reduce farm dependence on grid supplied electricity for irrigated sugarcane production.

BRIG has engaged JYMC media to manage our knowledge sharing.

During this milestone period a campaign was developed and deployed incorporating both mainstream / industry media and social media. It included a dedicated Field Day on 15 May.

During this period we were also able to deliver multi channel promotion of the project to a wide audience across the NEM and to the general public.

We established a Facebook site, and a Twitter feed and this was used to drive traffic to our web site and we have achieved wide dissemination.

The deliverables achieved included:
• Promotion of the specific project in social media campaigns, deploying ‘shareable content’;
• A case study about the installations published on the BRIG, ARENA and NIC websites
• Video and related multi-media content about the project published and used in social media.

Maurie Haines (Bundaberg Sugar Services) and Axel Braunsberger (ERGON) with Tim Couchman (ARENA) at the field day.

Image 0024

Extensive TV coverage of the day was achieved.

Image 9862

Attendance of the event was very good with some attendees travelling from Mackay, Mundubbera, Oakie, Dubbo and Canberra.

Image 9884

A full report on this event and knowledge sharing is contained in the USB which will be posted with the hard copy of this report.

Post the field day we have given dedicated site visits to a range of entities and have had numerous enquiries such as the following:

I came across a video that mentioned this project that I have mentioned in the Subject line above. I was wondering if you have a close-out report that could be readily availed? It is extremely interesting from the fact that in Africa we have solar opportunities in the irrigated sugarcane estates.

Regards

Brent Griffiths
Agricultural Innovation and Technology Adoption Manager
ILLOVO SUGAR AFRICA (PTY) LTD

Mobile: +27 72 215 6936 | Tel: +27 31 508 4541 | Email: bgriffiths@illovo.co.za

1 Nokwe Avenue, Ridgeside, Umhlanga Rocks, Durban, South Africa
PO Box 194, Durban, South Africa, 4000
www.illovosugarafrica.com

Financial Reporting

9. Provide a statement of the Grant Funds, Recipient/Grantee Contributions (cash) and Other Contributions (cash) received and spent as identified in Schedule 4, 5 and 6 of the Funding Agreement.

See attachment 1A for:

A statement of income and expenditure for the project covering the period from commencement date to the completion of milestone 5.

i All cash income for project.
ii All cash expenditure for the project.
iii There are no unspent grant funds available for use in the next reporting period.

10. Provide a statement of the Grantee/Recipient Contributions (in-kind) and Other Contributions (in-kind) provided (refer to items 3 and 4 of Schedule 2).

See attachment 1B for details of in kind contributions for Milestone 5

11. Provide confirmation that the project is proceeding in accordance with the Budget, including grantee contributions and other contributions.
The project is within budget and on track

12. List of Attachments to the report
Attachment A – Milestone D5.1 – Review of Irrigation program Attachment B – Milestone D5.1 – Climate Data – July to December Attachment C – Milestone D5.1 – Irrigation and crop growth response Attachment D – Milestone D5.1 – Energy availability and consumption Attachment E – Milestone D5.1 – Crop and energy efficiency relationship Attachment F – Milestone D5.2 – Crop Production Attachment F – Milestone D5.3 – Evidence of energy efficiency Attachment G – Knowledge Sharing Activities (USB)

Certification

I Dale Holliss being a person duly authorised by the Grantee/Recipient hereby certify that:

- The milestone described above has been completed by 12/07/2019
- The information provided above is accurate, complete and not misleading.
- The risk management plan for the project is up to date and being implemented.
- I am aware of the Grantee's/Recipient's obligations under the Funding Agreement, including the need to keep ARENA informed of any circumstances that may impact on the objectives, completion or outcomes of the agreed project.

Signed *Dale Holliss* Date 12/07/2019