Bundaberg Regional Irrigators Group

Representing member irrigators in the Bundaberg Irrigation Area

ARENA

Australian Government

Australian Renewable Energy Agency

Impact of Energy Cost on Sugarcane Yield Potential and Energy Options At Bundaberg

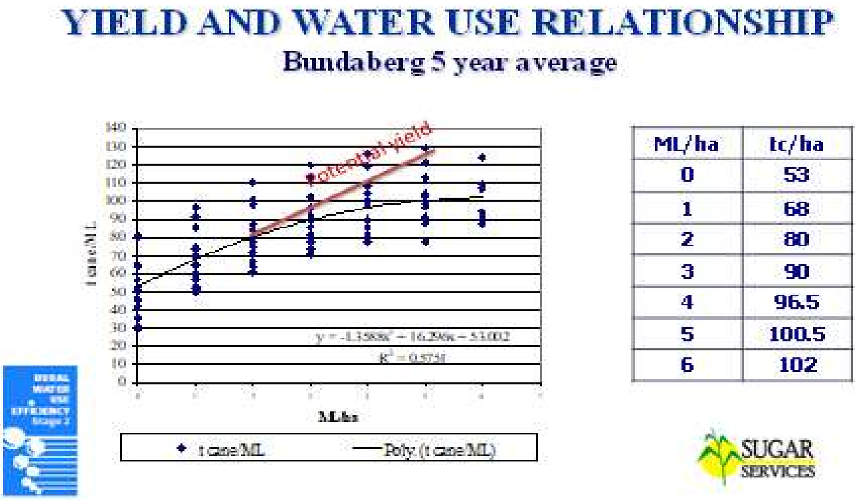
Productivity potential

This study of energy cost in the Bundaberg Sugar Industry is based on the main growth period from mid September to mid April which is approximately 200 days. Atmospheric conditions impact on about 40 % of this time which leaves about 120 days for irrigation to influence the annual crop.

A major cause of low productivity in sugarcane production is the extent of crop stress between rainfall and irrigation events. Sugarcane farming has many variables which influence the yield outcome but moisture availability is the most significant driver of productivity.

The yield to water use data shows that the highest level of production is only achieved by a limited number of farmers which suggests the presence of constraining factors.

When irrigation operations are constrained by external factors (e.g. low water allocation or high energy cost) the focus can shift from producing the crop to saving the crop. It is then often the case that the water pumped is not the determinant factor to achieving potential yield but it is the water that isn't pumped that constrains productivity.



ML/ha	tc/ha
0	53
1	68
2	80
3	90
4	96.5
5	100.5
6	102

To achieve the best production outcome the days in each irrigation cycle need to be no more than 15 days but this means longer peak pumping hours per day and subsequent higher cost per unit of production.

Energy cost impact

Energy cost is a major deterrent to restoring the productivity and profitability of the Bundaberg Sugar Industry. The following calculations were developed from actual production data and irrigation system performance at the Killer Family farm near Bundaberg prior to the commencement of a solar energy trial.

This calculated example shows operating cost scenarios based on the previous farm irrigation system which was a 100% grid option.

Calculated assessment of original system at Killers farm (100% grid supply)

Irrig area (ha)	Irrig applied (ML/ha)	Irrig cycle (days)	Pumped hours /year	Grid Energy use kWh	Opt Tariff	Grid energy cost ($)	Yield tc/ha	Gross yield tc/ha	Grid energy cost / tc ($)	Grid % of gross value
48	1	60	533	20,800	62	3,120	68	**3,264**	0.96	**2.78**
48	2	30	1067	41,600	62	6,816	82	**3,936**	1.73	**4.95**
48	3	20	1600	62,400	65	13,308	95	**4,560**	3.03	**8.65**
48	4	15	2133	83,200	66	20,805	110	**5,280**	3.98	**11.26**
48	5	12	2667	104,000	66	24,828	125	**6,000**	4.14	**11.82**

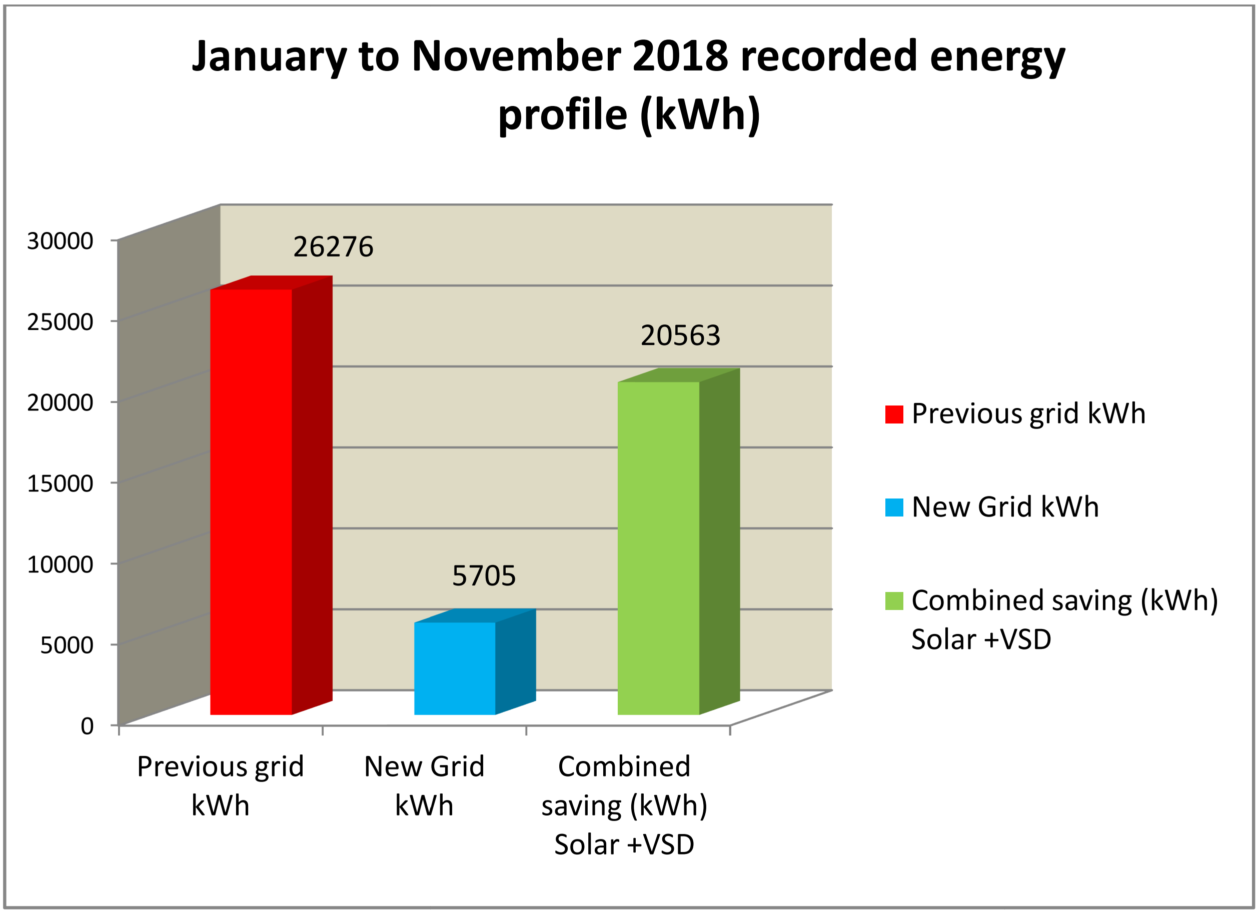
The cost constraints to increased water use are evident. At the highest application rate the cost of energy is 11 to12% of the current gross return per t/cane. The tariff applied to each water use rate was the cheapest daily rate for that scenario but what is evident is the differential cost for the step between the tariffs e.g Tariff 62, 1ML/ha to 2 ML/ha (1-2ML/ha = $3696 p.a.) and T 62 to T65, 2ML/a to 3 ML/ha (2-3ML/ha = $6992 p.a.).

The daily operating hours increased with the volume pumped and consequently more hours where in peak time which made it necessary to switch from T62 to T65 then to T66.

Solar Trial

In January 2018 a hybrid solar/grid trial was established at the Killer Family farm. The new system included 82.6 kw solar array, new 45 kw motor and pump unit suited to variable frequency operation and a VFD drive.

The VFD successfully manages the pump demand and has reduced grid off take from an average of 39 kWh to 27 kWh. The 2018 rcorded energy profile shows that the combination of solar and VFD has reduced grid kWh demand by 78%.



The following calculated example shows the operating cost of the solar/grid trial option over a similar range of water application rates, irrigation cycles and a range of operating hours. The trial site has been set up to operate on a flat rate tariff T20.

Calculated assessment of system at Killers farm (82.6 kw solar + VFD + grid supply)

Irrig area (ha)	Irrig applied (ML/ha)	Irrig cycle (days)	Pumped hours /year	Grid Energy use kWh	Tariff	Grid energy cost ($)	Yield tc/ha	Gross yield tc/ha	Grid energy cost / tc ($)	Grid % of gross value
48	1	60	533	0	20	0	68	**3,264**	0	**0**
48	2	30	1067	0	20	0	82	**3,936**	0	**0**
48	3	20	1600	1,872	20	495	95	**4,560**	0.11	**0.31**
48	4	15	2133	16,272	20	4,303	110	**5,280**	0.81	**2.33**
48	5	12	2667	30,672	20	8,110	125	**6,000**	1.35	**3.86**

The recorded grid energy savings align closely with the 4 ML/ha scenario but there are many additional benefits. The Killers have found that their farm management strategy is no longer constrained by energy cost structures and they are now more willing to irrigate according to crop need than economic considerations.

The question is whether further cost reductions can be achieved. Will the introduction of diesel mean that Bundaberg sugarcane irrigators can become completely independent of the grid energy supply?

Solar/ Diesel

Many farmers ask if diesel is an option?

If we are talking about a hybrid concept (e.g. solar/diesel generator combination) it appears to be possible. This option was assessed through the same technique applied to the grid and solar grid options.

Particular parameters applied were:

1. Pump demand load is 27 kWh (reduced from 39 kWh by VFD management)
2. Gen set 47 KVA (Prime load 34.4kw)
3. Operating at an average load of 75% (6.2 L/hr)
4. Fuel cost $1.50 – gst – fuel rebate = $0.98 / L

Calculated assessment of system at Killers farm (82.6 kw solar + VFD + Diesel gen set 47KVA)

Irrig area (ha)	Irrig applied (ML/ha)	Irrig cycle (days)	Pump hours /year	Diesel running hours/ year	Diesel Cost ex gst & rebate ($/liter)	Diesel energy cost ($)	Yield tc/ha	Gross yield tc/ha	Diesel energy cost / tc ($)	Diesel % of gross value
48	1	60	533	0	0.98	0	68	**3,264**	0	**0**
48	2	30	1067	0	0.98	0	82	**3,936**	0	**0**
48	3	20	1600	69	0.98	306	95	**4,560**	0.07	**0.19**
48	4	15	2133	603	0.98	2,658	110	**5,280**	0.50	**1.44**
48	5	12	2667	1,136	0.98	5,010	125	**6,000**	0.84	**2.39**

Based on the parameters applied to the calculations used to assess the system installed at Killers Farm there is strong evidence in support of a solar diesel combination which would result in a 100% off grid energy supply.