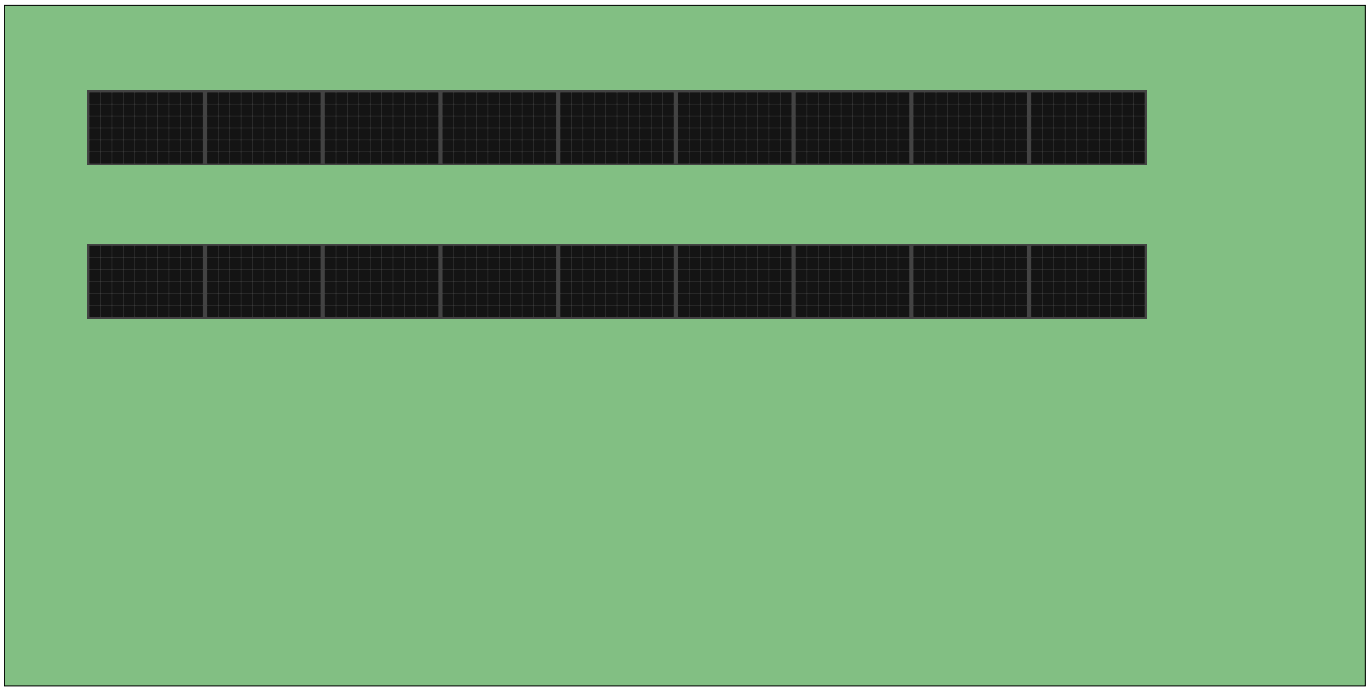
# Lucinda Ferguson

**Project Name:** 16th September 2022
**Phone:** 07997592736
**Address:** townhead Auchengillian , G63 9AU
**Date Created:** 16th September 2022
**Designer:** Jonathan Gallacher

# Layout

## Area 1



# Component list

| Item | Quantity |
| --- | --- |
|  JA Solar 410w solar panel | 18 |
|  Growatt SPH 5kW Dual MPPT Hybrid Inverter inverter | 1 |
|  Emlite ECA2 1ph Meter (Extended Cover) | 1 |
|  Label sheet | 1 |
|  Shine Lan - Growatt | 1 |
|  AC isolator - IMO - 32A 4-pole | 2 |
|  GROWATT 6.5KWH BATT GBLI6532 IP55 | 1 |
|  IMO DC isolator 16A 2p 1string | 2 |
|  Pair of MC4 connectors | 4 |
|  50m reel of 4mm2 solar cable | 1 |
|  Renusol console | 18 |
|  Console mounting bar | 36 |
|  Console mounting clips - pack of 4 | 18 |

# Inverter checks

## Growatt SPH 5kW Dual MPPT Hybrid Inverter

| Panels | | | |
|---|---|---|---|
| PV power | **7380** | Rated AC output | **5000** |

### Input 1: 9 JA Solar 410w solar panels in 1 strings

| Panels | | Inverter | |
|---|---|---|---|
| PV power | **3690 W** | | |
| Open circuit voltage at -10° C | **369 V** | Max DC voltage | **550 V** |
| $V_{mpp}$ at 40° C | **270 V** | $V_{mpp}$ lower limit | **150 V** |
| $V_{mpp}$ at -10° C | **309 V** | $V_{mpp}$ upper limit | **550 V** |
| $I_{mpp}$ at 40° C | **13 A** | Max DC input current | **12 A** |

**Max voltage**

The open circuit voltage of the solar panels never exceeds the voltage limit of the inverter.

✓

**Max power point range**

The maximum power point voltage of the solar panels is always above the lower limit of the inverter MPPT tracker. The maximum power point voltage of the solar panels is always below the upper limit of the inverter MPPT tracker.

✓

**Max Current**

## Input 2: 9 JA Solar 410w solar panels in 1 strings

| **Panels** | | **Inverter** | |
|---|---|---|---|
| PV power | **3690 W** | | |
| Open circuit voltage at -10° C | **369 V** | Max DC voltage | **550 V** |
| $V_{mpp}$ at 40° C | **270 V** | $V_{mpp}$ lower limit | **150 V** |
| $V_{mpp}$ at -10° C | **309 V** | $V_{mpp}$ upper limit | **550 V** |
| $I_{mpp}$ at 40° C | **13 A** | Max DC input current | **12 A** |

**Max voltage**

The open circuit voltage of the solar panels never exceeds the voltage limit of the inverter.

**Max power point range**

The maximum power point voltage of the solar panels is always above the lower limit of the inverter MPPT tracker. The maximum power point voltage of the solar panels is always below the upper limit of the inverter MPPT tracker.

**Max Current**

# Electrical

## Growatt SPH 5kW Dual MPPT Hybrid Inverter

### AC Isolator

A AC isolator - IMO - 32A 4-pole has been specified for this input

**Current**

The rated isolator current (32A) is greater than the rated inverter current (22A)

**Phases**

The isolator is suitable for use on a single phase inverter.

### Input 1

### DC Isolator

A IMO DC isolator 16A 2p 1string has been specified for this input

**Current**

The isolator is rated for a current of 3A,  which is not sufficient for the expected maximum current of NaNA.

**Voltage**

At 3A the isolator is rated for a voltage of 1500V,  which is more than the expected maximum voltage of 335.07V.

## Cable

10m of 4mm2 solar cable has been specified

**Voltage drop**

Voltage drop at maximum power point at 40°C will be around **1.10 V (0.41 percent)**

# Input 2

## DC Isolator

A IMO DC isolator 16A 2p 1string has been specified for this input

**Current**

The isolator is rated for a current of 3A,  which is not sufficient for the expected maximum current of NaNA.

**Voltage**

At 3A the isolator is rated for a voltage of 1500V,  which is more than the expected maximum voltage of 335.07V.

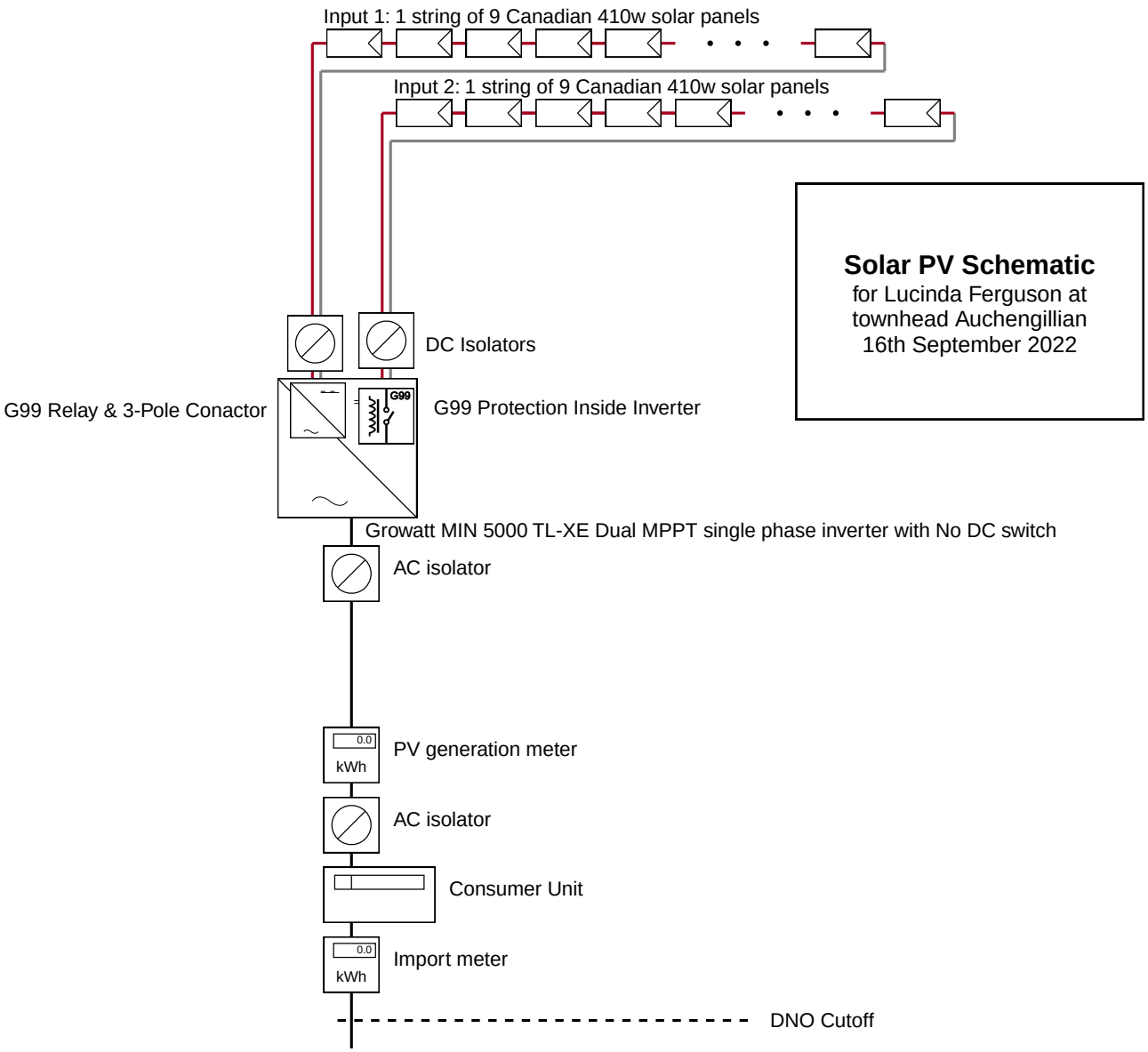
## Cable

10m of 4mm2 solar cable has been specified

**Voltage drop**

Voltage drop at maximum power point at 40°C will be around **1.10 V (0.41 percent)**

# Schematic diagram



# Performance Estimate

## Site details

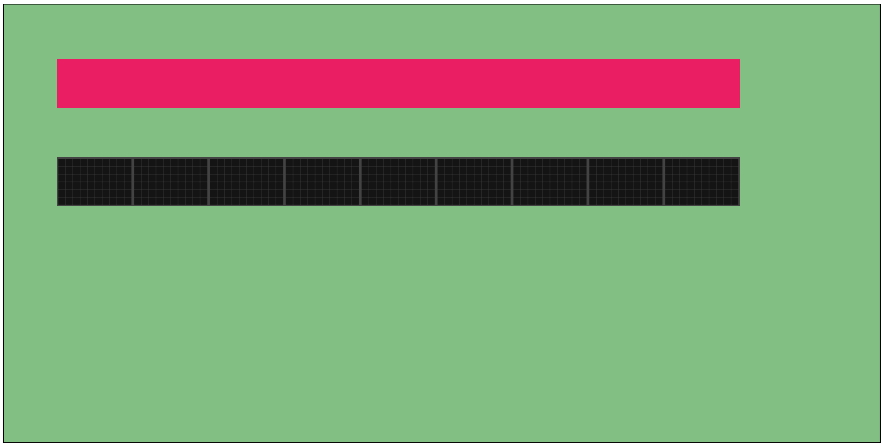
| | |
|---|---|
| **Client** | Lucinda Ferguson |
| **Address** | townhead Auchengillian |

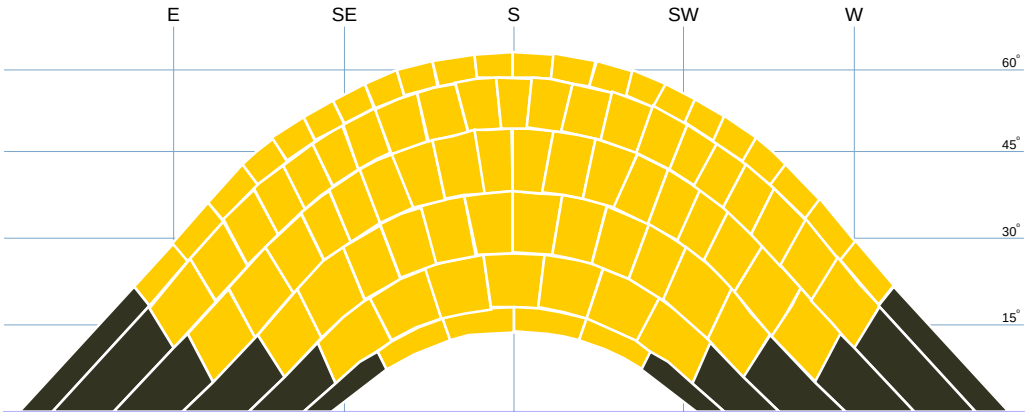
The sunpath diagram shows the arcs of the sky that the sun passes through at different times of the day and year as yellow blocks. The shaded area indicates the horizon as seen from the location of the solar array. Where objects on the horizon are within 10m of the array, an added semi-circle is drawn to represent the increased shading. Blocks of the sky that are shaded by objects on the horizon are coloured red, and a shading factor is calculated from the number of red blocks. The performance of the solar array is calculated by multiplying the size of the array (kWp) by the shading factor (sf) and a site correction factor (kk), taken from tables which take account of the geographical location, orientation and inclination of the array.

# Inverter 1

Growatt SPH 5kW Dual MPPT Hybrid Inverter

## Input 1

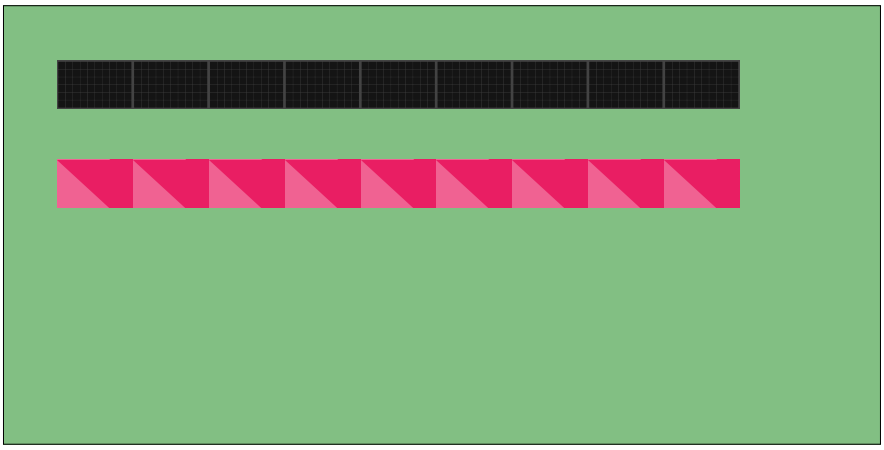


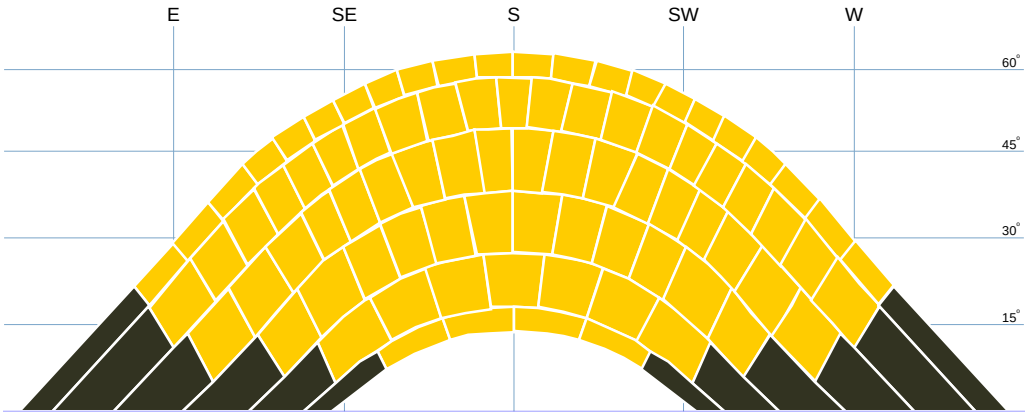



| A. Installation data | | |
|---|---|---|
| Installed capacity of PV system - kWp (stc) | **3.690** | kWp |
| Orientation of the PV system - degrees from South | **0** | ° |
| Inclination of system - degrees from horizontal | **15** | ° |
| Postcode region | **14** | |

| B. Performance calculations | | |
|---|---|---|
| kWh/kWp (Kk) | **781** | kWh/kWp |
| Shade factor (SF) | **1.00** | |
| Estimated output (kWp x Kk x SF) | **2882** | kWh |

# Input 2






| A. Installation data | | |
|---|---|---|
| Installed capacity of PV system - kWp (stc) | **3.690** | kWp |
| Orientation of the PV system - degrees from South | **0** | ° |
| Inclination of system - degrees from horizontal | **15** | ° |
| Postcode region | **14** | |

| B. Performance calculations | | |
|---|---|---|
| kWh/kWp (Kk) | **781** | kWh/kWp |
| Shade factor (SF) | **1.00** | |
| Estimated output (kWp x Kk x SF) | **2882** | kWh |

# Performance Summary

| A. Installation data | | |
|---|---|---|
| Installed capacity of PV system - kWp (stc) | **7.38** | kWp |
| Orientation of the PV system - degrees from South | **See individual inputs** | |
| Inclination of system - degrees from horizontal | **See individual inputs** | |
| Postcode region | **14** | |
| **B. Performance calculations** | | |
| kWh/kWp (Kk) | **See individual inputs** | |
| Shade factor (SF) | **See individual inputs** | |
| Estimated output (kWp x Kk x SF) | **5764** | kWh |
| **C. Estimated PV self-consumption - PV Only** | | |
| Assumed occupancy archetype | **home all day** | |
| Assumed annual electricity consumption, kWh | **5400** | kWh |
| Assumed annual electricity generation from solar PV system, kWh | **5764** | kWh |
| Expected solar PV self-consumption (PV Only) | **1844.48** | kWh |
| Grid electricity independence / Self-sufficiency (PV Only) | **34.16** | % |
| **D. Estimated PV self-consumption - with EESS** | | |
| Assumed usable capacity of electrical energy storage device, which is used for self-consumption, kWh | **5.850000000000001** | kWh |
| Expected solar PV self-consumption (with EESS) | **3573.68** | kWh |
| Grid electricity independence / Self-sufficiency (with EESS) | **66.18** | % |

**Important Note:** The performance of solar PV systems is impossible to predict with certainty due to the variability in the amount of solar radiation (sunlight) from location to location and from year to year. This estimate is based upon the standard MCS procedure is given as guidence only for the first year of generation. It should not be considered as a guarantee of performance.

The solar PV self-consumption has been calculated in accordance with the most relevant methodology for your system. There are a number of external factors that can have a significant effect on the amount of energy that is self-consumed so this figure should not be considered as a guarantee of the amount of energy that will be self-consumed

# Self consumption

We model here the performance of a solar PV system with battery storage over the course of a year, using high resolution minute-by-minute generation data for a typical PV system and consumption data for a typical house, and calculating the flow of energy from the solar panels to the house and the battery during the day, and from the storage battery back to the house at night - or from the grid to the house when the battery is empty or loads exceed the discharge capacity of the system.

We provide yearly profiles of generation, consumption, import / export and battery utilisation, along with detailed profiles for a typical spring day.

## Battery system specification

### Growatt SPH 5kW Dual MPPT Hybrid Inverter with a GROWATT 6.5KWH BATT GBLI6532 IP55 battery

Charge rate is directly taken from the inverter specification, this value can be less depending on the type of battery connected.

| | |
|---|---|
| Charge rate | **3000 W** |
| Inverter charge efficiency | **97.1 %** |
| Inverter discharge efficiency | **97.1 %** |
| Battery efficiency | **95.0 %** |
| Round trip efficiency | **89.6 %** |
| Battery bank capacity | **6.5 kWh** |
| Max discharge depth | **90 %** |
| Usable capacity | **5.8500000000000005** |

**Consumption** 5400 kWh

Electricity consumed in the property each year

**Generation** 5764 kWh

Electricity generated by the PV array each year

**Self consumption** 56 %

Proportion of PV generation used in the property

**Independence** 59 %

Proportion of electricity consumption provided by PV

**Import / Export** 2255 / 2453 kWh

Electricity import / export each year from the property

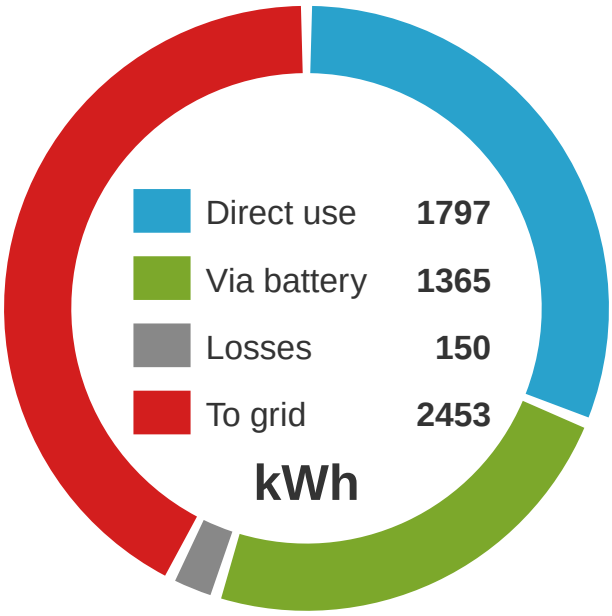
**Utilisation** 67 %

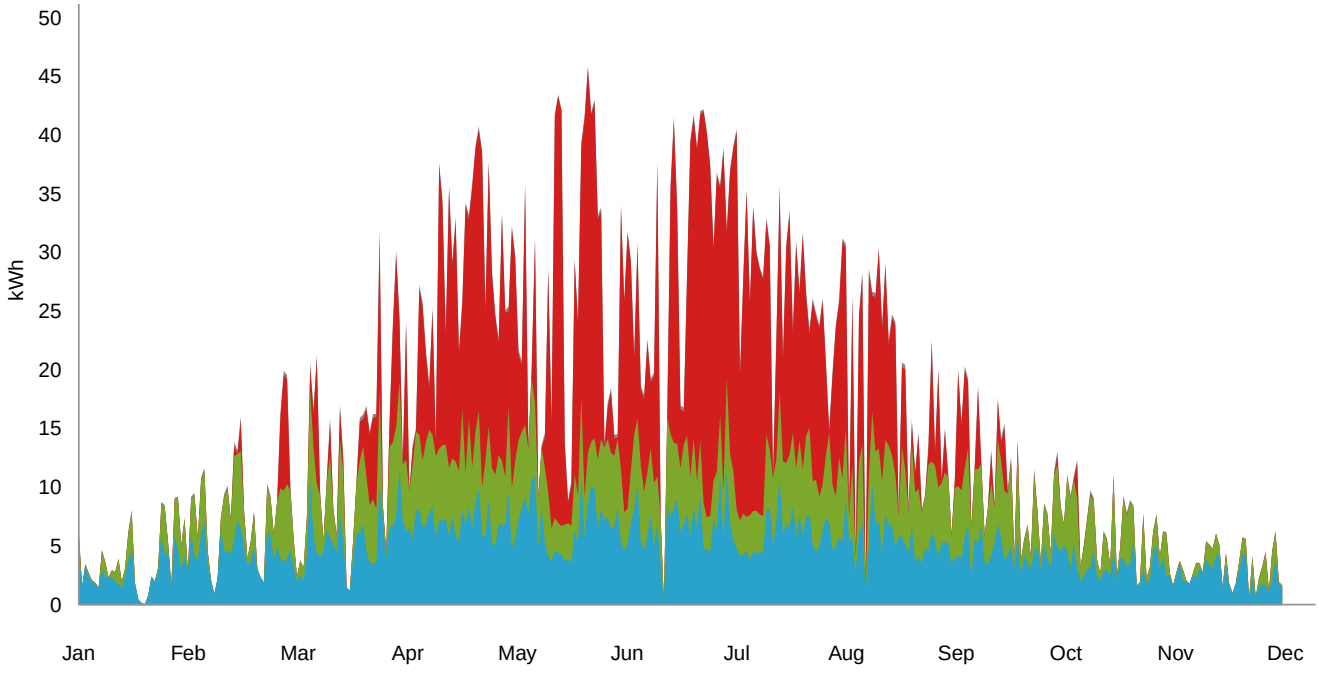
Average daily utilisation of the storage battery

# Yearly generation

The solar PV array is expected to generate 5764 kWh over a typical year. The graph shows whether the generated energy is used directly in the house, used to charge the storage battery, or exported to the grid.

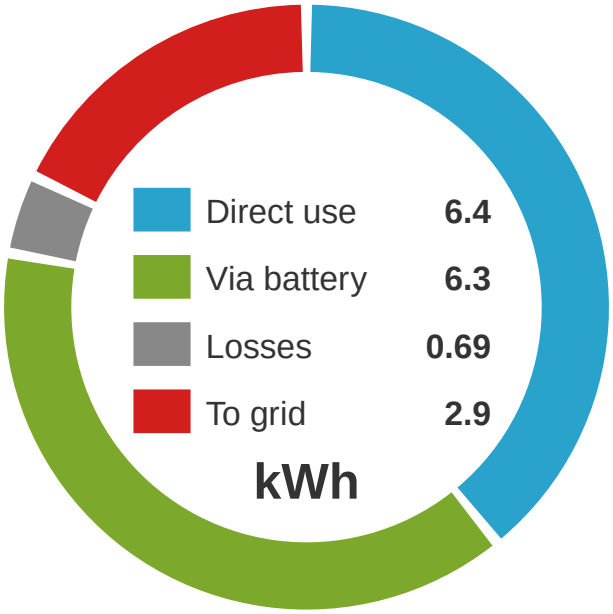
31% (1797 kWh) of the electricity generated is expected to be used directly in the property. 26% (1514 kWh) is directed to the battery for later use, although 150 kWh of this is lost during battery charging and discharging, leaving 1364 kWh for use in the property. The remaining generation (2453 kWh, or 43% of the total) is exported to the grid.

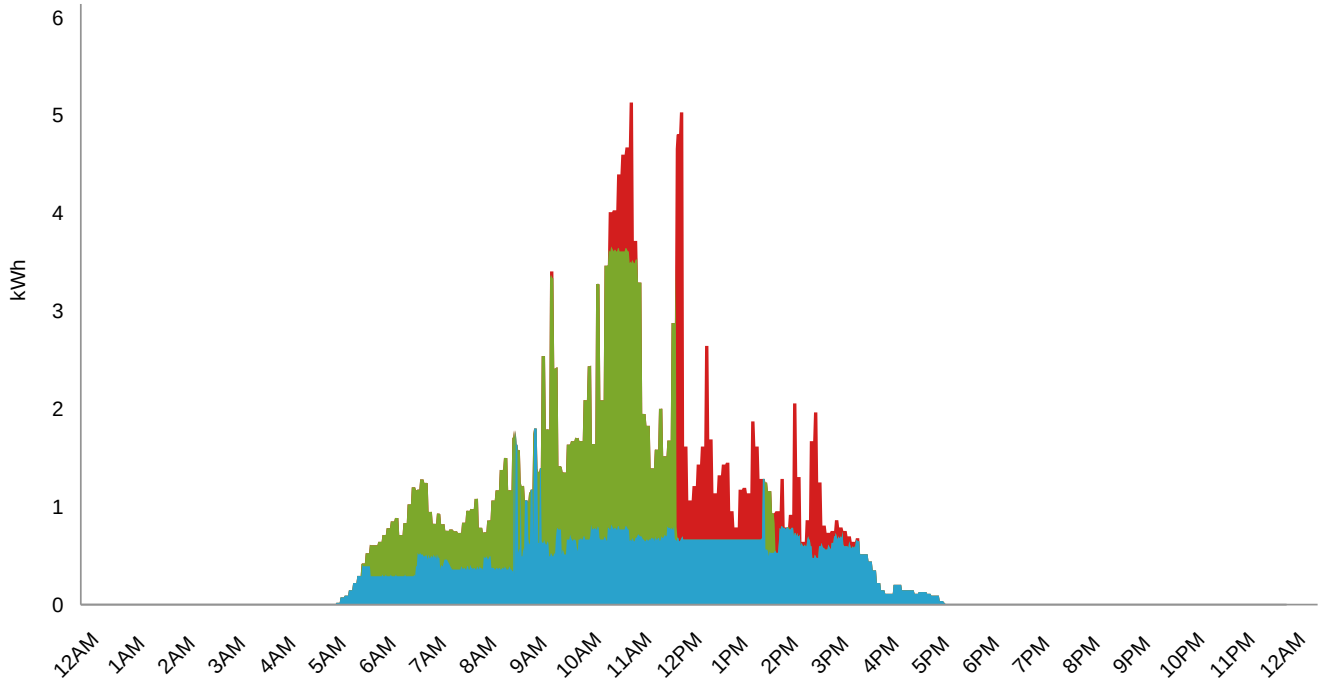


# Daily generation

This graph shows the modelled profile of electricity generated by the PV array on a selected day (March 27th). On this day the PV system is expected to generate 16.3 kWh. Of this, 6.4 kWh (39%) is used directly in the property, 7.0 kWh (43%) is stored in the battery for later re-use, and 2.9 kWh (18%) is exported to the grid.

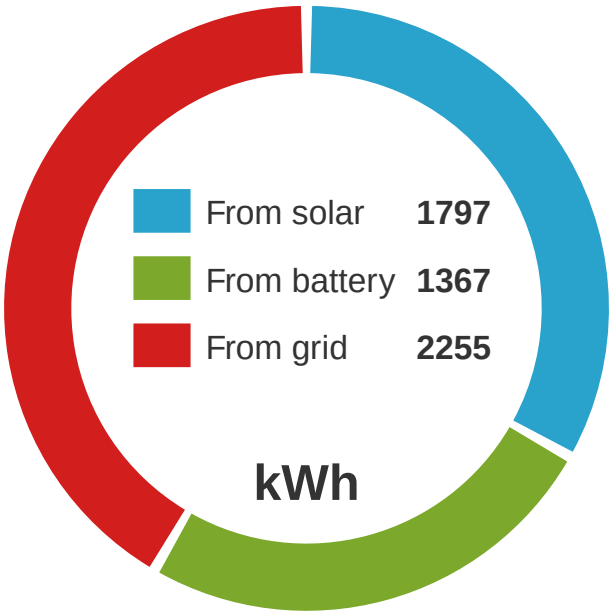


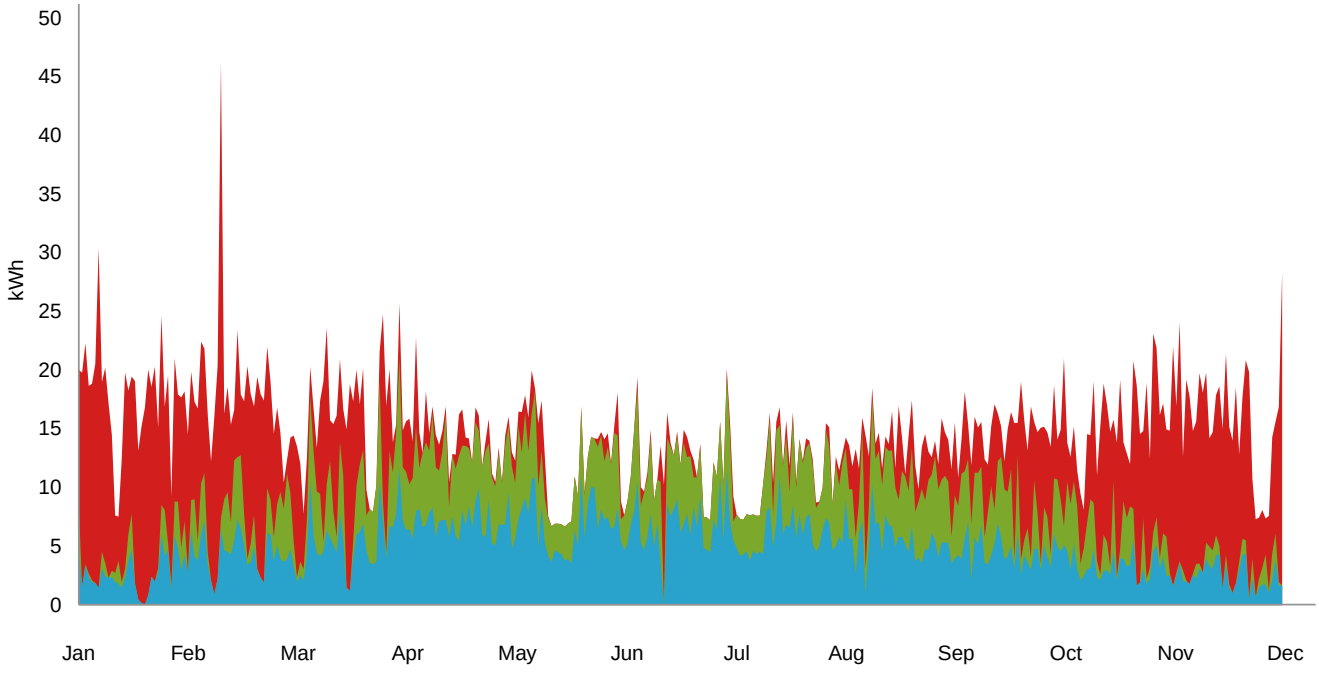



# Yearly consumption

The property is expected to consume 5400kWh of electricity each year. Around 33% of this (1797 kWh) is expected to be supplied directly by the solar array. Another 25% (1367 kWh) is supplied from the storage battery. The remaining 42% (2255 kWh) is supplied from the grid.

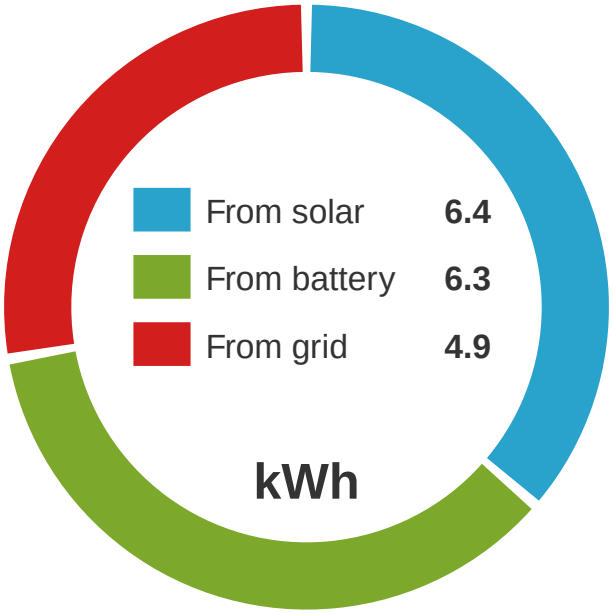
Overall, 58% (3164 kWh) of the electricity used in the property is expected to be supplied by the solar array and battery storage system. Without battery storage it would be 33% (1797 kWh).

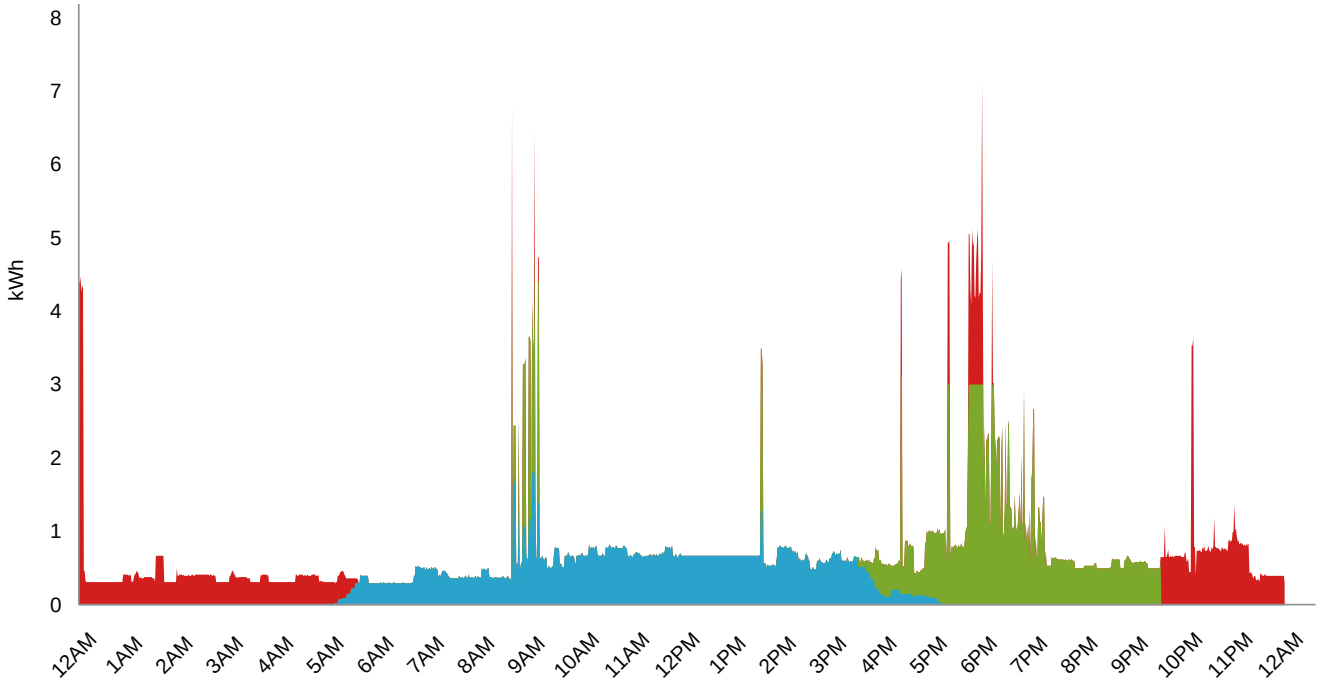


# Daily consumption

This graph shows modelled consumption data over the course of the selected day (March 27th). Total electricity consumption on this day was 17.5 kWh, of which 6.4 kWh (37%) is expected to be supplied directly by the solar array, and a further 6.3 kWh (36%) drawn from the battery storage system. The remaining 4.9 kWh (28%) is imported from the grid.

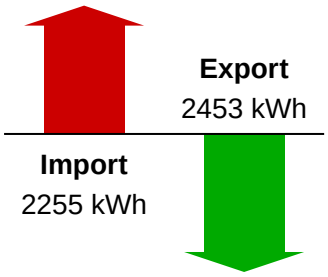


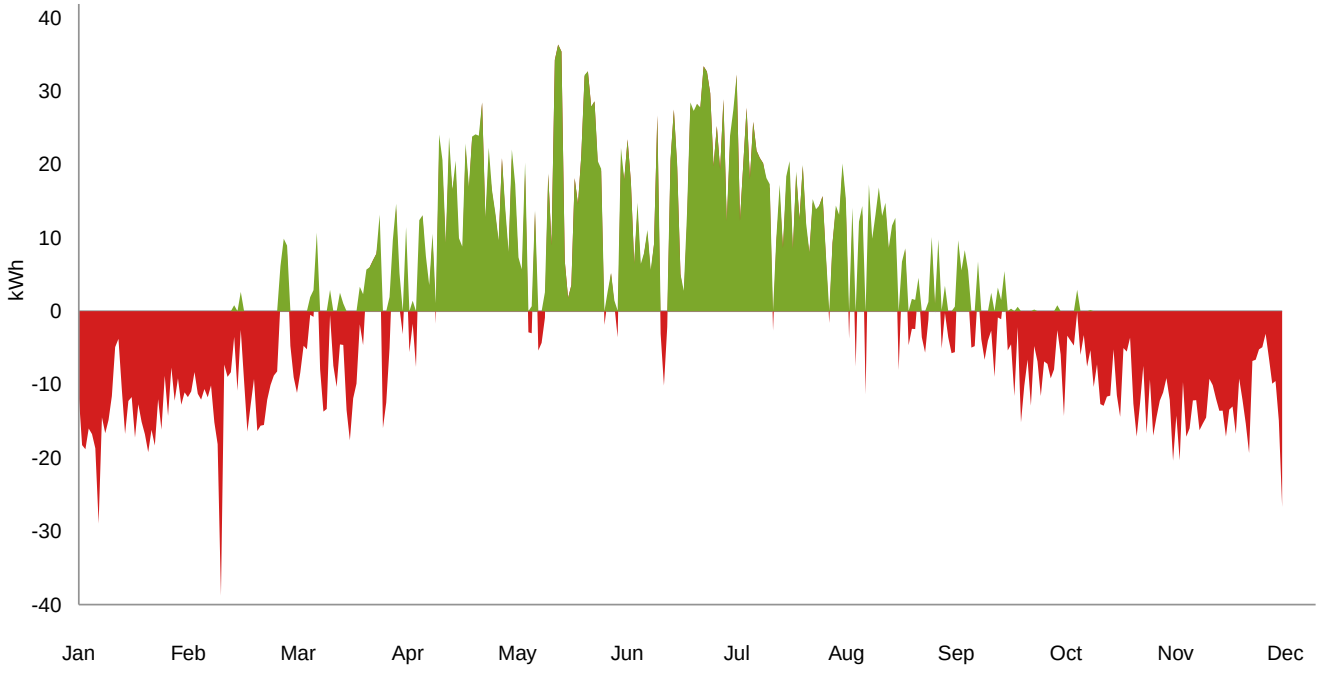



# Yearly import and export

This graph shows modelled profiles of electricity imported and exported to and from the grid over the course of a year. The red area above the horizontal axis represents imported electricity, and the green area beneath the axis exported electricity.

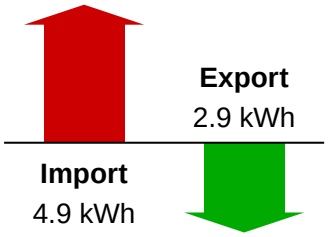
Over the course of the year, a total of 2255 kWh is expected to be imported by the property, and 2453 kWh exported back to the grid.

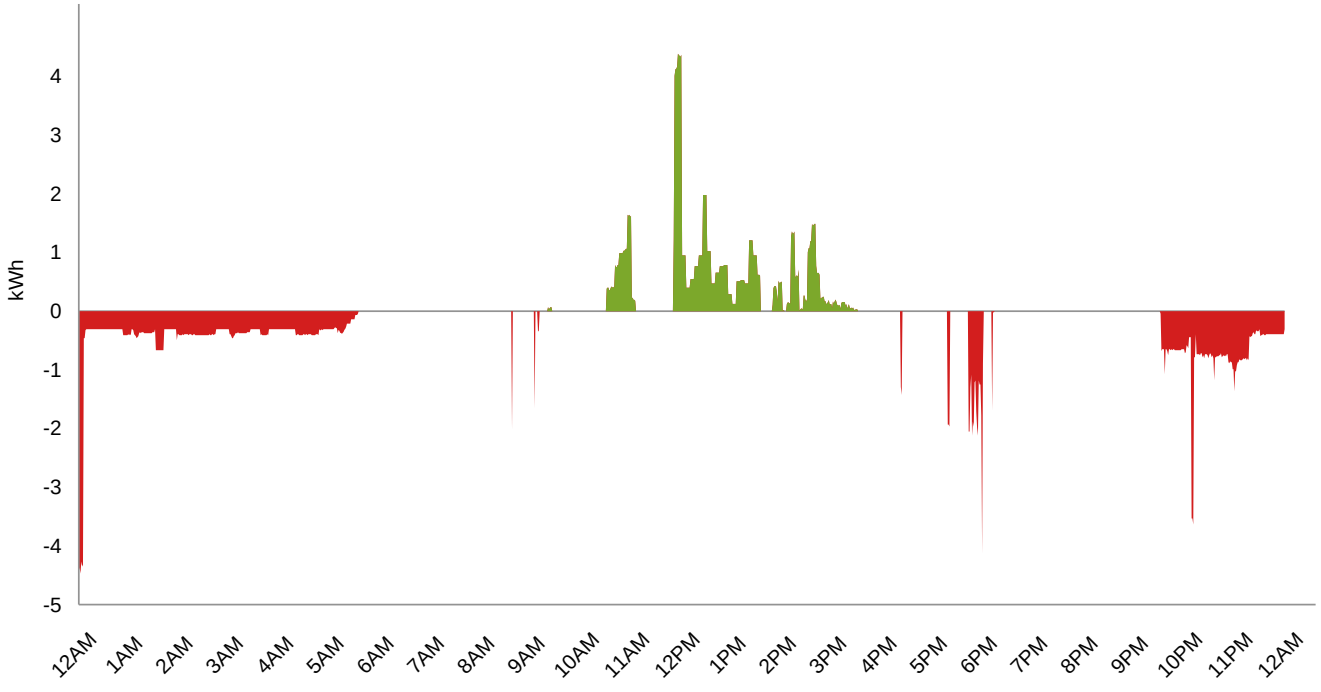


# Daily import and export

This graph shows the modelled import and export of electricity over a selected day (March 27th). On this day 4.90 kWh is expected to be imported from the grid, and 2.9 kWh exported.At times when no import or export is shown the battery storage system is charging or discharging.



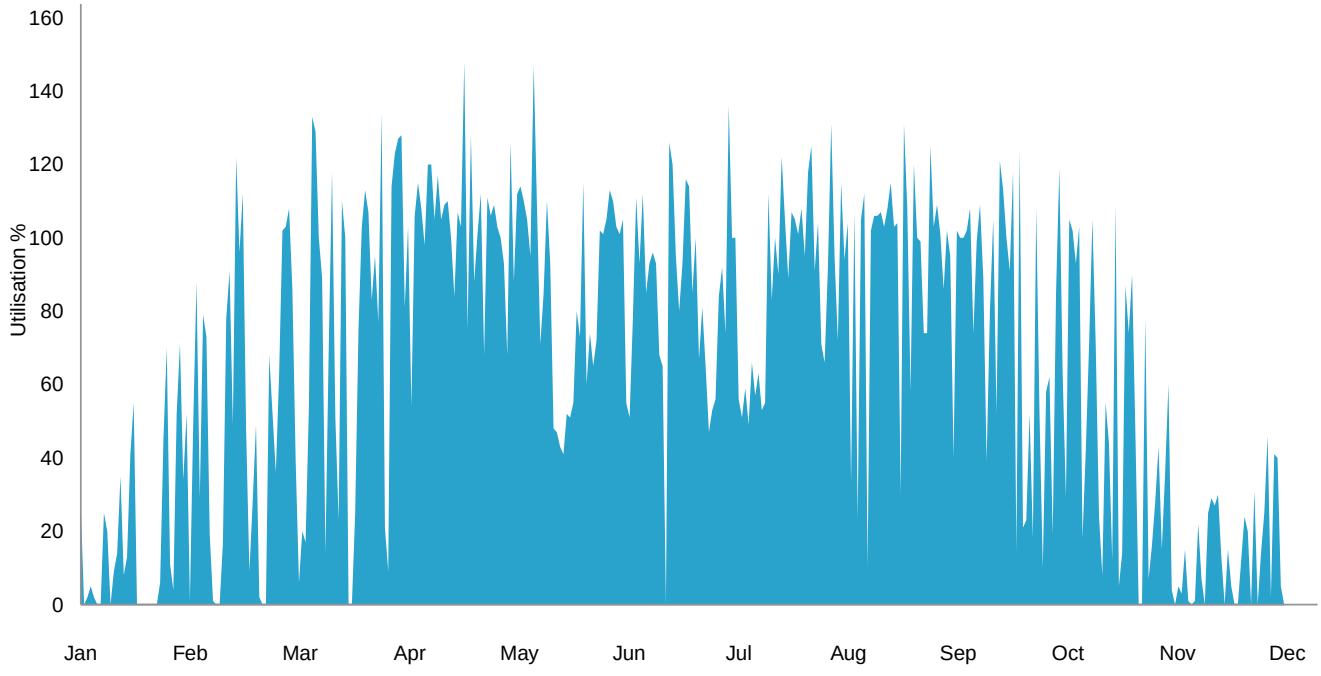
# Yearly battery utilisation

The graph shows the modelled utilisation of the battery over the course of the year - the fraction of the available battery capacity that is actually charged and discharged each day. Utilisation of over 100% is possible at times where a battery is charged and discharged more than once during a day.

Low battery utilisation can be due to either insufficient spare PV generation to charge the battery (often the case in winter, or on cloudy days), or because loads are small overnight and the battery does not fully discharge.

Average battery utilisation

67%



# Daily battery utilisation

The state of charge of the battery over a selected day (March 27th) is shown in the graph below. The battery discharges overnight or when there is heavy demand during the day, and charges when there is excess solar PV generation during the day. On this day, 113% of the battery capacity was utilised.

Average battery utilisation

113%