



Solvo Energy

Commercial Building Roof Top Solar Case Study

Project Cardiff 1

Project Cardiff 1 – Background

The Solvo Energy team were appointed by a commercial building owner to undertake the design and specification of the Engineering, Procurement and Construction (EPC) works for a rooftop solar PV installation located on their building in Cardiff.

164 kW	£149,753	£21,818	182,451 kWh
System Size	Total System Price	Estimated Annual Electricity Bill Savings	Annual Electricity Generation

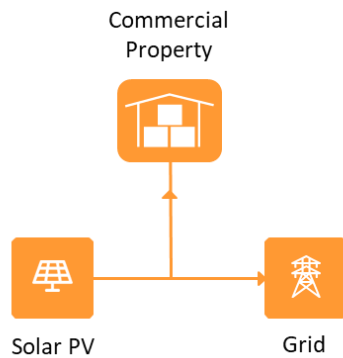
The installation of this system will save the client approximately £21,818 in electricity per annum and will pay for itself in just under 7 years. Excluding O&M, this will lead to a net saving through on-site electricity generation over the systems 25-year life cycle of £545,466.



The design displayed above represented the render of the site's preliminary system design before the initial site visit, construction design, equipment procurement and installation.

System Functionality

The installed system will function under three primary operational scenarios:

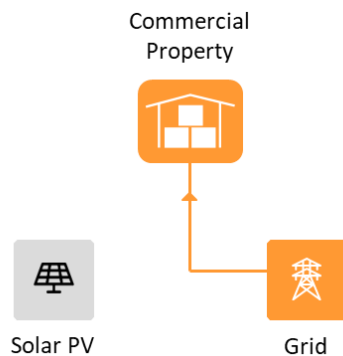
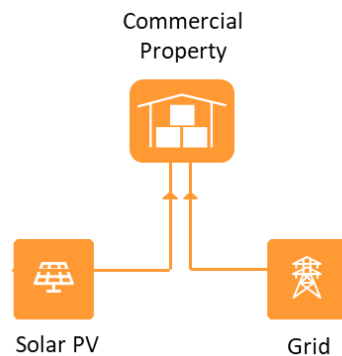


Generating Excess Solar

During daytime hours the system may produce more energy than required on site, and so excess energy is sold to the grid.

Partially Offset Usage

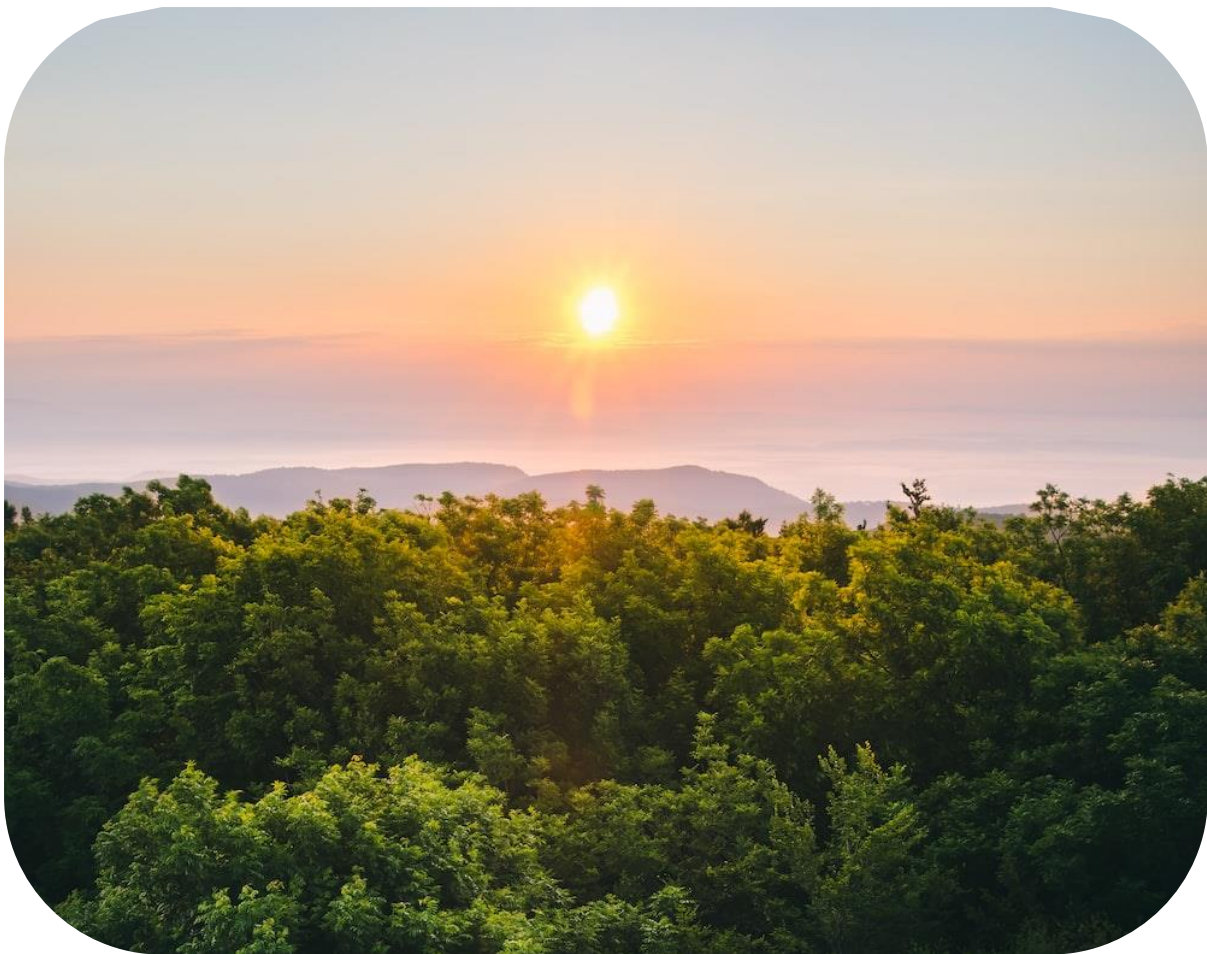
During daytime hours the system may not produce enough energy required to fully power the site. In this case excess energy is purchased from the grid to supply the deficit.



Overnight

As solar PV does not generate electricity outside of sunlight hours, no power is generated, and all electricity must be drawn from the grid.

Solar PV generates electricity savings and reduces carbon consumption on-site when generating excess solar and partially offsetting usage. The installation of a Battery Energy Storage System (BESS) can allow for utilisation of the system overnight, but as the client only operates during regular business hours a BESS would not produce any significant benefit.



Environmental Benefits

Solar PV produces no CO2 emissions when generating electricity, creating a completely clean source of energy. The table below demonstrates the estimated benefits provided by this system over its 25-year life cycle.

880	4,090,435	27,290	733
Estimated tonnes avoided CO ₂	Car miles avoided	Trees planted	Long haul flights avoided

Environmental benefits generated by commercial rooftop solar PV systems are key to reducing the UK’s energy mix carbon intensity, a measure critical to combat global warming and creating more sustainable businesses.

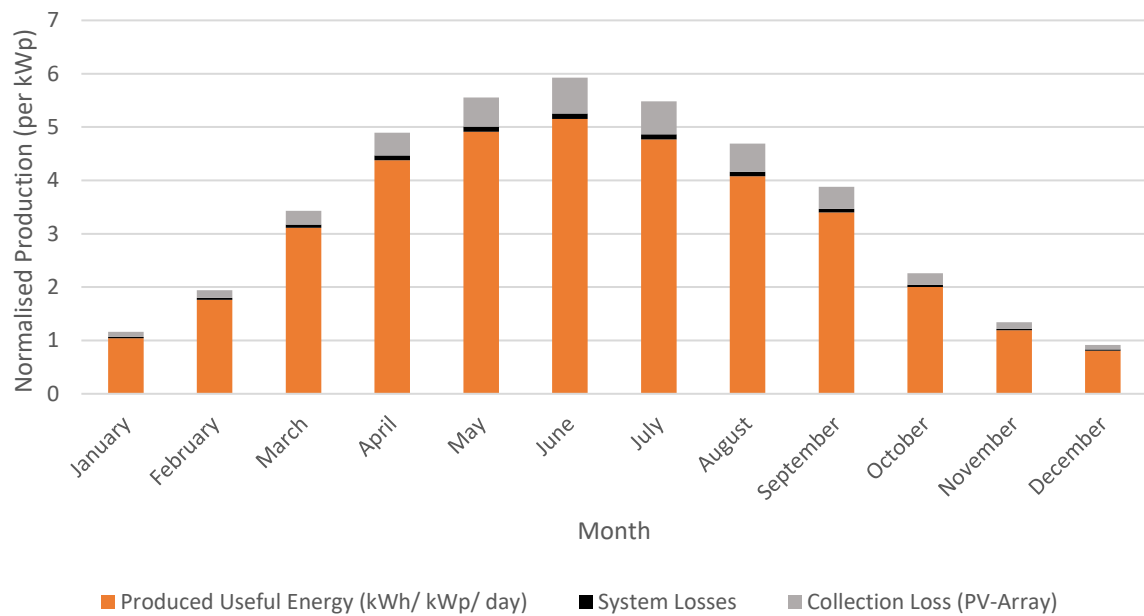
System Technical Evaluation

PV Array Parameters

PV module		Inverter	
Manufacturer	JA Solar	Manufacturer	Huawei Technologie
Model	JAM72-S10-410-PR	Model	SUN2000-36KTL-M3-400V
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	410 Wp	Unit Nom. Power	36.0 kWac
Number of PV modules	212 units	Number of inverters	2 units
Nominal (STC)	86.9 kWp	Total power	72.0 kWac
Array #1 - PV Array			
Number of PV modules	104 units	Number of inverters	1 unit
Nominal (STC)	42.6 kWp	Total power	36.0 kWac
Modules	8 Strings x 13 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	38.9 kWp	Max. power (=>45°C)	40.0 kWac
U mpp	491 V	Pnom ratio (DC:AC)	1.18
I mpp	79 A	Power sharing within this inverter	
Array #2 - Sub-array #2			
Number of PV modules	108 units	Number of inverters	1 unit
Nominal (STC)	44.3 kWp	Total power	36.0 kWac
Modules	9 Strings x 12 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	40.4 kWp	Max. power (=>45°C)	40.0 kWac
U mpp	454 V	Pnom ratio (DC:AC)	1.23
I mpp	89 A	Power sharing within this inverter	
Array #3 - Sub-array #3			
PV module		Inverter	
Manufacturer	JA Solar	Manufacturer	Huawei Technologie
Model	JAM72-S10-410-PR	Model	SUN2000-60KTL-M0_400Va
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	410 Wp	Unit Nom. Power	60.0 kWac
Number of PV modules	187 units	Number of inverters	1 unit
Nominal (STC)	76.7 kWp	Total power	60.0 kWac
Modules	11 Strings x 17 In series	Operating voltage	200-1000 V
At operating cond. (50°C)		Max. power (=>30°C)	66.0 kWac
Pmpp	69.9 kWp	Pnom ratio (DC:AC)	1.28
U mpp	643 V	Power sharing within this inverter	
I mpp	109 A		

The solar panel array is divided into three separate areas called sub-arrays. Each sub-array supplies their own inverter. The inverters convert the DC current produced by the solar panels into AC current suitable for supply to the client or export to the grid.

Normalised Production at Nominal Power: 164 kWp



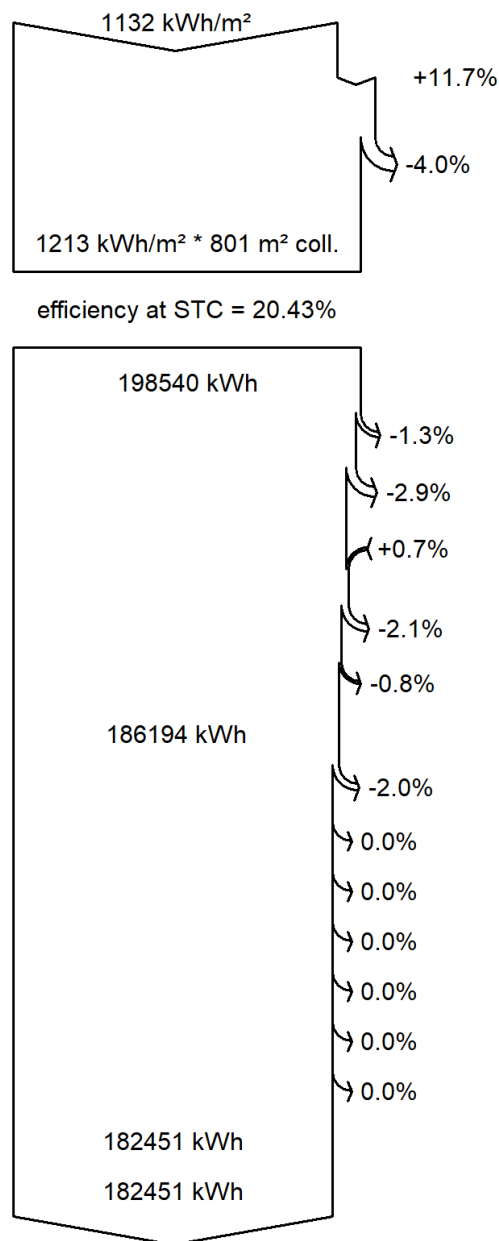
The system will produce a maximum average of 5.15 kWh/ kWp/ day in June, and a minimum average of 0.81 kWh/ kWp/ day during December. This is because production is correlated to irradiance from the sun, which is highest during the summer in the UK.

Table of Main Results

Month	Energy at Array (kWh)	Energy at Grid (kWh)	Performance Ratio
January	5383	5254	0.893
February	8229	8054	0.908
March	16064	15748	0.907
April	21940	21513	0.895
May	25412	24920	0.884
June	25803	25295	0.869
July	24670	24193	0.87
August	21090	20675	0.87
September	17003	16668	0.876
October	10377	10160	0.886
November	5982	5842	0.886
December	4238	4128	0.884

The system will produce a total of 186,191 kWh per annum, achieving an overall performance ratio of 0.882.

System Losses



Global horizontal irradiation

Global incident in coll. plane

IAM factor on global

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

PV loss due to irradiance level

PV loss due to temperature

Module quality loss

Mismatch loss, modules and strings

Ohmic wiring loss

Array virtual energy at MPP

Inverter Loss during operation (efficiency

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

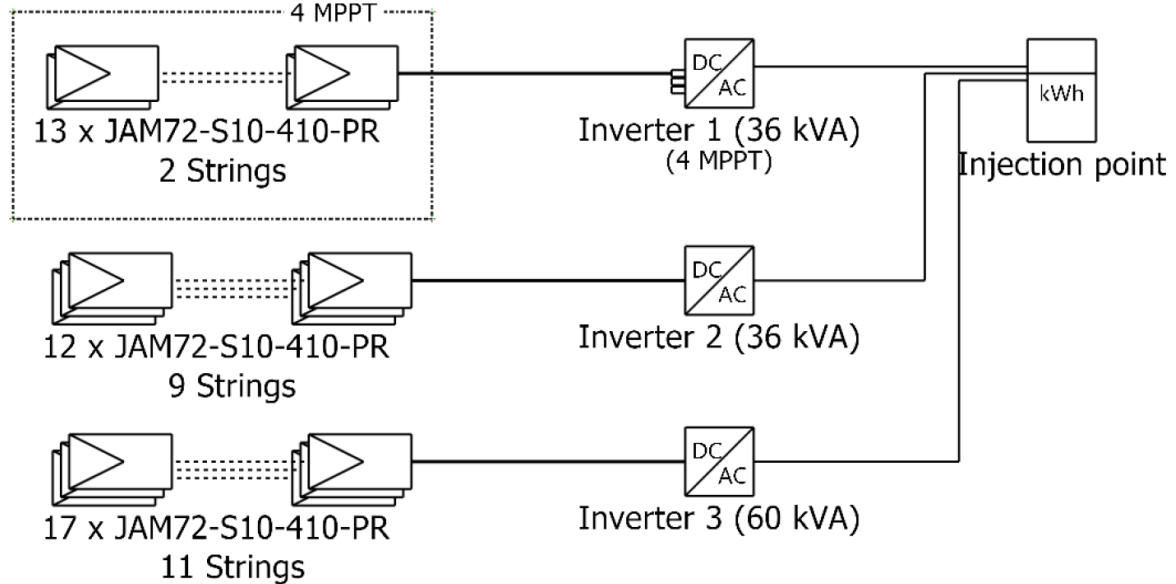
Night consumption

Available Energy at Inverter Output

Energy injected into grid

System based losses (a completely normal characteristic for any energy generation system) will reduce the energy available to be consumer or exported to the grid creating a final usable production value of 182,451 kWh per annum. This is the final value provided to the client and used for detailed modelling.

Single Line Diagram



PV Module	JAM72-S10-410-PR
Inverter 1	SUN2000-36KTL-M3-400V
Inverter 2	SUN2000-36KTL-M3-400V
Inverter 3	SUN2000-60KTL-MO_400Vac
String 1	13 x JAM72-S10-410-PR
String 2	12 x JAM72-S10-410-PR
String 3	17 x JAM72-S10-410-PR

A single line diagram provides a simple representation of the electrical system. This forms part of the design which is shared with the DNO (District Network Operator).

Final Design



After the team has established the building specifics via a site visit, the detailed redesign is finalised allowing the installation to begin.