

PHOTOVOLTAIC POWER IN DAIRY FARMS CASE STUDY

Owen's Farm Overview

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

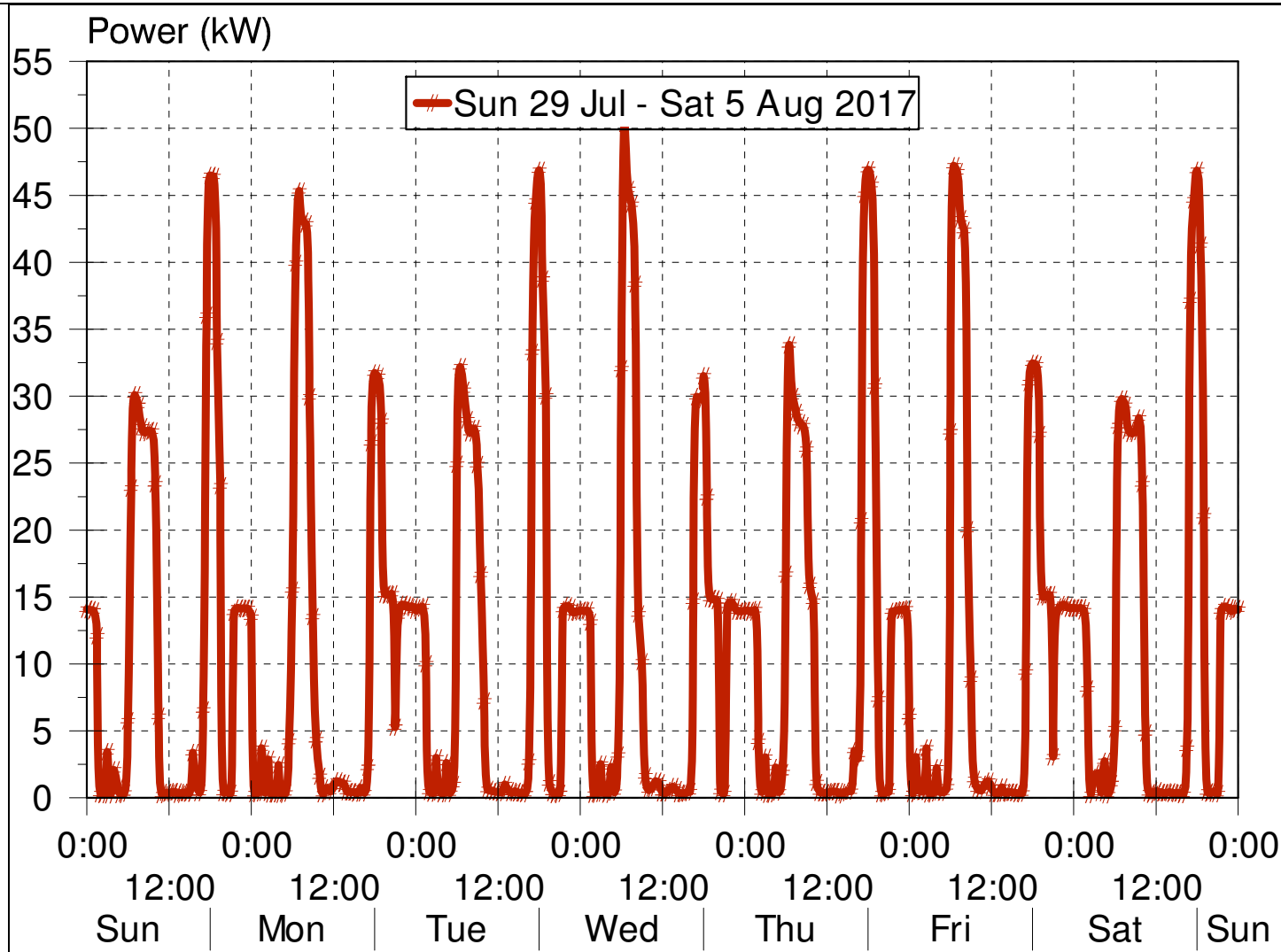


Fig. 1a. Electricity consumption at Owen's dairy prior to Solar.

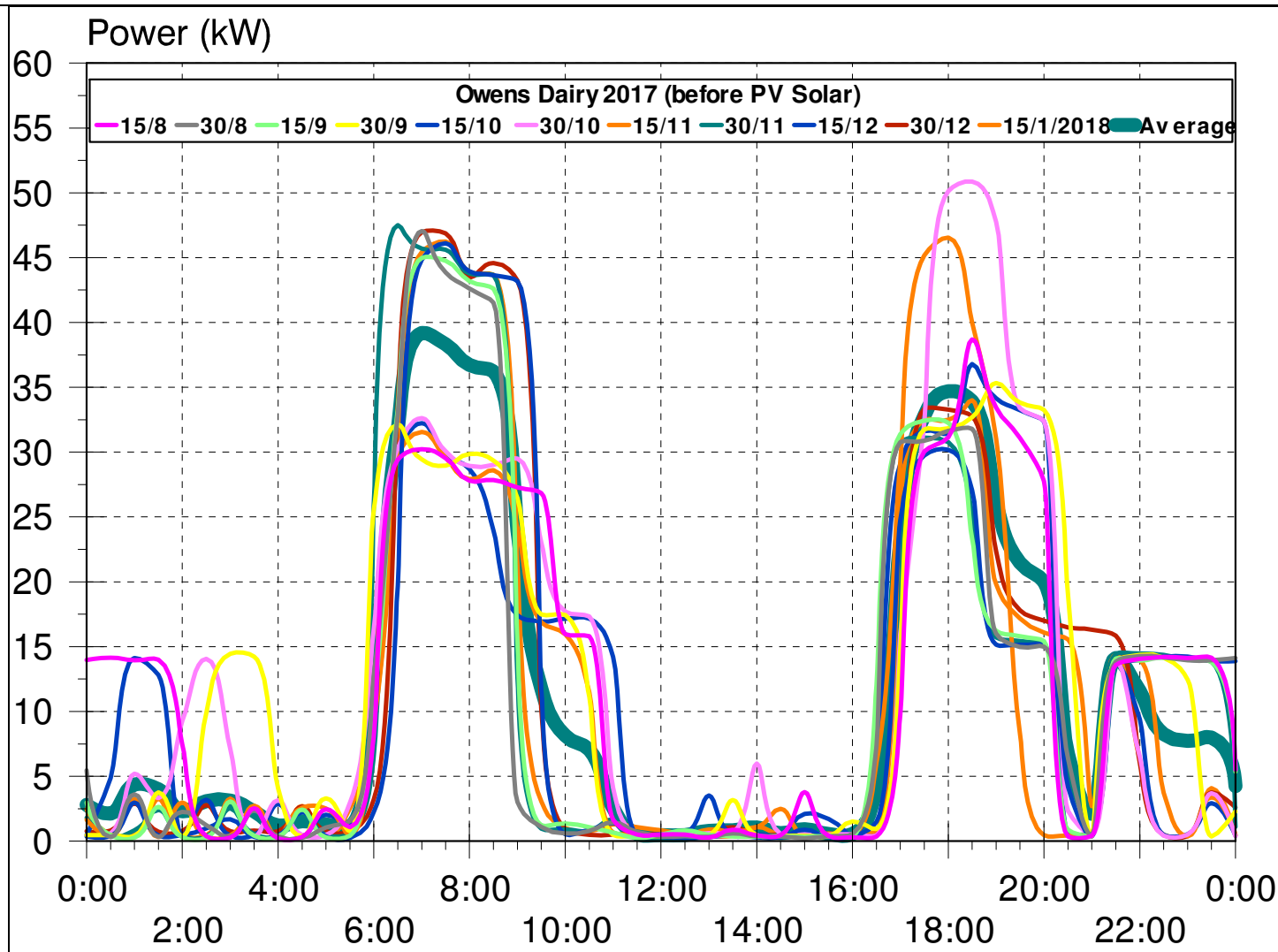


Fig. 1b. Electricity usage at Owen's dairy prior to installing Solar.

Background

- The Owen family received a letter in 2017 from Ergon advising that due to their high electricity load on the dairy's they have been classified as a large user defined (greater than 100,000 kWh or 100 MWh per annum).
- The reclassification from small user to large user meant that they would be switched to a Demand Charge Tariff (kWmax and kWh) as opposed to a Consumption (kWh) only Tariff.
- Because a large component of the tariff is due to Maximum Demand (kW) the estimate of this change meant an increase to their bills by \$6,428 per annum.
- Historically the dairy had been on Tariff 62 (Farm Time of Use) which is due to become obsolete in 2021. This tariff has a peak usage between 7 am to 9 pm weekdays with the remainder of usage being off-peak.

Introduction

- 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 Owen's 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.
- Given the sizeable investment the Owen's sought alternative options from Qld based Solar Energy & Battery Storage Solutions (SEBSS), whom they were referred to by a friend.

Evaluation of Electricity Usage

- SEBSS obtained half hourly NMI data to understand the electricity usage and build a load profile.
- Analysis showed a daily consumption of appr. 275 kWh with peak demand ranged from 39 to 52 kW, with two peaks 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 panels facing east and west to increase output energy at milking times.
- Another benefit of why a system no larger than 30 kW was chosen was due to the connection standards, application process, application fees and the ability to have excess solar energy fed back into the grid earning credit.
- A system up to 30 kW can be installed under Standard Micro Embedded Generation Connections as opposed to Standard Low Voltage Embedded Generation Connections which can be more difficult to approve.

Overview of Solar System

- 40 kW PV Crystalline panels, facing east / west spaced to reduce shading in early morning / 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; if one system was to fail then there is a backup system.
- Tier 1 quality PV 275 W panels and inverters were used.
- More recently 450 watt panels have come available, which are more suitable to commercial solar systems as opposed to household systems.
- Solar Analytics data logger equipment were installed.

Outcomes

- The 30 kW PV system reduced the daily usage from 275 kWh to 180 kWh.
- Looking to further utilise and store solar energy, upon SEBSS advice the dairy purchased a second hand vat that they use to cool water to 3.6 °C and run through the plate cooler.
- The milk is now entering the vat at 5°C to reduce its temperature by appr. 20°C.
- The cool water is then recycled back to the vat and re-cooled for future use.
- The 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.

Energy Management

- The data logger equipment allows the Owen's to monitor and manage solar output and to start certain equipment such as the water cooling vat and hot water system when PV electricity is being generated, shifting their load consumption to optimise energy 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 utilise PV energy which would otherwise fed back to the grid at 7.8 c/kWh.
- Using solar they were able to change heating water from night time to day time (no electricity usage between 8:30 pm and 5 am) and reduce their maximum demand to 35 kW.
- Amongst this investment, the Owen family also changed their Tariff from 62 to Tariff 20 which added to the savings.

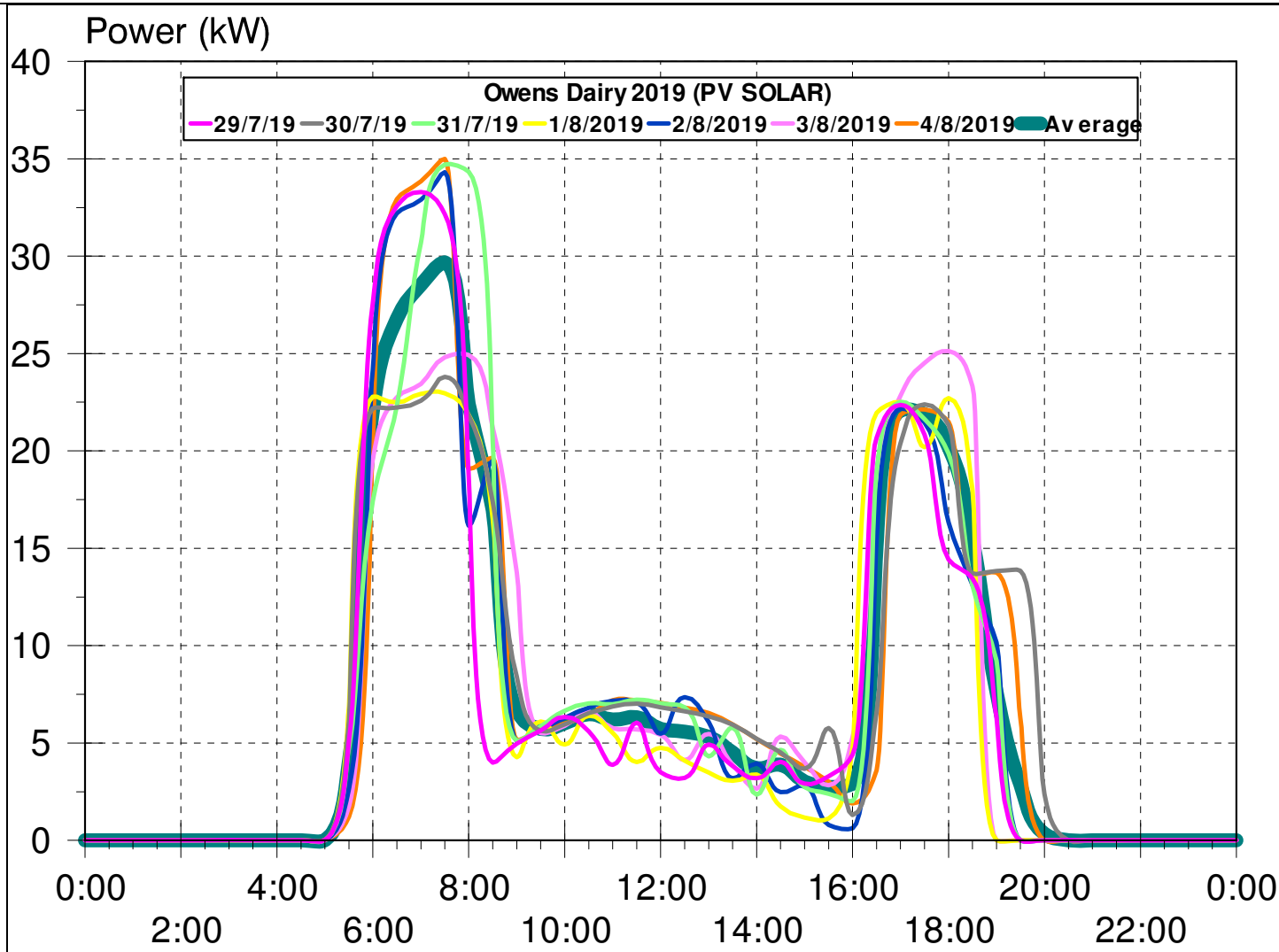


Fig. 2a. Electricity consumption post solar on the Owen's.

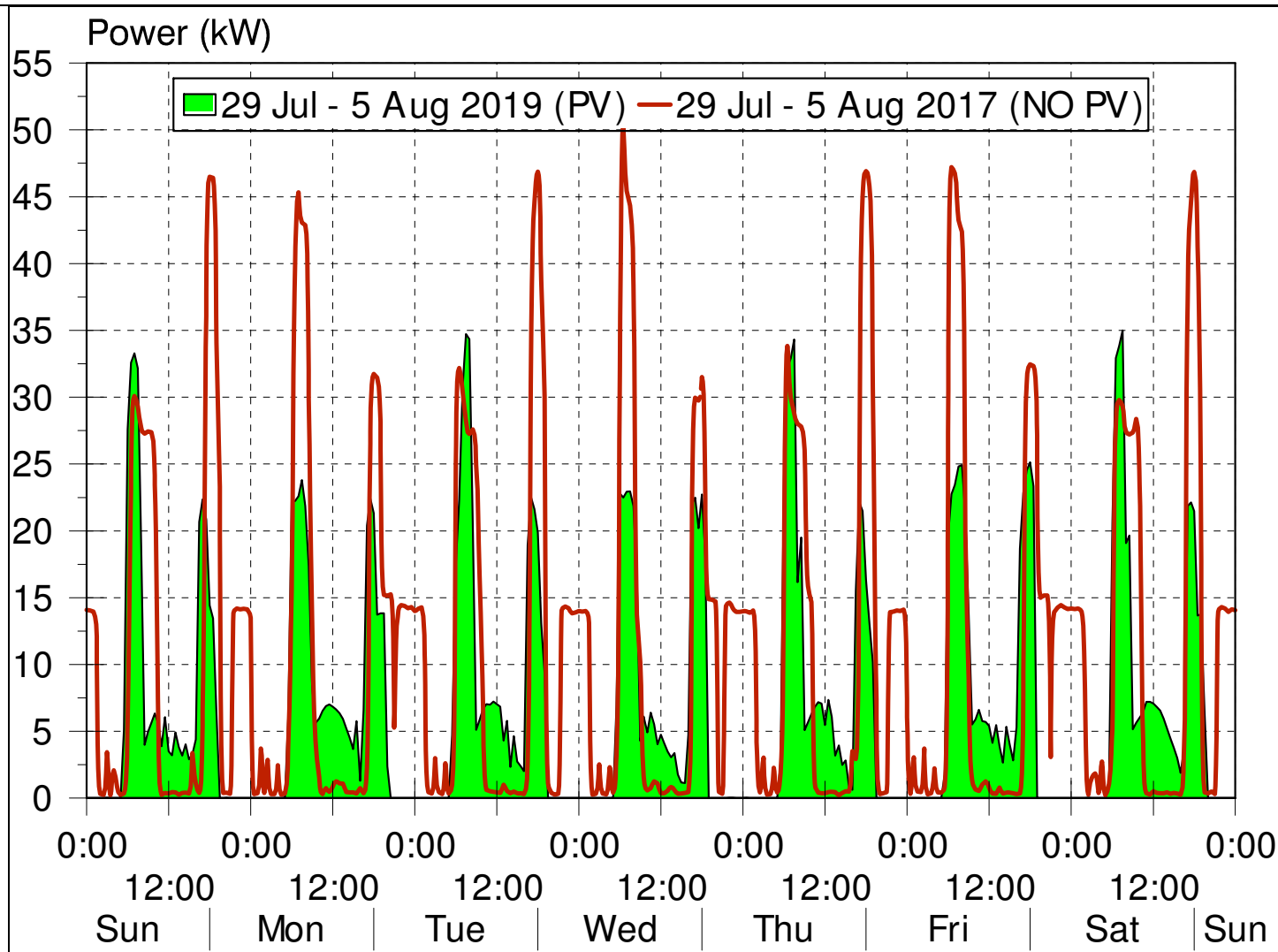


Fig. 2b. Electricity consumption before and after PV on the dairy.

Conclusions

- The use of PV electricity lowered the daily (and annual) consumption, thus electricity bills have reduced from projected \$37,542 per year on Tariff 44 to \$16,663 per year on tariff 20 with a 30 kW PV system.
- The Owen's family is extremely satisfied 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 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.

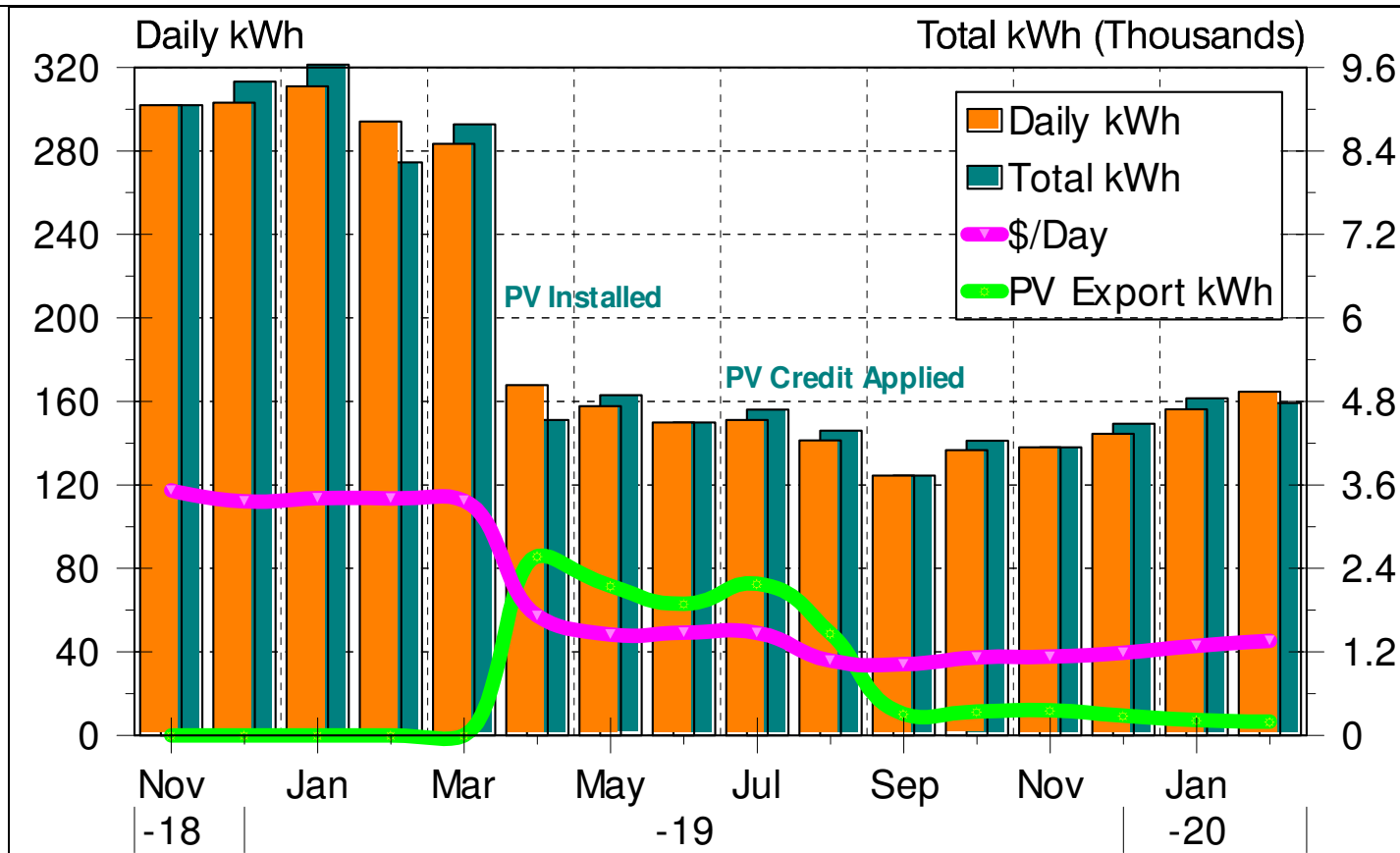


Fig. 3. Electricity usage before and after using PV at Owen's dairy in Oakey.

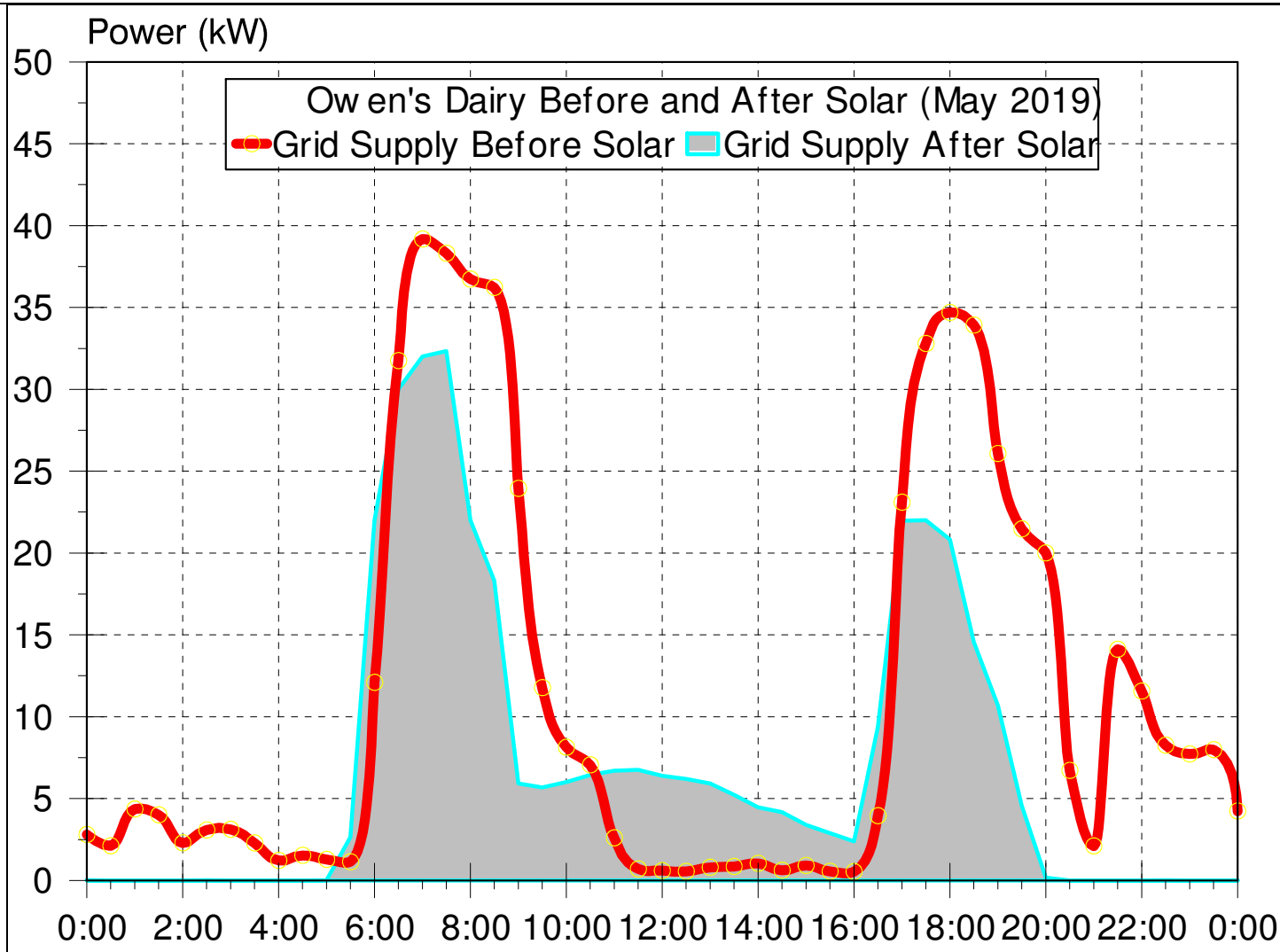


Fig. 4. Load curves before and after Solar.



Fig. 5. Owen's family dairy in Oakey, Queensland.