PHOTOVOLTAIC POWER APPLICATION IN DAIRY
CASE STUDY

Owen's Farm Overview

- Located at Oakey; 3.5 Million Litres
- Rotary 330 cows (up to 400 cows)
- 1500 hectare property with 170 hectares of irrigation
- Electricity consumption 2017: 106,000 kWh per year with 47% on peak demand and 53% on off peak demand. Demand Range from 39 kW to 52 kW throughout the year.

Introduction

In 2017, the Owen family received a letter from Ergon stating that due to their high electricity load on their dairy's National Meter Identifier (NMI) they have been classified as a large user greater than 100,000 kWh (100 MWh per annum). The reclassification of the dairy from small user to large user meant that they would be switched to a Demand Charge Tariff as opposed to a Consumption only Tariff. The estimate of this change meant an increase to their bills by $6,428 per annum. Historically the Owen family had been on Tariff 62 (Farm Time of Use) which is due to become obsolete. This tariff has a peak usage between 7 am to 9 pm weekdays with the remainder of usage being off-peak.

The Owen family sought options to reduce their consumption to stay under the 100 MWh threshold and remain on a consumption tariff. They already had heat recovery units installed on their vat, a plate cooler and hot water was heated on the off peak tariff at night time (T62 off peak). The family went on an information gathering exercise looking at options on how to conserve and store energy through the use of renewable energy. They first received a quote from an interstate company for a 80 kW photovoltaic (PV) system which they felt lacked technical details and financial outcomes, and given the sizeable cost of the investment they completed their due diligence by seeking another set of options through Qld based Solar Energy & Battery Storage Solutions (SEBSS), whom they were referred to by a friend.

SEBSS obtained half hourly NMI data to understand the electricity usage in the dairy and build a load profile. As seen in Fig. 1, the analysis showed a peak demand ranged from 39 to 52 kW on the days monitored, with two peaks throughout the day at milking times. Based on the data, SEBSS designed a solar system to optimise energy to be captured at milking times and utilise solar energy for water heating. The outcome was a 30 kW inverter system (40 kW PV) with half the panels being faced east and half the panels being faced west to increase the energy at milking times.

Another important benefit of why a system no larger than 30 kW was installed was due to utility connection standards, application process, application fee and the ability to feed excess solar energy back to the grid earning credit. An inverter system up to 30 kW can be installed under the standard Micro Embedded Generating Connections as opposed to being subject to Standard Low Voltage Embedded Generating Connections which can be more difficult to be approved based on the networks' capacity in the area. Furthermore, a 30 kW system is able to access the small scale solar certificates (STC).

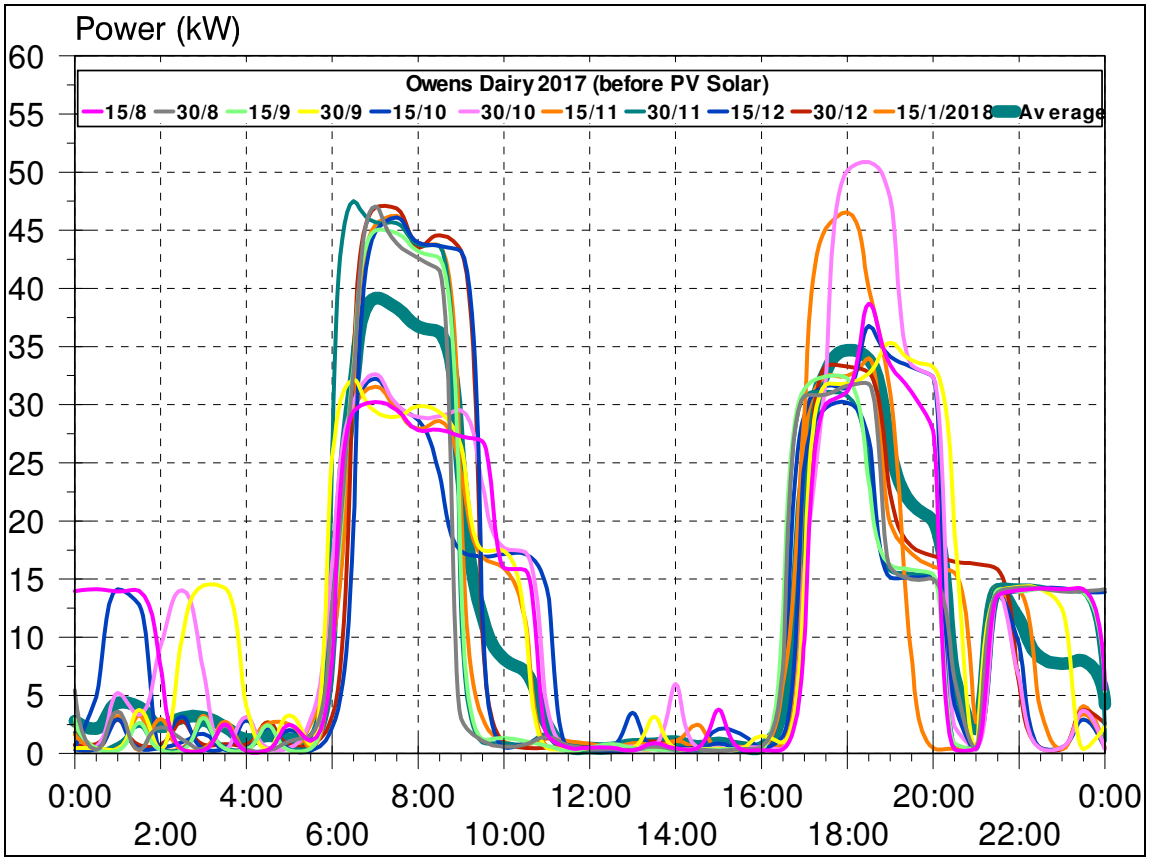

Fig. 1. Electricity consumption at Owen's dairy prior to installing Solar Photovoltaic.

The 30 kW PV system reduced their usage from 280 kWh/day to 180 kWh/day. Looking to further utilise and store solar energy, upon SEBSS recommendation the dairy purchased a secondhand vat that they use to cool water to 2.6 °C and run through the plate cooler. The milk is now entering the vat at 5°C, to reduce its temperature by approximately 20°C. The cool water is then recycled back to the vat and re-cooled for future use. The secondhand vat also came with two additional heat recovery units and therefore the Owen's were able to increase their capacity to heat water for cleaning purposes, with the water now entering the hot water system at 80°C. The additional heating of water to 90°C is done through the use of solar energy.

Amongst this investment, the Owen family also changed their Tariff from 62 to Tariff 20 which added to the savings. The result of this project meant that their electricity bills have reduced from a proposed $37,542 per year on Tariff 44 to $16,663 per year on tariff 20 with a 30 kW PV system.

Overview of Solar System

- 40 kW PV crystalline panels, facing east-west spaced to reduce shading in early morning and later afternoon
- 2 Fronius inverters totaling 30 kW
- Lifespan is 25 years with 10 year warranty

Two inverters were installed on the property for risk management strategy; if one system was to fail then there is a backup system. Tier 1 quality brand panels and inverters were used. The panels were 275 watt and more recently 450 watt panels have come into the market, which are more suitable to commercial solar systems as opposed to household systems.

Energy Management

SEBSS also installed a monitoring system on the dairy. The equipment used is Solar Analytics and allows the Owen's to monitor solar being produced and to start certain equipment such as the water cooling vat and hot water system when solar is being produced, shifting their consumption load to optimise solar utilization. This allows them to ensure they aren't using electricity unnecessarily from the grid at 24.5 c/kWh when if delayed the use of such equipment, they can then utilise solar energy which would otherwise fed back into the grid at 7.8 c/kWh.

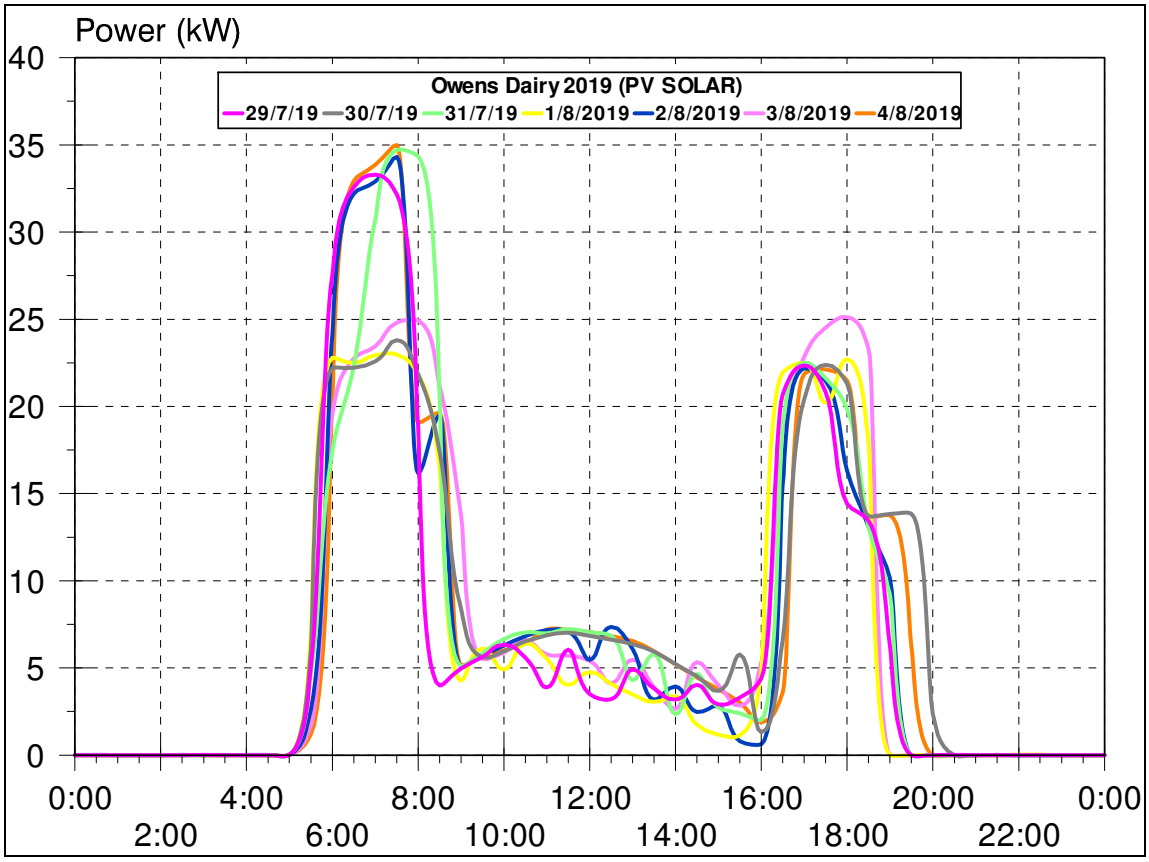

Fig. 2. Electricity use post PV on the Owen's. Using solar they were able to change heating water from night time to day time (no usage 8:30 pm to 5 am) and reduce maximum demand to 35 kW.

Overall the Owen family is extremely happy with their investment. They were able to save $1,903 per month on solar and vat with a payback period of 27 months on the solar investment alone and 36 months on combined solar and vat. They have other NMIs on their property for water pumping and irrigation and are reviewing their usage with the consideration to using solar.

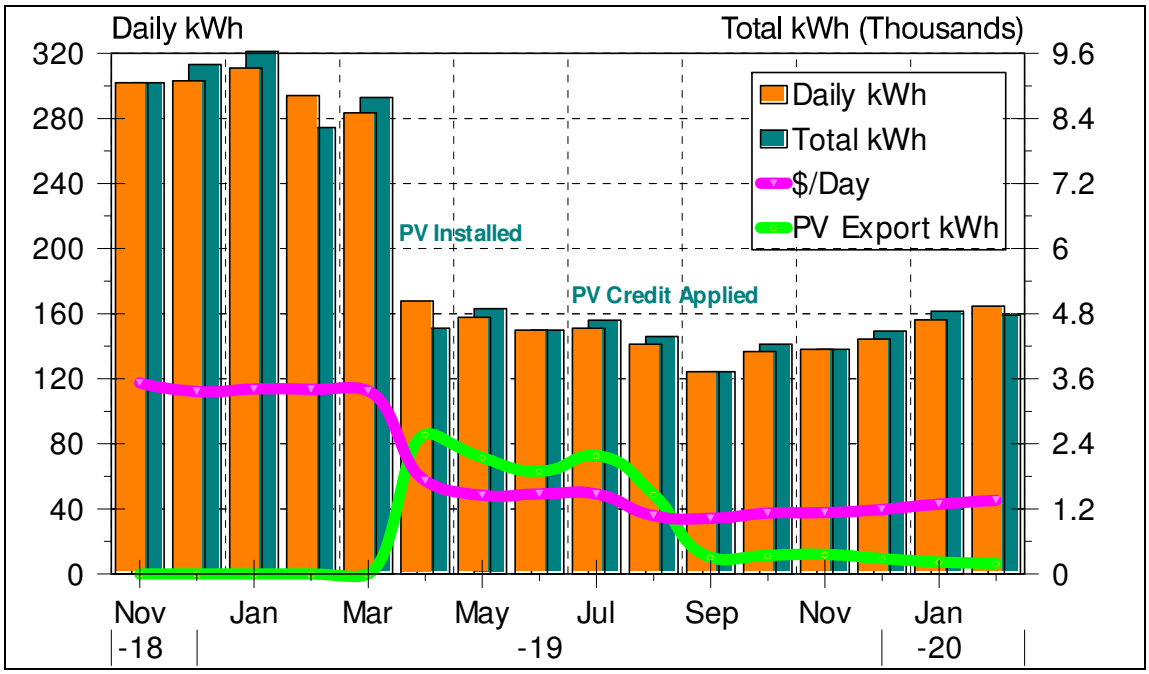

Fig. 3. Electricity Consumption before and after using Solar Energy at Owen's dairy in Oakey.

Fig. 4. Owen's family dairy in Oakey, Queensland.