Mr and Mrs Thomas

Project Name: Thomas/Regis

Phone:

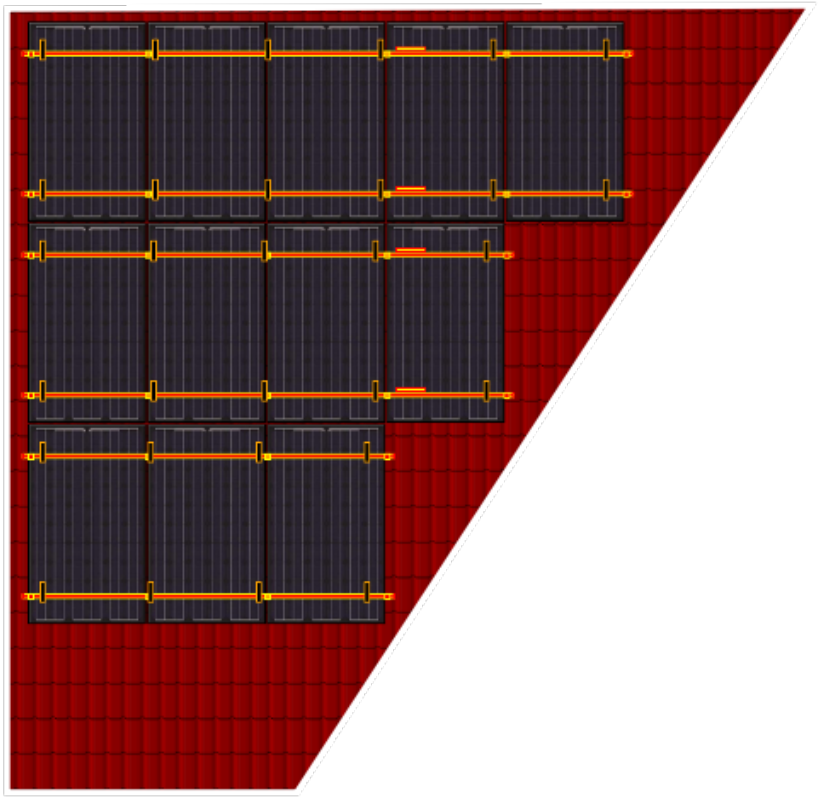
Address: Briarwood House, Sheringwood, Beeston Regis, NR26 8TS

Date Created: 8th February 2022

Designer: Derek Boone

Roof Layout

Roof 1



Component list

Item	Quantity
 Trina 330W All Black Split Cell Mono solar panel	12
 Growatt MIN 3600 TL-XE Dual MPPT single phase inverter with DC switch inverter	1
 Emlite ECA2 extended cover	1
 Label sheet	1
 AC isolator - KN Newbury 20A 4-pole	2
Pair of MC4 connectors	4
50m reel of 4mm2 solar cable	1
Fastensol end clamp (35mm black)	12
Fastensol mid clamp (35mm black)	18
Fastensol end cap (black)	12
Fastensol portrait pan tile roof hook	30
Fastensol rail splice	4
FS Black rail 3.3m	0
FS Silver rail 3.3m	8

Inverter checks

Growatt MIN 3600 TL-XE Dual MPPT single phase inverter with DC switch

Panels			
PV power	**3960**	Rated AC output	**3600**

Input 1: 6 Trina 330W All Black Split Cell Mono solar panels in 1 strings

Panels		Inverter	
PV power	**1980 W**		
Open circuit voltage at -10° C	**263 V**	Max DC voltage	**550 V**
V_{mpp} at 40° C	**195 V**	V_{mpp} lower limit	**80 V**
V_{mpp} at -10° C	**222 V**	V_{mpp} upper limit	**550 V**
I_{mpp} 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.

Input 2: 6 Trina 330W All Black Split Cell Mono solar panels in 1 strings

Panels		**Inverter**	
PV power	**1980 W**		
Open circuit voltage at -10° C	**263 V**	Max DC voltage	**550 V**
V_{mpp} at 40° C	**195 V**	V_{mpp} lower limit	**80 V**
V_{mpp} at -10° C	**222 V**	V_{mpp} upper limit	**550 V**
I_{mpp} 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 MIN 3600 TL-XE Dual MPPT single phase inverter with DC switch

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 (16A)

Phases

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

Input 1

DC Isolator

Integrated isolator

This inverter contains an integrated DC Isolator.

Cable

10m of 4mm2 solar cable has been specified

Voltage drop

Voltage drop at maximum power point at 40°C will be around **0.85 V (0.44 percent)**

Input 2

DC Isolator

Integrated isolator

This inverter contains an integrated DC Isolator.

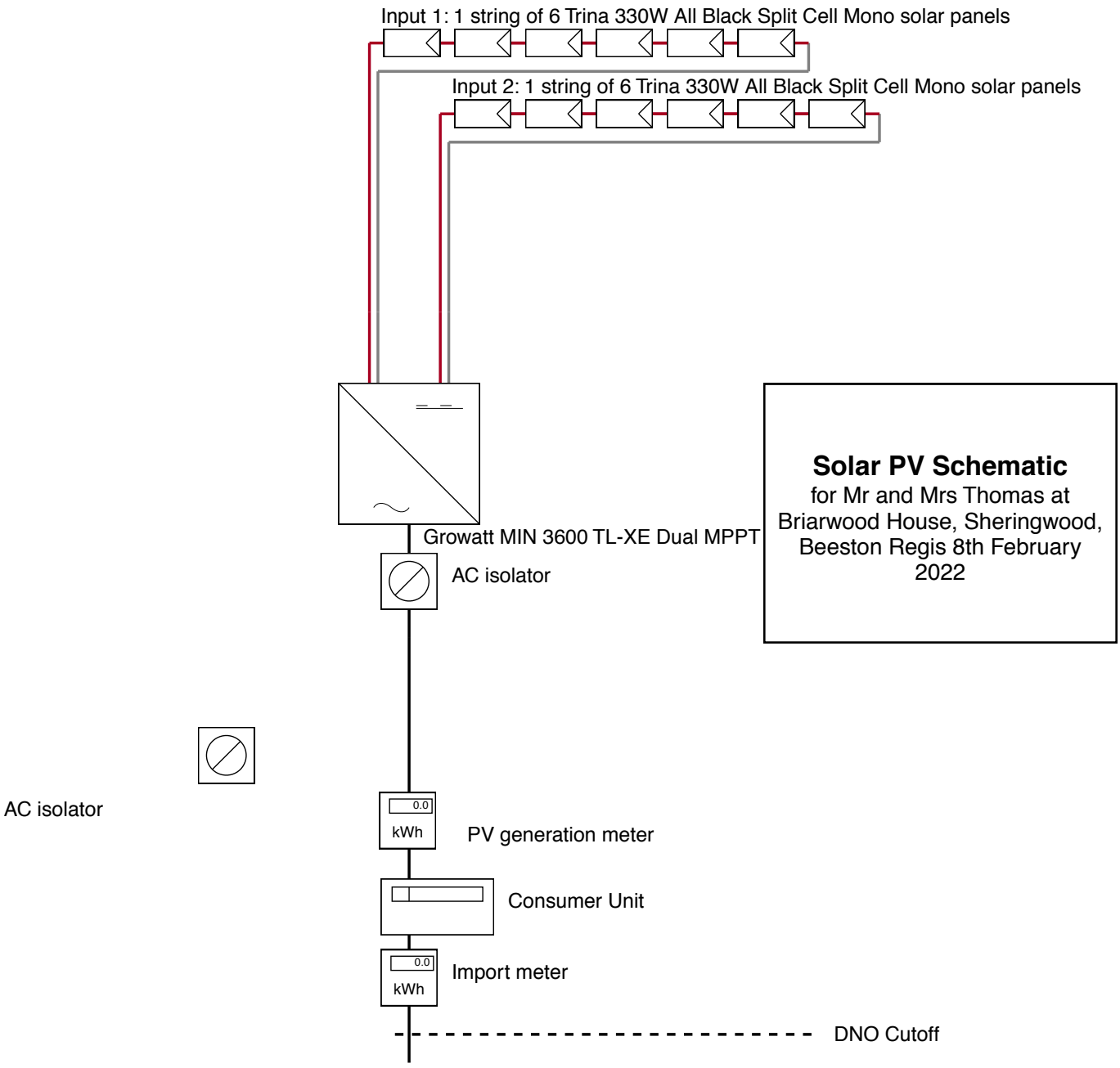
Cable

10m of 4mm2 solar cable has been specified

Voltage drop

Voltage drop at maximum power point at 40°C will be around **0.85 V (0.44 percent)**

Schematic diagram



Structural calculations

Weight loading calculations

Roof 1

Weight of solar panels and mounting	255.4 kg
Area of solar array	20.2 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:

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

Roof 1

Q_p	1201 Pa
in From Fig 34 in Guide to the Installation of Photovoltaic Systems for a building 10 m high, windzone 2, in country terrain, at a distance of less than 2km 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}	20.2m^2

F	Roof Centre	Roof edge
Uplift	**-31537N**	**-53369N**
Pressure	**24259N**	**26685N**

With 30 roof hooks we should allow for an uplift force per hook in the central zone of **1051N**, rising to **1779N** at the edges. If 2 screws are used per roof hook, this equates to **526N**per fixing in the central zone, and **889N** 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 less than the expected wind loading, even when the fixings are close to the edge of the roof.

Performance Estimate

Site details

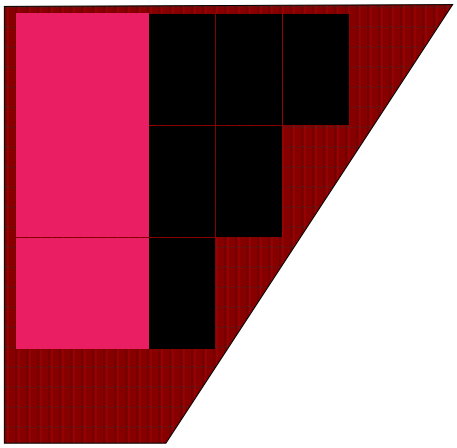
Client	Mr and Mrs Thomas
Address	Briarwood House, Sheringwood, Beeston Regis

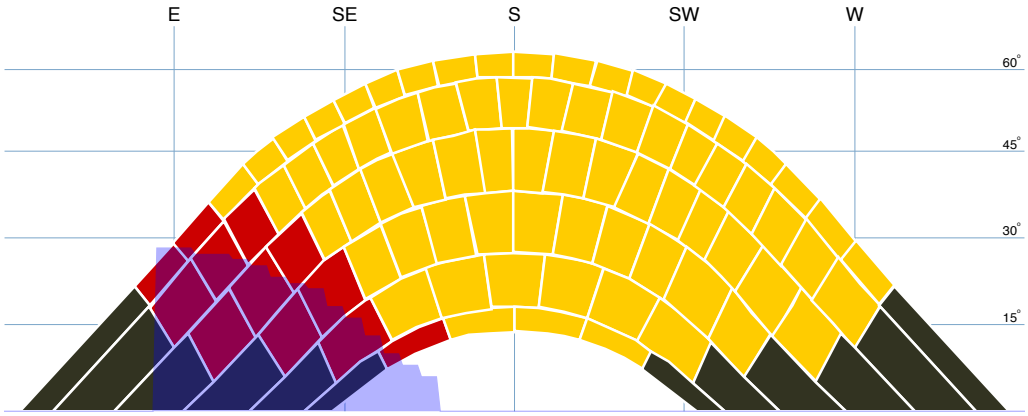
The sunpath diagram shows the arcs of the sky that the sun passes through at different times of the day and year as yellow blocks. The shaded area indicates the horizon as seen from the location of the solar array. Where objects on the horizon are within 10m of the array, an added semi-circle is drawn 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 MIN 3600 TL-XE Dual MPPT single phase inverter with DC switch

Input 1

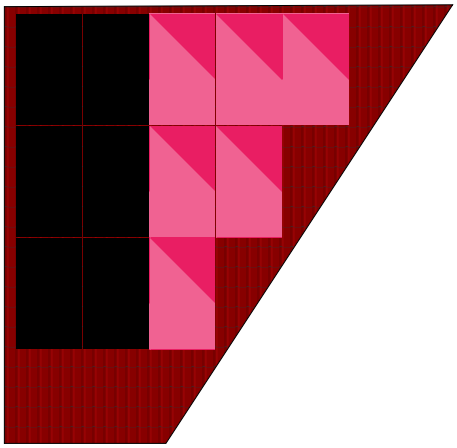


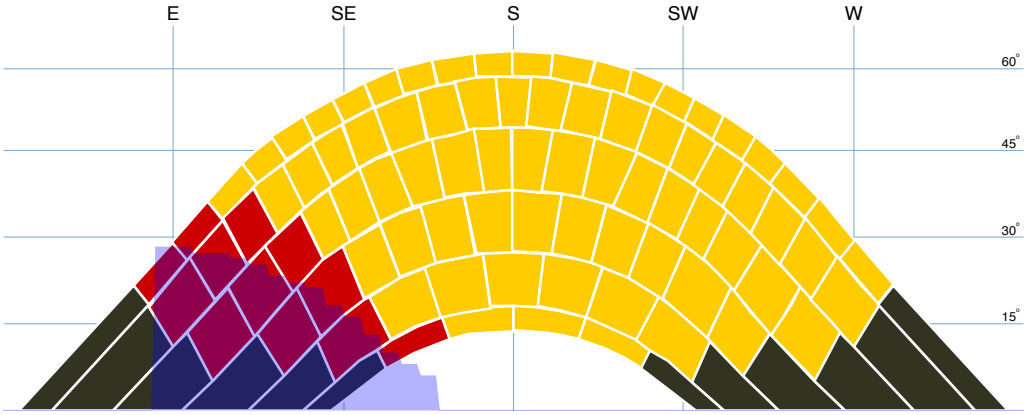


A. Installation data		
Installed capacity of PV system - kWp (stc)	**1.980**	kWp
Orientation of the PV system - degrees from South	**-78**	°
Inclination of system - degrees from horizontal	**30**	°
Postcode region	**12**	

B. Performance calculations		
kWh/kWp (Kk)	**808**	kWh/kWp
Shade factor (SF)	**0.88**	
Estimated output (kWp x Kk x SF)	**1408**	kWh

Input 2





A. Installation data		
Installed capacity of PV system - kWp (stc)	**1.980**	kWp
Orientation of the PV system - degrees from South	**-78**	°
Inclination of system - degrees from horizontal	**30**	°
Postcode region	**12**	

B. Performance calculations		
kWh/kWp (Kk)	**808**	kWh/kWp
Shade factor (SF)	**0.88**	
Estimated output (kWp x Kk x SF)	**1408**	kWh

Performance Summary

A. Installation data		
Installed capacity of PV system - kWp (stc)	**3.96**	kWp
Orientation of the PV system - degrees from South	**See individual inputs**	
Inclination of system - degrees from horizontal	**See individual inputs**	
Postcode region	**12**	
B. Performance calculations		
kWh/kWp (Kk)	**See individual inputs**	
Shade factor (SF)	**See individual inputs**	
Estimated output (kWp x Kk x SF)	**2816**	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.

Equipment and Services

Equipment Costs	
12x Trina 330W All Black Split Cell Mono solar panel	£2,280.00
Growatt MIN 3600 TL-XE Dual MPPT single phase inverter with DC switch inverter	£640.00
Emlite ECA2 extended cover	£28.50
Label sheet	£3.00
1x AC isolator - KN Newbury 20A 4-pole	£31.80
4x Pair of MC4 connectors	£16.00
50m reel of 4mm2 solar cable	£60.00
12x Fastensol end clamp (35mm black)	£28.80
18x Fastensol mid clamp (35mm black)	£43.20
12x Fastensol end cap (black)	£13.20
30x Fastensol portrait pan tile roof hook	£240.00
4x Fastensol rail splice	£14.00
8x FS Silver rail 3.3m	£200.00
Total equipment cost	**£3,598.50**

Services Costs	
1day 2men	£320.00
MCS /certification fees	£150.00
Total services cost	**£470.00**

Totals	
Total before tax	**£4,068.50**
VAT at 5%	**£203.43**

Total including tax	**£4,271.93**

Financial

Generation

The system is expected to generate 2816 kWh per year initially, decreasing gradually as the solar cells degrade. Over the 30 year term of this financial projection the total generation is expected to be 78435 kwh, of which 78435 kWh will be consumed on site and 0 kWh exported.

78 MWh

Payback

After adjusting projected costs and benefits for inflation, and applying a discount rate of 0%, the initial system cost of £4,271.93 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 0% per year, is £38,479.85. The cost of the PV system is £4,271.93. The net present value of the project is therefore £34,207.92. A positive net present value is a good indication that the project is financially worthwhile.

£34207.92

IRR

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

17.1 %

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	**5%**
Cost of electricity	**£0.22 /kWh** increases with inflation
System size	**3.96 kWp** degrades at 0.5% per year
Discount rate	**0%**
Projection length	**30 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 5 percent.

	Export payments	Electricity savings	Total
Year 1	0	633	**633**
Year 2	0	662	**662**
Year 3	0	691	**691**
Year 4	0	722	**722**
Year 5	0	755	**755**
Year 6	0	788	**788**
Year 7	0	824	**824**
Year 8	0	861	**861**
Year 9	0	899	**899**
Year 10	0	939	**939**
Year 11	0	981	**981**
Year 12	0	1025	**1025**
Year 13	0	1071	**1071**
Year 14	0	1119	**1119**
Year 15	0	1169	**1169**
Year 16	0	1221	**1221**
Year 17	0	1276	**1276**
Year 18	0	1333	**1333**
Year 19	0	1393	**1393**
Year 20	0	1455	**1455**
Year 21	0	1520	**1520**
Year 22	0	1588	**1588**
Year 23	0	1659	**1659**
Year 24	0	1734	**1734**
Year 25	0	1811	**1811**
Year 26	0	1892	**1892**
Year 27	0	1977	**1977**
Year 28	0	2066	**206**
Year 29	0	[illegible]	**[illegible]**
[illegible]	0	[illegible]	**[illegible]**

£0

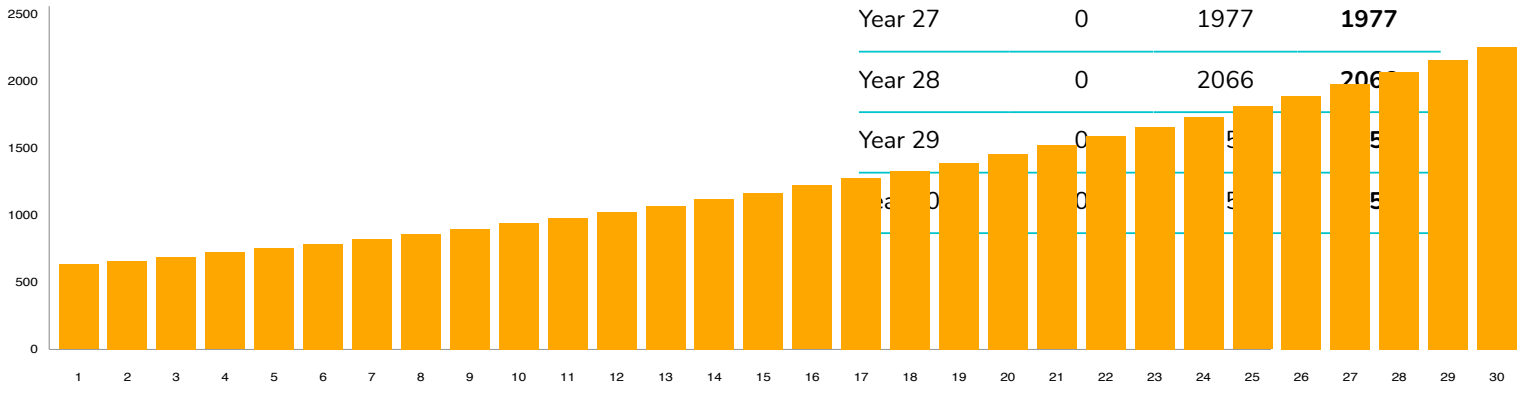
Total Export Payments

over 30 years

£38479

Electricity savings

over 30 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	633	633	0	4272	**-3639**
Year 2	662	1295	0	4272	**-2977**
Year 3	691	1987	0	4272	**-2285**
Year 4	722	2709	0	4272	**-1563**
Year 5	755	3464	0	4272	**-808**
Year 6	788	4252	0	4272	**-20**
Year 7	824	5076	0	4272	**804**
Year 8	861	5936	0	4272	**1664**
Year 9	899	6835	0	4272	**2563**
Year 10	939	7775	0	4272	**3503**
Year 11	981	8756	0	4272	**4484**
Year 12	1025	9781	0	4272	**5509**
Year 13	1071	10852	0	4272	**6580**
Year 14	1119	11971	0	4272	**7699**
Year 15	1169	13140	0	4272	**8869**
Year 16	1221	14362	0	4272	**10090**
Year 17	1276	15638	0	4272	**11366**
Year 18	1333	16971	0	4272	**12699**
Year 19	1393	18364	0	4272	**14092**
Year 20	1455	19819	0	4272	**15547**
Year 21	1520	21340	0	4272	**17068**
Year 22	1588	22928	0	4272	**18656**
Year 23	1659	24588	0	4272	**20316**
Year 24	1734	26321	0	4272	**22049**
Year 25	1811	28133	0	4272	**23861**
Year 26	1892	30025	0	4272	**25753**
Year 27	1977	32002	0	4272	**27730**
Year 28	2066	34067	0	4272	**29795**
Year 29	2158	36225	0	4272	**31953**
Year 30	2255	38480	0	4272	**34208**