



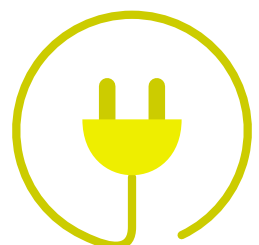
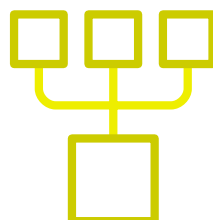
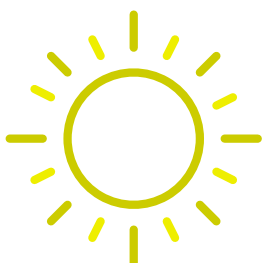
# LIGHTNING SOLUTIONS

**Project Name:** THE OLD SIX BELLS INN

**Phone:** 01443693271

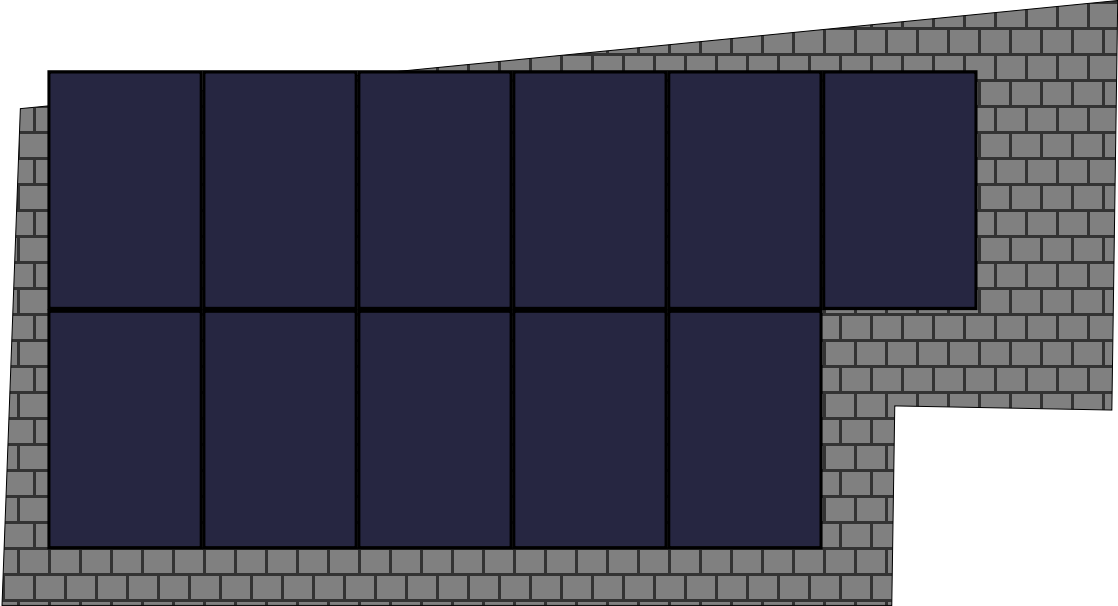
**Date Created:** 11th March 2024

**Designer:** Jamie Chamberlain

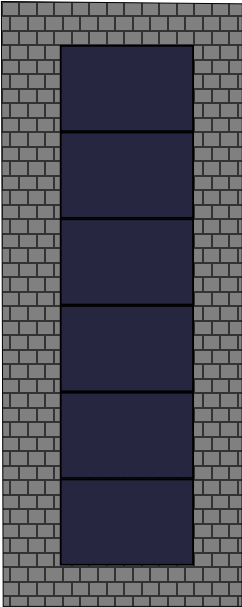


# Roof Layout

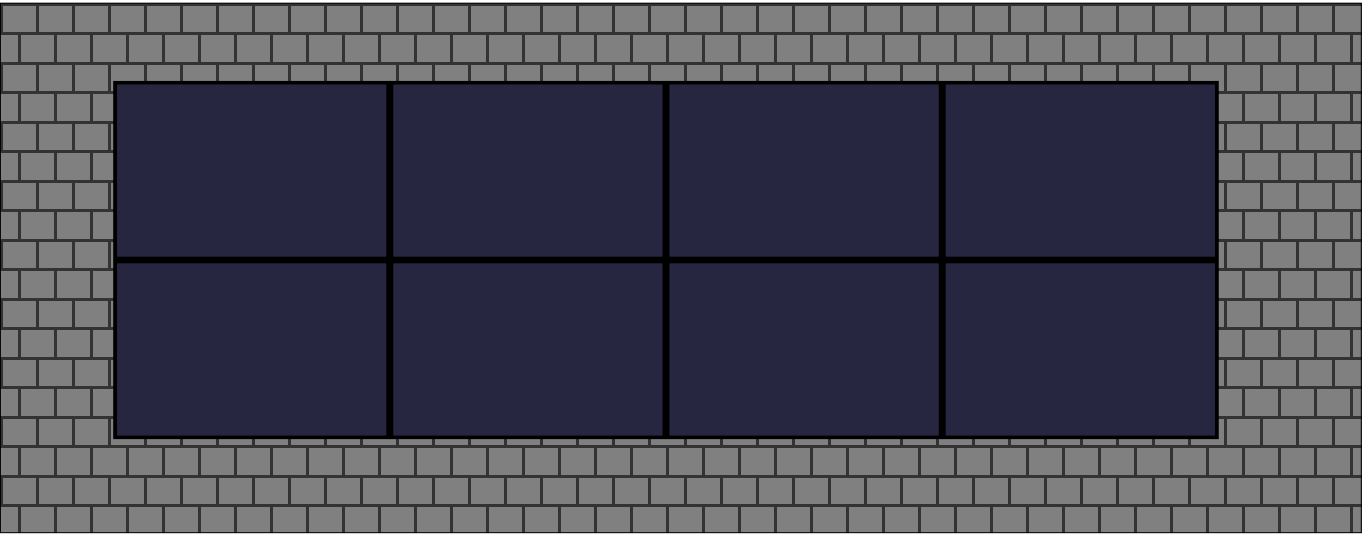
Roof 1



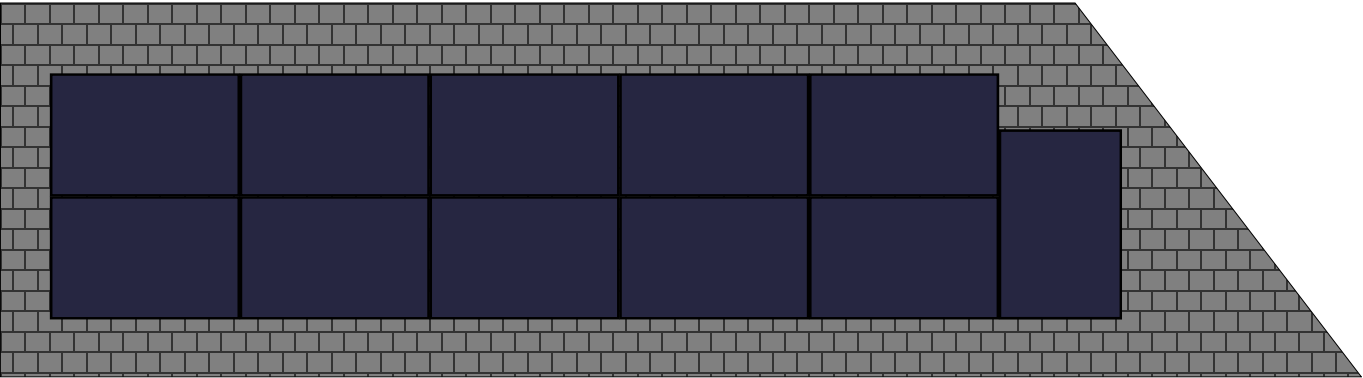
Roof 2



Roof 3



Roof 4



# Component list

| Item                                                                                                                                 | Quantity |
|--------------------------------------------------------------------------------------------------------------------------------------|----------|
|  Trina Vertex S 415W All Black Mono solar panel     | 36       |
|  Growatt MOD 4000 TL3-X 3ph inverter                | 1        |
|  SolaX X3 G4 12.0kW hybrid inverter                 | 1        |
|  Emlite EMP1 3ph Meter                              | 1        |
|  Label sheet                                        | 2        |
|  DC cable warning sticker sheet                    | 1        |
|  AC isolator - IMO - 20A 4-pole                   | 4        |
|  Tigo Retrofit Frame Mounted Optimiser TS4-A-O    | 8        |
|  MC4 4mm Connector Pair                           | 2        |
|  SolaX Triple 5.8kWh LFP Battery (Master Console) | 1        |
|  SolaX Triple 5.8kWh LFP Battery (Slave Console)  | 1        |
|  K&N DC isolator - KGD40-3                        | 1        |
|  MC4 6mm Connector Pair                           | 6        |
|  IMO DC isolator 16A 2p 1string                   | 1        |
|  50m reel of 4mm2 solar cable                     | 1        |



100m reel of 6mm<sup>2</sup> solar cable

2



Fastensol black universal clamp

98



Fastensol black end cap

52



Fastensol portrait slate roof hook

30



Fastensol rail splice

6



Fastensol black rail 3550mm

8



Fastensol landscape slate roof hook

68



Fastensol silver rail 3550mm

23



Fastensol rail bolt

8



# Inverter checks

## Growatt MOD 4000 TL3-X 3ph

### Panels

PV power **3320** Rated AC output **4000**

Input 1: 8 Trina Vertex S 415W All Black Mono solar panels in 1 strings

### Panels

### Inverter

|                                |               |                              |               |
|--------------------------------|---------------|------------------------------|---------------|
| PV power                       | <b>3320 W</b> |                              |               |
| Open circuit voltage at -10° C | <b>437 V</b>  | Max DC voltage               | <b>1000 V</b> |
| V <sub>mpp</sub> at 40° C      | <b>321 V</b>  | V <sub>mpp</sub> lower limit | <b>140 V</b>  |
| V <sub>mpp</sub> at -10° C     | <b>364 V</b>  | V <sub>mpp</sub> upper limit | <b>1000 V</b> |
| I <sub>mpp</sub> at 40° C      | <b>10 A</b>   | Max DC input current         | <b>13 A</b>   |

#### 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

The maximum power point current of the solar panels is always below the maximum current for the inverter MPPT tracker.



Input 2: No panels

SolaX X3 G4 12.0kW hybrid

### Panels

|          |       |                 |       |
|----------|-------|-----------------|-------|
| PV power | 11620 | Rated AC output | 13200 |
|----------|-------|-----------------|-------|

Input 1: 8 Trina Vertex S 415W All Black Mono solar panels in 2 strings

### Panels

### Inverter

|                                |        |                              |       |
|--------------------------------|--------|------------------------------|-------|
| PV power                       | 6640 W |                              |       |
| Open circuit voltage at -10° C | 437 V  | Max DC voltage               | 950 V |
| V <sub>mpp</sub> at 40° C      | 321 V  | V <sub>mpp</sub> lower limit | 180 V |
| V <sub>mpp</sub> at -10° C     | 364 V  | V <sub>mpp</sub> upper limit | 950 V |
| I <sub>mpp</sub> at 40° C      | 20 A   | Max DC input current         | 26 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

The maximum power point current of the solar panels is always below the maximum current for the inverter MPPT tracker.



Input 2: 12 Trina Vertex S 415W All Black Mono solar panels in 1 strings

| Panels                         |        | Inverter                     |       |
|--------------------------------|--------|------------------------------|-------|
| PV power                       | 4980 W |                              |       |
| Open circuit voltage at -10° C | 655 V  | Max DC voltage               | 950 V |
| V <sub>mpp</sub> at 40° C      | 482 V  | V <sub>mpp</sub> lower limit | 180 V |
| V <sub>mpp</sub> at -10° C     | 546 V  | V <sub>mpp</sub> upper limit | 950 V |
| I <sub>mpp</sub> at 40° C      | 10 A   | Max DC input current         | 16 A  |

#### Max voltage

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



#### Max power point range

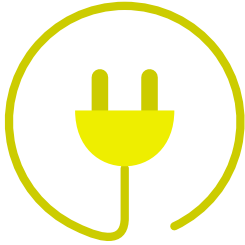
The maximum power point voltage of the solar panels is always above the lower limit of the inverter MPPT tracker. The maximum power point voltage of the solar panels is always below the upper limit of the inverter MPPT tracker.



### **Max Current**

The maximum power point current of the solar panels is always below the maximum current for the inverter MPPT tracker.





# Electrical

## Growatt MOD 4000 TL3-X 3ph



### AC Isolator

A AC isolator - IMO - 20A 4-pole has been specified for this input

#### Current

The rated isolator current (20A) is greater than the rated inverter current (6.7A)



#### Phases

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



## Input 1



### DC Isolator

#### Integrated isolator

This inverter contains an integrated DC Isolator.





## Cable

10m of 4mm<sup>2</sup> solar cable has been specified

### Voltage drop

Voltage drop at maximum power point at 40°C will be around  
**0.85 V (0.26 percent)**



Input 2: No panels

## SolaX X3 G4 12.0kW hybrid



## AC Isolator

A AC isolator - IMO - 20A 4-pole has been specified for this input

### Current

The rated isolator current (20A) is greater than the rated inverter current (19.3A)



### Phases

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



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## Input 1



### DC Isolator

A K&N DC isolator - KGD40-3 has been specified for this input

#### Current

The isolator is rated for a current of 40A, which is more than the expected maximum current of 21.1A.



#### Voltage

At 40A the isolator is rated for a voltage of 600V, which is more than the expected maximum voltage of 400V.



### Cable

30m of 6mm<sup>2</sup> solar cable has been specified

#### Voltage drop

Voltage drop at maximum power point at 40°C will be around **3.48 V (1.08 percent)**

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## 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 16A, which is more than the expected maximum current of 10.55A.



### Voltage

At 16A the isolator is rated for a voltage of 700V, which is more than the expected maximum voltage of 600V.



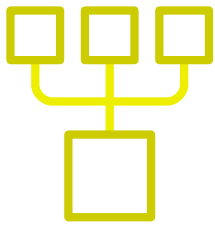
## Cable

30m of 6mm<sup>2</sup> solar cable has been specified

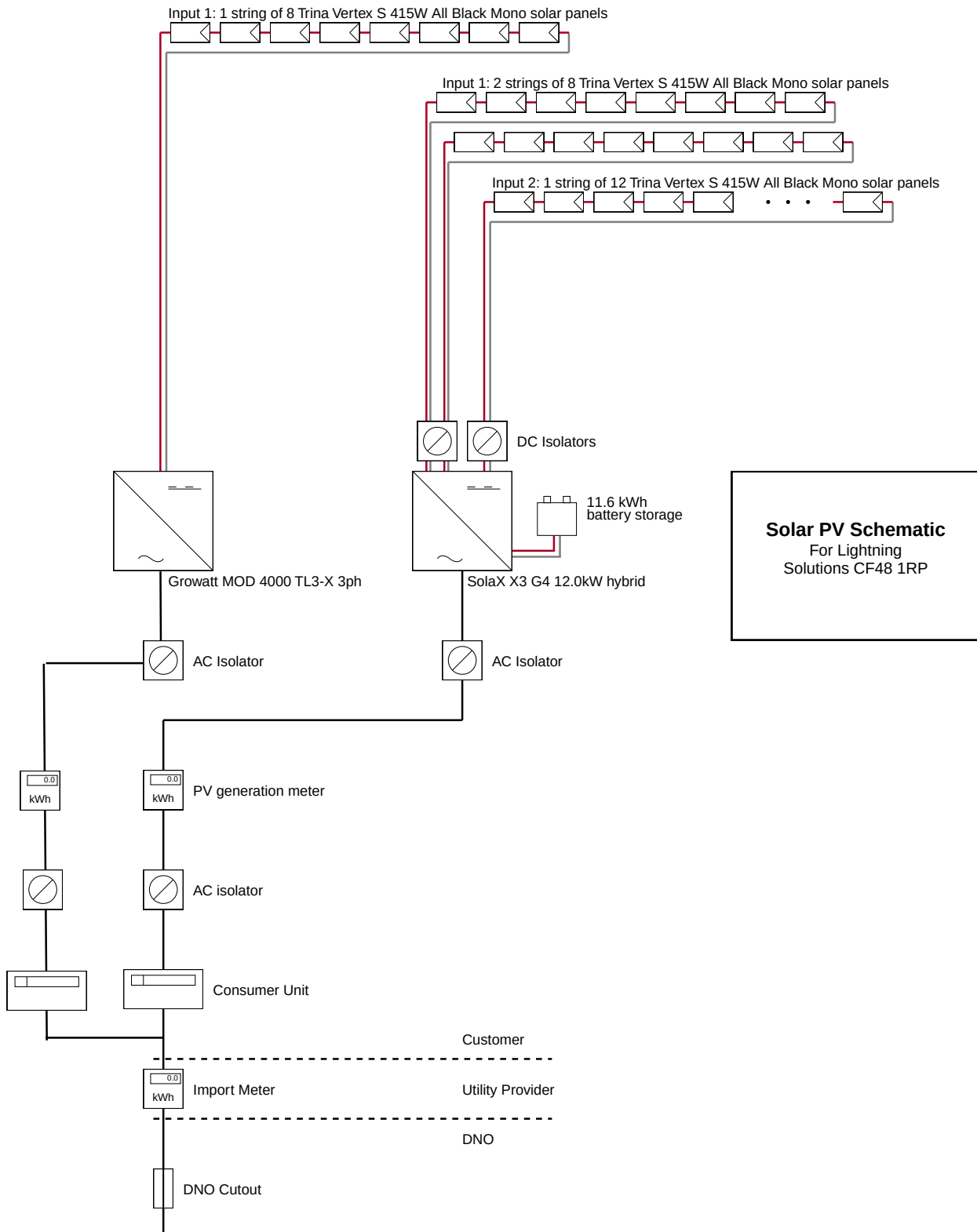
### Voltage drop

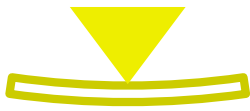
Voltage drop at maximum power point at 40°C will be around **1.74 V (0.36 percent)**





# Schematic diagram





# Structural calculations

## Weight loading calculations

### Roof 1

|                                                                   |                               |
|-------------------------------------------------------------------|-------------------------------|
| Weight of solar panels and mounting                               | 254.4 kg                      |
| Area of solar array                                               | 20 m <sup>2</sup>             |
| Loading imposed by solar array                                    | 0.12 kN/m <sup>2</sup>        |
| Dead load from roof covering                                      | 0.34 kN/m <sup>2</sup>        |
| <b>Total dead load of solar array, mounting and roof covering</b> | <b>0.46 kN/m<sup>2</sup></b>  |
| <b>Permitted dead load</b>                                        | <b>0.785 kN/m<sup>2</sup></b> |

The solar array, mounting system, and roof covering are expected to impose a total dead load on the roof of **0.46kN/m<sup>2</sup>**. This is less than the permitted dead load for the roof of **0.785kN/m<sup>2</sup>**.



Roof 2

|                                                            |                         |
|------------------------------------------------------------|-------------------------|
| Weight of solar panels and mounting                        | 151.8 kg                |
| Area of solar array                                        | 12 m <sup>2</sup>       |
| Loading imposed by solar array                             | 0.12 kN/m <sup>2</sup>  |
| Dead load from roof covering                               | 0.34 kN/m <sup>2</sup>  |
| Total dead load of solar array, mounting and roof covering | 0.46 kN/m <sup>2</sup>  |
| Permitted dead load                                        | 0.785 kN/m <sup>2</sup> |

The solar array, mounting system, and roof covering are expected to impose a total dead load on the roof of **0.46kN/m<sup>2</sup>**. This is less than the permitted dead load for the roof of **0.785kN/m<sup>2</sup>**.



# Wind loading calculations

The maximum force acting on a solar array from wind loading is given by the following formula in BRE Digest 489:

$$F = q_p \times C_{p \text{ net}} \times C_a \times C_t \times A_{\text{ref}}$$

## Roof 1

|                                                                                                                                                                            |                     |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------|
| $Q_p$                                                                                                                                                                      | 677 Pa              |           |
| From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 5 m high, in windzone 2, in urban terrain, at a distance of greater than 20km from the sea |                     |           |
| $C_{p \text{ net}}$                                                                                                                                                        | Roof Centre         | Roof edge |
| Uplift                                                                                                                                                                     | -1.3                | -2.2      |
| Pressure                                                                                                                                                                   | 1                   | 1.1       |
| $C_a$                                                                                                                                                                      | 1.306               |           |
| At an altitude of 12m                                                                                                                                                      |                     |           |
| $C_t$                                                                                                                                                                      | 1.7                 |           |
| When there is no significant topography                                                                                                                                    |                     |           |
| $A_{\text{ref}}$                                                                                                                                                           | 19.98m <sup>2</sup> |           |
| $F$                                                                                                                                                                        | Roof Centre         | Roof edge |
| Uplift                                                                                                                                                                     | -39043N             | -66073N   |
| Pressure                                                                                                                                                                   | 30033N              | 33036N    |

With 24 roof hooks we should allow for an uplift force per hook in the central zone of **1627N**, rising to **2753N** at the edges. If 4 screws are used per roof hook, this equates to **407N** per fixing in the central zone, and **688N** at the edges.

Roof hooks for slate roofs are fixed with screws that pass through the 5mm plate of the roof hook and a 20mm batten (or spacing pad of wood) before being driven home in the rafter. So there is approximately 45 mm of thread in the timber. The pull-out force in C16 timber is given by tables and formulae in BS5268 Part 2:

$$18.74 \times 1.25 \times 45 = 1054N$$

The pullout force on the fixings is more than the expected wind loading, even when the fixings are close to the edge of the roof.



## Roof 2

$Q_p$  677 Pa

From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 5 m high, in windzone 2, in urban terrain, at a distance of greater than 20km from the sea

| $C_{p \text{ net}}$ | Roof Centre | Roof edge |
|---------------------|-------------|-----------|
| Uplift              | -1.3        | -2.2      |
| Pressure            | 1           | 1.1       |

$C_a$  1.306

At an altitude of 12m

$C_t$  1.7

When there is no significant topography

$A_{\text{ref}}$  11.99m<sup>2</sup>

| $F$      | Roof Centre | Roof edge |
|----------|-------------|-----------|
| Uplift   | -23426N     | -39644N   |
| Pressure | 18020N      | 19822N    |

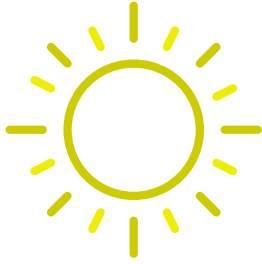
With 16 roof hooks we should allow for an uplift force per hook in the central zone of **1464N**, rising to **2478N** at the edges. If 4 screws are used per roof hook, this equates to **366N** per fixing in the central zone, and **619N** at the edges.

Roof hooks for slate roofs are fixed with screws that pass through the 5mm plate of the roof hook and a 20mm batten (or spacing pad of wood) before being driven home in the rafter. So there is approximately 45 mm of thread in the timber. The pull-out force in C16 timber is given by tables and formulae in BS5268 Part 2:

$$20.18 \times 1.25 \times 45 = 1135N$$

The pullout force on the fixings is more than the expected wind loading, even when the fixings are close to the edge of the roof.





# Performance Estimate

## Site details

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**Client**

LIGHTNING SOLUTIONS

**Address**

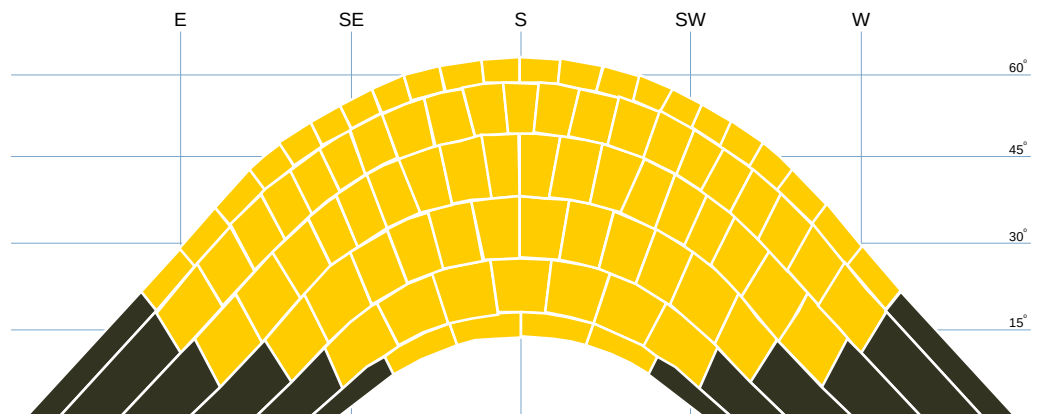
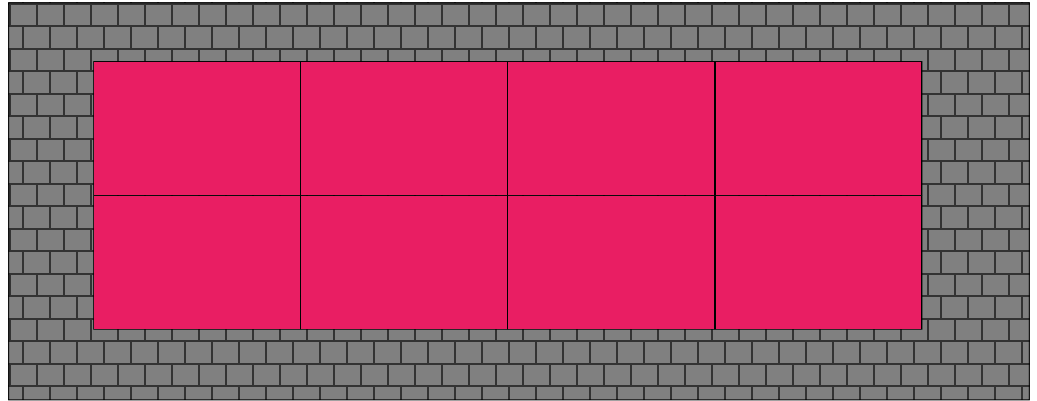
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The sunpath diagram shows the arcs of the sky that the sun passes through at different times of the day and year as yellow blocks. The shaded area indicates the horizon as seen from the location of the solar array. Where objects on the horizon are 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 MOD 4000 TL3-X 3ph

## String 1 -Shading group 1



### A. Installation data

|                                                   |       |     |
|---------------------------------------------------|-------|-----|
| Installed capacity of PV system – kWp (stc)       | 3.320 | kWp |
| Orientation of the PV system – degrees from South | 53    | °   |
| Inclination of system – degrees from horizontal   | 30    | °   |
| Postcode region                                   | 5W    |     |



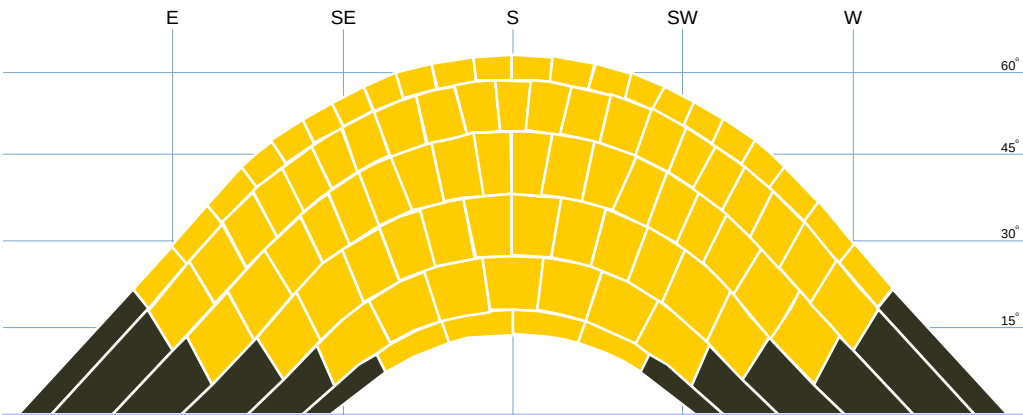
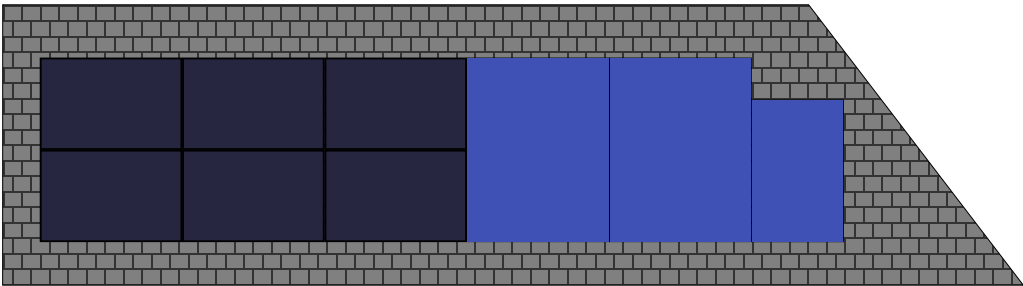
### B. Performance calculations

|                                  |      |         |
|----------------------------------|------|---------|
| kWh/kWp (Kk)                     | 872  | kWh/kWp |
| Shade factor (SF)                | 1.00 |         |
| Estimated output (kWp x Kk x SF) | 2895 | kWh     |

# Inverter 2

SolaX X3 G4 12.0kW hybrid

Input 1



**A. Installation data**

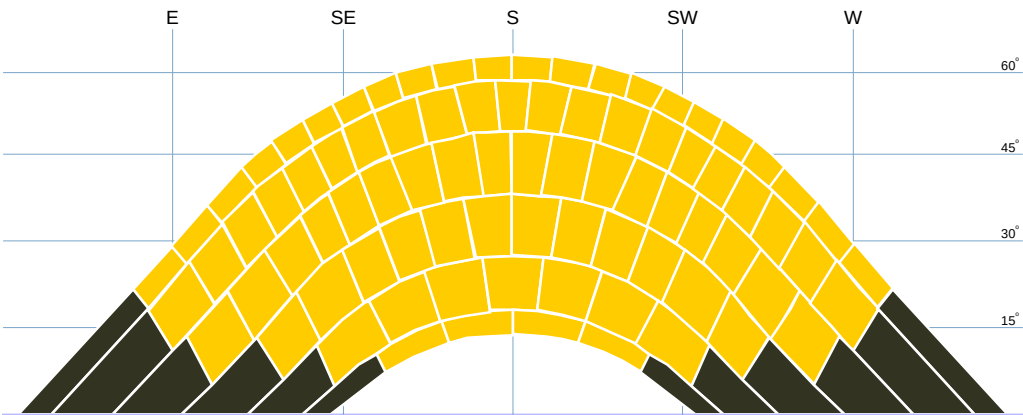
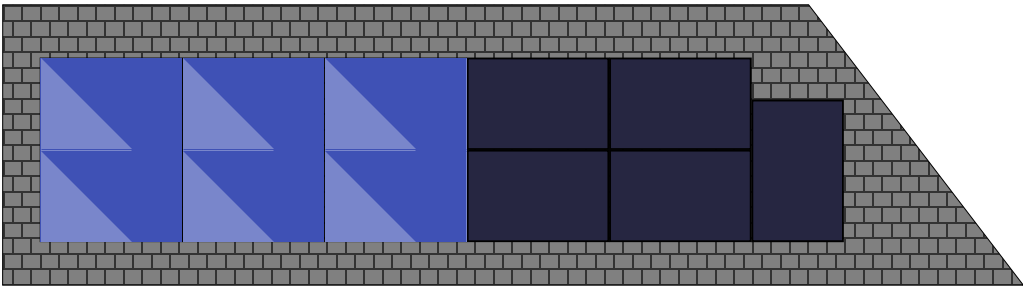
|                                                   |       |     |
|---------------------------------------------------|-------|-----|
| Installed capacity of PV system – kWp (stc)       | 6.640 | kWp |
| Orientation of the PV system – degrees from South | 48    | °   |
| Inclination of system – degrees from horizontal   | 30    | °   |
| Postcode region                                   | 5W    |     |



**B. Performance calculations**

|                                  |      |         |
|----------------------------------|------|---------|
| kWh/kWp (Kk)                     | 884  | kWh/kWp |
| Shade factor (SF)                | 1.00 |         |
| Estimated output (kWp x Kk x SF) | 5870 | kWh     |

Input 2



A. Installation data

|                                                   |       |     |
|---------------------------------------------------|-------|-----|
| Installed capacity of PV system – kWp (stc)       | 4.980 | kWp |
| Orientation of the PV system – degrees from South | 48    | °   |
| Inclination of system – degrees from horizontal   | 30    | °   |
| Postcode region                                   | 5W    |     |



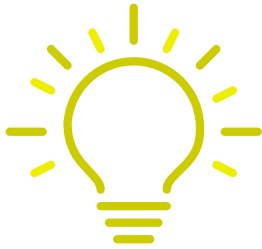
B. Performance calculations

|                                  |      |         |
|----------------------------------|------|---------|
| kWh/kWp (Kk)                     | 884  | kWh/kWp |
| Shade factor (SF)                | 1.00 |         |
| Estimated output (kWp x Kk x SF) | 4402 | kWh     |

# Performance Summary

| A. Installation data                              |                       |     |
|---------------------------------------------------|-----------------------|-----|
| Installed capacity of PV system – kWp (stc)       | 14.94                 | kWp |
| Orientation of the PV system – degrees from South | See individual inputs |     |
| Inclination of system – degrees from horizontal   | See individual inputs |     |
| Postcode region                                   | 5W                    |     |
| B. Performance calculations                       |                       |     |
| kWh/kWp (Kk)                                      | See individual inputs |     |
| Shade factor (SF)                                 | See individual inputs |     |
| Estimated output (kWp x Kk x SF)                  | 13167                 | kWh |

**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 guidance only for the first year of generation. It should not be considered as a guarantee of performance.



# 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

### SolaX X3 G4 12.0kW hybrid with 2 SolaX Triple 5.8kWh LFP Battery batteries

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

|                               |           |
|-------------------------------|-----------|
| Charge rate                   | 6000 W    |
| Inverter charge efficiency    | 98.5 %    |
| Inverter discharge efficiency | 98.5 %    |
| Battery efficiency            | 95.0 %    |
| Round trip efficiency         | 92.2 %    |
| Battery bank capacity         | 11.6 kWh  |
| Max discharge depth           | 90 %      |
| Usable capacity               | 10.44 kWh |



#### Consumption

Electricity consumed in the property each year

12000 kWh



#### Generation

Electricity generated by the PV array each year

13171 kWh



#### Self consumption

Proportion of PV generation used in the property

53 %



#### Independence

Proportion of electricity consumption provided by PV

57 %



#### Import / Export

Electricity import / export each year from the property

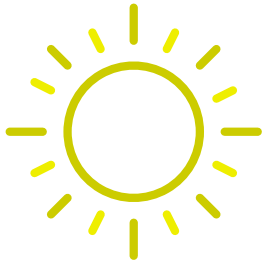
5217 / 6119 kWh



#### Utilisation

Average daily utilisation of the storage battery

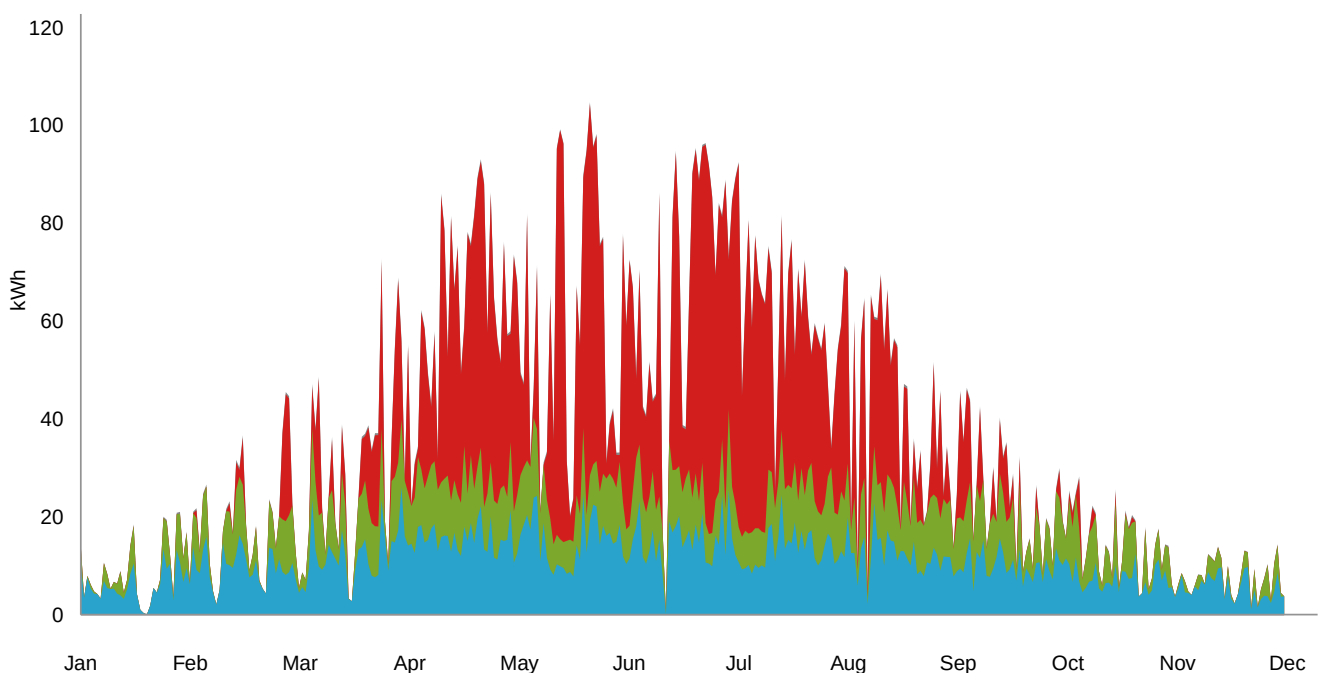
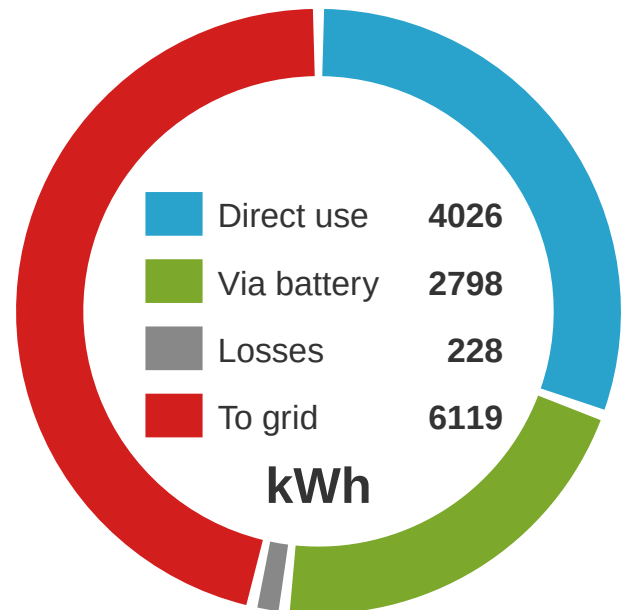
76 %

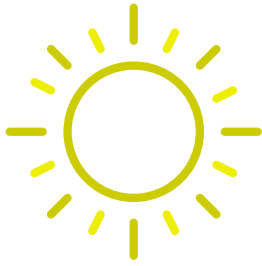


# Yearly generation

The solar PV array is expected to generate 13171 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.

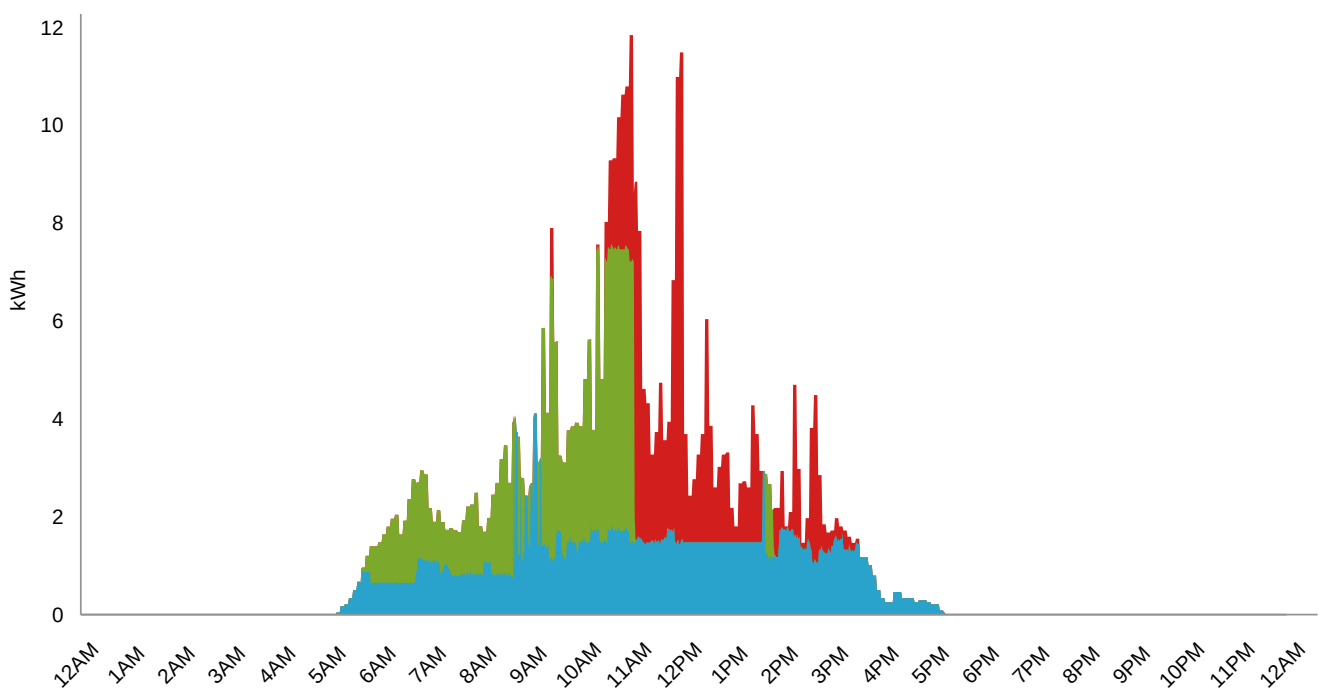
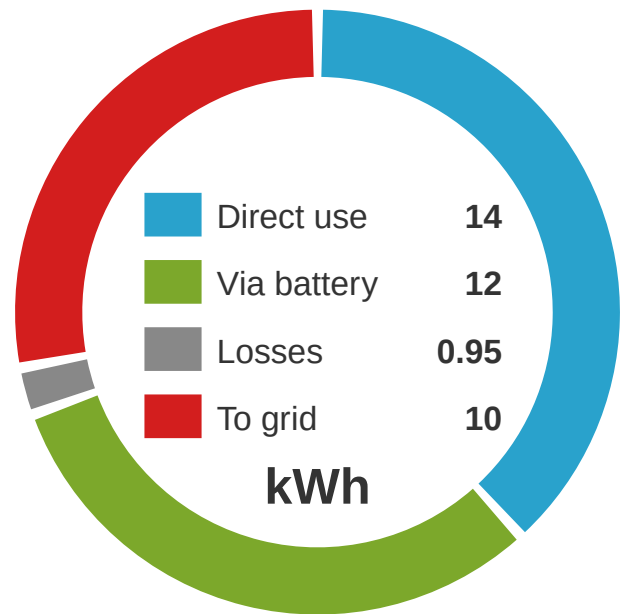
31% (4026 kWh) of the electricity generated is expected to be used directly in the property. 23% (3026 kWh) is directed to the battery for later use, although 228 kWh of this is lost during battery charging and discharging, leaving 2798 kWh for use in the property. The remaining generation (6119 kWh, or 46% of the total) is exported to the grid.

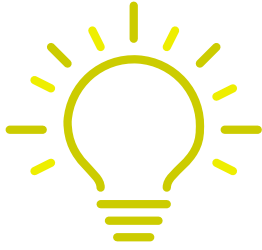




# Daily generation

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 37.2 kWh. Of this, 14.2 kWh (38%) is used directly in the property, 13 kWh (35%) is stored in the battery for later re-use, and 10.4 kWh (28%) is exported to the grid.

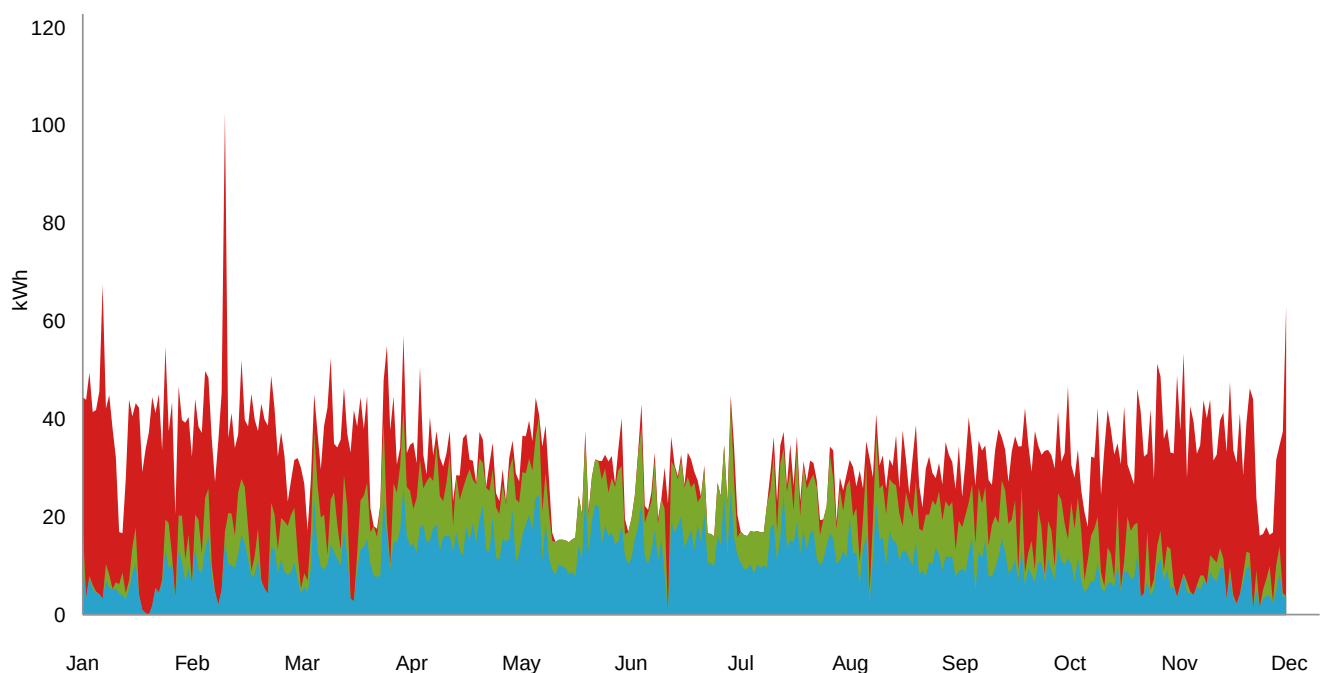
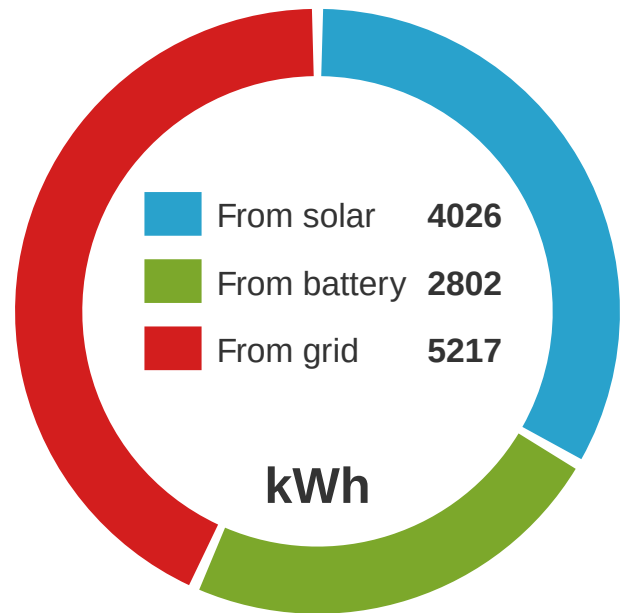


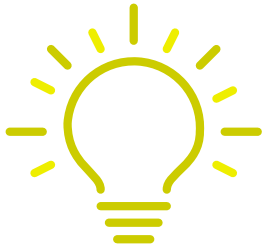


# Yearly consumption

The property is expected to consume 12000kWh of electricity each year. Around 33% of this (4026 kWh) is expected to be supplied directly by the solar array. Another 23% (2802 kWh) is supplied from the storage battery. The remaining 43% (5217 kWh) is supplied from the grid.

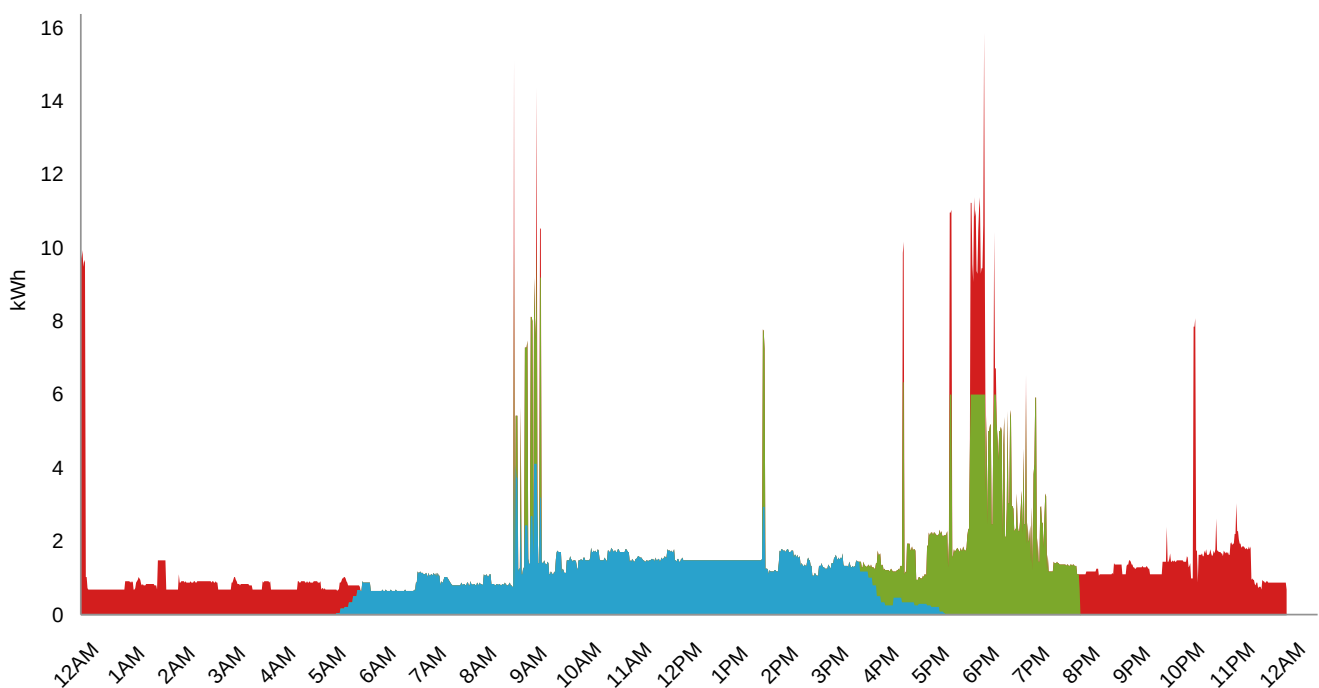
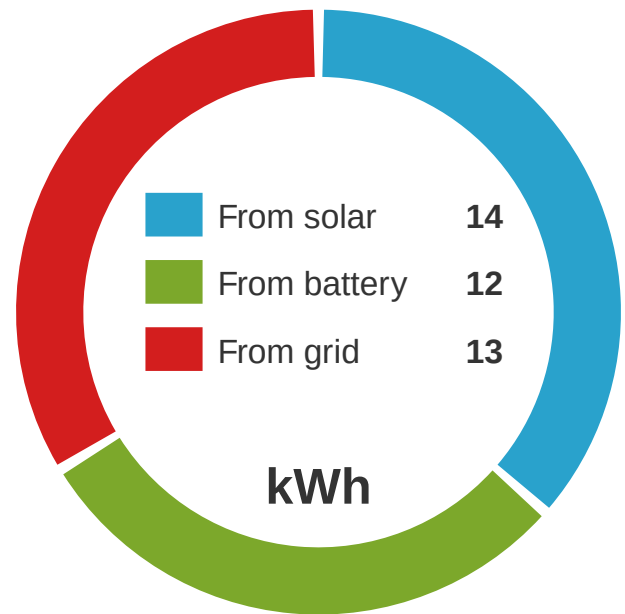
Overall, 56% (6828 kWh) of the electricity used in the property is expected to be supplied by the solar array and battery storage system. Without battery storage it would be 33% (4026 kWh).

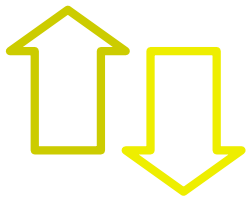




# Daily consumption

This graph shows modelled consumption data over the course of the selected day (March 27th). Total electricity consumption on this day was 39 kWh, of which 14.2 kWh (36%) is expected to be supplied directly by the solar array, and a further 11.6 kWh (30%) drawn from the battery storage system. The remaining 13.1 kWh (34%) is imported from the grid.

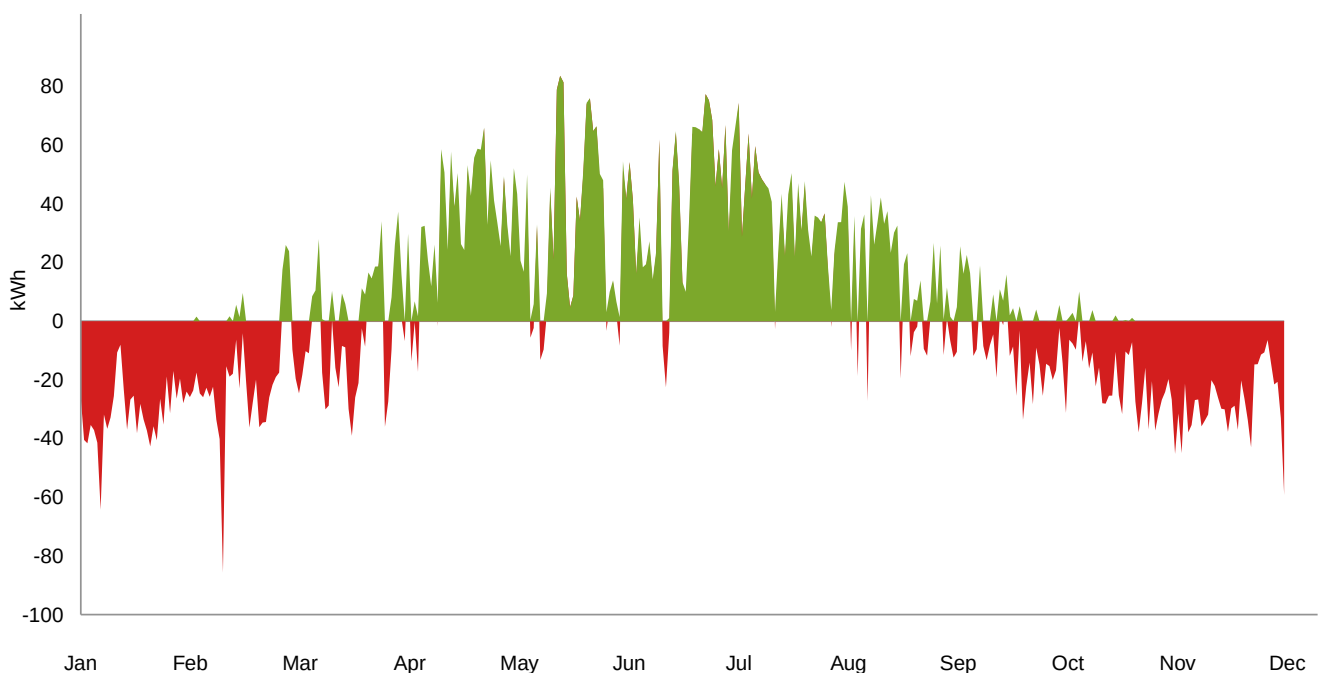
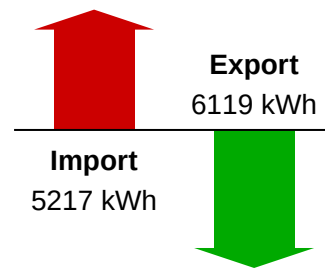


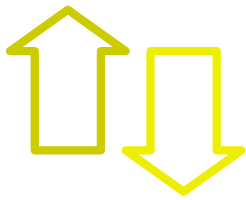


# Yearly import and export

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.

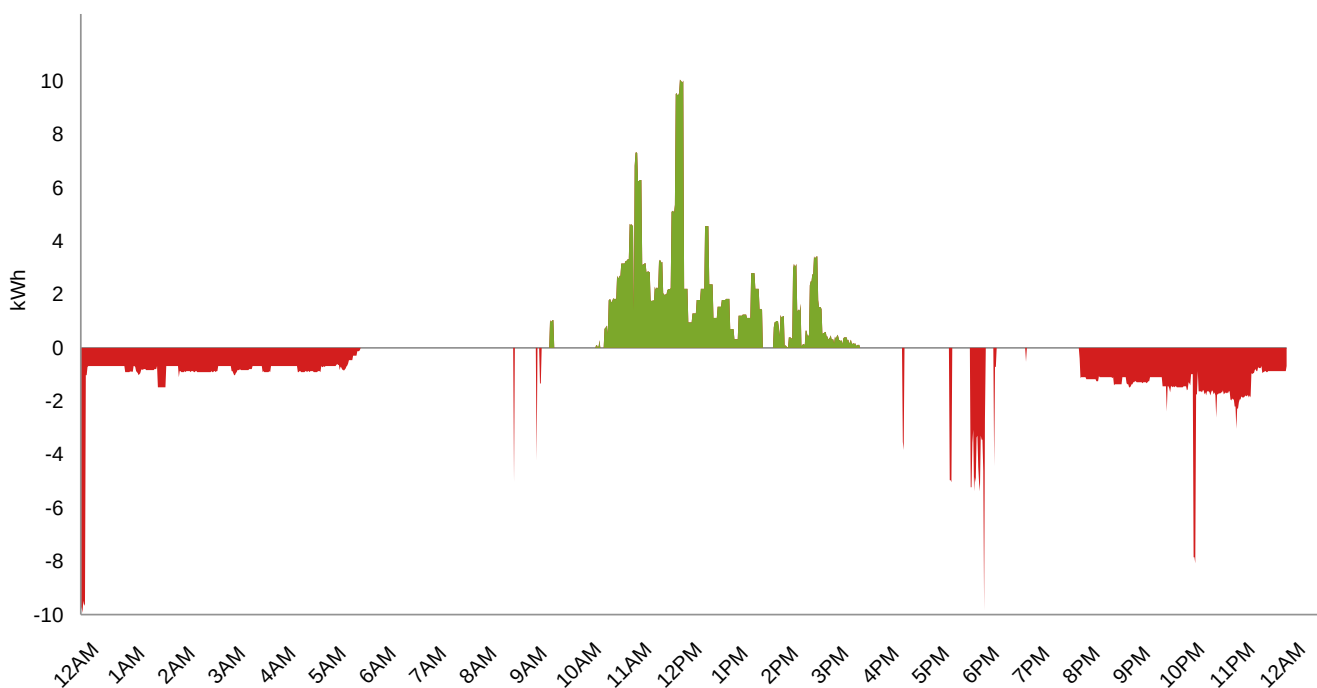
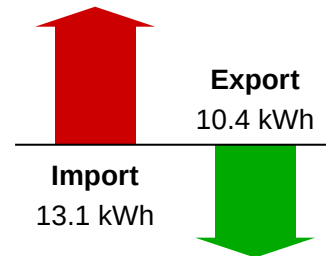
Over the course of the year, a total of 5217 kWh is expected to be imported by the property, and 6119 kWh exported back to the grid.

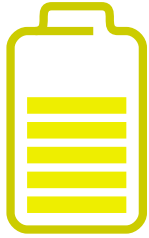




# Daily import and export

This graph shows the modelled import and export of electricity over a selected day (March 27th). On this day 13.10 kWh is expected to be imported from the grid, and 10.4 kWh exported. At times when no import or export is shown the battery storage system is charging or discharging.





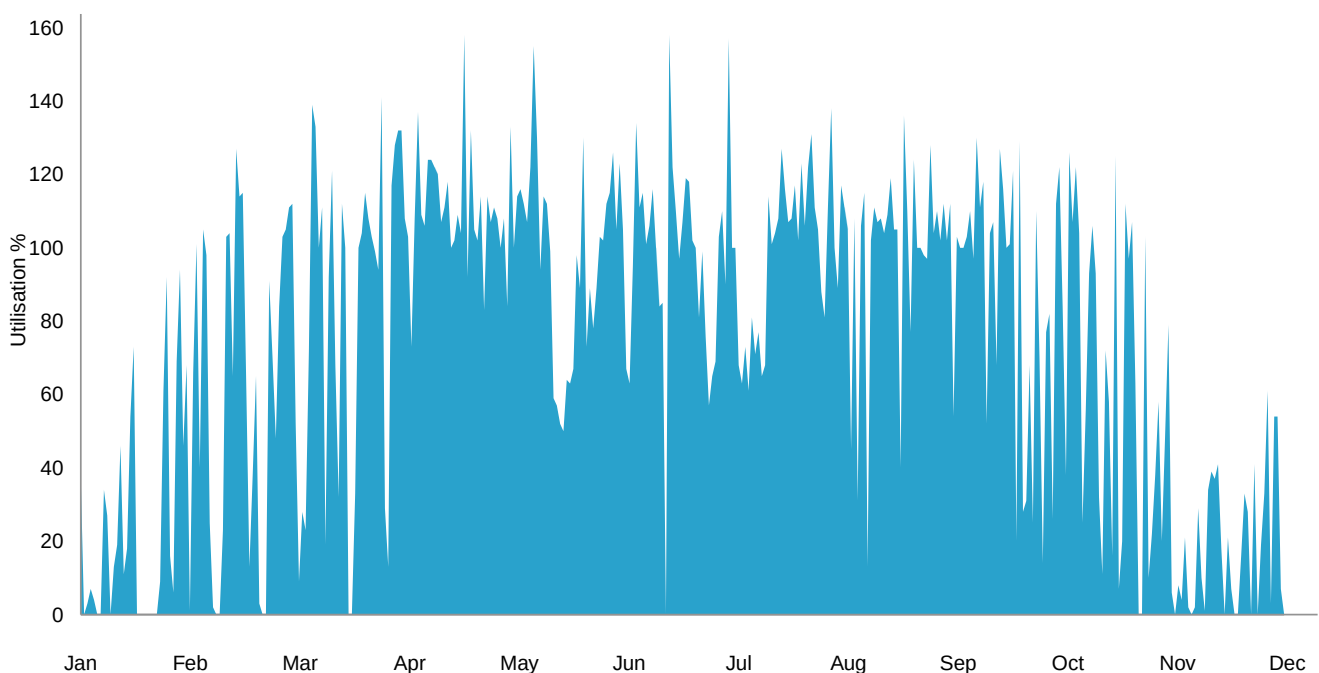
# Yearly battery utilisation

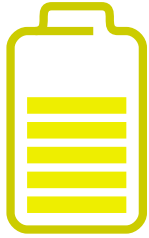
The graph shows the modelled utilisation of the battery over the course of the year - the fraction of the available battery capacity that is actually charged and discharged each day. Utilisation of over 100% is possible at times where a battery is charged and discharged more than once during a day.

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

76%



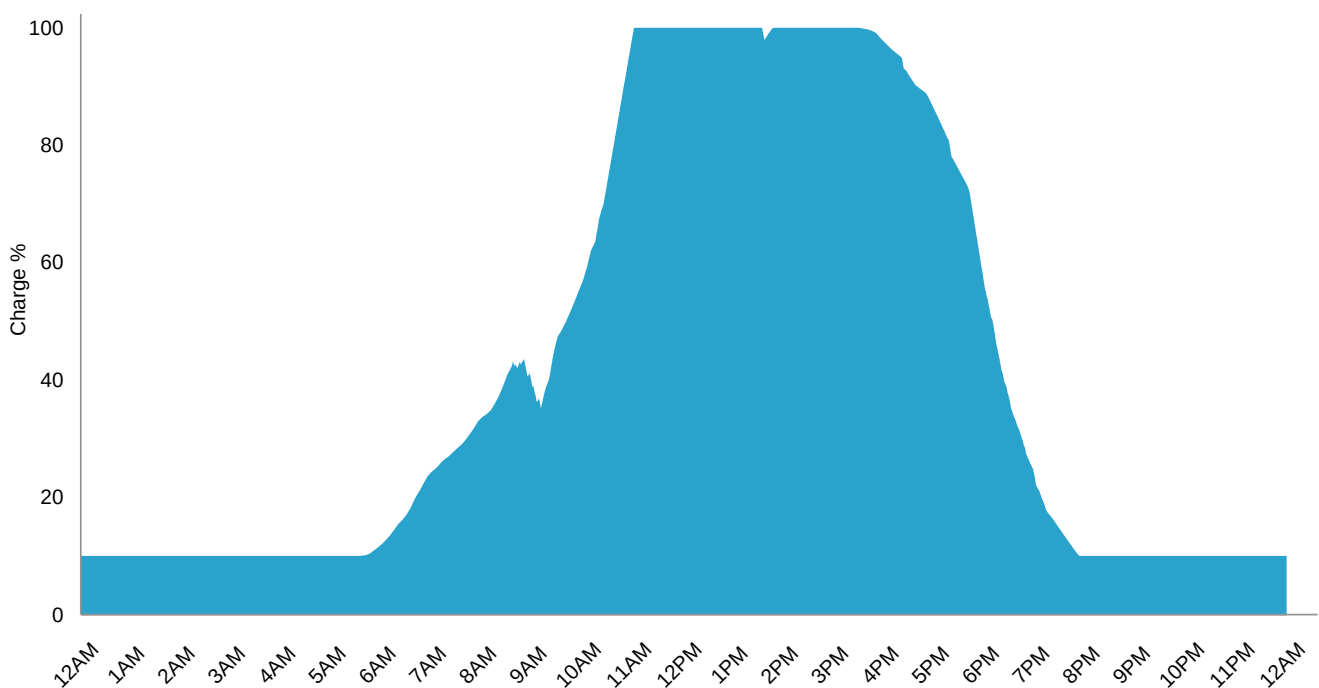


# Daily battery utilisation

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, 115% of the battery capacity was utilised.

Average battery utilisation

115%





# Equipment and Services

## Equipment Costs

|                                                    |                   |
|----------------------------------------------------|-------------------|
| 36x Trina Vertex S 415W All Black Mono solar panel | £4,515.84         |
| Growatt MOD 4000 TL3-X 3ph inverter                | £974.40           |
| SolaX X3 G4 12.0kW hybrid inverter                 | £3,821.44         |
| Emlite EMP1 3ph Meter                              | £187.04           |
| 2x Label sheet                                     | £8.06             |
| DC cable warning sticker sheet                     | £4.48             |
| 4x AC isolator - IMO - 20A 4-pole                  | £100.35           |
| 8x Tigo Retrofit Frame Mounted Optimiser TS4-A-O   | £537.60           |
| 2x MC4 4mm Connector Pair                          | £8.96             |
| SolaX Triple 5.8kWh LFP Battery (Master Console)   | £4,208.96         |
| SolaX Triple 5.8kWh LFP Battery (Slave Console)    | £3,465.28         |
| K&N DC isolator - KGD40-3                          | £70.29            |
| 6x MC4 6mm Connector Pair                          | £43.68            |
| IMO DC isolator 16A 2p 1string                     | £48.83            |
| 50m reel of 4mm <sup>2</sup> solar cable           | £67.20            |
| 2x 100m reel of 6mm <sup>2</sup> solar cable       | £380.80           |
| 98x Fastensol black universal clamp                | £241.47           |
| 52x Fastensol black end cap                        | £52.42            |
| 30x Fastensol portrait slate roof hook             | £252.00           |
| 6x Fastensol rail splice                           | £24.19            |
| 8x Fastensol black rail 3550mm                     | £340.48           |
| 68x Fastensol landscape slate roof hook            | £563.58           |
| 23x Fastensol silver rail 3550mm                   | £927.36           |
| 8x Fastensol rail bolt                             | £7.17             |
| <b>Total equipment cost</b>                        | <b>£20,851.88</b> |

**Services Costs**

|                                          |                   |
|------------------------------------------|-------------------|
| Access - Scaffolding                     | £6,400.00         |
| Labour - Roofing                         | £7,200.00         |
| Labour - Electrical (inc. Commissioning) | £6,400.00         |
| <b>Total services cost</b>               | <b>£20,000.00</b> |

**Totals**

|                            |                   |
|----------------------------|-------------------|
| <b>Total before tax</b>    | <b>£40,851.88</b> |
| <b>VAT at 20%</b>          | <b>£8,170.38</b>  |
| <b>Total including tax</b> | <b>£49,022.26</b> |



# Financial

## Generation

The system is expected to generate 13167 kWh per year initially, decreasing gradually as the solar cells degrade. Over the 25 year term of this financial projection the total generation is expected to be 309386 kwh, of which 160438 kWh will be consumed on site and 148948 kWh exported.

309  
MWh

## Payback

After adjusting projected costs and benefits for inflation, and applying a discount rate of 4%, the initial system cost of £49,022.26 is expected to be recouped after 14 years.

14  
years

## Net Present Value

The total present value of future benefits and costs, using a discount rate of 4% per year, is £62,751.30. The cost of the PV system is £49,022.26. The net present value of the project is therefore £21,899.42. A positive net present value is a good indication that the project is financially worthwhile.

£21899.  
42

## IRR

The Internal Rate of Return is a useful measure for comparing the relative profitability of investments.

8.0  
%

## Disclaimer

Our financial model calculates the benefits of a solar PV installation (such as savings in electricity, or payments for exported electricity) and costs (the initial purchase cost, and any future maintenance costs if entered), over the projected lifespan of the system. Values are corrected for inflation, system degradation, and discount rate - a measure that accounts for the fact that a promise of a monetary sum in the distant future is usually considered less valuable than the promise of the same sum in the near future.

A model is only as accurate as the assumptions it makes. You should consider whether the values chosen are appropriate for your situation. There are many variables that dictate the financial return of a solar installation and we cannot forecast how they may change in the future. This financial projection shows a likely scenario for future financial returns. Actual returns may vary significantly from this forecast.

## Assumptions

|                     |                                                       |
|---------------------|-------------------------------------------------------|
| Inflation rate      | 2%                                                    |
| Cost of electricity | £0.5 /kWh<br><small>increases with inflation</small>  |
| System size         | 14.94 kWp<br><small>degrades at 0.5% per year</small> |
| Discount rate       | 4%                                                    |
| Projection length   | 25 years                                              |

# Income and savings

The projected income from the system over the project lifetime in payments for generated and exported electricity, along with electricity savings, are shown in the table and graph below. These figures assume an inflation rate of 2 percent.

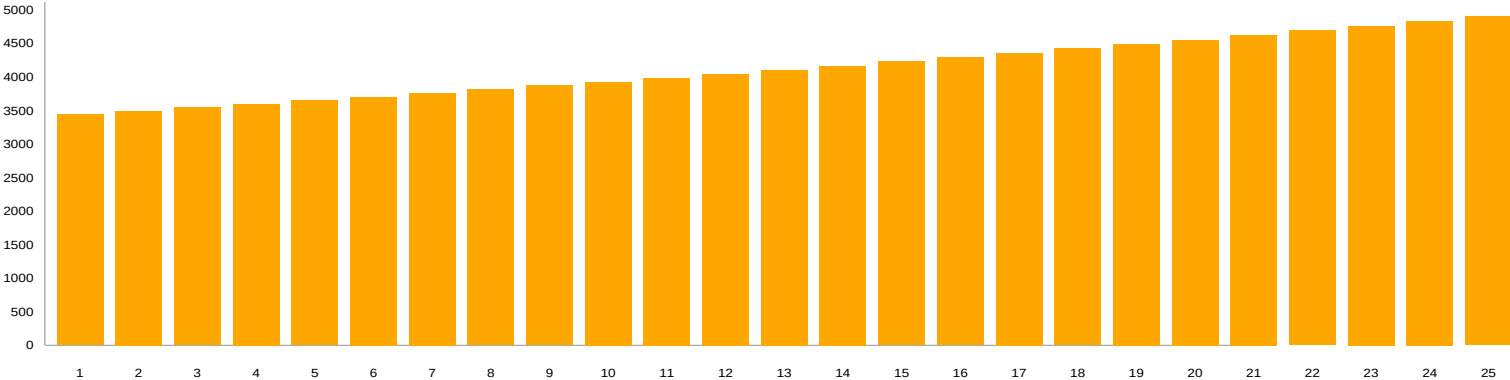
|         | Export payments | Electricity savings | Total |
|---------|-----------------|---------------------|-------|
| Year 1  | 0               | 3440                | 3440  |
| Year 2  | 0               | 3491                | 3491  |
| Year 3  | 0               | 3543                | 3543  |
| Year 4  | 0               | 3596                | 3596  |
| Year 5  | 0               | 3649                | 3649  |
| Year 6  | 0               | 3704                | 3704  |
| Year 7  | 0               | 3759                | 3759  |
| Year 8  | 0               | 3815                | 3815  |
| Year 9  | 0               | 3872                | 3872  |
| Year 10 | 0               | 3929                | 3929  |
| Year 11 | 0               | 3988                | 3988  |
| Year 12 | 0               | 4047                | 4047  |
| Year 13 | 0               | 4107                | 4107  |
| Year 14 | 0               | 4169                | 4169  |
| Year 15 | 0               | 4231                | 4231  |
| Year 16 | 0               | 4294                | 4294  |
| Year 17 | 0               | 4358                | 4358  |
| Year 18 | 0               | 4423                | 4423  |
| Year 19 | 0               | 4489                | 4489  |
| Year 20 | 0               | 4556                | 4556  |
| Year 21 | 0               | 4623                | 4623  |
| Year 22 | 0               | 4692                | 4692  |
| Year 23 | 0               | 4762                | 4762  |
| Year 24 | 0               | 4833                | 4833  |
| Year 25 | 0               | 4905                | 4905  |



Total Export Payments  
over 25 years



Electricity savings  
over 25 years



# The bottom line

The table and graph below show the discounted costs for the project (including the initial capital required for the installation), against the total discounted benefits from income and savings on electricity bills.

The system pays for itself in 14 years.

|         | Discounted benefits | Cumulative benefits | Discounted costs | Cumulative costs | Cashflow |
|---------|---------------------|---------------------|------------------|------------------|----------|
| Year 1  | 3371                | 3371                | 0                | 40852            | -37481   |
| Year 2  | 3284                | 6655                | 0                | 40852            | -34197   |
| Year 3  | 3200                | 9855                | 0                | 40852            | -30997   |
| Year 4  | 3118                | 12972               | 0                | 40852            | -27880   |
| Year 5  | 3037                | 16009               | 0                | 40852            | -24842   |
| Year 6  | 2959                | 18969               | 0                | 40852            | -21883   |
| Year 7  | 2883                | 21852               | 0                | 40852            | -19000   |
| Year 8  | 2809                | 24661               | 0                | 40852            | -16191   |
| Year 9  | 2737                | 27398               | 0                | 40852            | -13454   |
| Year 10 | 2667                | 30065               | 0                | 40852            | -10787   |
| Year 11 | 2598                | 32663               | 0                | 40852            | -8189    |
| Year 12 | 2531                | 35195               | 0                | 40852            | -5657    |
| Year 13 | 2466                | 37661               | 0                | 40852            | -3191    |
| Year 14 | 2403                | 40064               | 0                | 40852            | -788     |
| Year 15 | 2341                | 42405               | 0                | 40852            | 1553     |
| Year 16 | 2281                | 44686               | 0                | 40852            | 3834     |
| Year 17 | 2222                | 46909               | 0                | 40852            | 6057     |
| Year 18 | 2165                | 49074               | 0                | 40852            | 8222     |
| Year 19 | 2110                | 51184               | 0                | 40852            | 10332    |
| Year 20 | 2056                | 53239               | 0                | 40852            | 12388    |
| Year 21 | 2003                | 55242               | 0                | 40852            | 14390    |
| Year 22 | 1951                | 57193               | 0                | 40852            | 16341    |
| Year 23 | 1901                | 59094               | 0                | 40852            | 18243    |
| Year 24 | 1852                | 60947               | 0                | 40852            | 20095    |
| Year 25 | 1805                | 62751               | 0                | 40852            | 21899    |

