STANDARDS DOCUMENT

MCS 032: 2025 ISSUE 1.0

MCS 2025

Solar PV & Battery: Pre-Sale Information and System Performance Estimate Standard

To be used in conjunction with the MCS Customer Commitment

This Standard was prepared by the MCS Solar PV and Battery Storage Working Groups.

It is published by The MCS Service Company Ltd on behalf of The MCS Charitable Foundation.

The MCS Service Company Ltd welcomes comments of a technical or editorial nature and these should be sent to *meetings@mcscertified.com*

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TABLE OF CONTENTS

ABOUT MCS

MCS: Giving everyone confidence in home-grown energy

With energy costs constantly rising and climate change affecting us all – low-carbon technology has a bigger and bigger role to play in the future of UK energy. MCS is here to ensure it's a positive one.

MCS is the UK's quality mark for small-scale renewable energy technologies like solar PV, solar heating, heat pumps, biomass, and battery storage. We have two main roles – setting and maintaining standards, and providing consumer protection.

Our Standards define how certified renewable energy installations should be designed and installed using MCS certified products. They are a benchmark for quality developed in close consultation with industry through independent technical working groups.

The Standards are owned by The MCS Foundation (a charitable trust), but maintained and developed by MCS.

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CHANGES TO STANDARDS

When MCS Standards are revised, the issue number is also revised to indicate the nature of the changes. This can either be a whole new issue or an amendment to the current issue. Details will be posted online, www.mcscertified.com

Technical or other significant changes which affect the requirements for the approval or certification of the product or service will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number is given on the left of the decimal point, and the amendment number on the right. For example, issue 3.2 indicates that it is the third significant version of the document which has had two sets of minor amendments.

Users of this Standard should ensure that they are using the latest issue.

Amendments issued since publication

Issue No.	Amendment details	Date
1.0	First publication for MCS:2025 1.0	01/01/2025

FOREWORD

Compliance with this Standard is mandatory for MCS Contractors certified to MCS: 2025.

The purpose of this Standard is to specify best practice in achieving high-quality low carbon technology installations. Whilst it is not possible to ensure safety, this Standard provides requirements which should help mitigate potential safety risks associated with the design and installation of this technology.

This document contains references to other documents which may be either normative or informative. At the time of publication any editions of those documents, where indicated, were valid. However, as all documents are subject to revision, any users of this document should apply the most recent editions of those referenced documents (unless a dated version is specified).

NOTE:
This MCS Standard makes use of the terms 'must', 'shall' and 'should' when prescribing certain requirements and procedures. In the context of this document:

- the term 'must' identifies a requirement by law at the time of publication;
- the term 'shall' prescribes a requirement or procedure that is intended to be complied with in full and without deviation;
- the term 'should' prescribes a requirement or procedure that is intended to be complied with unless reasonable justification can be given.

Compliance with this MCS Standard does not in itself confer immunity from legal obligations.

1 DEFINITIONS

Solar PV self-consumption	The amount of solar electricity generated by a domestic solar PV system which is subsequently consumed within the property and not exported to the distribution network. This includes solar PV directly consumed during the day and any solar PV generated electricity which is first stored in an electrical energy storage system and then discharged into domestic loads when the solar PV system is not generating enough electricity to meet the demand. The self-consumption can be quoted in kWh or as a percentage of the total PV generation. Self-consumption is different to the grid electricity independence.
Grid electricity independence / Self-sufficiency	The percentage of electricity consumed in the property over a year which is met by either behind the meter solar or electrical energy storage. Note that grid independence is distinct from the self-consumption.
Electrical Energy Storage System (EESS)	A system which converts electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion, in a controllable manner, of that energy back into electrical energy. For the purposes of this document, this is installed within the same domestic electrical system as the solar PV system and loads i.e. on the domestic side of the utility meter. The electrical energy storage is operated for provision of increasing self-consumption. The guidance in this document is not suitable for self-consumption of other microgeneration technologies via an electrical energy storage system.
Usable capacity (kWh)	The total capacity (kWh) of the EESS which is available for use for solar PV self-consumption.
First life EESS	An electrical energy storage system which is installed as new for the purpose of increasing the solar PV self-consumption in a domestic context.
Second life EESS	An electrical energy storage system which has previously been used for another application and which has been repurposed for the purpose of increasing the solar PV self-consumption in a domestic context.
Annual Generation from Solar PV (kWh)	The total amount of electricity generated (kWh) by a domestic solar PV system over a year. For the purposes of this document, the annual electricity generation from solar PV is calculated using the methodology described in MIS 3002: The PV Standard (Installation), unless metered annual generation data is available.

Annual electricity consumption (kWh)	The total amount of electricity consumed (kWh) in the domestic property over the last year. In the absence of any microgeneration this will be the total grid electricity import at the site as evidenced by the most recent total annual utility meter readings or consumer bills.
Occupancy archetype	A behavioural parameter used to represent when a domestic property is occupied or unoccupied.
Electric vehicle	All classes of vehicle whereby some or all automotive traction is provided from an electrical storage device which can be charged or discharged from the electricity grid - including full electric vehicles (BEV) and plug-in hybrid vehicles (PHEV).
Electric space heating	Any technology which is used under normal circumstances to provide the primary space heating to a building. This includes heat pumps and storage heaters but excludes single room heating devices such as fires or bar heaters.
Electric water heating	Any technology used for domestic hot water for using an immersion element or heat pump.
Diverters	Technologies which automatically apply a load when a domestic solar PV system is generating more electricity than the domestic consumption (before or after EESS charging). Examples include diverters for electric water heating or electric vehicle charging.

2 SCOPE

This Standard describes the methods to estimate the amount of renewable energy which might be delivered, by a solar PV and/or EESS system during a typical year. This document is to be used in conjunction with the MCS Customer Commitment. The format in which this Performance Estimate shall be presented to the customer is also given along with the technical information to accompany the estimate.

Performance estimates enable customers to compare different systems. The use of this MCS Standard for performance estimates brings a comparable and consistent methodology for different solar PV and EESS configurations – particularly for self-consumption.

The estimates are based on the best knowledge of MCS of the EESS applications, domestic electricity consumption and solar PV generation.

This Standard and its associated requirements shall be complied with before a contract is awarded to the customer.

Note: Where site characteristics are unknown (e.g. where the contract may be signed when the property is pre-built), best assumptions shall be made.

3 SOLAR PV

3.1 Method

3.1.1 Site evaluation

Inclination, orientation and shading are the three main site factors that influence the performance of a PV system. While drawings, maps or photos are a suitable means to determine inclination and orientation, an accurate estimation of any shade effects will typically require a site visit.

In some circumstances (e.g. for a new build multi-dwelling development), data may need to be estimated or taken remotely.

Where the site has been evaluated remotely, the MCS Contractor shall at all times make the customer aware if the performance of the system may be demonstrably different as a result of any site-based factors that later become apparent and not originally taken into account. Any such variations shall be notified to the client and dealt with accordingly.

3.1.2 Standard estimation method

The approach is as follows:

1) Establish the electrical rating of the PV array in kilowatts peak (kWp)
2) Determine the postcode region
3) Determine the array pitch
4) Determine the array orientation
5) Look up kWh/kWp (Kk) from the appropriate location specific table
6) Determine the shading factor of the array (SF) according to any objects blocking the horizon

The estimated annual electricity generated (AC) in kWh/year of installed system shall then be determined using the following formula:

Annual AC output (kWh) = kWp x Kk x SF

Where:

kWp of Array (kWp)

The kWp value used shall be the sum of the data plate value (Wp at STC) of all modules installed (the value printed on the module label).

Postcode zone

Determine the postcode zone of the site from the map and the table below. Once this has been obtained, you will be able to select the correct table for the kWh/kWp (Kk) values to be selected.

Note: These zones are the same as the SAP postcode zones

Figure 1: Postcode zones

Postcode	Region	Postcode	Region	Postcode	Region	Postcode	Region
AB	16	G	14	N	1	SK	7E
AL	1	GL	5E	NE	9E	SK13	6
B	6	GU	1	NG	11	SK17	6
BA	5E	GU11-12	3	NN	6	SK22-23	6
BB	7E	GU14	3	NP	5W	SL	1
BD	11	GU28-29	2	NPS	13	SM	1
BD23-24	10	GU30-35	3	NR	12	SN	5E
BH	3	GU46	3	NW	1	SN7	1
BL	7E	GU51-52	3	OL	7E	SO	3
BN	2	HA	1	OX	1	SP	5E
BR	2	HD	11	PA	14	SP6-11	3
BS	5E	HG	10	PE	12	SR	9E
BT	21	HP	1	PE9-12	11	SR7-8	10
CA	8E	HR	6	PE20-25	11	SS	12
CB	12	HS	18	PH	15	ST	6
CF	5W	HU	11	PH19-25	17	SW	1
CH	7E	HX	11	PH26	16	SY	6
CH5-8	7W	IG	12	PH30-44	17	SY14	7E
CM	12	IP	12	PH49	14	SY15-25	13
CM21-23	1	IV	17	PH50	14	TA	5E
CO	12	IV30-32	16	PL	4	TD	9S
CR	1	IV36	16	PO	3	TD12	9E
CT	2	KA	14	PO18-22	2	TD15	9E
CV	6	KT	1	PR	7E	TF	6
CW	7E	KW	17	RG	1	TN	2
DA	2	KW15-17	19	RG21-29	3	TQ	4
DD	15	KY	15	RH	1	TR	4
DE	6	L	7E	RH1-20	2	TS	10
DG	8S	LA	7E	RH77	2	TW	1
DH	10	LA7-23	8E	RM	12	UB	1
DH4-5	9E	LD	13	S	11	W	1
DL	10	LE	6	S18	6	WA	7E
DN	11	LL	7W	S32-33	6	WC	1
DT	3	LL23-27	13	S40-45	6	WD	1
DY	6	LL30-78	13	S49	6	WF	11
E	1	LN	11	SA	5W	WN	7E
EC	1	LS	11	SA14-20	13	WR	6
EH	15	LS24	10	SA31-48	13	WS	6
EH43-46	9S	LU	1	SA61-73	13	WV	6
EN	1	M	7E	SE	1	YO	10
EN9	12	ME	2	SG	1	YO15-16	11
EX	4	MK	1			YO25	11
FK	14	ML	14			ZE	20
FY	7E						

Table 1

kWh/kWp Value (Kk)

Tables of kWh/kWp (Kk) values for each postcode zone are available for download from the MCS website. They provide kWh/kWp values for the zone in question for 1° variations of inclination (pitch) and 5° variations of orientation.

Note: This data has been provided by the European Commission, Joint Research Centre. The data is drawn from the Climate-SAF-PVGIS dataset and multiplied by 0.8.

Orientation

The orientation of the array is to be measured or determined from plan. The required value is the azimuth angle of the PV modules relative to due South. Hence, an array facing due south has an azimuth value of 0°; an array facing either SW or SE has an azimuth value of 45°; and an array facing either East or West has an azimuth value of 90°.

The azimuth value is to be rounded to the nearest 5°.

Inclination

The inclination (or pitch) of the array is to be measured or determined from plan. The required value is the degrees from horizontal. Hence, an inclination of 0° represents a horizontal array; 90° represents a vertical array.

The inclination value is to be rounded to the nearest 1°.

Shade factor (SF)

Where there is an obvious clear horizon and no near or far shading, the assessment of SF can be omitted and an SF value of 1.00 used in all related calculations.

Otherwise, determine likely losses due to shade using a suitable method such as that described in Appendix A where SF shall be calculated using the following formula:

$$1 - \text{Estimated Loss} = 0.XX$$

For example, where it is estimated that losses due to shade will be 11% then:

$$SF = 1 - 0.11 = 0.89$$

Alternative methodologies to that described in Appendix A shall only be used when it can be demonstrated that they are equivalent to or better than the MCS methodology in Appendix A.

Where alternative methodologies are used then SF may have to be derived. Where using proprietary software then one way of doing this would be to model system generation both with and without the obstacles causing shade thus:

$$SF = \frac{\text{Annual Generation with shade}}{\text{Annual Generation without shade}}$$

4 ELECTRICAL ENERGY STORAGE SYSTEMS

4.1 Determine the specific method for estimating system performance (See Figure 2):

4.1.1 Where the EESS is intended to increase the self-consumption of solar PV follow the procedure in section 4.2.

4.1.2 Where the EESS is **not** intended to increase the self-consumption of solar PV follow the procedure in section 4.3.

4.1.3 Where the EESS is intended to increase the self-consumption of solar PV **and** additional services follow the procedure in section 4.4.

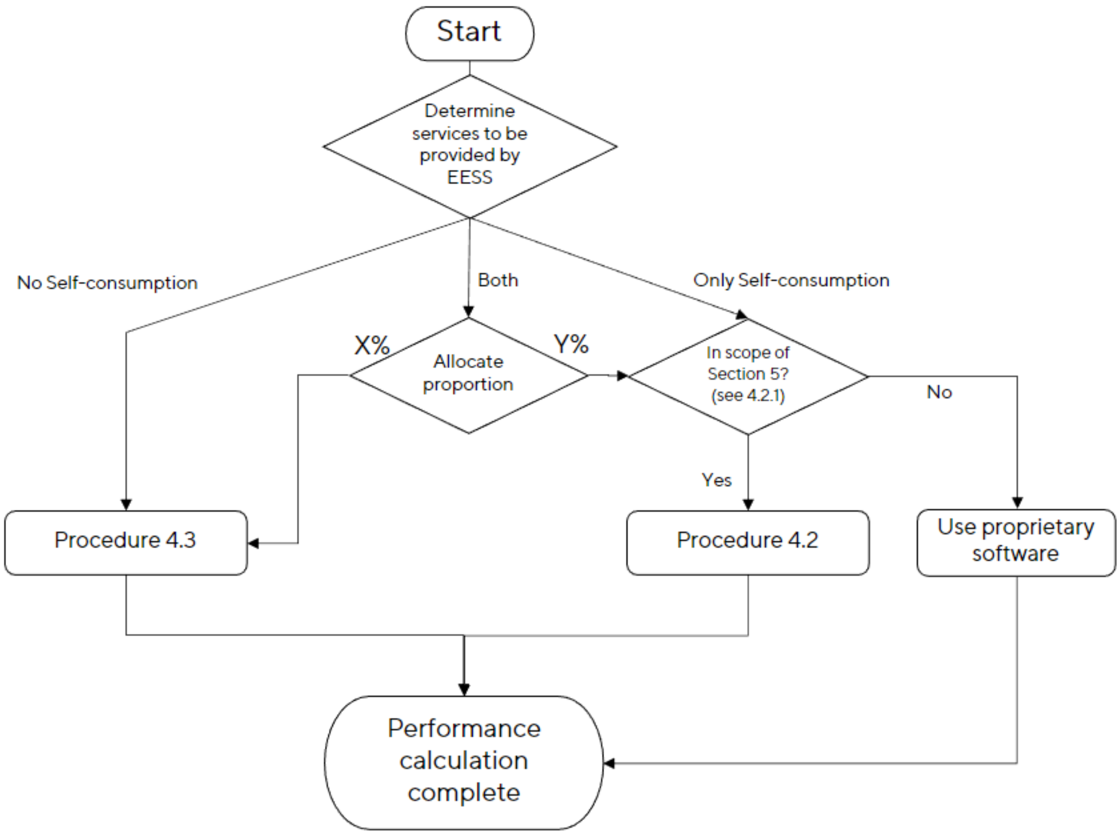


Figure 2: Determine the required method to be used for MCS performance estimates

4.2 Where the EESS is intended to increase the self-consumption of solar PV

4.2.1 Determine if the application is within the scope of Section 5:

a) The EESS is serving a domestic building

b) The annual electricity consumption is between 1500 kWh and 6000 kWh (excluding consumption attributable to electric vehicles and electrified space heating).
c) The estimated annual generation of the solar PV system (calculated in accordance with MIS 3002) is between 1500kWh and 6000kWh
d) There are no other forms of local electricity generation serving the building (other than the solar PV)

4.2.2 If the application is in-scope of Section 5 then:

a) Follow the procedure in Section 5 and the requirements in Section 6.4

4.2.3 If the application is out of scope of Section 5 calculate self-consumption using proprietary software.

4.2.4 Where additional self-consumption is anticipated from power diverters, electric space heating, electric water heating or electric vehicle charging this can be calculated using any suitable method and the results shall be included in section E of Table 5 prescribed in Section 6 provided that the sum of all self-consumption shall not exceed 95% of:

a) The total annual generation of the solar PV system
b) The total annual domestic electricity consumption (including consumption attributed to domestic loads, EV charging and electric heating)

Note: even when solar PV generated electricity is used for EV charging etc. it is unlikely in most domestic situations for self-consumption to be 100% as there is always likely to be times, particularly mid-year, when some export is inevitable because the EV is not home or plugged in (or may be fully charged), space heating is not required and any power diverters have heated hot water cylinders to the maximum safe temperature.

4.3 Where the EESS is NOT intended to increase the self-consumption of solar PV

4.3.1 Calculate total energy discharged each year by multiplying the useable capacity by a factor of 730 and include in section E of Table 5 prescribed in Section 6.

Note: other services can include backup power, arbitrage, and ancillary services. Benefits are often a function of the number of units (kWh) charged and discharged which in turn is a function of the number of cycles. The greater the number of cycles then the greater the benefits can be but the longevity of the EESS can be adversely affected. Therefore, MCS limits the number of cycles assumed when calculating the total energy discharged each year to 2 cycles per day, 730 cycles each year.

4.4 Where the EESS is to increase the self-consumption of solar PV AND other services

4.4.1 Decide on the proportion of the EESS useable capacity in kWh:

a) To be allocated for self-consumption and use that in the procedure prescribed in section 4.2 (shown as Y% in Figure 2)
b) To be allocated for other services and use that in the procedure prescribed in section 4.3 (shown as X% in Figure 2)

Note: the sum total of the capacity allocated to each calculation cannot exceed 100% of the total useable capacity of the EESS. It is understood that the capacity allocated for each function can change throughout a year, but an assumed average should be used.

4.5 Worked example for an EESS with useable capacity of 13kWh

A. Solar PV installation data		Calculations
Installed capacity of PV system – kWp (stc)	3 kWp	
Orientation of the PV system – degrees from South	45°	
Inclination of system – degrees from horizontal	30°	
Postcode region	1	
B. Performance calculations		
kWh/kWp (Kk) from table	925 kWh/kWp	
Shade Factor (SF)	1.0	
Estimated annual output (kWp x Kk x SF)	2775 kWh	3 x 925 x 1.0
C. Estimated PV self-consumption – PV Only		
Assumed occupancy archetype	Home half day	
Assumed annual domestic electricity consumption	3500 kWh	Table 9.14 from MGD003
Expected solar PV self-consumption (PV Only)	805 kWh	2775 x 29%
Grid electricity independence / Self-sufficiency (PV Only)	23%	805/3500 × 100
D. Estimated PV self-consumption – with EESS		
Assumed usable capacity of electrical energy storage device, which is used for self-consumption	9 kWh	
Expected solar PV self-consumption (with EESS)	2276 kWh	2775 x 82%
Grid electricity independence / Self-sufficiency (with EESS)	65 %	2276/3500 × 100
E. Additional benefits from PV and EESS		
EESS capacity not used for self-consumption	4 kWh	13 kWh – 9 kWh
Total energy discharged per annum	2920 kWh	4 × 730
Additional self-consumption from EV, heat pumps, diverters (only when present)	360 kWh	2775 × 95% - 2276

5 SOLAR PV SELF-CONSUMPTION (WITH AND WITHOUT EESS)

5.1 Scope

5.1.1 This section describes a method to estimate the electrical self-consumption of solar photovoltaic (PV) installations with and without an EESS for domestic buildings.

5.1.2 The method is not applicable for non-domestic buildings.

5.1.3 Heat storage devices are not included.

5.1.4 Additional self-consumption arising from non-typical domestic loads such as electric space heating, swimming pools, heat pumps, electricity power diverters, electric water heating and electric vehicles is not accounted for in the method.

5.1.5 Lookup tables are provided on the MCS website to determine the average self-consumption of electricity from solar PV with and without an EESS for particular generation, demand and occupancy archetypes.

5.1.6 Inherent variability in user behaviour and solar PV generation means that there will be uncertainty in the self-consumption of solar PV with and without an EESS. Therefore, self-consumption calculated is not a performance prediction for an individual property but rather it is the average self-consumption for a sample of domestic properties with similar occupancies, electricity consumption and solar PV systems. The self-consumption value therefore should only be considered an estimate of the energy saving that might be expected.

5.1.7 The method given can also be used as a sense check for sizing decisions of EESS products, but has not been designed to be used as an EESS design or sizing tool.

5.1.8 The results do not reflect the change in consumer behaviour which often occur after installing microgeneration systems, such as energy savings consequent from greater energy awareness through the installation and use of monitoring equipment and smart meters, or utilisation of active energy management systems, such as diverters.

5.1.9 The method is equally suitable for when solar PV and EESS installed at the same time and when an EESS is retrofitted to a property with an existing solar PV installation.

5.1.10 The following additional assumptions apply:

- The method for determining the generation from solar PV systems is as described in Section 3 above.
- The total annual domestic electricity consumption is between 1,500 kWh and 6,000 kWh per year.
- The total expected annual electricity generation from the solar PV system is less than 6,000 kWh per year.
- Any EESS:
  - Has a round-trip efficiency at 25°C (as defined by BS EN IEC 62933-2) greater than or equal to 80%.
  - Has a power rating sufficient for them to be fully charged and discharged within 6 hours at rated power.

5.1.11 Whilst it is also assumed that any EESS is primarily operated in a "self-consumption mode" with solar PV, it is permissible to use other operating modes which reduce the self-consumption benefit e.g. time of use charging, ancillary services or backup. In this case, the impact of this on reduced self-consumption should be calculated and clearly communicated.

5.1.12 Both the PV system and any EESS are connected in parallel with the distribution network. Systems not normally operating in parallel with the distribution network ("Off-Grid") are not included due to differences in the electricity consumption patterns of off-grid properties.

5.1.13 The self-consumption estimate is valid for the first year of the EESS installation. It does not reflect the changing self-consumption as a result of degradation in solar PV output, battery degradation and changing behaviour.

5.1.14 The self-consumption value in subsequent years may still be estimated using the method provided that the usable capacity of an EESS, occupancy archetype and a post-degradation solar PV generation are representative for the year under consideration.

5.1.15 Systems outside of the scope of this section shall use a method for calculating self-consumption that is no less valid than that within section 5.2.

5.2 Procedure

5.2.1 Self-consumption is determined using: the total annual expected AC electricity generation in kWh from the solar PV system, the annual electricity consumption of the property in kWh and the domestic occupancy archetype. In the case of electrical energy storage, any increase in annual self-consumption shall be estimated using the usable capacity of the energy storage device. The value of these parameters shall be determined as described below.

5.2.2 Occupancy archetype

a) Self-consumption is estimated for different occupancy archetypes (see Table 2). These archetypes describe when the domestic property is occupied during the day and represents an important behavioural component in the efficacy of solar PV and EESS.

b) The appropriate occupancy archetype is to be selected by asking the occupier which archetype best represents their typical occupancy pattern. The closest approximation to the idealised archetypes should be used.

c) The number of occupants in a property is not directly considered as this is represented (as a proxy) by the annual electricity consumption.

Table 2: Description of occupancy archetypes

Occupancy archetype	Description
Home all day	The domestic property is generally occupied by at least one occupant between 9:00am to 5:00pm on weekdays
In half the day	The domestic property is typically empty for half the day e.g. either all morning or all afternoon on weekdays.
Out all day	The domestic property is typically empty on weekdays
Occupancy unknown	If typical occupancy behaviour is unavailable, refer to the "in half the day" data table.

5.2.3 Establishing annual electricity consumption

a) The annual electricity consumption is the total amount of electricity consumed in the property in kilowatt-hours (kWh) in a full 12-month period. Depending on the circumstances, this should be derived in one of the following ways:

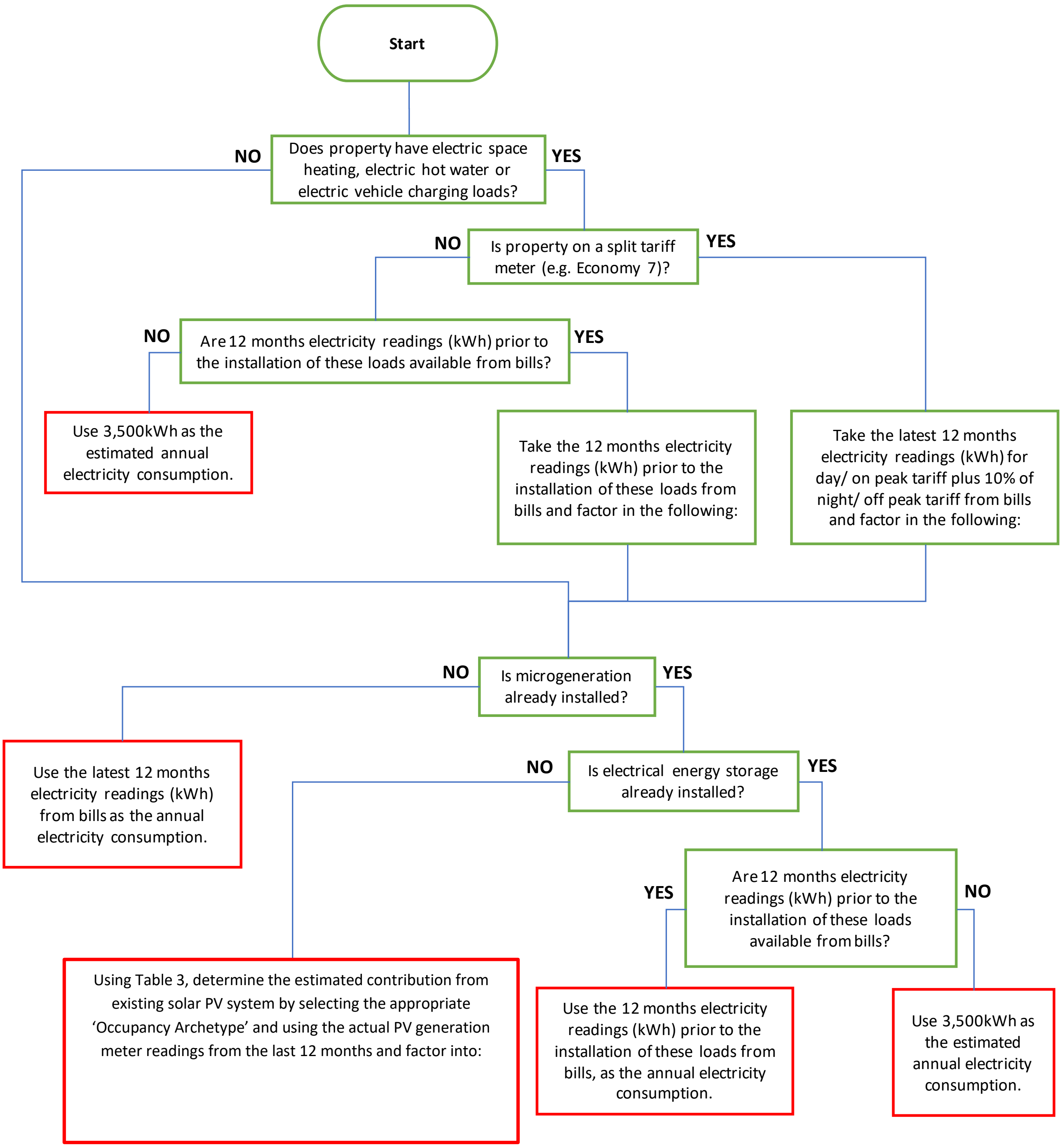


Figure 3: Flowchart showing how electricity consumption should be determined

b) In the absence of any microgeneration:

If the property has no microgeneration, then the annual electricity consumption is taken from the latest available information, preferably electricity utility bills from a supplier based on actual meter readings.

c) Adjustments for the presence of an electric vehicle or electric space heating (in properties with or without domestic solar PV):

If possible, the electricity consumption used to determine self-consumption shall exclude electricity used to provide domestic space heating / hot water or electric vehicle charging although this is not essential. To do so, an annual grid electricity reading before the installation of electric heating / hot water or electric vehicle charging should be used if available.

d) In the presence of microgeneration in the form of domestic solar PV without an EESS:

Where the property already has solar PV then electricity bills and meter readings will be net of the contribution from the PV. Therefore to establish the amount of electricity consumed it needs to be added back in:

Obtain the units (kWh) of grid electricity purchased from a supplier from the latest available information, preferably a recent electricity bill based on actual meter readings.

Lookup the estimated contribution from the solar PV using Table 3. The occupancy archetype shall be selected in accordance with the guidance in 5.2.2. The annual electricity generated by solar PV system in accordance with 5.2.4.

The annual electricity consumption is then calculated as the sum of the metered/purchased electricity and the contribution from the solar PV system.

e) In all other cases:

If it is not possible to determine the annual electricity consumption or if none of the above circumstances apply, then the annual electricity consumption shall be taken as

3,500kWh per annum. This is the mean, non-population weighted British electricity consumption according to UK Government statistics[1].

Note: alternative methods, such as readings from in home electricity monitors, are not recommended as these do not always have MID approval and may have poor accuracy.

Table 3: Lookup table to determine the contribution of solar PV when already reducing metered/purchased electricity. Values are in kWh.

Annual contribution of existing solar PV generation to domestic electricity supply			
Annual electricity generated by solar PV system, kWh	Occupancy Archetype: Home all day	Occupancy Archetype: In half day	Occupancy Archetype: Out all day
0 kWh to 299 kWh	143	127	98
300 kWh to 599 kWh	347	288	219
600 kWh to 899 kWh	499	427	327
900 kWh to 1,199 kWh	616	506	379
1200 kWh to 1,499 kWh	715	580	424
1500 kWh to 1,799 kWh	794	644	459
1800 kWh to 2,099 kWh	859	697	488
2100 kWh to 2,399 kWh	916	742	512

[1] Source: Department of Business, Energy and Industrial Strategy. SUB-NATIONAL ELECTRICITY AND GAS CONSUMPTION STATISTICS. January 2018. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/678653/Sub-national_electricity_and_gas_consumption_summary_report_2016.pdf

2400 kWh to 2,699 kWh	968	782	534
2700 kWh to 2,999 kWh	1,016	814	554
3000 kWh to 3,299 kWh	1,063	844	573
3300 kWh to 3,599 kWh	1,103	874	592
3600 kWh to 3,899 kWh	1,140	905	611
3900 kWh to 4,199 kWh	1,174	934	624
4200 kWh to 4,499 kWh	1,205	957	634
4500 kWh to 4,799 kWh	1,234	979	640
4800 kWh to 5,099 kWh	1,261	1,002	647
5100 kWh to 5,399 kWh	1,291	1,024	654
5400 kWh to 5,699 kWh	1,318	1,046	659
5700 kWh to 5,999 kWh	1,344	1,067	661

Note:
Values in Table 3 have been derived reflecting non-storage cases and annual electricity consumption of 3,500 kWh per annum (consistent with a reasonable UK domestic average electricity consumption).

5.2.4 Expected annual electricity generation from the solar PV system

a) An estimate of annual energy generation from the solar PV system shall be made using the methodology prescribed in Section 3; taking account of the actual orientation, pitch, location and shading conditions.

b) No adjustment for the age of the solar PV installation shall be made unless metered data is available for the particular installation to which electrical energy storage is being added.

c) Metered electrical generation data can be used for calculation as an alternative only where this has been measured by an MID approved meter. The most recently available data shall be used and this must represent a full 12-month period of generation from the solar PV system only.

5.2.5 Usable capacity of the EESS

a) The usable capacity of the EESS is the energy within the storage device available to the customer for use of any domestic energy storage application, including solar PV self-consumption. It is measured in kWh.

b) If the EESS is used for multiple functions (such as backup supply to the home or ancillary services to the network or system operator) then the usable capacity is taken as the capacity within the battery that is used for solar PV self-consumption. For example, if 20% of the battery is permanently reserved for backup, then only 80% of the usable capacity is to be used in self-consumption calculations.

c) For first and second life batteries, the usable capacity shall be taken from the product datasheet. This shall reflect the usable capacity of the storage system when installed in the domestic property. If several values are given, then the capacity at or closest 1C rate shall be used.

d) Where the EESS usable capacity is not clearly stated on the datasheet as "usable capacity" then the nominal capacity shall be taken and multiplied by the maximum depth of discharge of the EESS, calculated as follows:

$$\underline{\text{Usable Capacity} = \text{Nominal Capacity} \times \text{Maximum Depth of Discharge}}$$

e) Where the maximum depth of discharge is not clearly provided, it shall be reflective of that battery chemistry. For the avoidance of doubt, the depth of discharge must be 50% for lead acid batteries and 90% for all other electrical energy storage chemistries unless otherwise stated on the product datasheet.

f) Efficiency effects from the storage or power conversion equipment on the usable capacity do not need to be considered for the purposes of this document.

Note: Second-life batteries may have a lower usable storage capacity than their original specification. Consequently, the usable capacity of second-life batteries must be taken from the second-life product datasheet and users of this document must ensure that this reflects the capacity of the storage when it is being installed for domestic solar PV self-consumption.

5.2.6 Expected solar PV self-consumption

a) The expected self-consumption from the solar PV system with an EESS can be established once the expected solar PV generation, the annual electricity consumption, the occupancy archetype and the EESS usable capacity have been determined using the methods described above.

b) The solar PV self-consumption is tabulated in a series of lookup tables (see MCS website). Each lookup table is for a specific customer architecture and annual electricity consumption.

c) Navigate to the section which refers to the most appropriate occupancy archetype for the domestic property as determined in 5.2.2.

d) Navigate to the table which refers to the relevant total electricity consumption of the domestic property as determined in 5.2.3.

e) Each row of the table refers to an electricity generation figure from the solar PV. Identify which row corresponds to the projected electricity generation as determined in 5.2.4.

f) Each column refers to a total usable electrical energy storage capacity. For self-consumption without electrical energy storage, use the "PV Only" column. For self-consumption with electrical energy storage, identify which column refers to the usable capacity of the storage device as determined in 5.2.5.

g) The value in the identified row and column is the projected electrical self-consumption for that particular demand, generation, EESS usable capacity and occupancy archetype. This is expressed as a percentage of the total annual generation from the solar PV system.

Note: The values within the cells given in the lookup tables are rounded to whole integers for simplicity. Under certain conditions, this can give unexpected results. To avoid this the values in the excel spreadsheets also published by MCS can be used.

h) The quotable self-consumption of solar PV generation where there is NO ELECTRICAL ENERGY STORAGE is determined as follows:

$$\begin{matrix}\text{Solar PV generation directly consumed}\\ \text{within domestic property over a year (kWh)}\end{matrix} = \begin{matrix}\text{Self consumption}\\ \text{from lookup table (\%)}\\ -PV\ only\end{matrix} \times \begin{matrix}\text{Total solar PV}\\ \text{generation per annum(kWh)}\end{matrix}$$

i) The quotable self-consumption of solar PV generation with electrical energy storage is determined as follows:

$$\text{Solar PV generation consumed directly or via electrical energy storage within domestic property over a year (kWh)} = \text{Self consumption from lookup table (\%)} \times \text{Total solar PV generation per annum(kWh)}$$

Note: The self-consumption cannot exceed 95% of the total annual generation.

5.2.7 Calculating the grid electricity independence / self-sufficiency

a) The grid electricity independence / self-sufficiency is the fraction of electricity consumed in the property which is met by self-consumed electricity as calculated above.

b) This distinguishes the expected reduction in grid electricity consumption from the self-consumption.

c) To prevent irregular results this is capped at 90% of the electricity consumed in the property.

d) This is calculated as follows, where the self-consumption with or without electrical energy storage is determined as described in 5.2.6 and the annual electricity demand is determined as described in 5.2.3.

$$\text{Grid electricity independence (\%)} = \min\left(90\%, \frac{\text{Solar PV electricity self} - \text{consumption (kWh)}}{\text{Annual electricity demand (kWh)}}\right)$$

5.3 Worked examples

Table 4 provides worked examples of how to use the document lookup tables to determine the self-consumption with and without electrical energy storage for different use cases.

Table 4: Example use cases of the document lookup tables

Use case	1	2
Occupancy archetype	Home all day As per 5.2.2	In half the day As per 5.2.2
Total annual electricity consumption, kWh	3,879 kWh As per 0	5,783 kWh As per 0
Table used for electricity consumption	3,500 kWh to 3,999 kWh	5,500 kWh to 5,999 kWh
Total annual electricity generation from solar PV system, kWh	4,059 kWh As per 5.2.4	2,456 kWh As per 5.2.4
Row used for electricity generation	3,900 kWh to 4,199 kWh	2,400 kWh to 2,699 kWh

Usable capacity of EESS, kWh	7.5 kWh As per 5.2.5	5.1 kWh As per 5.2.5
Column used for self-consumption with electrical energy storage	≥ 7.1, < 8.1	≥ 5.1, < 6.1
Table used	Occupancy: Home all day. Annual electricity consumption: 3,500 kWh to 3,999 kWh Error! Reference source not found.	Occupancy: In half the day. Annual electricity consumption: 5,500 kWh to 5,999 kWh Error! Reference source not found.
Self-consumption without EESS, %	29%	39%
Self-consumption without EESS, kWh	1,177 kWh (29% x 4,059)	958 kWh (39% x 2,456)
Self-consumption with EESS, %	69%	88%
Self-consumption with EESS, kWh	2,801 kWh (69% x 4,059)	2,161 (88% x 2,456)
Grid electricity independence without EESS, %	30% (1,177 / 3,879) As per 4.7.4	17% (958 / 5,783) As per 4.7.4
Grid electricity independence with EESS, %	72% (2,801 / 3,879) As per 4.7.4	37% (2,161 / 5,783) As per 4.7.4

6 PRE-SALE INFORMATION FOR SOLAR PV AND EESS SYSTEMS

6.1 The results from the system performance estimates and self-consumption shall be communicated, in the format of Table 5, to the customer before the point that the contract is awarded.

Table 5: Format of the annual energy performance estimate:

A. Solar PV installation data	
Installed capacity of PV system – kWp (stc)	kWp
Orientation of the PV system – degrees from south	°
Inclination of system – degrees from horizontal	°
Postcode region	
B. Performance calculations	
kWh/kWp (Kk) from table	kWh/kWp
Shade Factor (SF)	
Estimated annual output (kWp x Kk x SF)	kWh
C. Estimated PV self-consumption – PV Only	
Assumed occupancy archetype	Home all day/ Home half day/ Out all day
Assumed annual domestic electricity consumption	kWh
Expected solar PV self-consumption (PV Only)	kWh
Grid electricity independence / Self-sufficiency (PV Only)	%
D. Estimated PV self-consumption – with EESS	
Assumed usable capacity of electrical energy storage device, which is used for self-consumption	kWh
Expected solar PV self-consumption (with EESS)	kWh
Grid electricity independence / Self-sufficiency (with EESS)	%
E. Additional benefits from PV and EESS	
EESS capacity not used for self-consumption	kWh
Total energy discharged per annum	kWh
Additional self-consumption from EV, heat pumps, diverters (only when present)	kWh

Notes:

Where the EESS is not installed in conjunction with solar PV to increase the PV self-consumption then sections A, B, C, D in the above table can be omitted.

Where no EESS is being installed with the solar PV then section D in the above table can be omitted.

Where occupancy archetype is not known (e.g. new build) then both sections C & D in the above table can be omitted (or marked as N/A).

Kk values for solar PV are obtained from the tables in Section 3 or Irradiance Datasets downloadable from the MCS website.

6.2 Where installing solar PV

6.2.1 The estimate shall be accompanied by the following text:

"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."

6.2.2 Where the shade factor (SF) is less than 1 (i.e. shading is present) the following additional note shall accompany the above Important Note:

Where the MCS methodology is used:

"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."

Where another methodology is used:

"Shading will be present on your system that will reduce its output to the factor stated. This factor was NOT calculated using the MCS shading methodology, but we can confirm that the system as quoted, taking into account the shading present, will deliver at least 90% of the energy (in kWh) as set out in this performance estimate."

6.2.3 Where the site has been evaluated remotely, the following additional note shall accompany the above Important Note:

"This system performance calculation has been undertaken using estimated values for array orientation, inclination or shading. Actual performance may be significantly lower or higher if the characteristics of the installed system vary from the estimated values."

6.2.4 As a minimum, the following technical information shall be communicated in writing to the customer before the point that the contract is awarded:

a) The result of the performance estimate calculated in accordance with Section 5.2.1

b) Manufacturer's datasheet for the proposed solar modules

c) Manufacturer's datasheet for the proposed inverter

d) Manufacturer's datasheet for the Module Level Power Electronics Device, if applicable

e) Manufacturer's datasheet for the proposed EESS, if applicable

f) A drawing with the proposed module layout

g) The Sunpath diagram used to calculate SF (where SF<1.0 and the MCS methodology is used)

6.2.5 For multi-building/system projects (e.g. new housing developments) items e), f) and g) above can be omitted from the information communicated in writing to the customer.

6.3 Where installing EESS

6.3.1 The estimate shall be accompanied by the following text:

"Important Note: The energy performance and benefits of EESS is impossible to predict with certainty due to the numerous functions a system can be programmed to perform. This estimate is based upon the standard MCS procedure and is given as guidance only. It should not be considered as a guarantee of performance."

6.3.2 As a minimum, the following technical information shall be communicated in writing to the client before the point that the contract is awarded:

a) The result of the performance estimate calculated in accordance with Section 5.2.1.

b) The classification of the system (see Section 2.2 in MIS 3012).

c) The battery type and any special precautions that should be taken such as ventilation and fire safety.

d) The physical characteristics of the system (size and weight).

e) The proposed location of the system.

f) Whether AC or DC coupled and if using an existing in-situ inverter.

g) Maximum power output in kilowatts (kW).

h) Maximum continuous current output in amperes (A).

i) The useable storage capacity in kilowatt-hours (kWh) accounting for the maximum allowable depth of discharge.

Note: it would be helpful for consumers if the useable storage capacity could be expressed in terms of the time that particular devices could be run. For example, a 100 W Television with 100 W of lighting could run for X hours.

j) Round-trip efficiency (%) and energy loss (kWh) if charged from grid electricity.

k) Current cost of additional or replacement batteries, monoblocs or cells.

l) If capable (or not) of running in Island mode (during loss of grid power) and limitations in terms of maximum load in kW.

m) Warranties applying to the system and its storage capacity (degradation, number of cycles, energy throughput etc.)

n) How the EESS indicates its current usable capacity or state of health (thus indicating if it is ending its life or the storage capacity is below the warrantied capacity).

o) For Class 3 and Class 4 systems, the warranties provided for each discrete component.

p) End of life, recycling, arrangements in accordance with the Waste Electrical and Electronic Equipment Regulations 2013 as amended and the Batteries and Accumulators (Placing on the Market) Regulations 2008 as amended.

q) Where the EESS is to be remotely controlled by third parties, the terms of that arrangement including the terms applying should the consumer wish to terminate the arrangement and assume full control of their system. Penalties for early termination shall be clearly stated.

r) If the EESS can be controlled to respond to time of use electricity tariffs and, if so, how. It shall be highlighted whether this is a manual process (manually setting charge and discharge times) or can be automated (such that charge and discharge times change automatically when tariffs change).

Note: it is the intention of MCS to review MIS 3012 such that, when the technology and communication protocols become commercially available, requirements will be introduced stipulating that EESS certifiable under MCS shall be able to communicate directly and locally with smart meters in real time and respond automatically where programmed to do so. Systems not able to operate this way may cease to be compliant.

Furthermore, systems that seek to keep consumers captive within a particular software platform, limiting consumers' choice of how their EESS can be used, may also be restricted or otherwise made non-compliant through the introduction of relevant requirements.

6.4 Communication on self-consumption

6.4.1 Where self-consumption is quoted with an electrical energy storage system (EESS) it shall be made clear if the MCS contractor is not certified in accordance with MIS 3012.

6.4.2 This document provides self-consumption values for domestic properties given specific occupancy archetype, solar PV electricity generation and electricity consumption.

a) The self-consumption figure for the solar PV installation shall be communicated in a written format and in such a way that it is clear whether this refers to a case with and without electrical energy storage.

b) It is permissible to communicate self-consumption for each of the occupancy archetypes on the same system. Both solar only and solar with storage values must be communicated. It must be clear which archetype it is assumed the customer corresponds to.

6.4.3 The advantages and disadvantages of other architectures and technologies can be qualitatively represented.

6.4.4 The self-consumption shall be communicated in both the estimated annual kWh and percentage of solar PV electricity consumed.

a) The annual domestic electricity consumption of the property used in the calculation in order to clearly demonstrate the grid electricity independence and solar self-consumption are distinct quantities.

6.4.5 The estimate shall be accompanied by the following text:

"The solar PV self-consumption has been calculated in accordance with MCS 032: Solar PV Self-Consumption. The self-consumption is valid before the impact of power diverters, electric space and water heating and electric vehicle charging are considered."

"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."

6.4.6 The following should be made clear to the customer:

a) The self-consumption value is an estimate of the average for the selected occupancy archetype, solar PV electricity generation and demand according to the modelling work undertaken for this document. As a result, the self-consumption value should not be treated as a performance prediction for that specific customer due to unique behavioural aspect for each dwelling and occupancy.

b) The resulting figures ascertained by this document should be used as a basis for impartially comparing offers from different installers and/ or different system sizes.

c) The self-consumption value can vary on an annual basis due to changes in irradiance, demand, occupancy and appliance choices.

APPENDIX A – SHADING PROCEDURE

This Appendix is provided as guidance. It is neither a mandatory MCS requirement, nor contains mandatory requirements, unless expressly stated as such in an MCS installation standard (MIS) using the words “should” or “shall” in the reference to MCS 032 or its clauses.

The purpose of this document is to describe a procedure to assess the potential impact of shading on a solar photovoltaic array as a result of both near and far objects. The result is a shade factor (SF) which can be used to modify the amount of electricity that it is predicted might be generated by a proposed solar photovoltaic (PV) system.

This procedure has been designed to provide a simplified and standardised approach for MCS contractors to use when estimating the impact of shade on system performance. It is not intended to be as accurate as more sophisticated methods such as, for example, those included in proprietary software packages. It is estimated that this shade assessment method will yield results within 10% of the actual annual energy yield for most systems. Unusual systems or environments may produce different results.

Where the proposed location for the PV array is subject to significant shading from numerous objects, and making assessment difficult, then installation in that location may simply not be appropriate and the customer should be advised. Near shading especially will have a considerable effect on system performance and should be avoided. Solar PV systems should not be sold where the impact of shade could be severe.

Module level power electronics can also be considered to reduce the impact from shading although this shade evaluation procedure does not account for the benefit of such devices because of the variability between projects. Proprietary software can be used to model shade both with and without module level power electronics.

HEALTH WARNING
This evaluation method implies the need to undertake assessment at height which can be very dangerous. In most cases it should be possible to follow the method without climbing on roofs provided you can be confident the result is representative. Where users of this method decide working at height is necessary then all appropriate precautions should be taken to reduce the risk of death or injury from falling.

Procedure:

Where there is a potential for shading from objects further than 10m away from the centre midpoint of the array then the procedure given in clause A1 shall be used.

Where there are objects at or less than 10m away (near shade) from the centre midpoint of the array then the procedure stated in clause A2 shall be used.

Assessment shall be undertaken and recorded using the Sunpath chart given in A4 to represent the potential irradiance which could be blocked by objects on the horizon at differing times of the day and of the year (as indicated by the different arcs).

Note: where manipulating or drawing on the Sunpath chart on a computer it is important the proportions of the chart are not distorted.

A1. Objects further than 10m

Principles

The chart has a total of 84 segments each of which has a value of 0.01.

By marking objects on the horizon according to their height and orientation in relation to the proposed array the segments that are touched are then counted to derive the Shade Factor

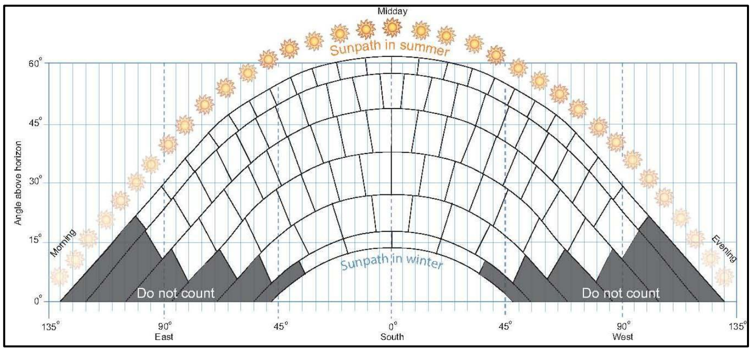


Figure 3: Sunpath chart showing segments

Location

Stand as near as possible to the base and centre of the proposed array, e.g. through an upstairs window, unless there is shading from objects within 10m (e.g. aerials, chimneys, etc.) in which case follow the procedure given later.

Tools

As a minimum the tools required to undertake this analysis are a compass and a device to measure the elevation of obstacles on the horizon such as an inclinometer.

Other more sophisticated tools can be used, and a selection are discussed in Section A3

Detailed Method

Looking due south (irrespective of the orientation of the array), draw a line showing the uppermost edge of any objects that are visible on the horizon (either near or far) onto the Sunpath chart.

This line is called the "horizon line", an example of which is shown here:

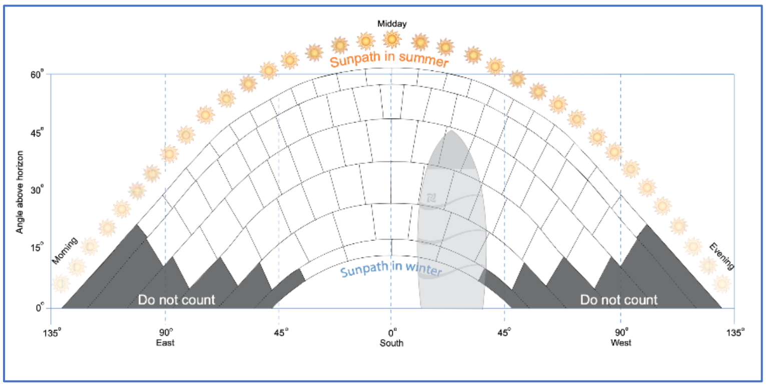


Figure 4: Sunpath Chart with object on the horizon

Once the horizon line has been drawn, the number of segments that have been touched by the line, or that fall under the horizon line shall be counted, in the following example you can see there are 11 segments covered or touched by the horizon line.

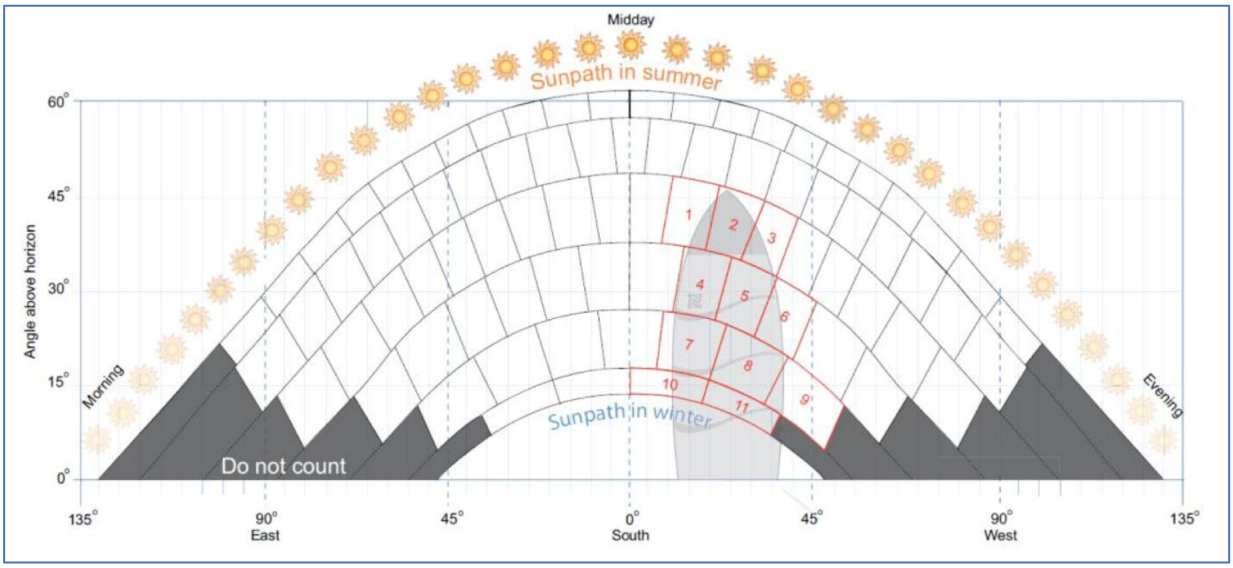


Figure 5: Sunpath chart showing segments affected and counted

In Figure 5 the total number of affected segments is 11. This number is then multiplied by their value for each segment (0.01) and the total deducted from 1 to arrive at the Shading Factor (SF) for the proposed installation. In this example the shading factor is calculated as follows:

$$1 - (11*0.01) = 1 - 0.11 = 0.89$$

Notes:

Printing the Sunpath chart onto paper to hold at arm's length and sketching the horizon will not produce a valid result.

For systems connected to module level optimisers, multiple inverters, or a single inverter with multiple independent maximum power-point trackers (MPPT), it is acceptable to do a separate calculation of SF for each sub array (each array connected to a dedicated MPPT).

A2. Objects at, or less than, 10m

Principles

Shading from objects close to the array (for example: vent pipes, chimneys, and satellite dishes located to the East, South, or West) can have a very significant impact on the performance of PV systems. This is because near objects cast larger shadows, and for more hours of the day, than objects further away. Objects located behind the proposed array (e.g. to the North) do not need to be considered as they will cast little, if any, shadow.

To reflect this greater impact the method counts all segments affected within a circle with a radius equal to the height of any object casting a shadow.

Where such shading is apparent, it is strongly recommended that either the array should be repositioned away from the objects casting a shadow, or the object(s) casting the shadow should be removed altogether. Then there would be no need to use this method.

A further option would to perform a series of calculations and measurements that would allow you to create a chart representative of the shadows cast by objects.

Where the installation is still to proceed, and only when all other options have been discounted, then the following method should be used.

Location

The reading should be taken from the array location worse affected by shade. This will usually mean a location just south of the object casting a shadow.

Tools

The same tools should be used as described previously. Additionally, a working platform should be erected or, if a roof is to be accessed only with a ladder, then fall arrest equipment should be used.

Other more sophisticated tools can be used, and a selection are discussed in Section A3

Detailed Method

Looking due south, a standard horizon line, as described in Section A1, should be drawn onto the Sunpath chart.

Objects on the horizon that are 10m or closer to any part of the array, shall have a shade circle added to the chart. Where there are multiple objects within 10m, then multiple circles shall be drawn – one for each object.

The shade circle shall have a radius equal to the height of the object. The shade circle should be located so that the apex of the circle sits on the highest point of the shade object.

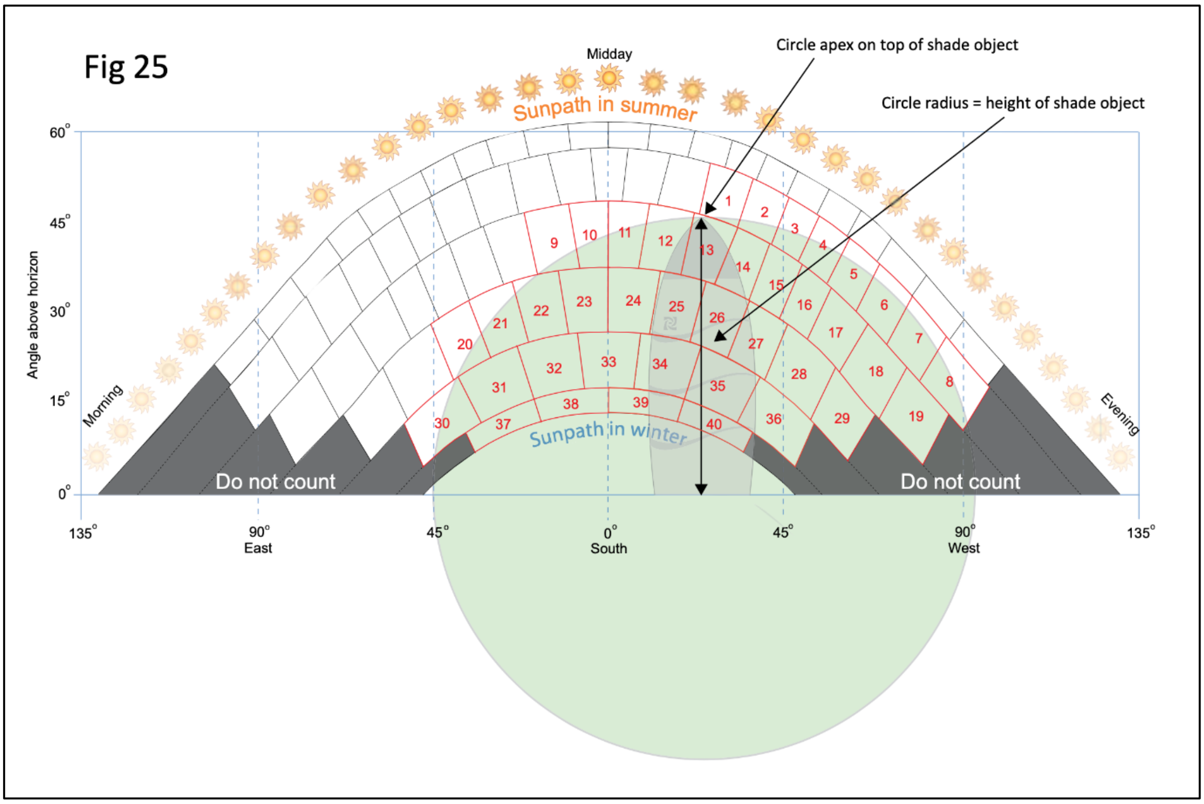


Figure 6: Sunpath chart showing near object, circle and segments counted

If the top of any object extends above the uppermost arc, which represents the Summer path of the Sun, then the apex of the circle should be located at the intersection of the object and that arc.

All segments touched by or within the shade circle should be counted as part of the overall shade analysis.

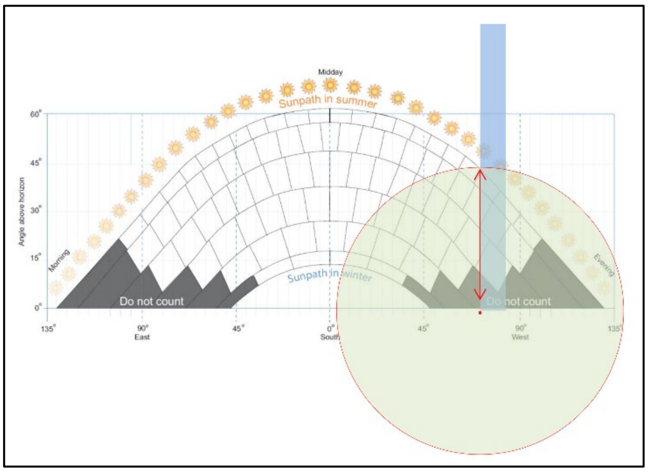
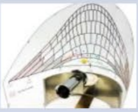


Figure 7: Object above the uppermost arc

In the example shown, using the same shade object as before but now assumed to be nearer than 10m, 40 segments are counted resulting in a shade factor of 0.6 (compared with 0.89 before).

A3. Examples of shade assessment tools

Method		Advantages	Disadvantages
	**Compass & elevation tool**	• Low cost • Readily available tools • Good for simple shade objects	• Slow • Difficult for complex shade
	**Reflective dome tool**	• Good visualisation of shade • Quick	• Needs transferring to MCS chart • Needs space to operate
	**Transparent acetate tool**	• Instant visualisation of sunpath • Quick	• Lower resolution?
	**Phone Apps**	• Instant visualisation of sunpath • Quick	• Checking (compass errors) • Identifying near objects • Needs transferring to MCS chart
	**Camera methods**	• Creates good record for client	• Needs transferring to MCS chart
	**Electronic shade analyser**	• Quick • Accurate • Remote pole mount option	• Cost
	**3D modelling** (a way of plotting existing data)	• Good for new build sites • Can animate shade travel • Can model different scenarios	• Slow • Still need to collect site data • Need object heights

A4. Sunpath diagram