South Lincs Solar

Jackie Jankiewicz

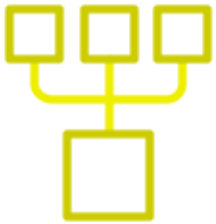
Project Name: Orchard House

Address: Orchard House, Blue Gowt Drove, Spalding,, PE11 3PX

Date Created: 22nd July 2022

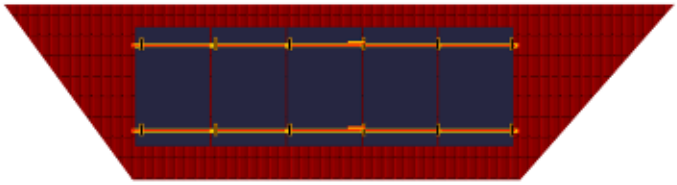
Designer: Matt Parker



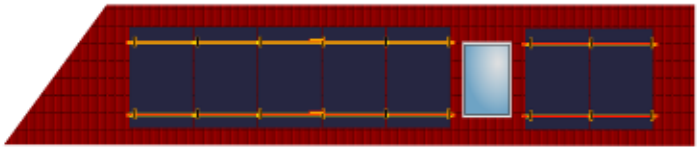



Roof Layout

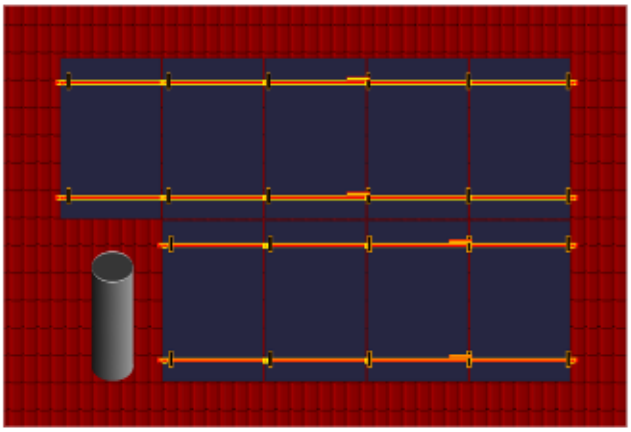
East Roof



West



South Lower



Component list

Item	Quantity
 Trina Vertex S 390W All Black Mono solar panel	21
 SolarEdge 7000 3ph inverter	1
 Emlite EMP1 Three Phase meter	1
 Label sheet	1
 SolarEdge Wattnode Modbus Meter with 100A CT Clamp	1
 SolarEdge Wifi Antenna for SETAPP inverters	1
 AC electrical install materials	1
 AC isolator - KN Newbury 20A 4-pole	2
SolarEdge Optimiser S500	21
Pair of MC4 connectors	2
50m reel of 4mm2 solar cable	2
Fastensol end clamp (30mm black)	20
Fastensol mid clamp (30mm black)	32
Fastensol black end cap	20
Fastensol portrait adjustable roof hook	52

Fastensol rail splice 8

Fastensol silver rail 3300mm 17

Fastensol rail bolt 21

Inverter checks

SolarEdge 7000 3ph

Panels

PV power	**8190**	Rated AC output	**7000**

String 1: 21 Trina Vertex S 390W All Black Mono solar panels with S500 optimisers

Panels		**Optimiser**	
PV power	**390 W**	Rated input power	**500 W**
Open circuit voltage at -10° C	**45 V**	Max DC voltage	**60 V**
V_{mpp} at 40° C	**33 V**	V_{mpp} lower limit	**8.00 V**
V_{mpp} at -10° C	**37 V**	V_{mpp} upper limit	**60 V**
I_{mpp} at 25° C	**11.54 A**	Max DC input current	**15.00 A**

String

Total string power	**8190 W**	Max string power	**11250 W**
String length	**21**	Permitted string lengths	**16/50**

Electrical

SolarEdge 7000 3ph

AC Isolator

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

Current

The rated isolator current (20A) is greater than the rated inverter current (11.5A)

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.

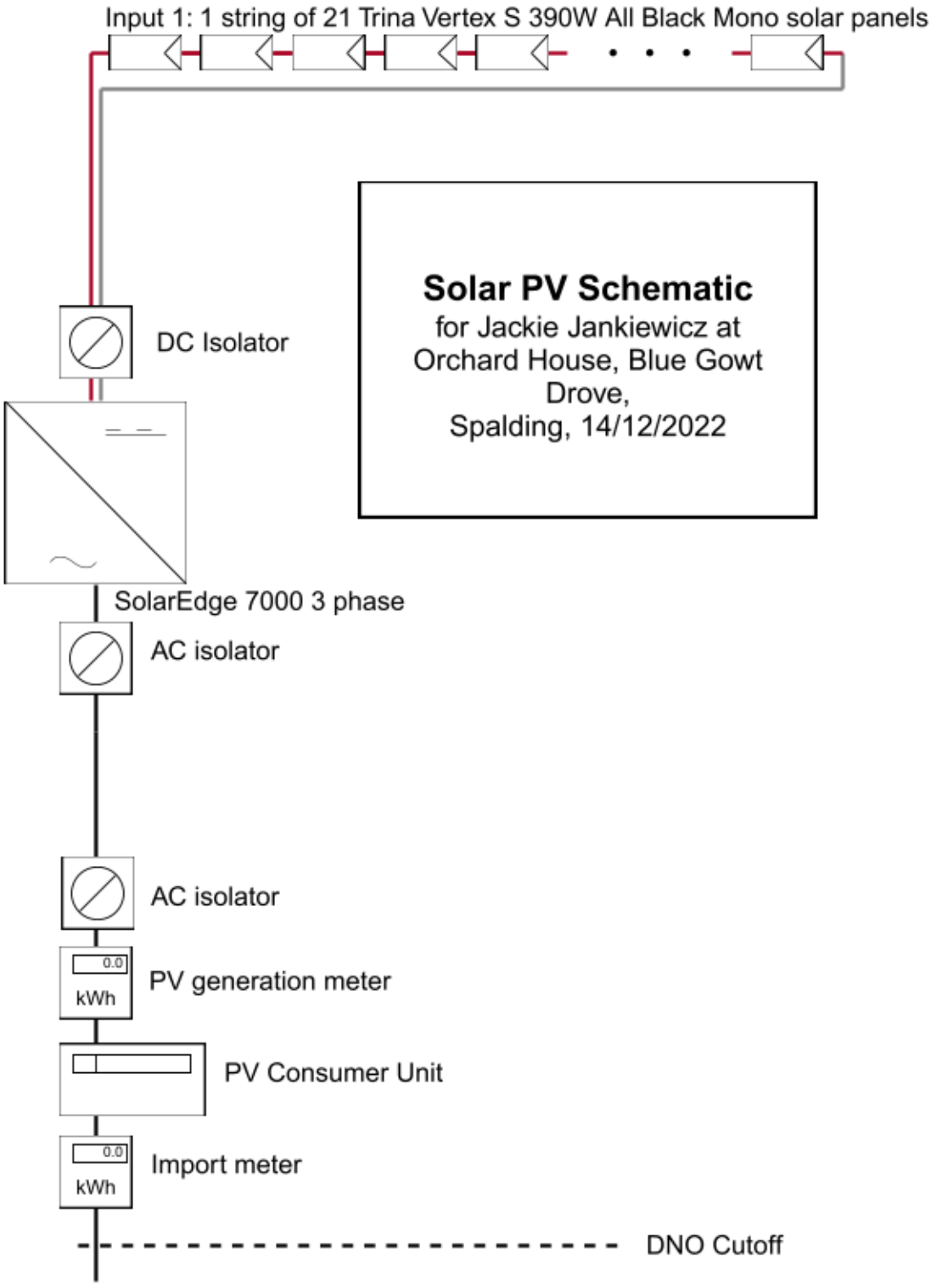
Cable

50m of 4mm2 solar cable has been specified

Voltage drop

Voltage drop at maximum power point at 40°C will be around **5.10 V (0.68 percent)**

Schematic diagram



Structural calculations

Weight loading calculations

For a traditional cut roof with rafters and purlins we recommend also using our rafter calculator to check the load-bearing capacity of the rafters. Even if the increase in loading is more than 15% the rafters may well be able to take the additional weight.

Please note that this method does not calculate the strength of the roof, and if a roof was badly constructed, does not meet existing building regulations, or is in poor condition then it may still not be appropriate to install an array.

South Lower

Dead load from roof covering	0.44 kN/m^2
Imposed load	0.75 kN/m^2
Total loading without solar array	**1.19 kN/m^2**

Weight of solar panels and mounting	243.7 kg
Area covered by solar array	19.2 m^2
Loading imposed by solar array	0.12 kN/m^2
Total loading with solar array	**1.3 kN/m^2**

Increase in loading due to solar array: 10.1%

An increase of less than 15% in the load imposed on a roof is not considered to be a significant change (The Building Regulations 2010, Approved Document A).



Weight loading calculations

East Roof

Weight of solar panels and mounting	121.9 kg
Area of solar array	9.6 m^2
Loading imposed by solar array	0.12 kN/m^2
Dead load from roof covering	0.44 kN/m^2
Total dead load of solar array, mounting and roof covering	**0.56 kN/m^2**
Permitted dead load	**0.785 kN/m^2**

The solar array, mounting system, and roof covering are expected to impose a total dead load on the roof of **0.56kN/m^2**. This is less than the permitted dead load for the roof of **0.785kN/m^2**.



West

Weight of solar panels and mounting	146.1 kg
Area of solar array	11.5 m^2
Loading imposed by solar array	0.12 kN/m^2
Dead load from roof covering	0.44 kN/m^2
Total dead load of solar array, mounting and roof covering	**0.56 kN/m^2**
Permitted dead load	**0.785 kN/m^2**

The solar array, mounting system, and roof covering are expected to impose a total dead load on the roof of **0.56kN/m^2**. This is less than the permitted dead load for the roof of **0.785kN/m^2**.



Wind loading calculations

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

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

East Roof

Q_p		872 Pa
in	From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 10 m high, windzone 1, in country terrain, at a distance of greater than 20km from the sea	
$C_{p\,net}$	Roof Centre	Roof edge
Uplift	-1.3	-2.2
Pressure	1	1.1
C_a		1
At an altitude of 12m		
C_t		1
When there is no significant topography		
A_{ref}		9.61m^2
F	Roof Centre	Roof edge
Uplift	**-10896N**	**-18440N**
Pressure	**8382N**	**9220N**

With 12 roof hooks we should allow for an uplift force per hook in the central zone of **908N**, rising to **1537N** at the edges. If 2 screws are used per roof hook, this equates to **454N**per fixing in the central zone, and **768N** at the edges.

Pan tile roof hooks are fixed with screws that pass through the 5mm plate of the roof hook and are then buried fully into the rafter beneath. So there is approximately 75 mm of thread in the timber. The pull-out force in C16 timber is given by tables and formulae in BS5268 Part 2:

$$18.74 \times 1.25 \times 75 = \mathbf{1757N}$$

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.



West

Q_p	872 Pa
in	From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 10 m high, windzone 1, in country terrain, at a distance of greater than 20km from the sea

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

C_a	1
At an altitude of 12m	

C_t	1
When there is no significant topography	

A_{ref}	$11.53m^2$

F	Roof Centre	Roof edge
Uplift	**-13075N**	**-22127N**
Pressure	**10058N**	**11064N**

With 14 roof hooks we should allow for an uplift force per hook in the central zone of **934N**, rising to **1581N** at the edges. If 2 screws are used per roof hook, this equates to **467N**per fixing in the central zone, and **790N** at the edges.

Pan tile roof hooks are fixed with screws that pass through the 5mm plate of the roof hook and are then buried fully into the rafter beneath. So there is approximately 75 mm of thread in the timber. The pull-out force in C16 timber is given by tables and formulae in BS5268 Part 2:

$$18.74 \times 1.25 \times 75 = \mathbf{1757N}$$

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.



South Lower

Q_p	718 Pa
in	From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 5 m high, windzone 1, in country terrain, at a distance of greater than 20km from the sea

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

C_a	1
At an altitude of 12m	
C_t	1
When there is no significant topography	
A_{ref}	19.22m^2

F	Roof Centre	Roof edge
Uplift	**-17944N**	**-30366N**
Pressure	**13803N**	**15183N**

With 24 roof hooks we should allow for an uplift force per hook in the central zone of **748N**, rising to **1265N** at the edges. If 2 screws are used per roof hook, this equates to **374N**per fixing in the central zone, and **633N** at the edges.

Pan tile roof hooks are fixed with screws that pass through the 5mm plate of the roof hook and are then buried fully into the rafter beneath. So there is approximately 75 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 x 1.25 x 75 = **1757N**

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

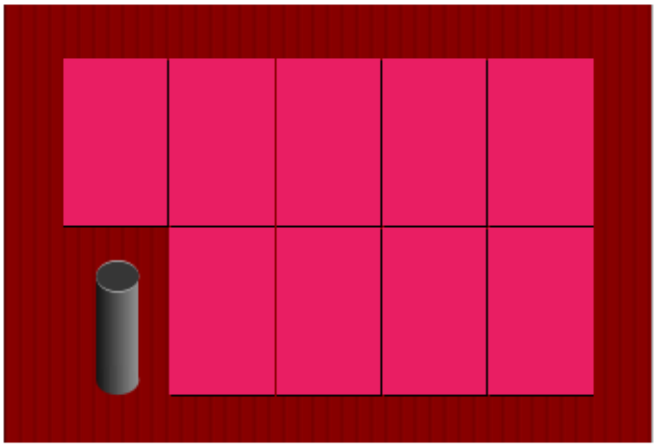
Client	Jackie Jankiewicz
Address	Orchard House, Blue Gowt Drove, Spalding,

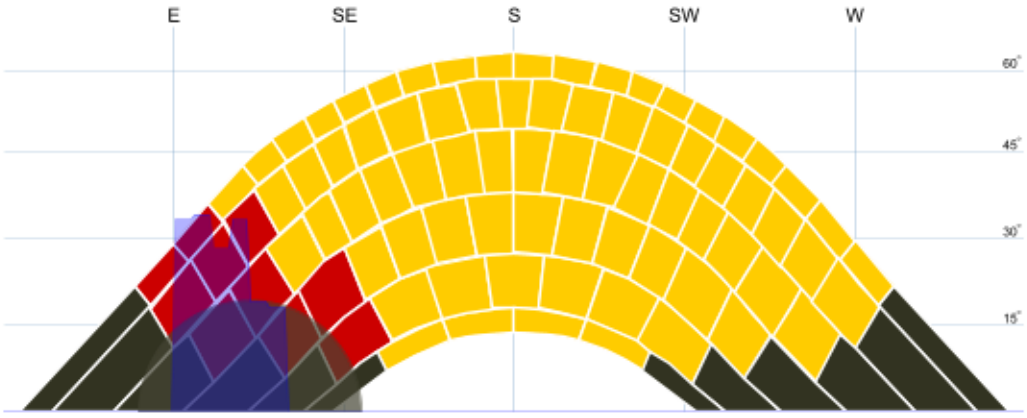
The sunpath diagram shows the arcs of the sky that the sun passes through at different times of the day and year as yellow blocks. The shaded area indicates the horizon as seen from the location of the solar array. Where objects on the horizon are within 10m of the array, an added semi-circle is drawn 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

SolarEdge 7000 3ph

String 1 -Shading group 1





A. Installation data		
Installed capacity of PV system - kWp (stc)	**8.190**	kWp
Orientation of the PV system - degrees from South	**5**	°
Inclination of system - degrees from horizontal	**26**	°
Postcode region	**11**	

B. Performance calculations		
kWh/kWp (Kk)	**876**	kWh/kWp
Shade factor (SF)	**0.90**	
Estimated output (kWp x Kk x SF)	**6457**	kWh

Performance Summary

A. Installation data		
Installed capacity of PV system - kWp (stc)	**8.19**	kWp
Orientation of the PV system - degrees from South	**See individual inputs**	
Inclination of system - degrees from horizontal	**See individual inputs**	
Postcode region	**11**	
B. Performance calculations		
kWh/kWp (Kk)	**See individual inputs**	
Shade factor (SF)	**See individual inputs**	
Estimated output (kWp x Kk x SF)	**6457**	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 guidence only for the first year of generation. It should not be considered as a guarantee of performance.

Shading will be present on your system that will reduce its output to the factor stated. This factor was calculated using the MCS shading methodology and we believe that this will yield results within 10% of the actual energy estimate stated for most systems.

Self consumption

We model here the performance of a solar PV system 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 during the day, and from the grid back to the house at night.

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

Consumption

Electricity consumed in the property each year

8500 kWh

Generation

Electricity generated by the PV array each year

6478 kWh

Self consumption

Proportion of PV generation used in the property

39 %

Independence

Proportion of electricity consumption provided by PV

30 %

Import / Export

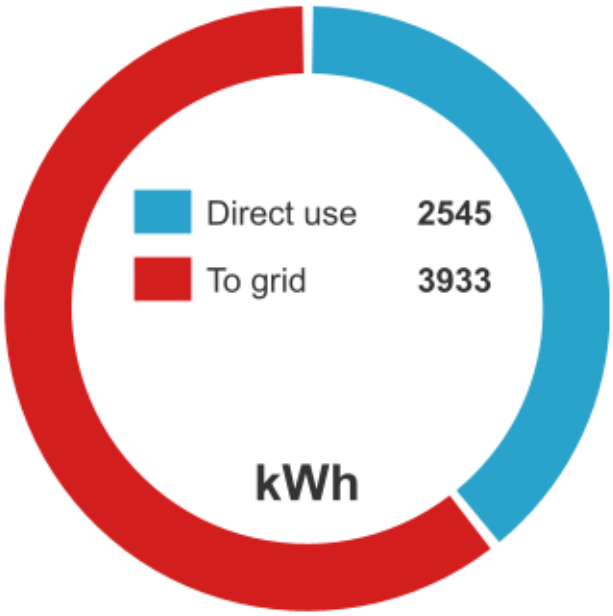
Electricity import / export each year from the property

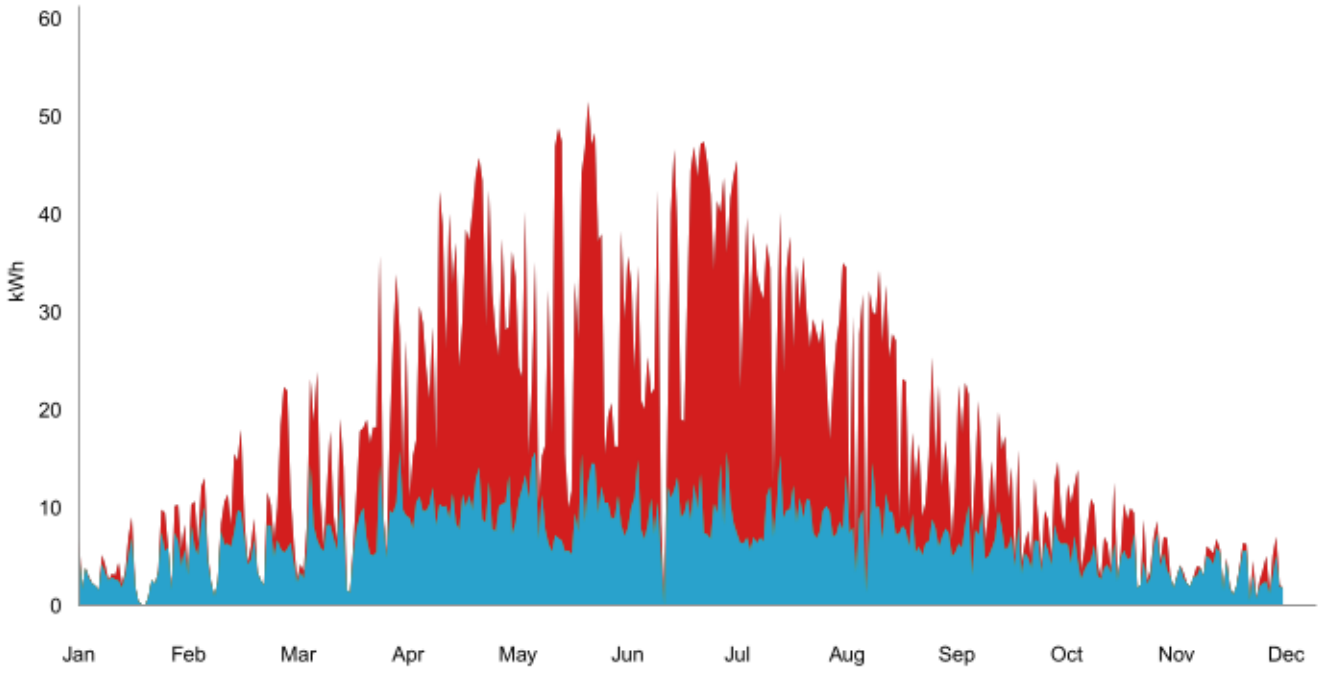
5985 / 3933 kWh

Yearly generation

The solar PV array is expected to generate 6478 kWh over a typical year. The graph shows whether the generated energy is used directly in the house or exported to the grid.

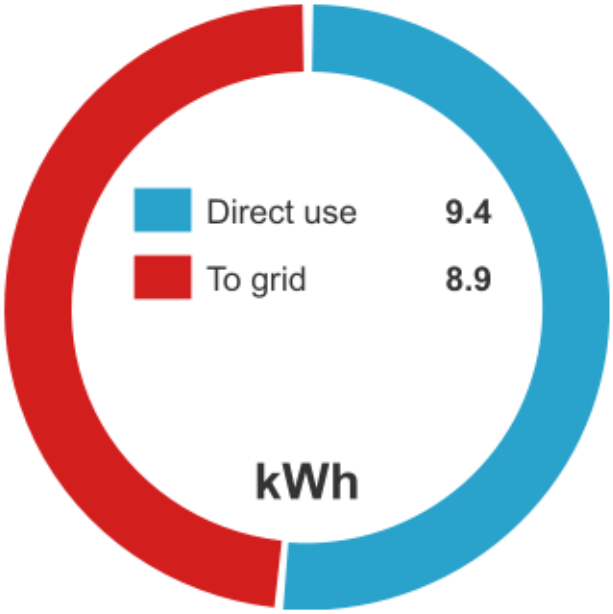
39% (2545 kWh) of the electricity generated is expected to be used directly in the property. The remaining generation (3933 kWh, or 61% of the total) is exported to the grid.

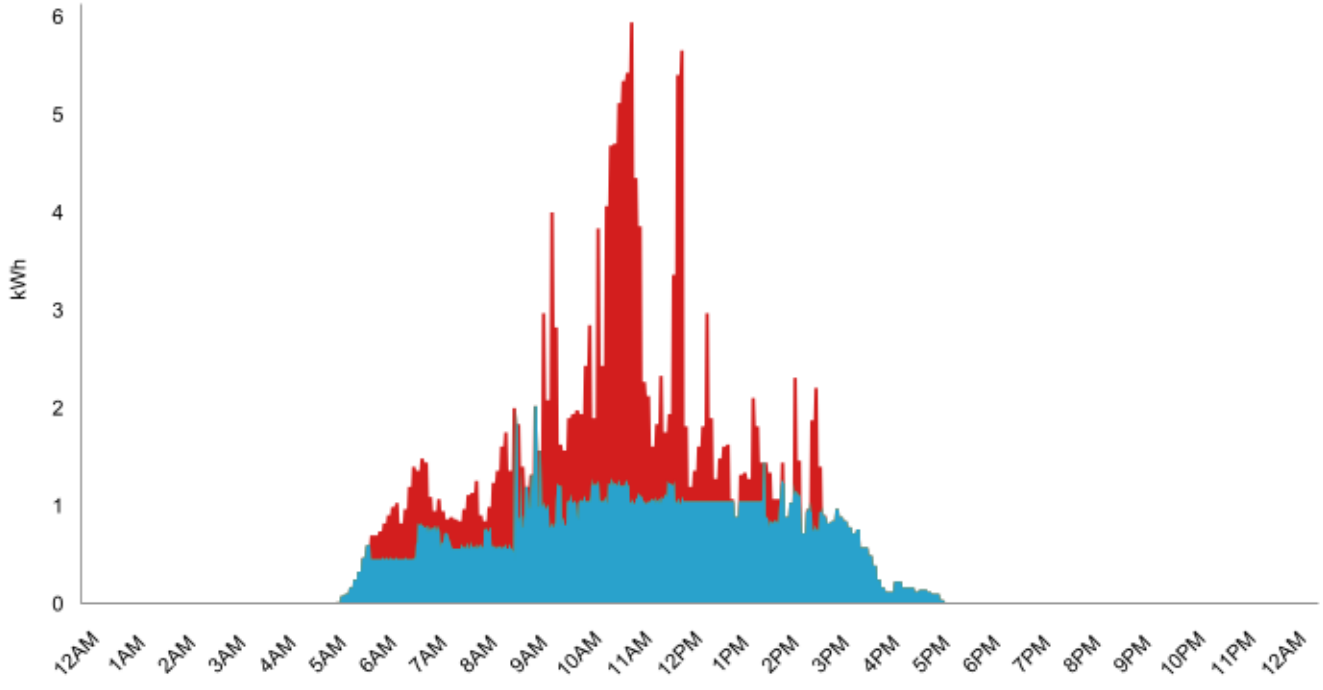




Daily generation

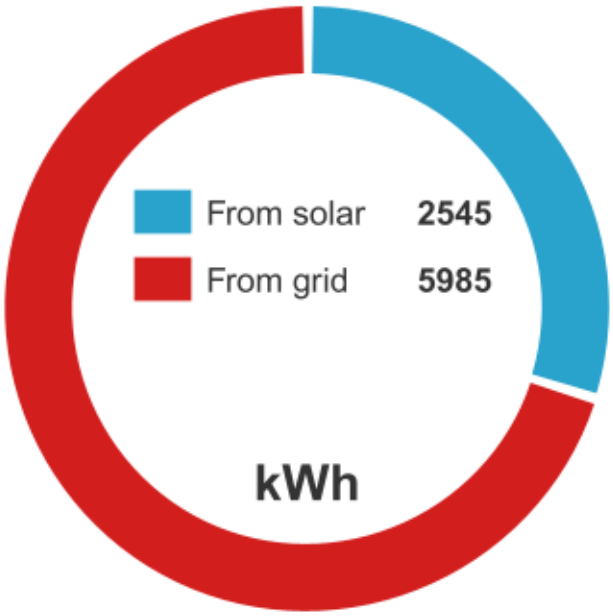
This graph shows the modelled profile of electricity generated by the PV array on a selected day (March 27th). On this day the PV system is expected to generate 18.3 kWh. Of this, 9.4 kWh (51%) is used directly in the property, and 8.9 kWh (49%) is exported to the grid.

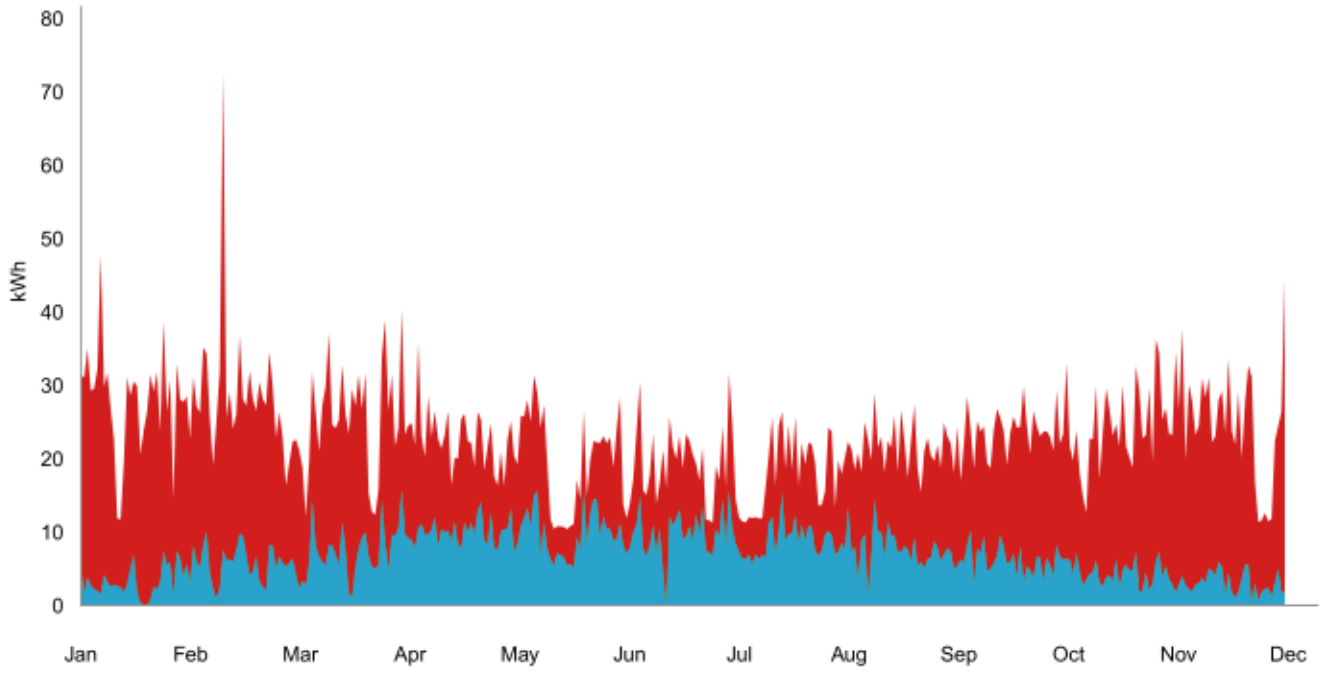




Yearly consumption

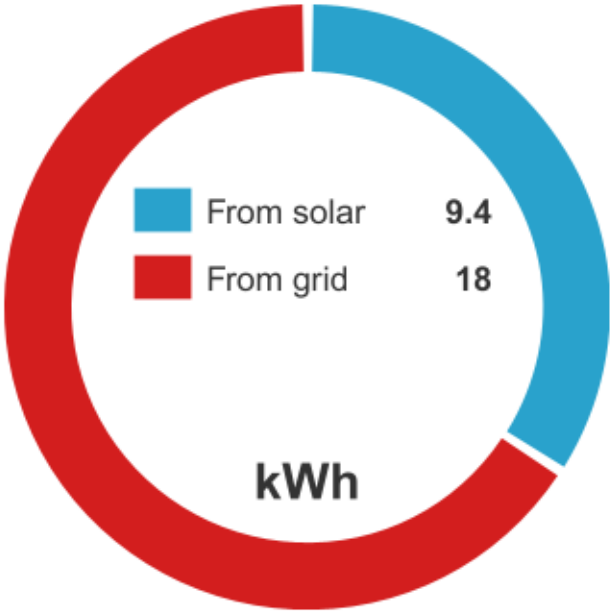
The property is expected to consume 8500kWh of electricity each year. Around 30% of this (2545 kWh) is expected to be supplied directly by the solar array. The remaining 70% (5985 kWh) is supplied from the grid.

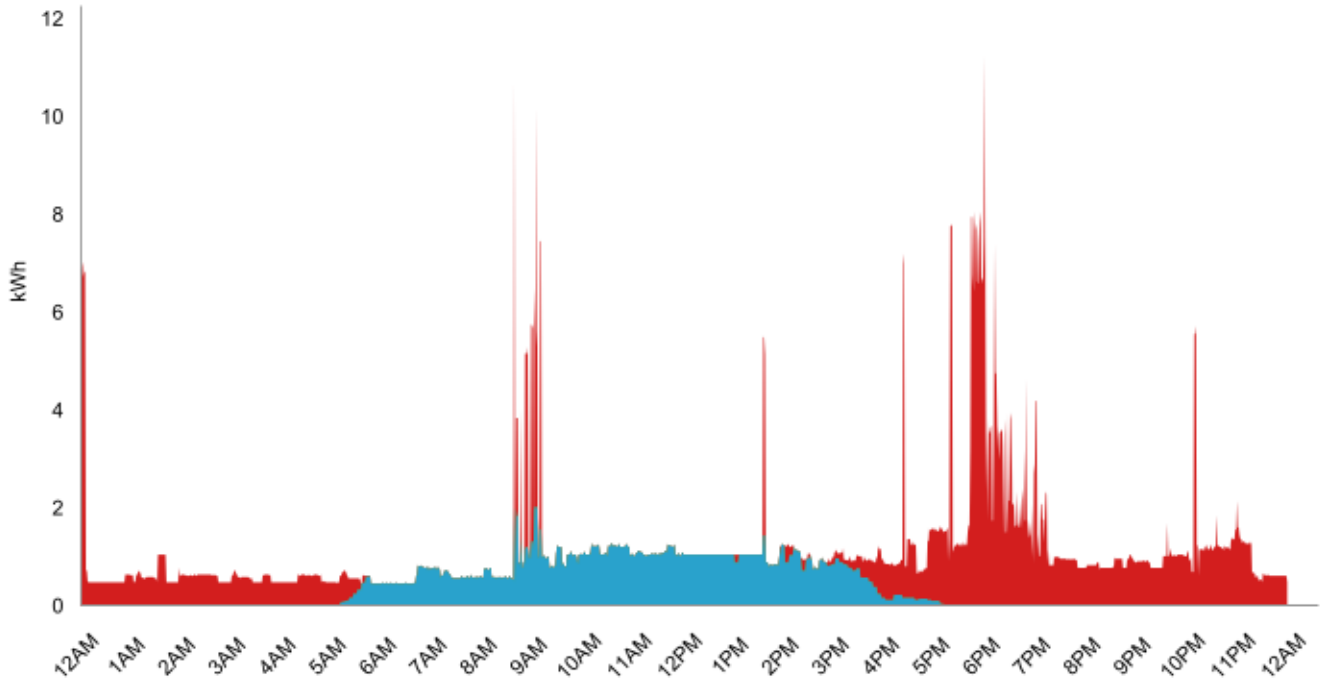




Daily consumption

This graph shows modelled consumption data over the course of the selected day (March 27th). Total electricity consumption on this day was 27.6 kWh, of which 9.4 kWh (34%) is expected to be supplied directly by the solar array. The remaining 18.2 kWh (66%) is imported from the grid.

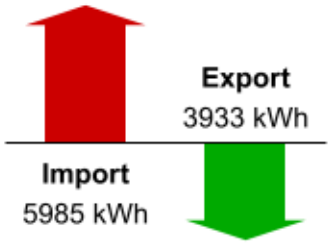


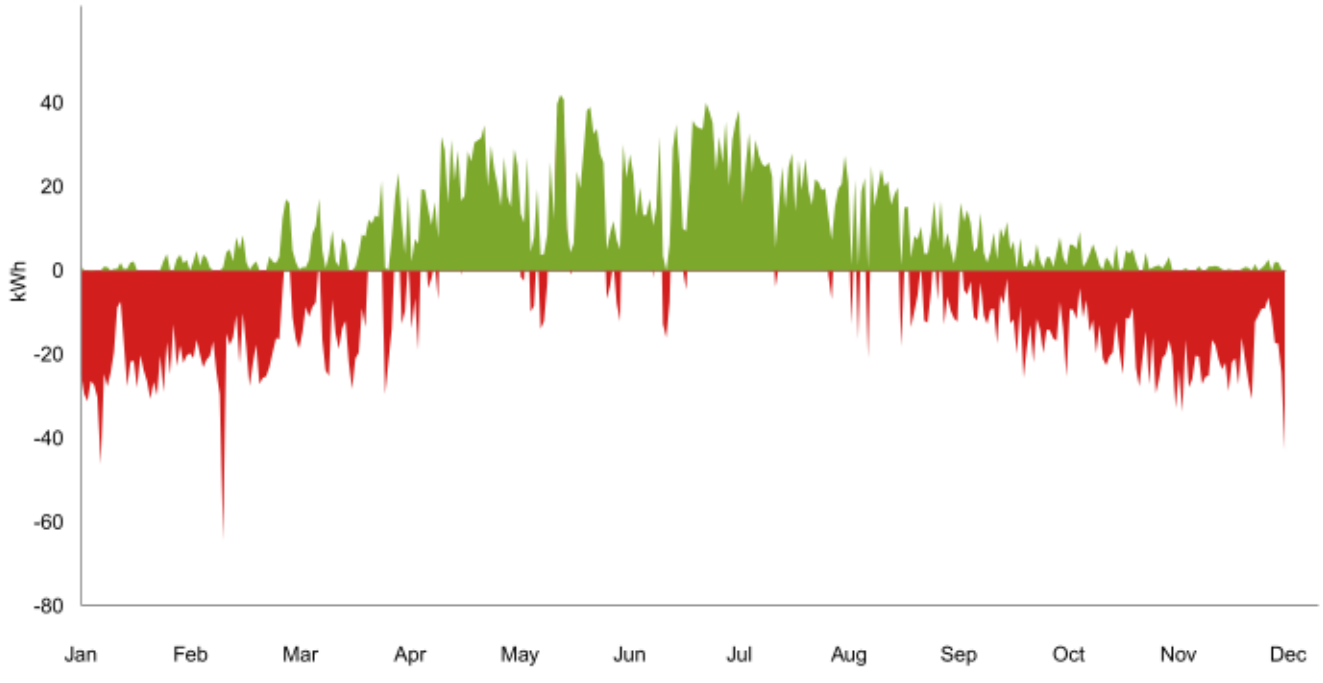


Yearly import and export

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.

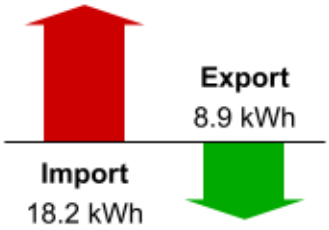
Over the course of the year, a total of 5985 kWh is expected to be imported by the property, and 3933 kWh exported back to the grid.

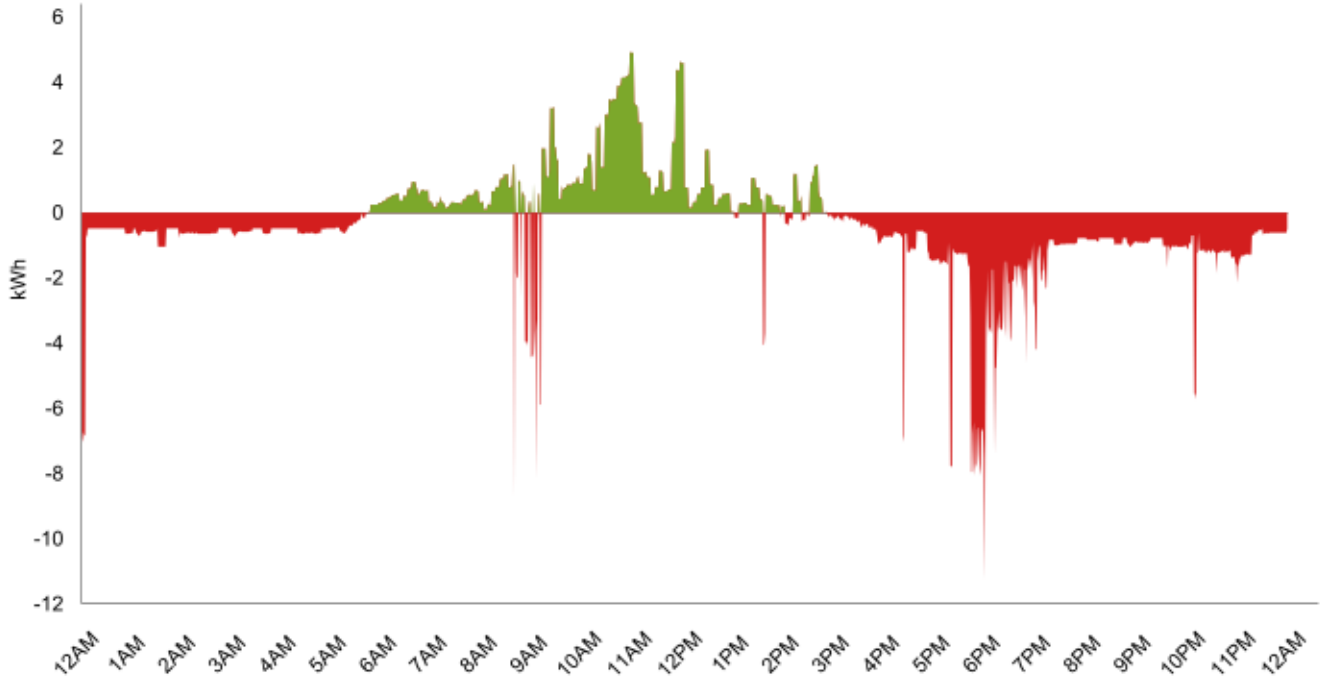




Daily import and export

This graph shows the modelled import and export of electricity over a selected day (March 27th). On this day 18.20 kWh is expected to be imported from the grid, and 8.9 kWh exported.





Equipment and Services

Equipment Costs	
21x Trina Vertex S 390W All Black Mono solar panel	£3,439.80
SolarEdge 7000 3ph inverter	£1,378.00
Emlite EMP1 Three Phase meter	£91.00
Label sheet	£2.34
SolarEdge Wattnode Modbus Meter with 100A CT Clamp	£120.00
SolarEdge Wifi Antenna for SETAPP inverters	£27.30
2x AC isolator - KN Newbury 20A 4-pole	£32.50
21x SolarEdge Optimiser S500	£1,317.23
2x Pair of MC4 connectors	£5.20
2x 50m reel of 4mm2 solar cable	£52.00
20x Fastensol end clamp (30mm black)	£31.41
32x Fastensol mid clamp (30mm black)	£66.74
20x Fastensol black end cap	£17.05
52x Fastensol portrait adjustable roof hook	£399.20
8x Fastensol rail splice	£28.73
17x Fastensol silver rail 3300mm	£362.00
21x Fastensol rail bolt	£13.65
Total equipment cost	**£7,384.15**

Services Costs	
Labour	£1,200.00
MCS Registration and Commissioning	£300.00
Fixed Scaffolding - to be provided by client	£0.00
Total services cost	**£1,500.00**

Totals

Total before tax	£8,884.15
VAT at 0%	£0.00
Total including tax	£8,884.15

Financial

Generation

The system is expected to generate 6457 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 151721 kwh, of which 59807 kWh will be consumed on site and 91913 kWh exported.

152 MWh

Payback

After adjusting projected costs and benefits for inflation, and applying a discount rate of 4%, the initial system cost of £8,884.15 is expected to be recouped after 6 years.

6 years

Net Present Value

The total present value of future benefits and costs, using a discount rate of 4% per year, is £37,581.99. The cost of the PV system is £8,884.15. The net present value of the project is therefore £28,697.84. A positive net present value is a good indication that the project is financially worthwhile.

£28697.84

IRR

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

19.5 %

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 increases at 2% above inflation per year	**£0.41 /kWh**
System size degrades at 0.5% per year	**8.19 kWp**
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	597	1062	**1659**
Year 2	618	1099	**1717**
Year 3	639	1137	**1776**
Year 4	662	1177	**1838**
Year 5	685	1217	**1902**
Year 6	708	1260	**1968**
Year 7	733	1304	**2037**
Year 8	759	1349	**2108**
Year 9	785	1396	**2181**
Year 10	812	1445	**2257**
Year 11	840	1495	**2335**
Year 12	870	1547	**2417**
Year 13	900	1601	**2501**
Year 14	931	1656	**2588**
Year 15	964	1714	**2678**
Year 16	997	1774	**2771**
Year 17	1032	1835	**2867**
Year 18	1068	1899	**2967**
Year 19	1105	1965	**3070**
Year 20	1144	2034	**3177**
Year 21	1183	2105	**3288**
Year 22	1224	2178	**3402**
Year 23	1267	2254	**3521**
Year 24	1311	2332	**3643**
Year 25	1357	2413	**3770**

£23191

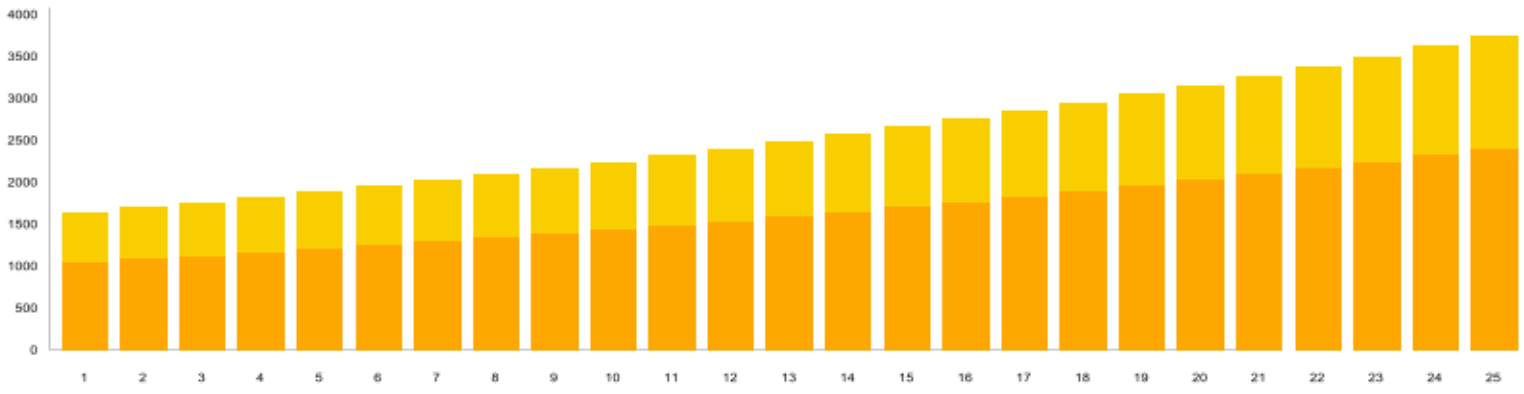
Total Export Payments

over 25 years

£41246

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 6 years.

	Discounted benefits	Cumulative benefits	Discounted costs	Cumulative costs	**Cashflow**
Year 1	1626	1626	0	8884	**-7259**
Year 2	1615	3240	0	8884	**-5644**
Year 3	1604	4845	0	8884	**-4039**
Year 4	1594	6438	0	8884	**-2446**
Year 5	1583	8022	0	8884	**-863**
Year 6	1573	9594	0	8884	**710**
Year 7	1562	11157	0	8884	**2272**
Year 8	1552	12709	0	8884	**3825**
Year 9	1542	14251	0	8884	**5366**
Year 10	1532	15782	0	8884	**6898**
Year 11	1522	17304	0	8884	**8420**
Year 12	1512	18815	0	8884	**9931**
Year 13	1502	20317	0	8884	**11433**
Year 14	1492	21809	0	8884	**12924**
Year 15	1482	23290	0	8884	**14406**
Year 16	1472	24762	0	8884	**15878**
Year 17	1462	26225	0	8884	**17341**
Year 18	1453	27678	0	8884	**18793**
Year 19	1443	29121	0	8884	**20237**
Year 20	1434	30554	0	8884	**21670**
Year 21	1424	31979	0	8884	**23094**
Year 22	1415	33393	0	8884	**24509**
Year 23	1405	34799	0	8884	**25915**
Year 24	1396	36195	0	8884	**27311**
Year 25	1387	37582	0	8884	**28698**

