ADAPTING RENEWABLE ENERGY CONCEPTS TO IRRIGATED SUGARCANE PRODUCTION AT BUNDABERG

MILESTONE REPORT No: 3

Australian Government
Australian Renewable Energy Agency

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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.*
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Milestone Summary

Milestone Number	**3**		
Report Dates	Due: 13/07/2018	Submitted: 13/07/2018	Reporting period: 09/03/2018 to 13/07/2018
Comments if report is late			

Technical Delivery of Milestone

1. Provide a technical report of the milestone activities.
Construction of the project field demonstration site was completed and commissioning of the project equipment commenced by 15/01/2018. The solar pump system has now completed 398 hrs of operation and the data gathered clearly indicates that the new solar/grid irrigation system is using approximately 70% less grid supplied kWh than the previous all grid system. Wet weather and minor commissioning issues have impacted on irrigation scheduling during this start up season resulting in lower operating hours than would normally be expected, notwithstanding the interruptions the data gathering package has provided good insight into the potential of the equipment. The three season time frame for this project will allow for more than adequate opportunity to fully assess the potential of the equipment. The project weather station equipment was installed prior to the construction of the pump system on 13/11/2017 and has provided reliable data on factors effecting crop response to irrigation and daily solar energy potential. The field moisture monitoring equipment was installed on November 2017 and this data shows the limited demand on irrigation this season due to the extent of rainfall received. Monitoring of crop growth commenced in January when the crop had reached the point (100cm) where elongation of all stalks is more consistent. This monitoring shows that growth was erratic in February during a period of cloudy weather with significant rainfall and lower crop evapotranspiration (Etc). The inaugural knowledge sharing field day was held on the 20th February 2018 and it was an outstanding success. We have reported on this in Milestone 2. The Bundaberg Agro Trend field day was held on the Friday 27th April 2018. Bundaberg Regional Irrigators Group (BRIG) attended the field day to inform the community about the “Adapting Renewable Energy Concepts to Irrigated Sugarcane Production at Bundaberg” project. A field trip to the project demonstration site was attended by 20 local sugarcane growers and sugar industry staff. Growers at this field visit tended to be mainly smaller operators and some concern with the cost of adopting the new technology was expressed. Through the course of the visit it was explained that the project objective was to investigate the potential viability of solar and that a range of best fit options for various operational categories will be considered during the course of the project.

Technical delivery (Table 1)

Milestone (3) activity / deliverable *Activities to be completed for this milestone (as set out in Schedule 2 of the funding agreement*	**Completed**
D3.1 Provide a report to ARENA clearly outlining the data recording for the 2017-18 (last 6 months) crop including the: Irrigation program (Attachment A)	<u>Irrigation program</u> The irrigation trial area consists of 38.5 ha of sugarcane which is irrigated by the new solar pumping system. Each season the irrigated area contains 16 adjoining fields and during this trial one field is monitored (with Sentek Enviroscan probe) each season to compare soil moisture variation and crop growth is measured to gauge response to moisture availability. The irrigation program for the sugarcane crop to be harvested in 2018 on the monitored field is complete and the crop is now drying down and accumulating sugar content in readiness for the commencement of harvest on the 18th of June. The harvesting of the whole farm will continue to November and irrigation demand by the next crop (2019) is expected to begin in the spring months of 2018 (September –October). Evaluation of irrigation demand and the soil water balance for the 2018 crop which includes the period January to May 2018 when the solar trial was active is provided in Attachment A. This data includes calculations of daily crop water demand based on reference evapotranspiration data (Et) determined by the onsite weather monitoring equipment and estimated crop leaf area factors to determine average crop evapotranspiration (Etc) as mm/day. The Etc data is averaged across the irrigated area of each crop class to create a farm daily crop water demand. When interpreting this data it should be taken into account that this method is used to calculate a simple whole of farm daily water balance and it is realised that some of the farm fields will be irrigated during each monthly period and some not due to variation in crop harvest date and subsequent crop size. The data shows that excessive rainfall events

	occurred in October 2017 (305mm) and February 2018 (241 mm) however over the remainder of the period, rainfall events were less than the crop demand. The final water balance indicates that the total volume of moisture required by the crop was supplied but with the intensity of some rainfall events resulting in runoff or drainage losses and unavailability of irrigation during some critical periods resulting in falling growth rates the harvested crop will be less than potential. Technical issues with the setup and commissioning had some affect on the trial irrigation schedules from time to time and it is planned to address scheduling matters more closely in the second year of the project.
Climate data (rain ,solar radiation, reference evapotranspiration (Et) (Attachment B)	<u>Climate data</u> Rain, solar radiation and reference evapotranspiration (Et) data for the period January 2018 to end June 2018 is provided in Attachment B. This information contains the full data base from the weather station for each month and graphic illustration of the main elements per month.
Irrigation/crop growth response data (Attachment C)	<u>Irrigation/crop growth response data</u> Crop growth response was closely aligned to the soil moisture content in January when reference Et averaged 5.32 mm/day (Etc 6.0mm/day). During this period crop yield could have been enhanced had a second irrigation occurred on or about the 25th January 2018 (Shown in attachment C) however this irrigation was delayed due to forecast rainfall and subsequent recorded rainfall for 30th January was 76mm. Although soil moisture in February 2018 was maintained by regular rainfall with substantial falls occurring on 1st Feb – 53 mm , 4th Feb – 88 mm, 20th Feb -18 mm, 22nd Feb – 47 mm and 23rd Feb – 11 mm there were also many overcast days when falls of up to 5 mm occurred and these lengthy periods of cloudy conditions resulted in average reference Et of 3.75 mm/day (Etc 4.5mm/day). Crop growth rate was erratic during February which no doubt was affected by the prevailing conditions. Crop growth during March was less than expected however this is not believed to be associated with

	farm management issues. The sugarcane industry has an unresolved issue with a leaf yellowing syndrome which is known to affect production and during March 2018 this phenomenon was widespread across the Bundaberg district. During April and May the farmer allowed the monitored field to draw down stored soil moisture to prepare for harvest which is due on the 18th of June. Irrigation continued on other specific fields within the irrigation trial area. Irrigation, crop growth and soil moisture relationships for the monitored field are illustrated in Attachment C.
Energy availability verses consumption data (solar versus grid) and water applied (ML/HA) Attachment D Attachment E	<u>Energy availability verses consumption data (solar versus grid)</u> Solar energy availability data as provided by the onsite weather station indicates for the period 15th January to 6th June 2018 (142 days) there were a total of 1737 hrs of sunshine with 1027 hrs of sunshine above the threshold required to provide full power to the pumping system. Recorded pump day time hours 279 or 27% of the potential. Cloudiness resulting in intermittent sunshine particularly during February caused reference (Et) to fluctuate lowering the crop demand for moisture and rain events resulted in extended periods of adequate soil moisture. These weather conditions and other cultural factors subsequently reduced the demand for irrigation during the latter part of February, March and early April. It is evident that even after allowing for extenuating circumstances utilisation of the solar output was below expectation. During the trial period whole farm water application was 90 mm which is only a 20 % utilisation of available water allocation. Utilisation of solar energy and Water use data are shown in Attachment D. A significant benefit of the trial setup is that when operational use of available solar energy is not maximised, the blending capability of the Eco drive system allows for a portion of the power demand to be accessed from solar even when the solar output is below the deemed operational threshold. This drive is also a demand management system

	which results in a significant reduction in grid demand before the solar input is effective. The combined effect of the new system has been a 70% reduction in kWh over the 6 month period. Outcomes from these system features are illustrated in Attachment E.
D3.2 Provide a report on crop production D3.3 Provide evidence – energy efficiency (relationship between monitored irrigation crop data and energy consumption solar/grid (Attachment F)	<u>Crop production</u> The wide spread excessive rainfall event that occurred during October 2017 resulted in waterlogged fields and delayed the early development of the 2018 crop which meant that normal cultural activities (weed management and fertilising) were not completed in a timely manner. The waterlogged effect carried forward well in to the summer period causing noticeable crop reductions in some fields for 2018. After careful consideration the estimated crop on the area associated with the solar pumping trial (38.5 ha) is 86 tc/ha which is 3311 tonnes of cane. <u>Evidence of energy efficiency</u> The combined effect of motor, pump and variable speed management systems with solar has proven to be highly effective in reducing the cost of irrigation. Data illustrated in Attachment F shows that the previous grid demand for electricity was reduced from 39 kWh to 11.6 kWh. This saving can be attributed to the VSD drive and motor/pump upgrade 13.8 kWh and the solar array 13.6 kWh. Data previously shown in this report indicates that while the crop was not irrigated sufficiently to achieve high productivity, moisture monitoring indicates that during the growing period soil moisture was generally sufficiently maintained to avoid incidence of major stress. The overall cost saving over the trial period is $3023.48 which equates to a reduction in irrigation cost from $1.30 to $0.39 (-$0.91) per tonne of cane. It could be expected that in a season when full allocation (175 ML) is required that (based on the currently available data) the annual saving from the new pumping system would be $15,115 p.a.

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.
Now that construction has been completed and monitoring equipment appears to be bedded down 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 *List project outcomes as set out in the funding agreement.*	**Achieved / Not achieved (comment)**
D3.1 Update the Milestone 2 (D2.1 report) clearly outlining the Data recording for the 2017-18 (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
D3.2 Provide a report on crop production – estimated 2018 crop yield (tonnes cane/ha)	Achieved
D3.3. Provide Evidence of energy efficiency (relationship between monitored irrigation/crop data and energy consumption solar/grid) in a format agreed with ARENA.	Achieved
D3.4. Provide a milestone report and associated items in accordance with item 1 of Schedule 3 and Schedule 5 (Knowledge sharing)	Achieved

Knowledge Sharing

6. **Provide details of any knowledge sharing activities, including published reports, promotional material, media publicity or other documentation relevant to the project.**
The aim and the objectives of the project have been shared through media and industry communications. Photos and documents showing these communications are available on the website ww.brig.org.au. Promotions include an industry and grower field trip to the demonstration site on 27 April 2018.