Beeson Design

Energy Consumption Assessment

Sample

For

Sample Client

Revision A

1 July 2018

Beeson Design

Document Information

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Contents

1 Executive Summary

Data taken from the energy monitoring system was analysed to determine patterns of use, and possible efficiency improvements at XXXX. Six months of data was used, providing 15 million samples to process.

The site uses 60 kWh/day of electricity on average. This is higher than the benchmark 26 kWh/day. Bills are approximately $XXXX per year, with most of the cost in consumption, not network, charges.

Total electricity consumption is shown below, with a breakout for air-conditioning:

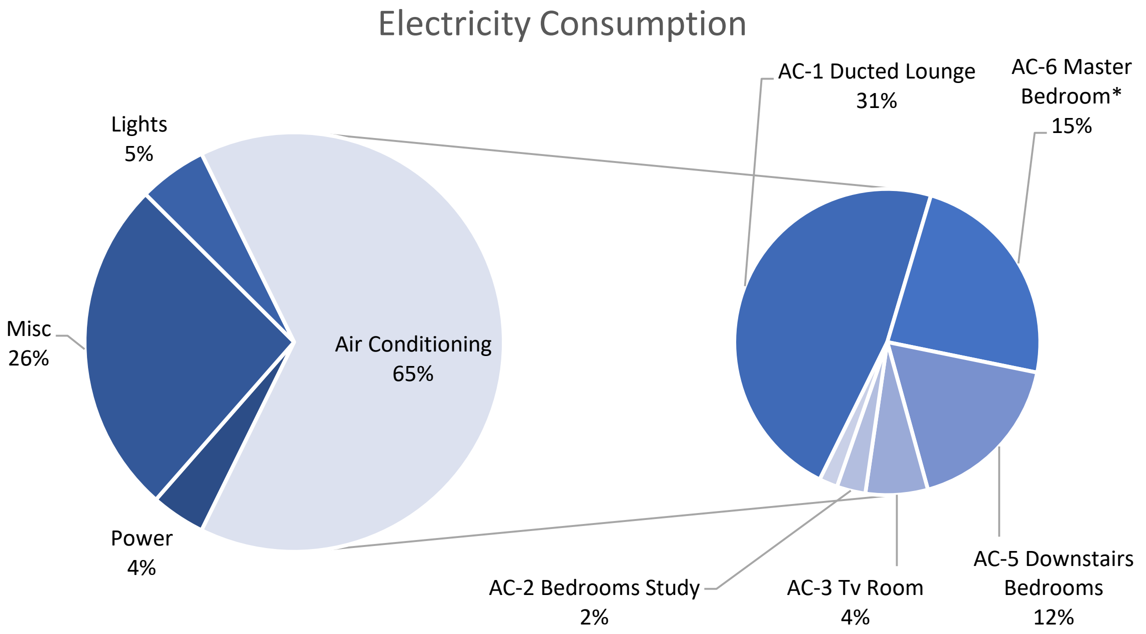


Figure 1 - Overall energy consumption

Air-conditioning is the main consumer. Although required for comfort, several measures are suggested to improve efficiency. These include controls changes, setpoint adjustments and building fabric changes – see to the main report for details.

Lights and power are relatively minor consumers of electricity. Some improvements are possible as detailed in the report.

The 'Misc' section includes the oven, pool, dryer and hot water. The hot water booster appears incorrectly configured - efficient improvements are possible here. The oven and dryer are relatively minor consumers. The pool is a major consumer – improvements to runtimes and pumps are possible in conjunction with a pool expert.

The solar system (5kW peak) is operating as expected, producing 20 kWh/day or 38% of consumption. During milder months, without air-conditioning, it provides a significant fraction of requirements. Most solar energy is consumed in the house. There has been a recent disconnection of the solar system but it is now restored.

The excellent solar feed-in tariff (51c/kWh compared to 25c/kWh for import) makes energy efficiency measures doubly attractive: more high-value solar energy would be exported.

With minor changes an estimated 15% reduction in cost is feasible. With more involved changes, a 30% reduction is feasible without lifestyle impacts, providing $1,900 a year cost savings.

2 Introduction and Method

The property in Brisbane was investigated by Brett Beeson, RPEQ, to understand electricity consumption and production. Electricity bills at the property are relatively high. A solar system is installed. Data were analysed over 14 circuits.

2.1 Tariffs

XXXX is the electrical retailer. A single tariff is used (i.e. no off-peak). Both the pool and solar hot water heater could use off peak electricity.

Nevertheless, adding off-peak metering is not recommended due to the additional costs of a separate (three phase, off peak) meter, and the use of solar hot water.

Tariffs are summarised below:

Table 1 - Tariffs

Cost of Energy	25 c/kWh
Solar Tariff	51 c/kWh
Supply (network) charges	$1.14 / day

Lower tariffs are available ($1,334 from QEnergy is the lowest found, compared to the current $1,520 per bill) although it can be annoying to change retailers.

Since consumption is relatively high, the network charges (fixed costs) are a small proportion of the overall bill. This is shown below. Therefore, a savings in consumption translate to smaller bills and are not 'washed out' by the network charges.

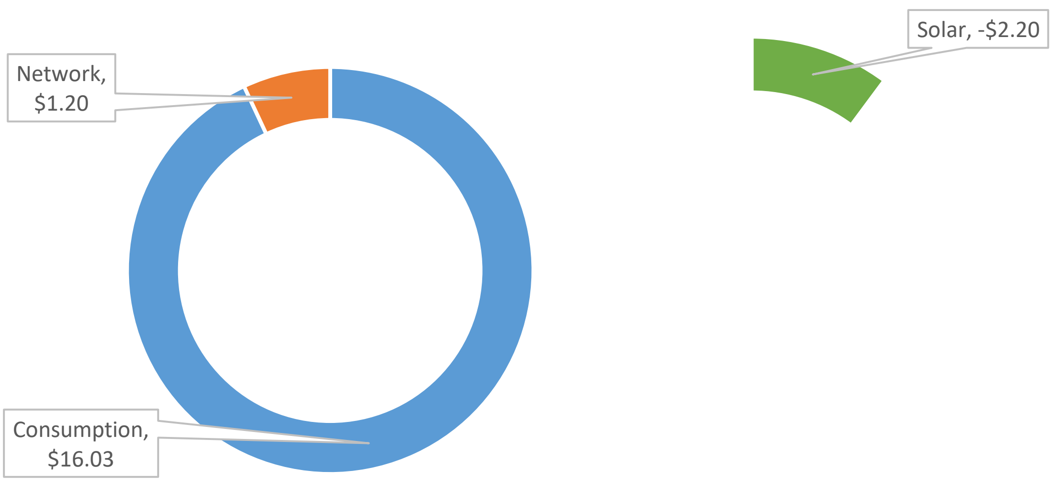


Figure 2 – Costs per day for consumption, network charges and solar exports

Most of the solar energy produced is consumed onsite and little is exported. Therefore, the $2.20 / day for solar export doesn't show the true value of solar.

Logging shows that solar provides 38% of total energy requirements – more on this later.

2.2 Electrical System and Logging

Three phase power is supplied to meter XXXXX and then to an internal board. This board has 20 circuits over three phases. Of these, 14 were logged via an automated system. The data received forms the basis of this report.

3 Consumption

The electrical consumption for the first half of 2018 was logged and analysed. An cross check against the supplied bill shows good agreement (see Appendix).

The average consumption per day is approximately **60 kWh/day**[1]. Typical usage for a 4 person home with a pool in Brisbane is 26 kWh/day. This brings us to the key question: why is the usage higher than typical?

[1] This differs from the bill as the utility meter cannot account solar consumed within the house, 'behind the meter.'

3.1 Total Usage

The total usage is shown below. We see that:

- Air-conditioning is the major consumer
- Miscellaneous is a major consumer – this is the pool, dryer, oven and hot water
- Lighting and power[2] are minor consumers

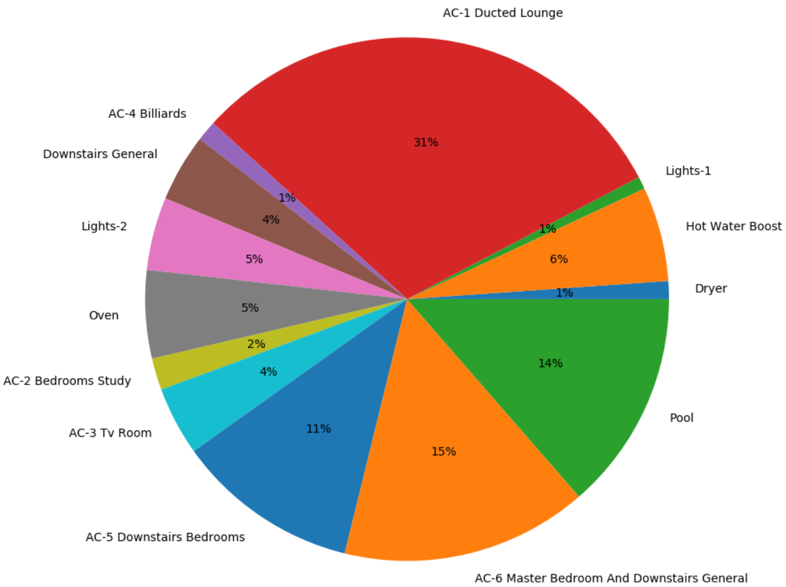


Figure 3 - Totals – Consumption – All circuits

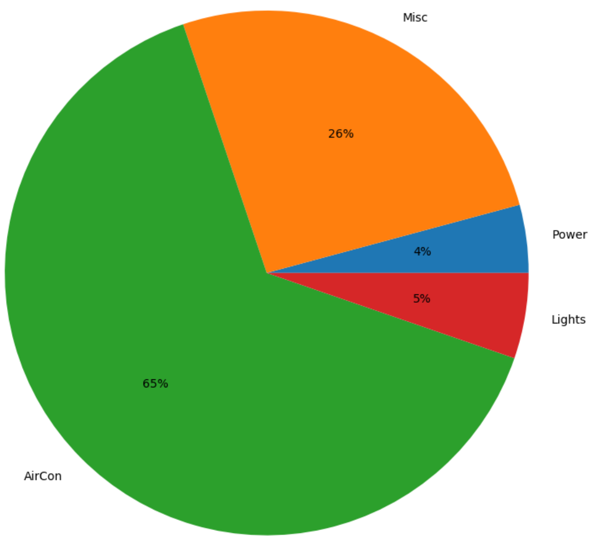


Figure 4 - Totals - Consumption Categories - Categorised

Each of these categories is now explored, with recommendations provided for decreasing consumption.

[2] Power is likely under estimated as not all power circuits could be logged. Refer to "Power" section for details.

3.2 Air-conditioning

This is the main consumer. In order of consumption, individual unit use is:

Table 2 - Air-conditioning breakdown

Supplies	Proportion
AC-1 Ducted Lounge	47%
AC-6 Master Bedroom*	24%
AC-5 Downstairs Bedrooms	18%
AC-3 Tv Room	7%
AC-2 Bedrooms Study	3%
AC-4 Billiards	2%

AC-1 (the large ducted unit for the top floor) has the highest use (31% of *total house* consumption). Note that AC-6 (master bedroom) is circuited with downstairs general power and so overestimates use.

In Summer, air-conditioning dominates consumption as seen below: on the left is January with large consumption in green from air-conditioning; on the right is May with minimal use of air-conditioning.

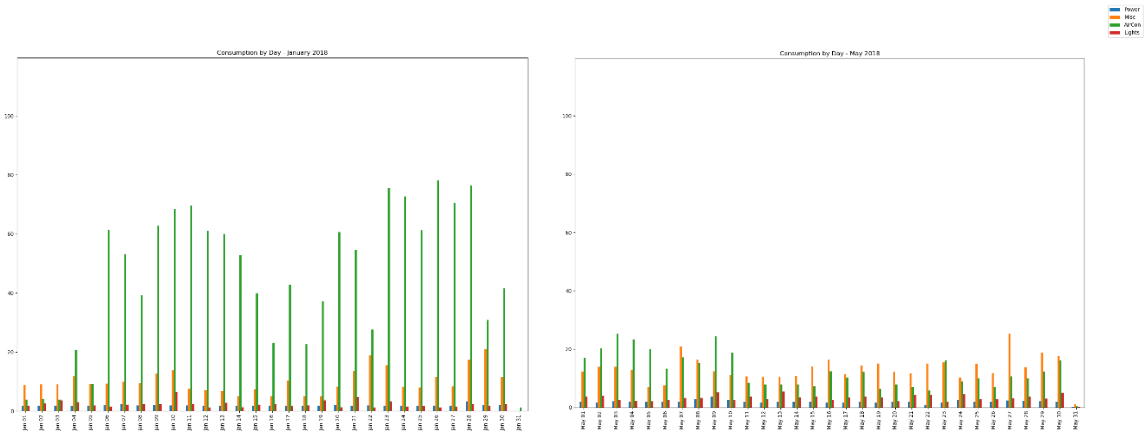
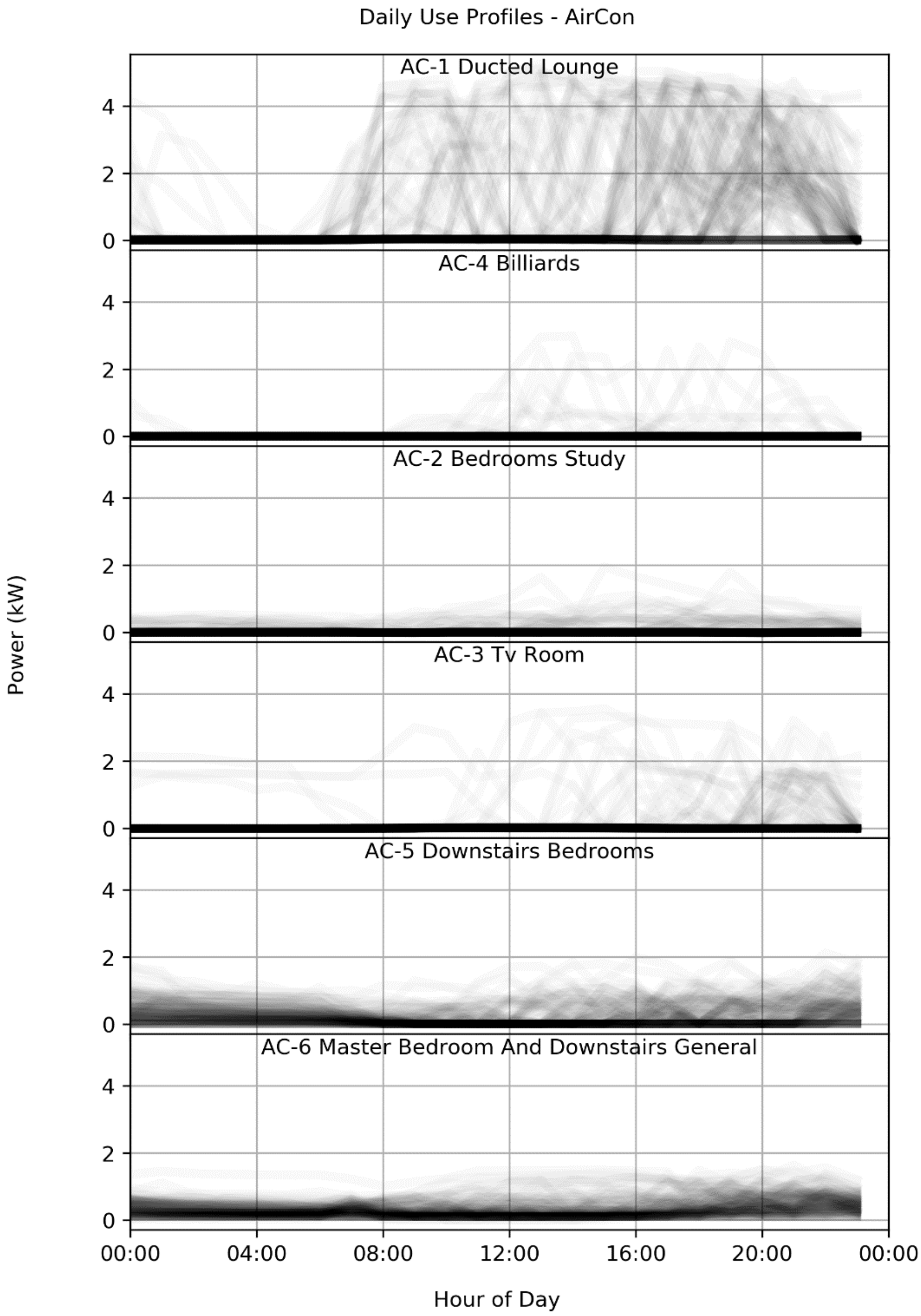


Figure 5 - January and May : air-conditioning energy per day in green

Air-conditioning consumption can be reduced in Summer by:

1. reducing run-hours,
2. decreasing cooling required or the “heat load”

The figure following shows a faint line for each day (about 160 days) of each air-conditioner’s use. Midnight is on the left of the x-axis. Noon is the middle of the x-axis.



We see that:

- AC-1 has long run hours, sometimes overnight (faints lines on the left).
- AC-5 (downstairs bedrooms) has very long run hours, over all day and night
- AC-3 (TV room) is sometimes left on through the night and morning
- Other units appear to run as expected.

Obviously air-conditioning is used for comfort. The easiest way to reduce consumption is to limit unnecessary use of air-conditioning (e.g. unoccupied rooms). This can be done manually, or via controls modification (i.e. auto-off functions).

The other method of reducing air-conditioning consumption is to reduce the load on the unit. The load on downstairs units is relatively low as there is good shading, thermal mass and fewer air leaks. The main consumer (AC-1 Ducted Lounge) has a high load and runs continuously. For example, on a day in Summer it runs at near 100% most of the day. Usually a unit would run at around 50%. The red line, below, shows this unit – it runs above 4kW for much of the day.

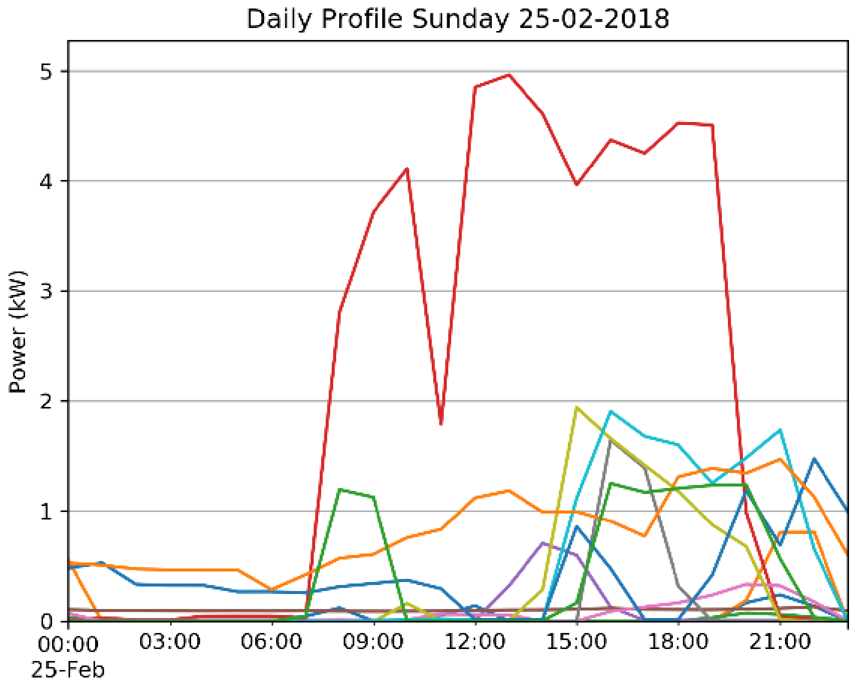


Figure 6 - Typical week in week with AC-1 Ducted Lounge in red

A detailed investigation of the house would be required to determine the most effective methods to reduce load, but they would include:

- Adjusting setpoint temperatures as high as comfortable
- Setting controller to automatically turn off (at, say, midnight in non-bedrooms)
- Setting controller to turn off after a present period (say 3 hours)
- Using ceiling fans
- Limiting open doors and windows
- Sealing doors, windows and pet flaps
- Checking ceiling space for insulation and air leaks
- Checking insulation levels
- Reducing heat load from old fridges, lighting, etc.

3.3 Miscellaneous (Pool, Dryer, Oven, Hot Water)

Together these use 26% of the energy consumed, or $1,750 per year:

Item	Proportion of Total Consumption
Pool	14%
Hot Water Boost	6%
Oven	5%
Dryer	1%

The oven is used as expected. Although large, it has few run hours. No changes are recommended.
The dryer is used throughout the year. Its usage could be reduced when conditions allow.

The pool and hot water use 20% of total energy, and are investigated in detail below.

3.3.1 Pool

Pool use includes pumps and associated equipment. With reference to the daily consumption in the following figure (in red):

- Consumption reduced from March, assumedly following pool equipment changes
- Consumption further reduced from May, assumedly following pool equipment changes
- Consumption has increased in June

Further investigation and a specialist pool contractor are required to reduce consumption, but the following can be noted:

- Pump run-time may be reduced in Winter
- Associated equipment (chlorinators, etc) can have reduced run-time in Winter
- On-demand running (ie. sense pool load) instead of timers may be an option

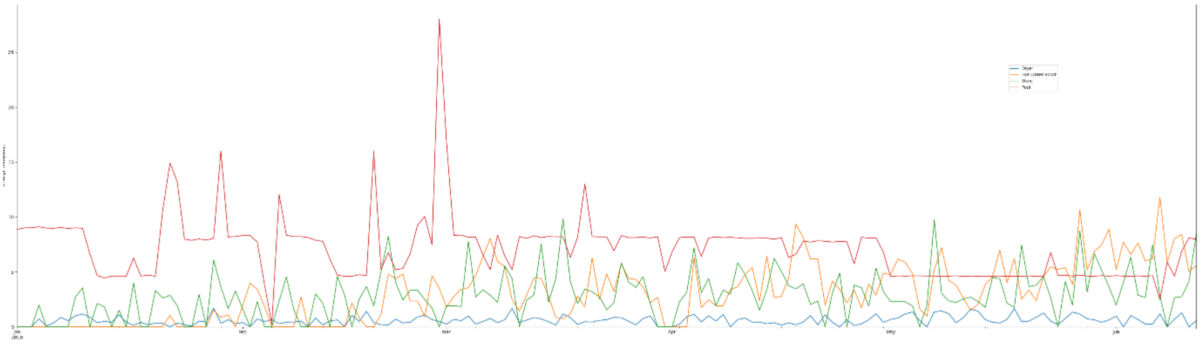


Figure 7 - Pool from January to July use in red

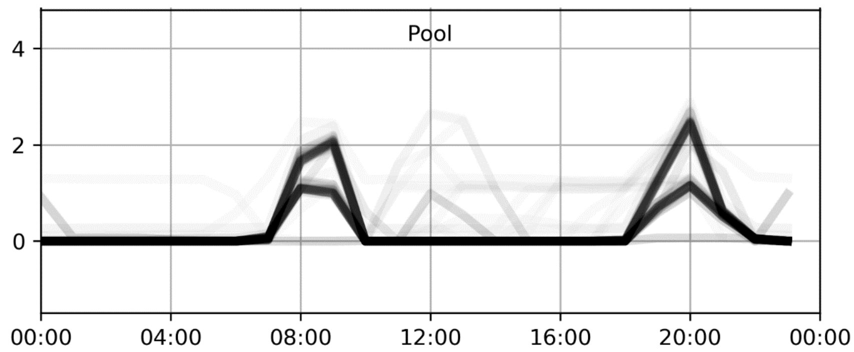


Figure 8 – The pool equipment runs on a timer at 8am and 8pm

3.3.2 Hot Water

A solar hot water system is used, with an electric booster. The booster should run only in Winter, and even then should not run during the day (to enable free solar heating).

The current configuration uses the booster in Summer and during the day – orange line:

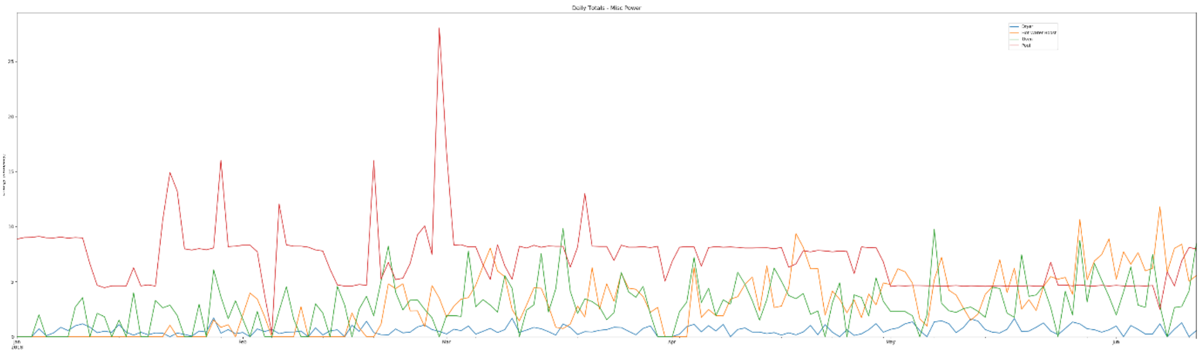


Figure 9 – Booster from January to July use in orange

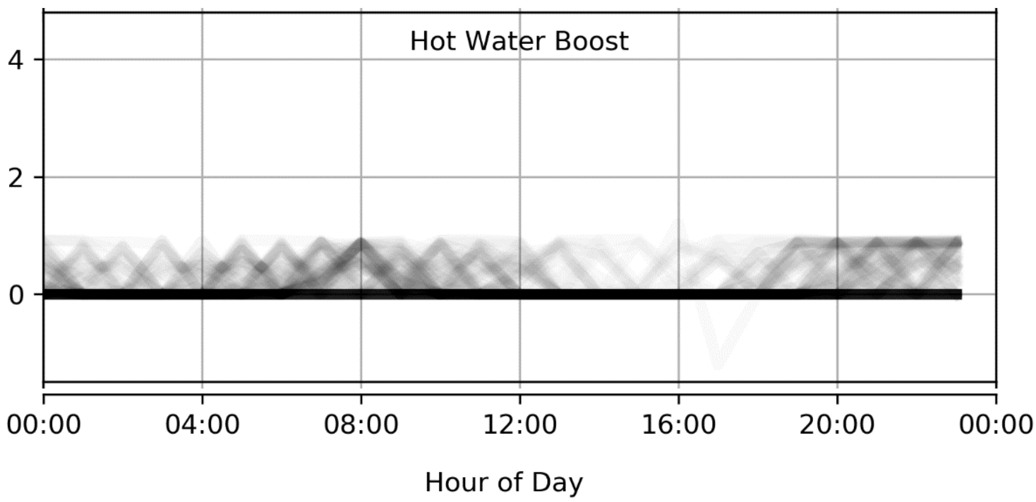


Figure 10 – Booster runs all the time, but should rarely run during the day

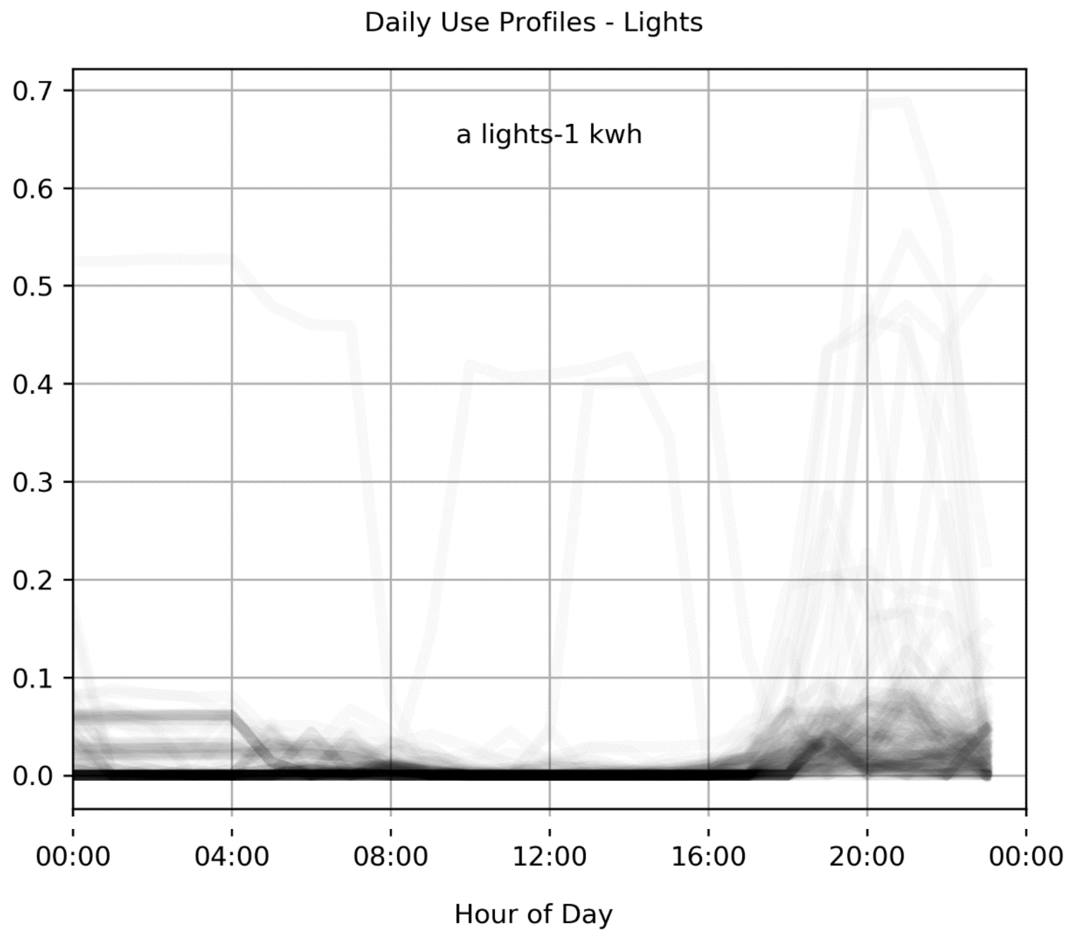
It is recommended the booster is checked and configured as follows:

- Turned off completely in Summer
- Timer installed to enable boost only in the evenings (to allow solar gain during the day)
- Thermostat and mixing value checked. Thermostat should be 65°C.
- Consideration given to a larger tank or booster, depending on the age of the system and usage

3.4 Lights

Despite being an visible use of energy, lights are a small proportion of overall use. The following figure shows that:

- On occasion, lights are left on over-night (faint lines to left)
- The external lights are the main energy consumptions but are less commonly used (faint peaks). On rare occasions they are on during the early morning or day. They could be replaced with more efficient units at their end of life.



3.5 Power

Few power circuits were logged as there are numerous circuits. The close agreement between bills and data logging totals shows little energy was 'missed.'

General power accounts for a small proportion of overall use and is usually well-used.

Nevertheless, the following items are noted for further investigation if desired:

- Modern appliances have low-energy standby mode
- Older computers and appliances should be considered for replacement.
- Fridges are the main power users here. Consider consolidation and/or replacement for fridges more than 7 years old. New units, if well installed, are significantly more efficient.

4 Production

The solar system provides approximately 20 kWh/day. This is consistent with a 5kW (peak) installed system. Overall, solar production covers around 38% of total energy consumption. Most of the solar energy (16 kWh/day) is used behind the meter, in the house. The balance (4 kWh/day) is exported at an excellent rate of 51 c/kWh.

Reductions in consumption will allow more solar energy to be exported, provide a double-gain (reduced costs and increased solar payments). In Summer, the air-conditioning load means solar provides around 20% of consumption. However, in Winter, solar is providing 80% of consumption.

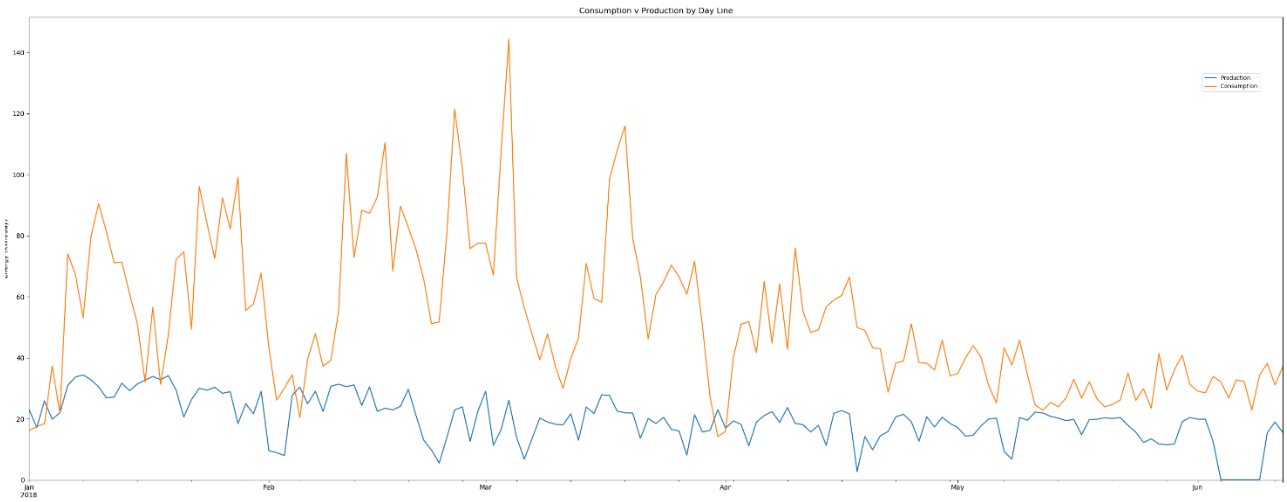


Figure 11 - Consumption and production (solar) from January to June 2018

The figures show the following:

- Peak production is 4.8kW. Including losses, this is as expected. Check to ensure panels are clean and unshaded to improve production.
- Recently (early June) the solar system was not working (flat blue line), but has been fixed.
- The darker, lower power band in the figure below is unexplained –a fault or shading?

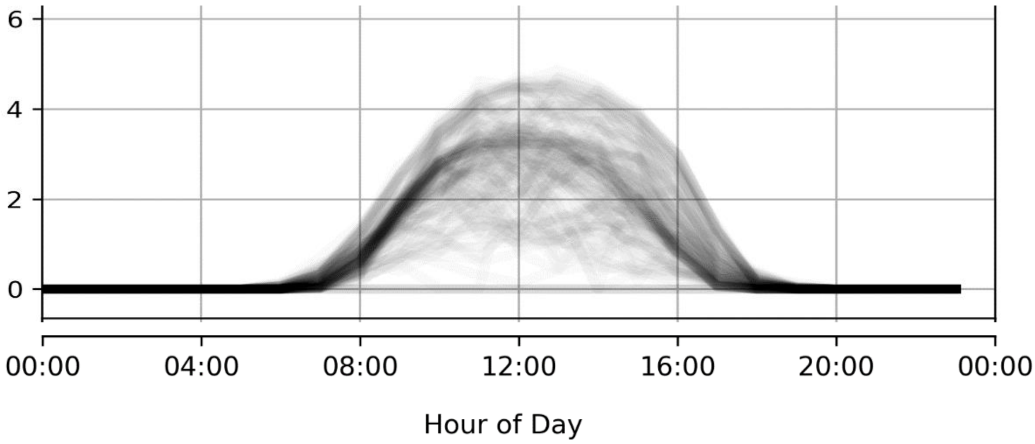


Figure 12 – Solar daily production profiles