164 Harefield Road, Uxbridge UB8 1PP

Daylight and sunlight report

Daylight and sunlight report
June 2024

Revision Schedule

Daylight and sunlight report
June 2024

Rev	Date	Details	Prepared by	Reviewed by	Approved by
1	June 2024	Draft	P Giesberg	S. Bamford	P Giesberg

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1 Introduction

It is proposed to erect a detached three-bedroom house to the rear of 164 Harefield Road, Uxbridge UB8 1PP. The proposed new house has the potential to affect the daylight and sunlight availability of the neighbouring properties and gardens. In addition the amenity quality with regards to daylight and sunlight of habitable rooms and garden space in the new house was examined. This report has been prepared in support of the planning application for the proposed development.

The proposed development is situated in a sub-urban residential neighbourhood in Uxbridge. (Fig. 1).

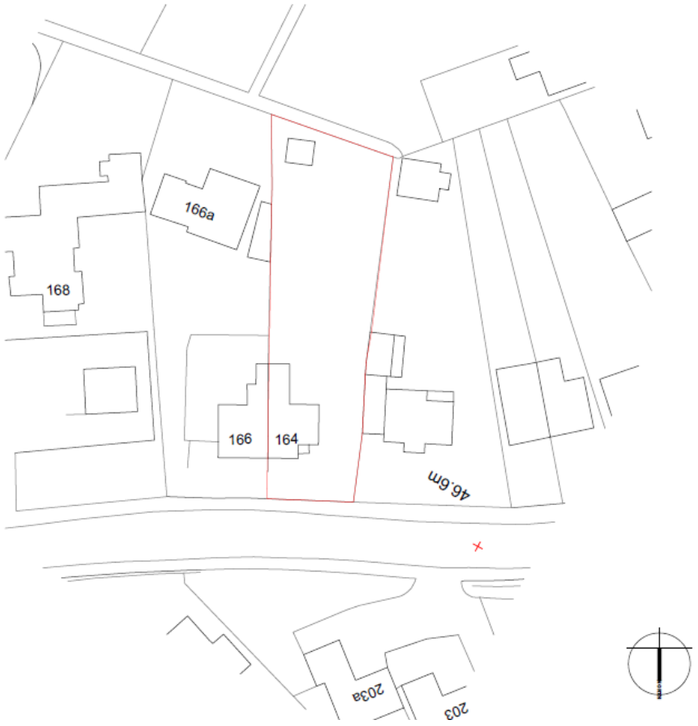


Figure 1. Site overview

2 Methodology and assessment criteria

2.1 Planning policy

The London Plan and Daylight and Sunlight Impacts

The London Plan 2021 includes a policy with regards to the daylight and sunlight impacts on neighbouring properties in "Chapter 3 Designs". Policy 6 Housing Quality and Standards states in clause D:

"*The design of development should provide sufficient daylight and sunlight to new and surrounding housing that is appropriate for its context, whilst avoiding overheating, minimising overshadowing and maximising the usability of outside amenity space."*

At this moment there are no revised guidelines in the London Plan on how to address this issue and the London Plan 2021 refers to the 2016 Housing SDP in this regard. In paragraph 1.3.45 it states:

"*An appropriate degree of flexibility needs to be applied when using BRE guidelines to assess the daylight and sunlight impacts of new development on surrounding properties, as well as within new developments themselves. Guidelines should be applied sensitively to higher density development, especially in opportunity areas, town centres, large sites and accessible locations, where BRE advice suggests considering the use of alternative targets. This should take into account local circumstances; the need to optimise housing capacity;*

2.2 Input data

A 3D model of the proposed new building and neigbouring properties was created using information provided by the client for the proposed development site, the planning portal for the neigbouring properties and a site visit to add further detail. The architectural drawings are shown in Appendix 1 and an overview of the 3D model in appendix 2.

2.3 Effects on existing buildings

The effects of the proposed buildings on the availability of daylight on the existing buildings have been considered. The appraisal has been carried out using the methodology set out by Paul Littlefair and colleagues in BR209 "*Site layout planning for daylight and sunlight: a guide to good practice*" (2022) (BRE Trust)

Diffuse light from the sky

It is important to safeguard the daylight that is available for nearby buildings in living rooms, kitchens and bedrooms. The Vertical Sky Component (VSC) is a measure of available daylight on a particular surface or window. The guidelines in the BRE209 document state that where a window has a VSC of 27 % or more daylighting is unlikely to be affected. In cases where the VSC is less than 27%, it is unlikely that a change in daylighting will be noticeable if a reduction in VSC is not less than 0.8 times the original value. Where information about internal layout is available a further test is the reduction in the area with a view of the sky is not more than 20%.

Where a room has more than 1 window the average weighted VSC could be used under certain circumstances, although care should be taken to use an average in extreme cases and where the windows are too far apart to be considered to provide daylight to the same habitable area.

Sunlight Availability

If a living room of an existing dwelling has a window facing with 90 degrees of due south and any part of a new development subtends an angle of more than 25 degrees to the horizontal measured from the centre of the window in a vertical section perpendicular to the window then the sun lighting of the existing dwelling may be adversely affected. This will be the case if the centre of the window meets all of the following three criteria:

- It receives less than 25% of annual probable sunlight hours (ASHP) or less than 5% of the annual probable sunlight hours between 21 September and 21 March
- It receives less than 0.8 times its former sunlight hours during either period
- It has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours

Sunlight and Gardens and open space

The BRE guidance recommends that for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21 March. If as a result of new development an existing garden or amenity area does not meet the above and the area which can receive two hours of sun on 21 March is less than 0.8 times its former value, then loss of sunlight is likely to be noticeable.

Overshadowing of Solar Panels

The impact of new development on existing solar panels on neighbouring properties is a material planning consideration as confirmed in the High court Judgement in the case of William Ellis McLennan vs Medway Council and Ken Kennedy (2019). The BRE document “Site layout planning for daylight and sunlight- A guide to good practice” (3rd edition 2022) provides guidance on the assessment of the potential impact of new buildings on neighbouring solar panels.

The guidance states that where the annual probable sunlight hours received by the centre of the panels after the development is implemented is not below 0.9 times the number of hours it receives under baseline circumstances, then the impact is negligible and no further detailed analysis is required. This guidance is specific for photovoltaic cells that are installed using micro-inverters on each panel.

Older systems often have only one inverter (also referred to as a string inverter) for the entire array or groups cells in larger arrays. In these circumstances a reduction on one panel, will cascade to the other panels in the same group, thereby exacerbating the reduction in output. A full yield assessment using the PVSyst software will provide accurate estimate of the effect of the new development on neighbouring PV arrays.

2.4 Daylight Provision Calculations

BS EN 17037:2018+A1:2021 recognises two methods to assess daylight provision to the interior. Both should be determine using specific software.

Method 1: Calculation method using daylight factors on the reference plane
Method 2 Calculation method of illuminance levels on the reference plane using climatic data for the given site and an adequate time step.

The central requirement of the standard is set out in table 1 below.

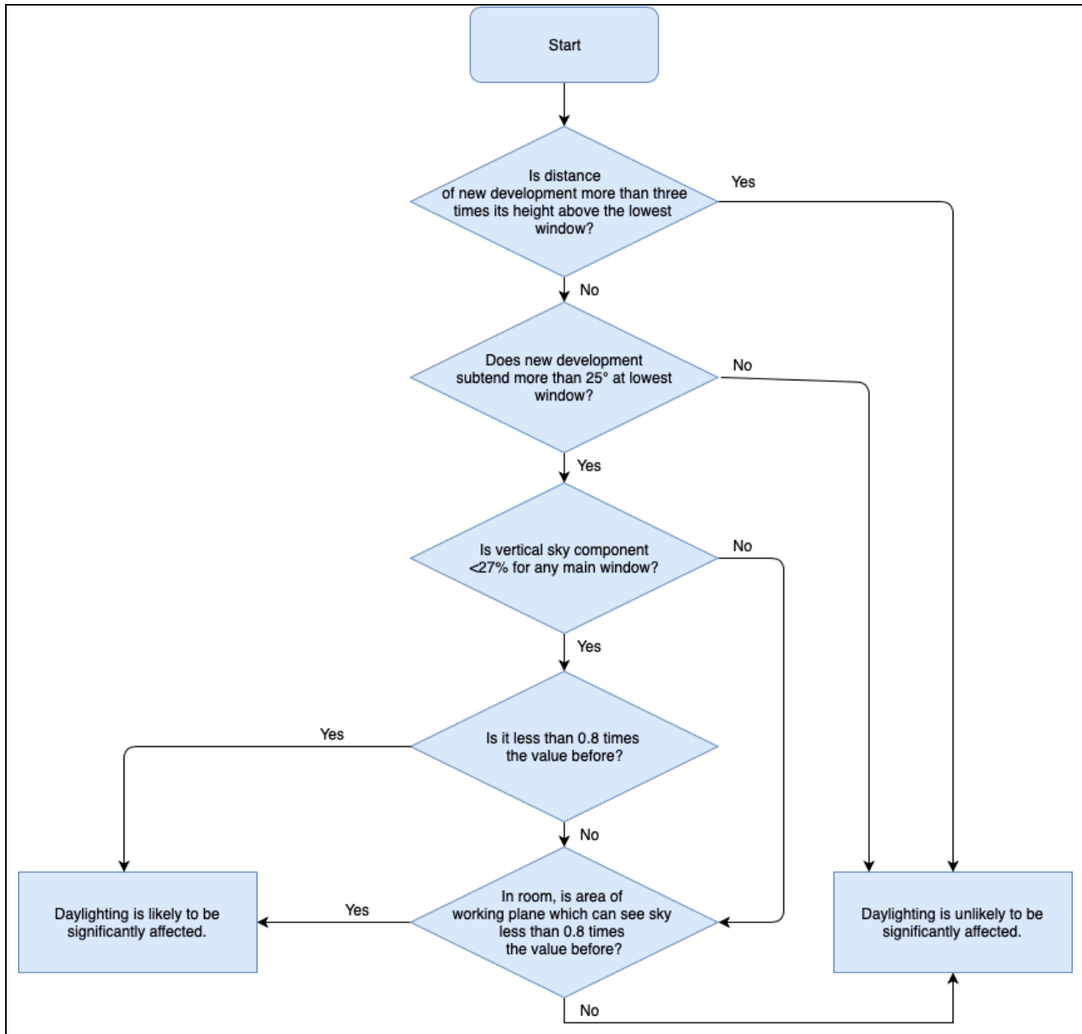


Figure 3. Decision chart daylight in existing buildings.

Table 1: Recommendations of daylight provision by daylight openings in vertical and inclined surface.

Level of recommendation for vertical and inclined daylight opening	Target illuminance E_T lx	Fraction of space for target level $F_{plane,\%}$	Minimum target illuminance E_{TM} lx	Fraction of space for minimum target level $F_{plane,\%}$	Fraction of daylight hours $F_{time,\%}$
Minimum	300	50 %	100	95 %	50 %
Medium	500	50 %	300	95 %	50 %
High	750	50 %	500	95 %	50 %
NOTE Table A.3 gives target daylight factor (D_T) and minimum target daylight factor (D_{TM}) corresponding to target illuminance level and minimum target illuminance, respectively, for the CEN capital cities.					

Using method 2 will directly provide these values. The daylight factor is a measure of the amount of daylight relative to the external daylight available. When using method 1, the requirement for the daylight factor will vary with the geographical location of the development site. So for instance to achieve a target of 300 Lux in Athens a Daylight Factor of 1.5% is required, whereas the same 300 Lux target would require a Daylight Factor of 2.6 in Reykjavik, Iceland.

There are some specific recommendations for dwellings in the UK. These are set out in the UK National Annex to the standard. The UK committee on BS EN 17037: 2018 believes that the recommendations as stated in the table 1 are not always achievable in all rooms of a dwelling. This could be the case for instance for rooms in basements, dwellings in dense urban areas or where existing buildings are being converted into dwellings.

The UK National Annex gives guidance on minimum daylight provision in all UK dwellings. The recommendations are 100 lux for bedrooms, 150 lux for living rooms and 200 lux for kitchens to be achieved in 50% of the time that daylight is available for 50 % of the assessment grid. The recommendations for 95% of the assessment grid do not apply for to dwellings in the UK.

2.5 Building parameters

The analysis that is described in this report was carried out using the Radiance module of the IES VE software suite, which is widely used internationally to analyse daylight in buildings. For this study the Annual Dynamic Illuminance analysis was used, which is a Climate Based Daylight Modelling approach.

The daylight in a room is determined by a wide range of factors. These factors can be external, such as nearby objects that provide both blocking of daylight and reflections. Other factors are internal and include size and shape of rooms as well as the light reflecting characteristics of walls, ceilings and floors. Finally, the light transmittance of the glazing is a determinant of the daylight levels in a building.

BRE209 provides guidance on the transmittance values of glazing as well as the light reflectance of internal and external surfaces.

For the light reflectance of the internal surfaces, values consistent with a contemporary light finishes of the interior were used: interior walls, 0.8, ceilings, 0.8, floors 0.4. External surfaces were assumed to have a reflectance value of 0.2. Standard double glazing was assumed with a diffuse transmittance value of 0.68 and maintenance factor of 0.96 for windows.

As recommended in the BRE209 guidance document, an “Area of Interest” was defined as the internal room space offset by 30 cm from the inside of the walls. The working plane was set at 0.85 m and the distance between points in the assessment grid was 0.25 m.

3 Results

3.1 Impact on Neighbouring Properties

Scope of the assessment

Not all neigbouring properties need to be assessed in detail. A first step to screen the need for a detailed computerised analysis is applying two basic sets of rules to the neighbouring buildings. For windows that are opposite a new building, the 25 degree rule would apply. For this it is required to measure the angle to the horizontal subtended by the new development at the level of the centre of the lowest window. If this angle is less than 25° for the whole of the development then it is unlikely to have a substantial effect on the diffuse skylight enjoyed by the existing building. If, for any part of the new development, this angle is more than 25°, a more detailed check is needed to find the loss of skylight to the existing building. Figure 2 below demonstrates that the lowest window opposite the development in the house at 162 Harefield Road has an angle to the top of the proposed development that is less than 25 degrees.

The second test it the 45 degree rule. For this a line is draws diagonally down at an angle of 45° away from the near top corner of the extension. Next take the plan and draw diagonally back at an angle of 45° towards the window wall from the end of the extension. Only if the centre of a main window of the next-door property lies on the extension side of both these 45° lines then the extension may well cause a significant reduction in the skylight received by the window. Alternatively, a line from the centre of the neighbouring window towards the proposed development can be drawn to test the need for a detailed analysis. Figure 3 shows that the 45 degree rule is not breach in plan and therefore no further analysis is required to conclude that there is no material impact to be expected. There is no need to further consider the 45 degree line in elevation, as both lines need to be breached for the need of a detailed analysis to be triggered.

Overshadowing and sunlight availability neigbouring gardens

Three garden areas were identified as having potential to be affected by the proposed development: the rear garden at 162 Harefield Road, the existing 164 Harefield Road and 166A Harefield Road. The results are shown in Appendix 3 and show that there is no material increase in overshadowing of the neighbouring gardens.

Overshadowing neigbouring photovoltaic cells

The results of the full yield analysis for the PV array at the property at 166A Harefield Road both before and after the proposed building would be completed, is shown in Appendix 7. The current predicted yield is 5075.38 kWh/year and this is predicted to be reduced to 5063.77 kWh/year, leaving 99.8% of the current yield available after the proposed building would be constructed.

3.2 Daylight and Sunlight Within Proposed Development

Illumination levels habitable rooms

Appendix 4 shows the results of the illumination test for the habitable rooms in the proposed new development using method 1. With the current design all the rooms meet the target values that are set out in the BRE guidance document. Distribution graphs are shown in Appendix 5.

Solar exposure

The proposed development has a living room that faces within 90 degrees of due north. It also has a large dining room and kitchen facing within 90 degrees due south. This satisfies the requirement of having at least main window wall facing within 90 degrees due south. Appendix 6 shows the exposure to direct sunlight on 21 March of each of the windows in the living room and dining room. All of the windows receive at least 1.5 hours of direct sunlight on that day.

Amenity Space

Both a front and rear garden are provided for use by the future residents of the proposed development. The BRE guidance suggests that only rear gardens should be considered as private space. The table in appendix 3 includes

an entry for the sunlight availability in the proposed rear garden and shows that 57.94% of this space will receive at least 2 hours of direct sunlight on 21 March. This meets the BRE criteria on amenity space.

4 Discussion and conclusion

A daylight and sunlight assessment were carried out analysing the effects of the proposed development on neighbouring properties of the proposed new dwelling at 164A Harefield Road, Uxbridge.

There were no windows in the neighbouring properties that were likely to be affected by the proposed development. The garden space in the adjacent properties were examined in detail. None of these are predicted to be affected materially by overshadowing caused by the proposed new dwelling.

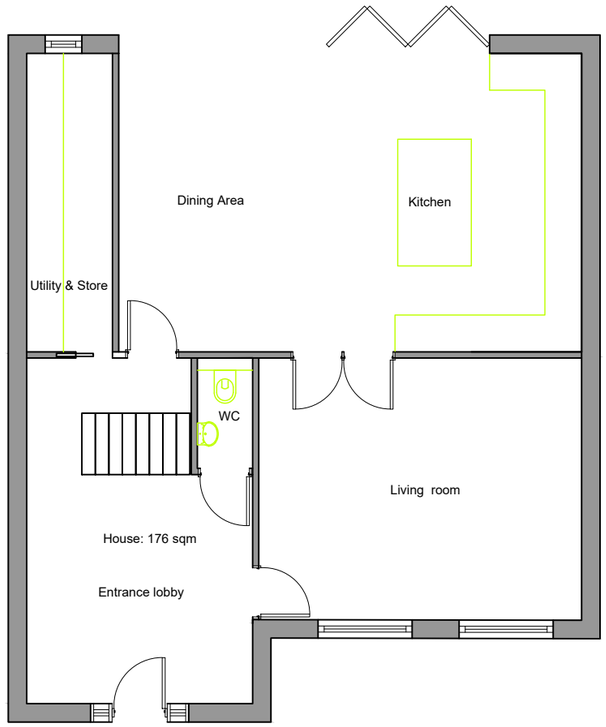
The PV array in the neighbouring property at 166A Harefield Road is predicted to retain 99.8% of its current capacity, which is a negligible effect.

An analysis of the available daylight and sunlight for the proposed new development shows that all of the spaces will receive sufficient levels of internal daylight when considering a contemporary light finish.

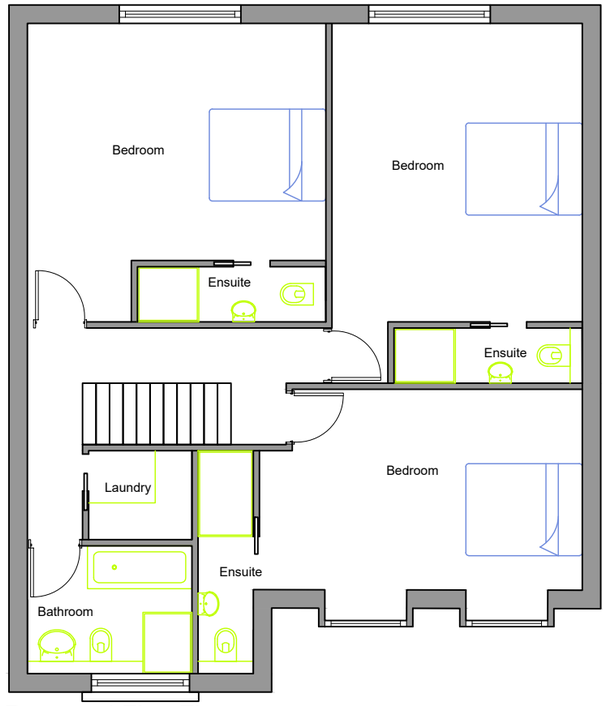
The living areas in the proposed new development will meet the minimum 1.5 hours of direct sunlight on 21 March.

50% of the proposed rear garden receives more than 2 hours of direct sunlight on 21 March in compliance with the BRE guidelines.

It is therefore concluded that the proposed development complies with the BRE guideline published in "*Site layout planning for daylight and sunlight: a guide to good practice*" (2022) (BRE Trust), as well as with the planning requirements in the London Plan.



Proposed Ground Floor



Proposed First Floor

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Proposed Ground & First Floor

Revisions

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1:100 scale 0 1 2 3 4 5 6 7 8 9 10
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Drawn by	Date drawn
FN	July 2024
Checked by	Date checked
RP	4/7/24

Scale at A3	Project number	Drawing number	Revision
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Proposed Front Elevation

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Proposed front elevation

Revisions

1:500 scale
1:200 scale
1:100 scale
1:50 scale

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Proposed Rear Elevation

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Proposed rear elevation

Revisions

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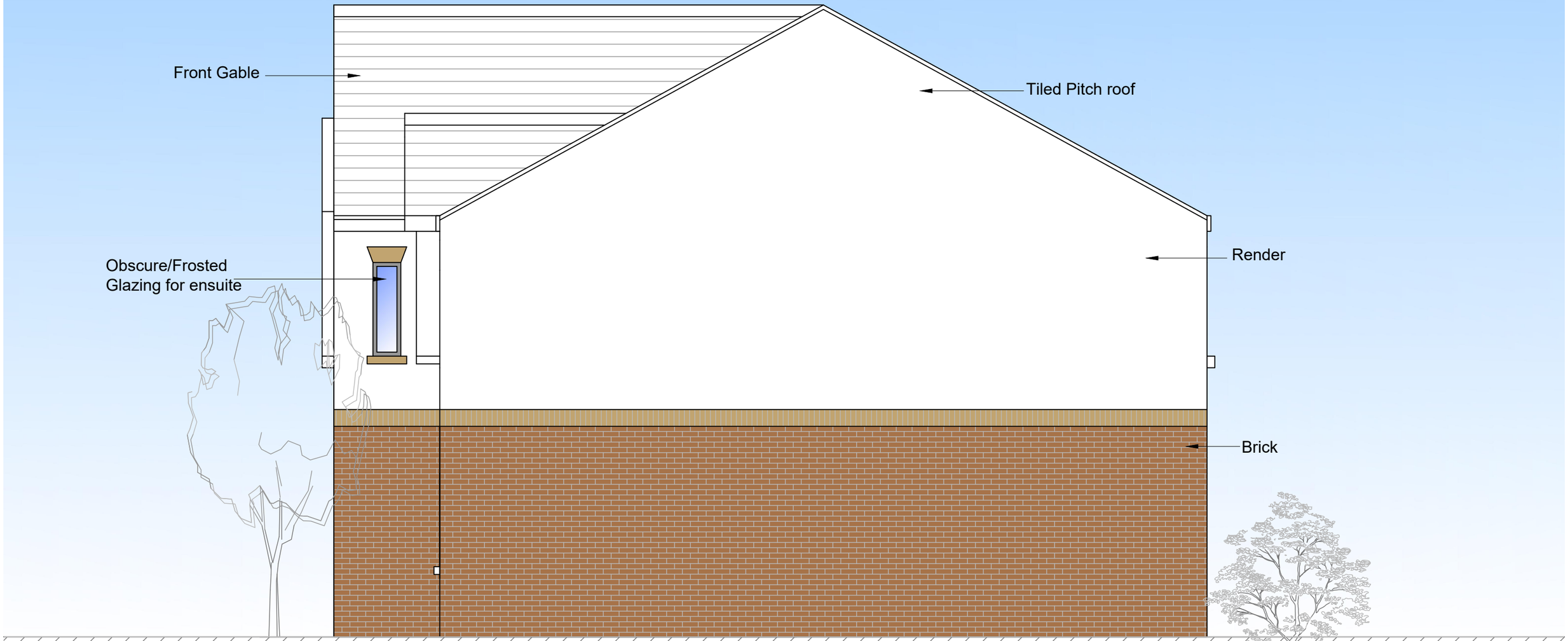

Proposed Side Elevation

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Proposed side elevation

Revisions

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1:50 scale 0 1 2 3 4 5

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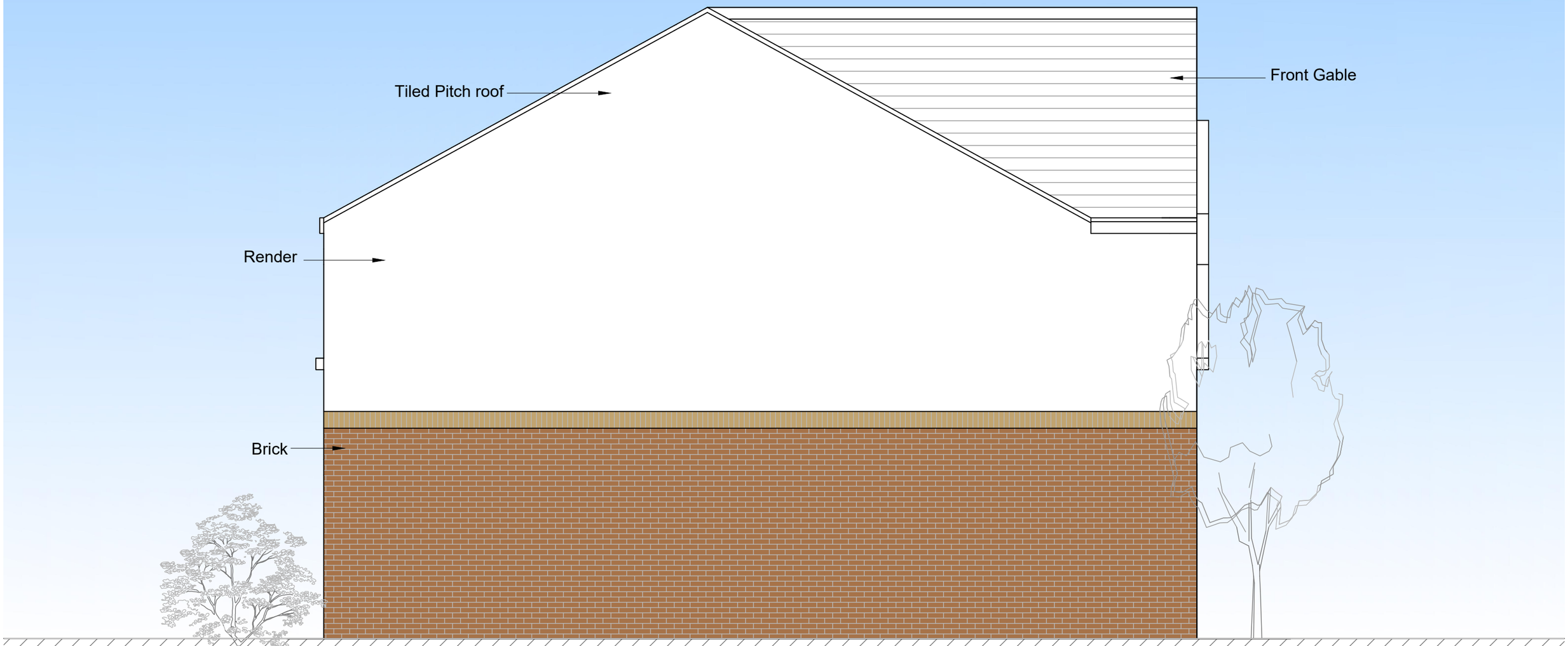

Proposed Side Elevation

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Proposed side elevation

Revisions

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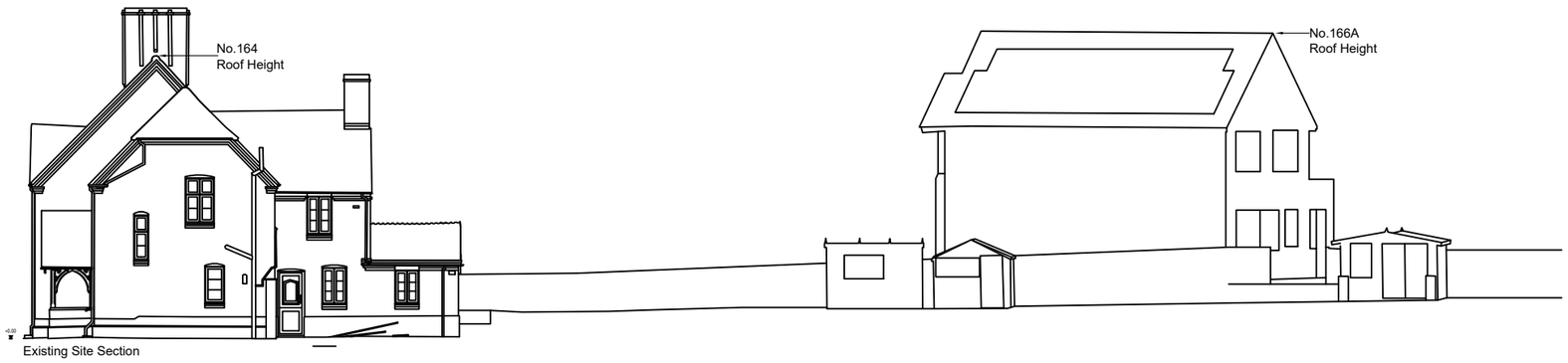
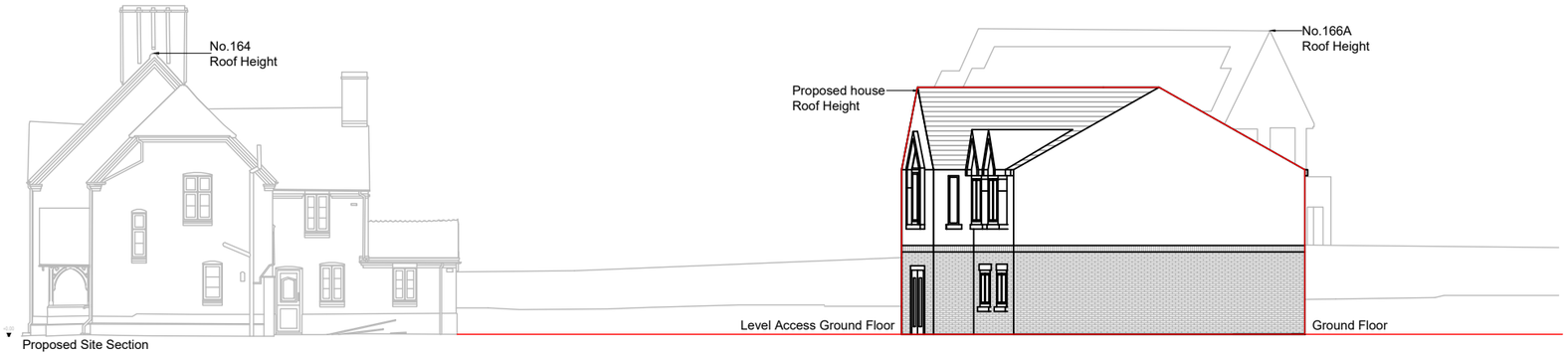


Existing Site Section



Proposed Site Section

Client

Project

Rear of 164 Harefield Rd, UB8 1PP

Drawing title

Existing & Proposed Site section

Revisions

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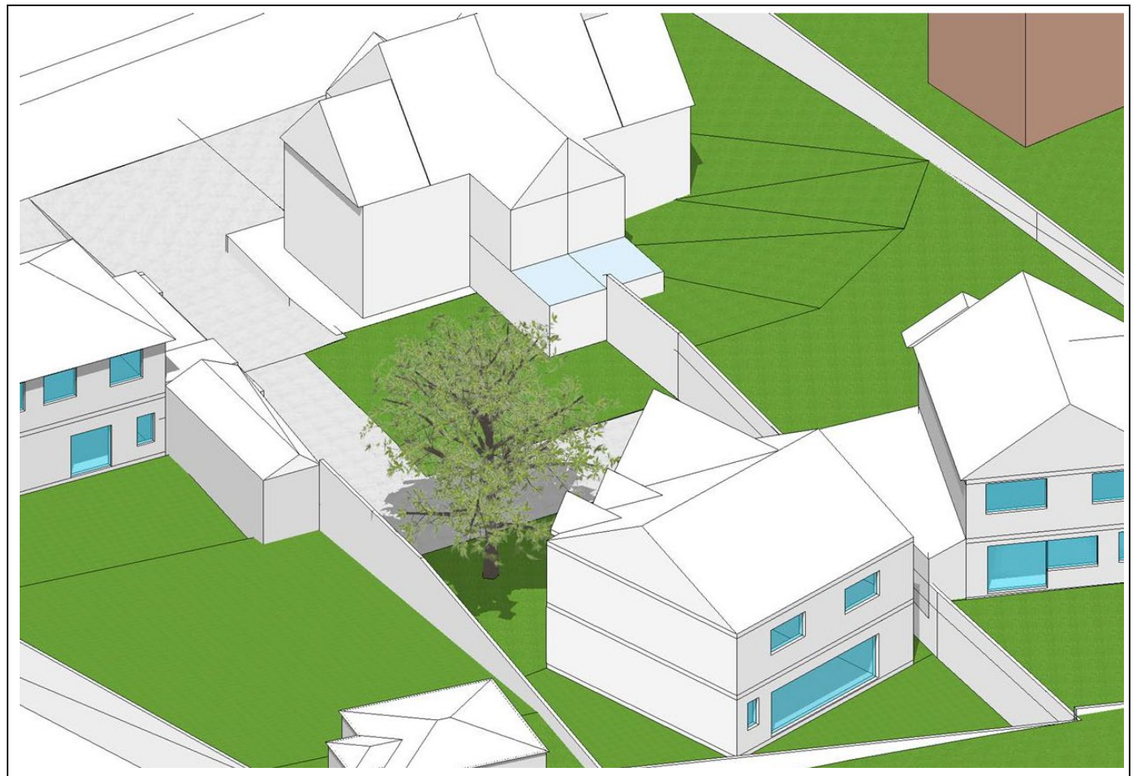
Appendix 1. Proposed Drawings

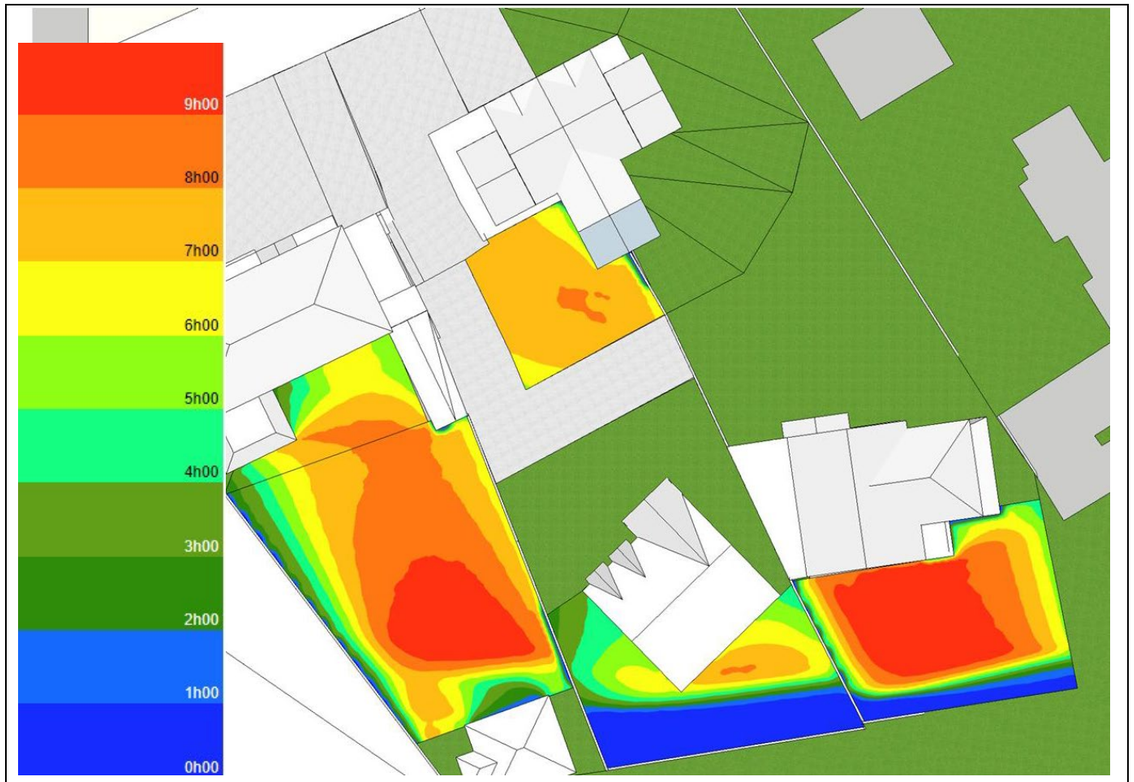
Appendix 2 Model Overview

Model overview- existing building



Model overview – proposed development

Appendix 3 Overshadowing gardens



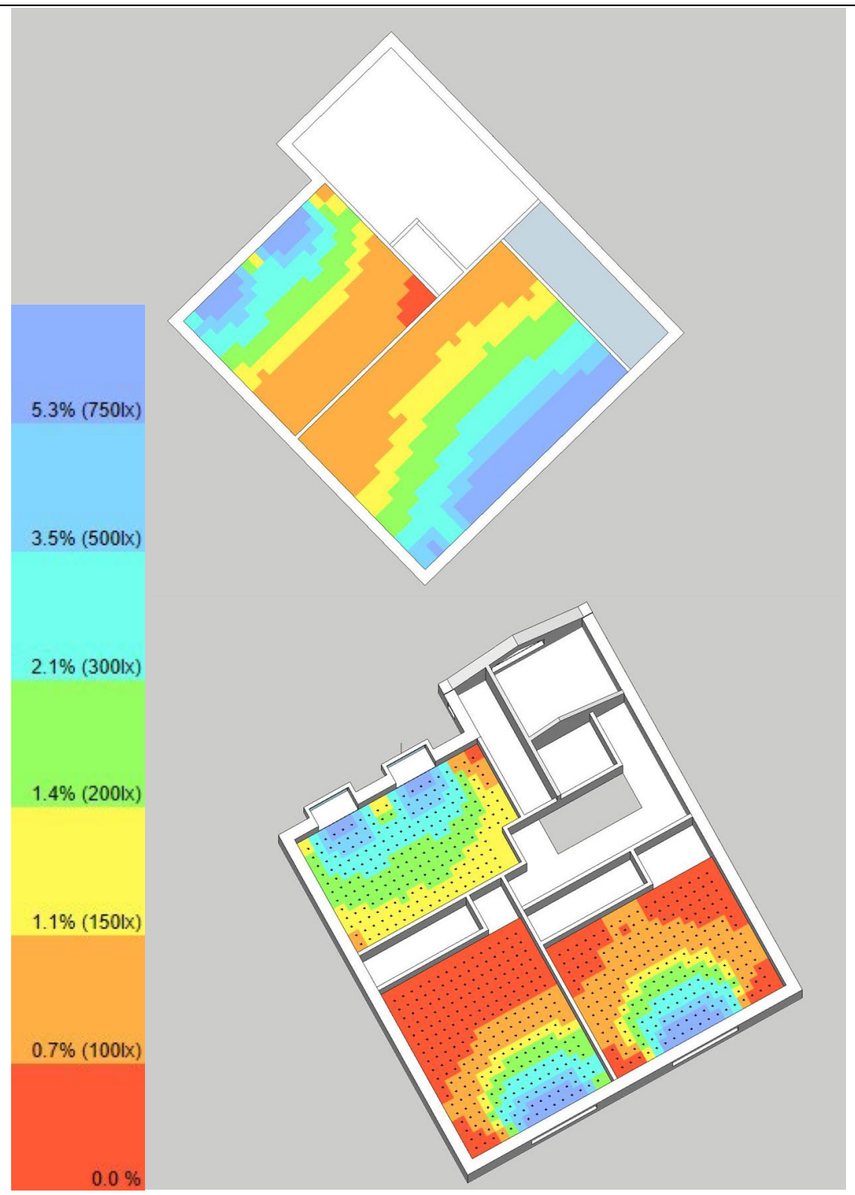
Proposed development areas receiving sunlight.

Building Name	Area	Lit area Ex	Lit Area Pr	Ex %	Prop %	Ratio	Meets BRE Target
162 Back Garden	389	371	371	95.63	95.63	1.00	Yes
164 Back Garden	97	96	95	98.94	89.71	0.91	Yes
166A Back Garden	201	166	166	82.81	82.81	1.00	Yes
Proposed development	152	-	88	-	57.94	-	Yes

Appendix 4 Illumination levels proposed development

Room name	Surface area [m2]	Median value (DF)	Percentage area above illumination level DF (lux)			Target	Result
			0.7% (100lx)	1.1% (150lx)	1.4% (200lx)		
Living Room	22.52	1.07	96.87	57.81	45.31	150 lux	Yes
Kitchen/dining room	37.23	1.69	100.00	77.01	60.15	200 lux	Yes
Bedroom 3	16.67	1.66	99.56	96.05	64.47	100 lux	Yes
Bedroom 1	19.86	0.73	51.48	32.22	26.29	100 lux	Yes
Bedroom 2	18.81	0.84	66.26	35.31	26.98	100 lux	Yes

Appendix 5 Daylight distribution graphs



Daylight distribution within the habitable rooms of the proposed development

Appendix 6 Sunlight Exposure Proposed Development

Window	Sunlit hours
Dining Room	7.25
Living Room 1	2.25
Living Room 2	1.75

Appendix 7 Yield analysis neighbouring photovoltaic cells

Version 7.4.0

PVsyst - Simulation report

Grid-Connected System

Project: Harefield Road

Variant: New simulation variant

Tables on a building

System power: 6.08 kWp

Uxbridge - United Kingdom

Author
Ahmed Adel

PVsyst V7.4.0
VC0, Simulation date:
06/04/24 22:48
with v7.4.0

Project summary

Geographical Site
Uxbridge
United Kingdom

Situation

Latitude	51.56 °N
Longitude	-0.47 °W
Altitude	46 m
Time zone	UTC

Project settings

Albedo	0.20

Meteo data
Uxbridge
PVGIS api TMY

System summary

Grid-Connected System

Tables on a building

PV Field Orientation
Fixed plane
Tilt/Azimuth 34.8 / 81.9 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	32 units
Pnom total	6.08 kWp

Inverters

Nb. of units	1 unit
Pnom total	6.00 kWac
Pnom ratio	1.013

Results summary

Produced Energy	5075.38 kWh/year	Specific production	835 kWh/kWp/year	Perf. Ratio PR	83.06 %

Table of contents

General parameters

Grid-Connected System

Tables on a building

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	34.8 / 81.9 °

Sheds configuration	
Nb. of sheds	32 units
Sizes	
Sheds spacing	1.24 m
Collector width	1.50 m
Ground Cov. Ratio (GCR)	121.7 %
Shading limit angle	
Limit profile angle	90.0 °

Models used	
Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	Jinkosolar
Model	JKM190M-72
(Custom parameters definition)	
Unit Nom. Power	190 Wp
Number of PV modules	32 units
Nominal (STC)	6.08 kWp
Modules	2 Strings x 16 In series
At operating cond. (50°C)	
Pmpp	5.45 kWp
U mpp	523 V
I mpp	10 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-6KTL-M1-400V
(Original PVsyst database)	
Unit Nom. Power	6.00 kWac
Number of inverters	1 unit
Total power	6.0 kWac
Operating voltage	140-980 V
Max. power (=>47°C)	6.60 kWac
Pnom ratio (DC:AC)	1.01
Power sharing within this inverter	

Total PV power

Nominal (STC)	6 kWp
Total	32 modules
Module area	32.2 m²

Total inverter power

Total power	6 kWac
Max. power	6.6 kWac
Number of inverters	1 unit
Pnom ratio	1.01

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 841 mΩ
Loss Fraction 1.5 % at STC

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation
Loss Fraction 2.0 %

Module Quality Loss
Loss Fraction -0.8 %

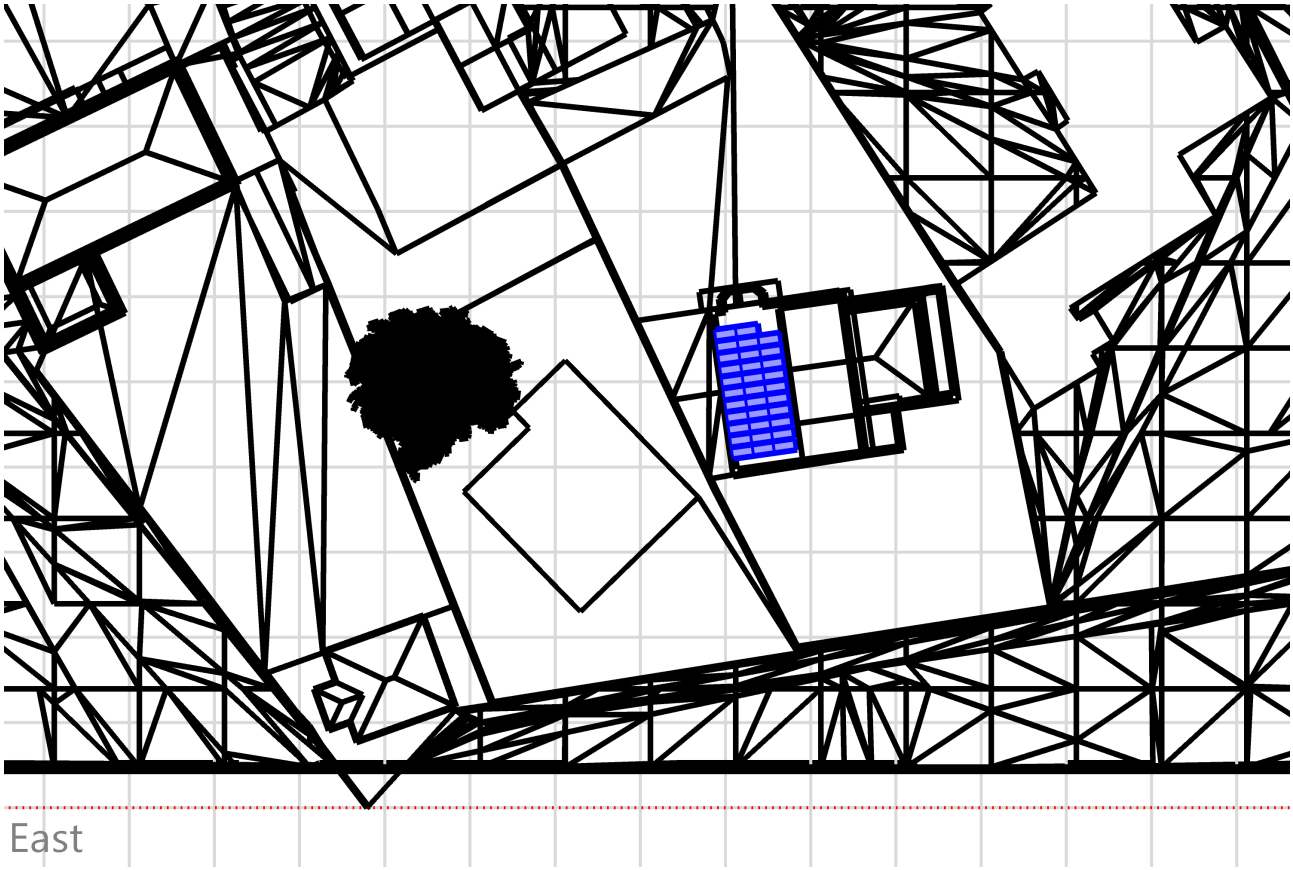
Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.2 %

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.05

Near shadings parameter

Perspective of the PV-field and surrounding shading scene

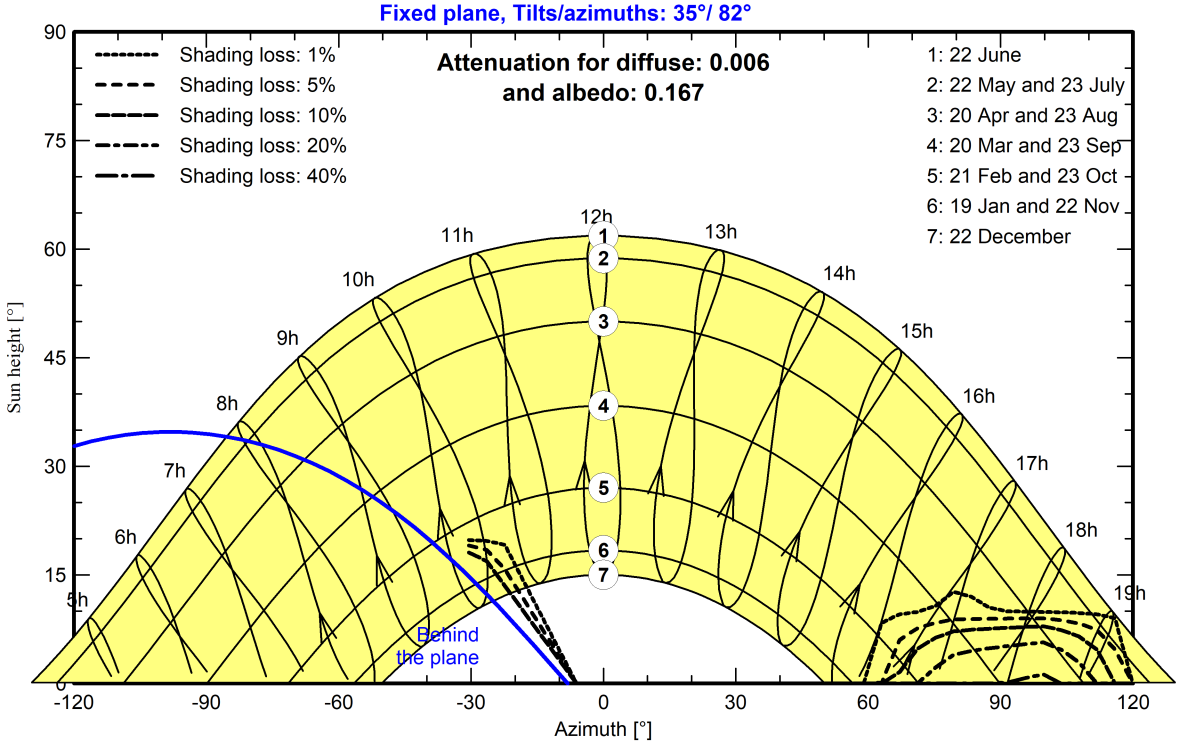


PVsyst V7.4.0
VC0, Simulation date:
06/04/24 22:48
with v7.4.0

Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 35°/ 82°



PVsyst V7.4.0
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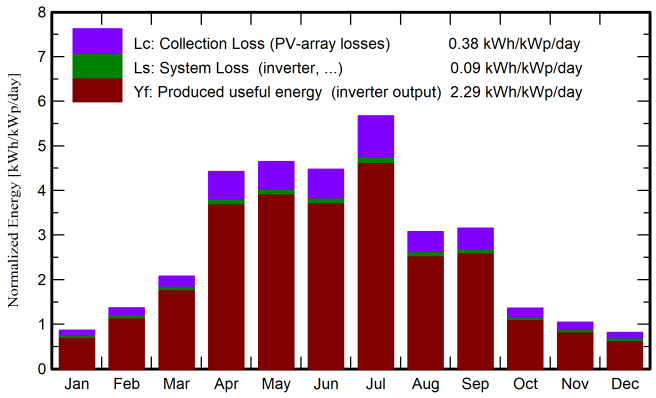
with v7.4.0

Main results

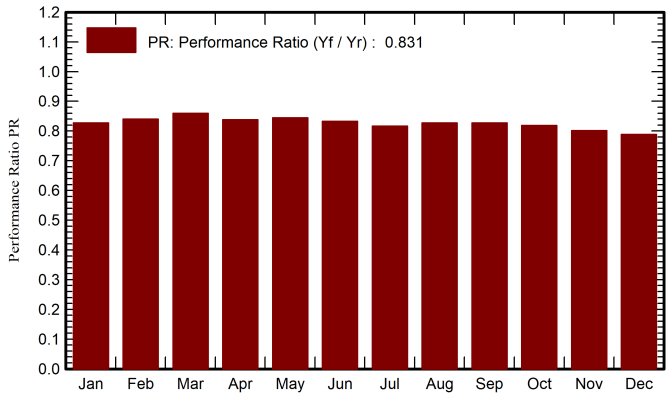
System Production

Produced Energy	5075.38 kWh/year	Specific production	835 kWh/kWp/year
		Perf. Ratio PR	83.06 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	24.4	14.09	3.01	26.8	24.3	144.0	134.7	0.828
February	38.9	25.28	4.00	38.3	35.0	206.4	195.6	0.840
March	65.6	44.72	5.29	64.3	59.6	350.5	336.2	0.860
April	141.9	60.97	12.24	132.8	123.6	696.8	676.6	0.838
May	155.8	82.88	12.64	144.1	134.8	762.4	740.0	0.845
June	150.0	83.21	14.75	134.2	125.3	701.5	679.7	0.833
July	188.4	76.77	19.31	175.9	165.3	899.1	873.3	0.817
August	105.8	70.58	16.56	95.2	88.6	497.7	479.1	0.827
September	96.7	56.47	15.84	94.6	87.6	493.2	476.1	0.828
October	45.6	33.44	11.20	42.3	39.0	223.2	210.5	0.819
November	30.3	18.07	8.59	31.3	28.3	162.9	152.3	0.801
December	23.5	12.73	6.41	25.3	22.5	131.3	121.2	0.789
Year	1067.2	579.22	10.85	1005.0	933.9	5268.9	5075.4	0.831

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

PVsyst V7.4.0
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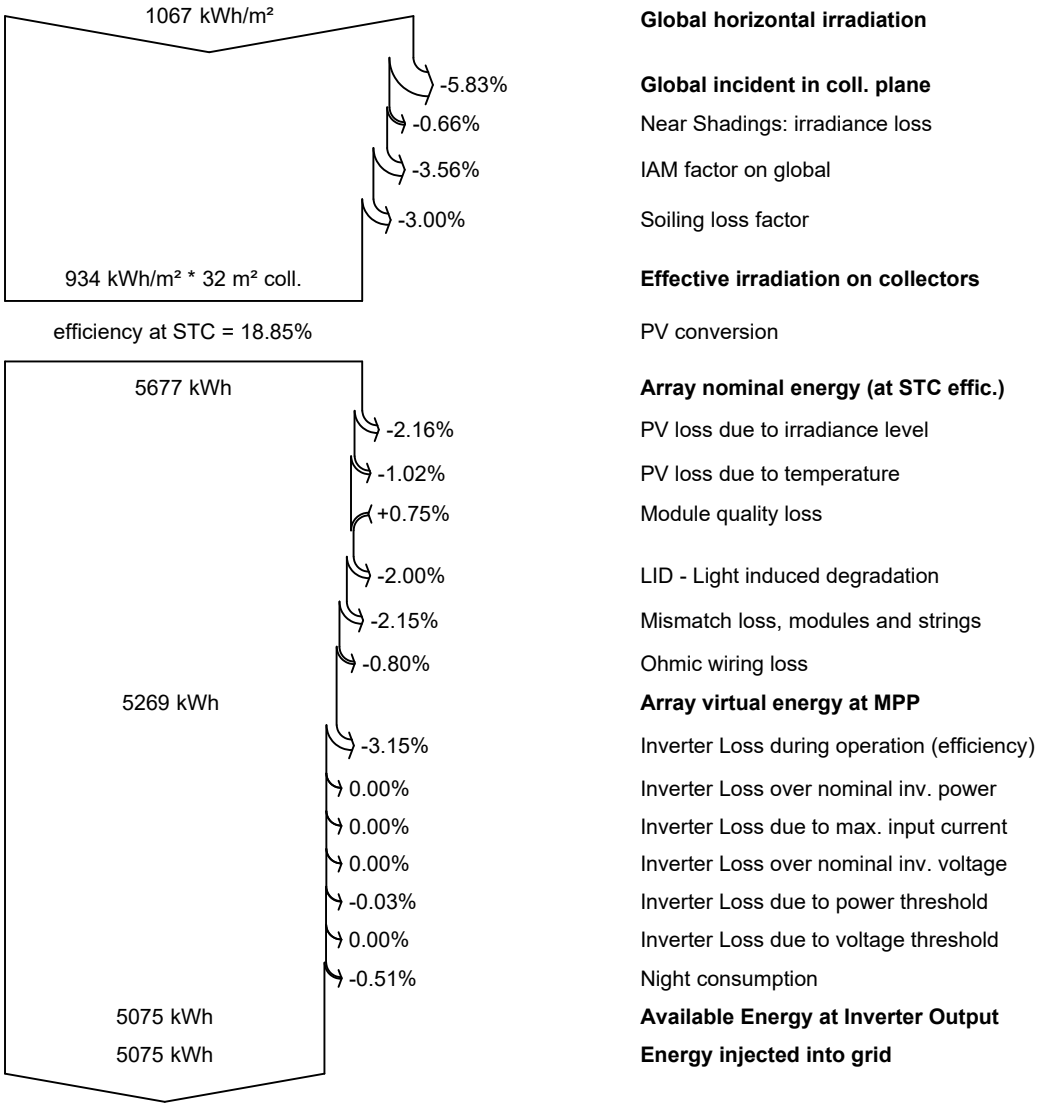
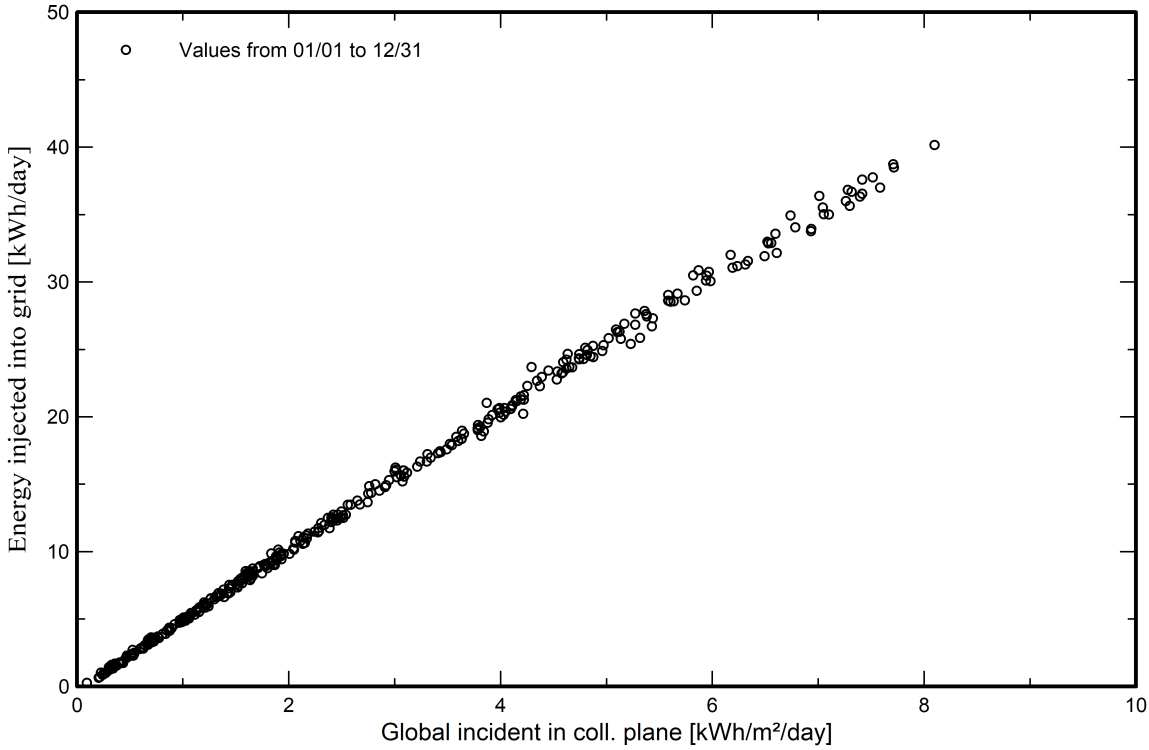
Loss diagram

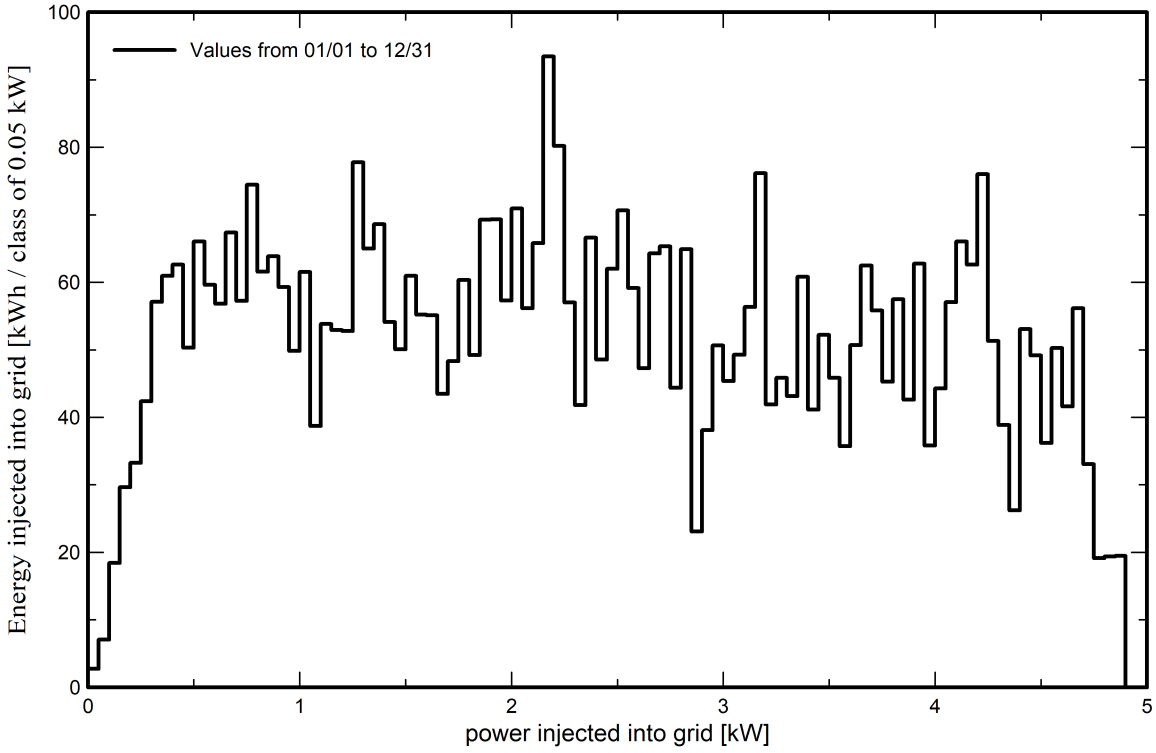


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



Single-line diagram

PVsyst V7.4.0
VC0, Simulation date:
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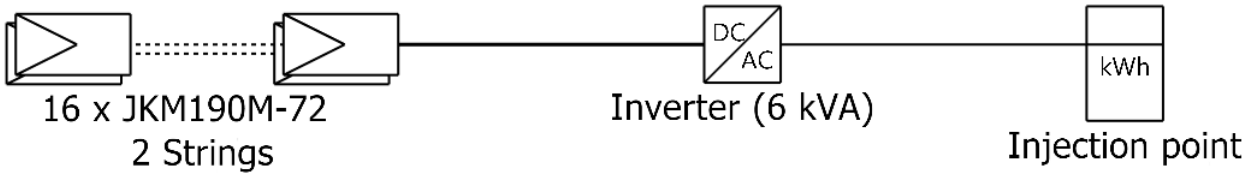


PV module	JKM190M-72
Inverter	SUN2000-6KTL-M1-400V
String	16 x JKM190M-72

	Harefield Road	
	VC0 : New simulation variant	06/04/24

Version 7.4.0

PVsyst - Simulation report

Grid-Connected System

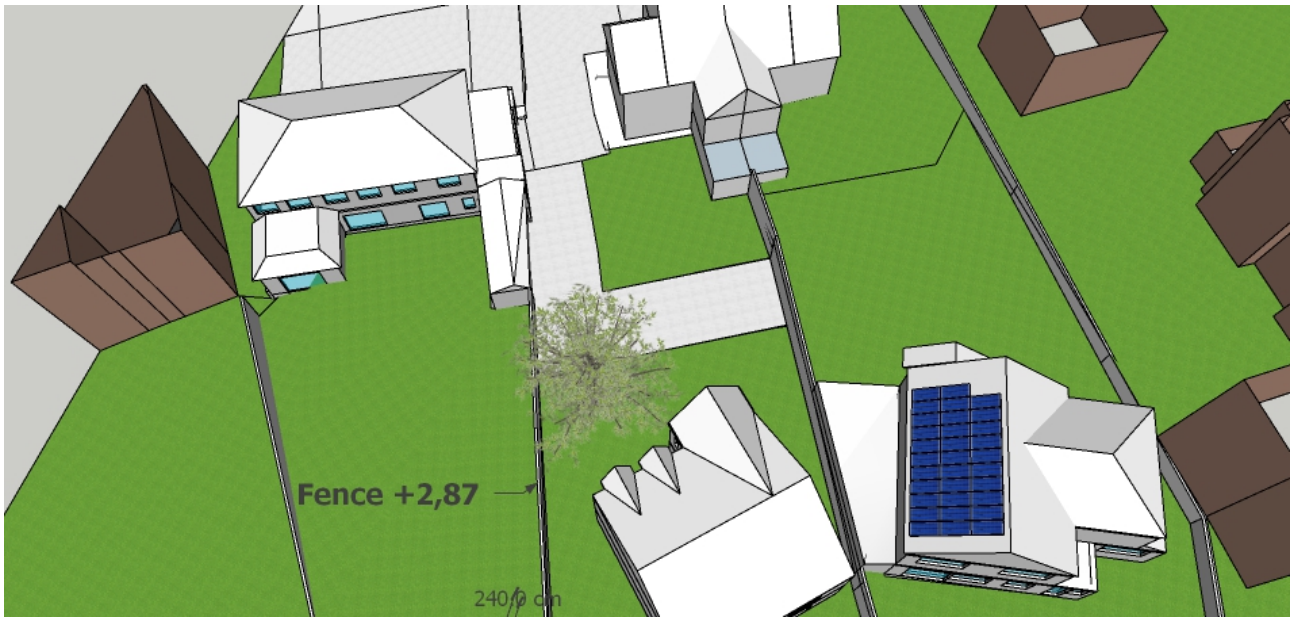
Project: Harefield Road

Variant: New simulation variant

Tables on a building

System power: 6.08 kWp

Uxbridge - United Kingdom



Author

Ahmed Adel

PVsyst V7.4.0
VC0, Simulation date:
06/04/24 06:56
with v7.4.0

Project summary

Geographical Site
Uxbridge
United Kingdom

Situation

Latitude	51.56 °N
Longitude	-0.47 °W
Altitude	46 m
Time zone	UTC

Project settings
Albedo 0.20

Meteo data
Uxbridge
PVGIS api TMY

System summary

Grid-Connected System

Tables on a building

PV Field Orientation
Fixed plane
Tilt/Azimuth 34.8 / 81.9 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	32 units
Pnom total	6.08 kWp

Inverters

Nb. of units	1 unit
Pnom total	6.00 kWac
Pnom ratio	1.013

Results summary

Produced Energy	5063.77 kWh/year	Specific production	833 kWh/kWp/year	Perf. Ratio PR	82.87 %

Table of contents

PVsyst V7.4.0
VC0, Simulation date:
06/04/24 06:56
with v7.4.0

General parameters

Grid-Connected System

Tables on a building

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	34.8 / 81.9 °

Sheds configuration	
Nb. of sheds	32 units
Sizes	
Sheds spacing	1.24 m
Collector width	1.50 m
Ground Cov. Ratio (GCR)	121.7 %
Shading limit angle	
Limit profile angle	90.0 °

Models used	
Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	Jinkosolar
Model	JKM190M-72
(Custom parameters definition)	
Unit Nom. Power	190 Wp
Number of PV modules	32 units
Nominal (STC)	6.08 kWp
Modules	2 Strings x 16 In series
At operating cond. (50°C)	
Pmpp	5.45 kWp
U mpp	523 V
I mpp	10 A

Inverter

Manufacturer	Huawei Technologies
Model	SUN2000-6KTL-M1-400V
(Original PVsyst database)	
Unit Nom. Power	6.00 kWac
Number of inverters	1 unit
Total power	6.0 kWac
Operating voltage	140-980 V
Max. power (=>47°C)	6.60 kWac
Pnom ratio (DC:AC)	1.01
Power sharing within this inverter	

Total PV power

Nominal (STC)	6 kWp
Total	32 modules
Module area	32.2 m²
Cell area	35.1 m²

Total inverter power

Total power	6 kWac
Max. power	6.6 kWac
Number of inverters	1 unit
Pnom ratio	1.01

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 841 mΩ
Loss Fraction 1.5 % at STC

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.1 % at STC

LID - Light Induced Degradation
Loss Fraction 2.0 %

Module Quality Loss
Loss Fraction -0.8 %

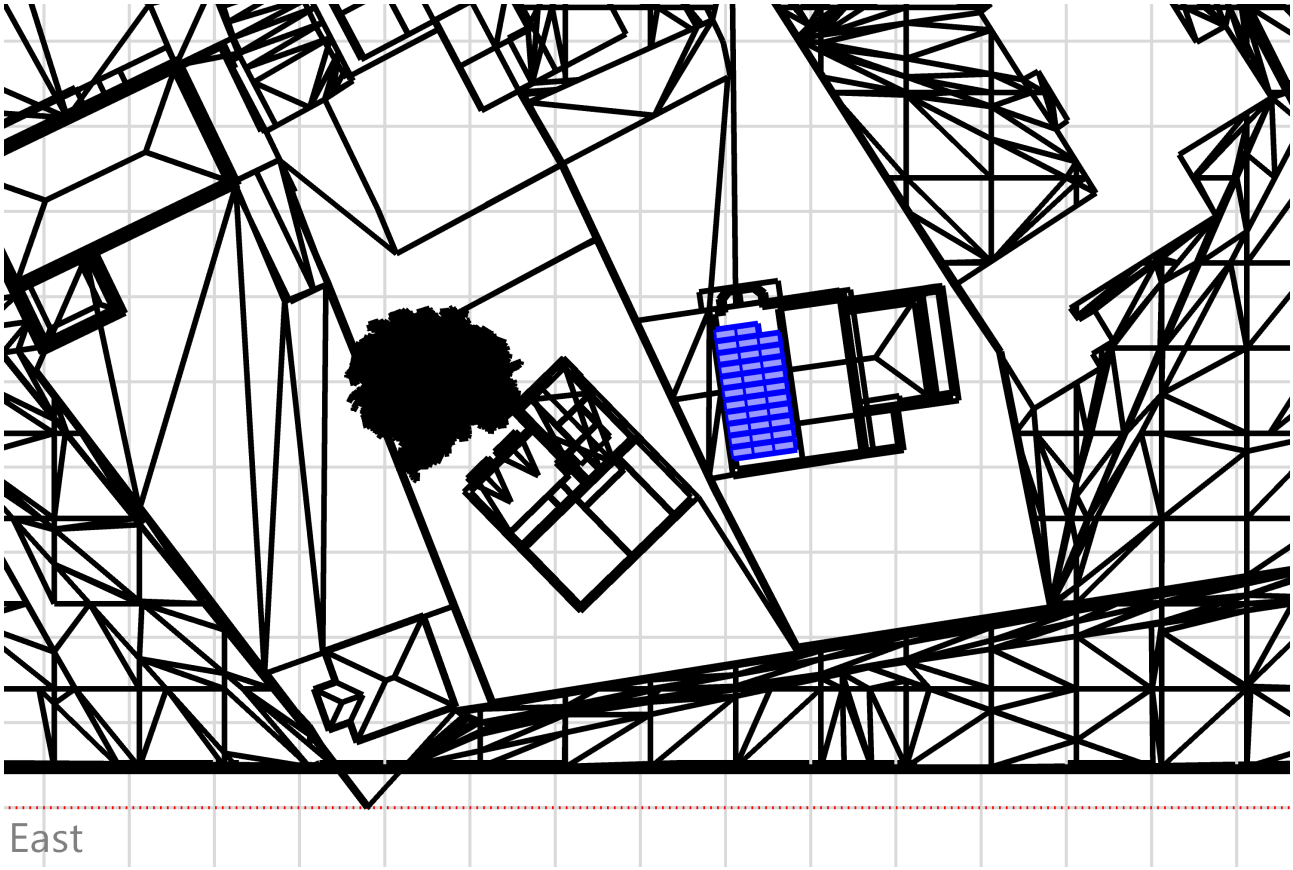
Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.2 %

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.05

Near shadings parameter

Perspective of the PV-field and surrounding shading scene



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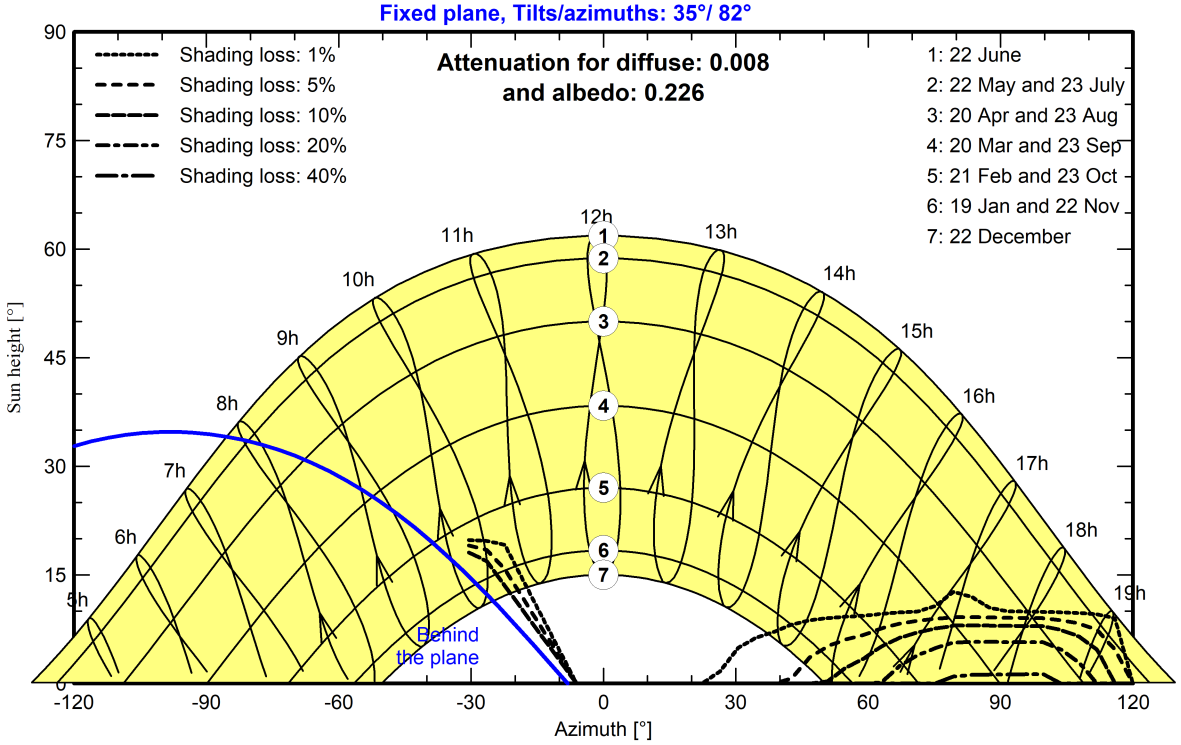
Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 35°/ 82°

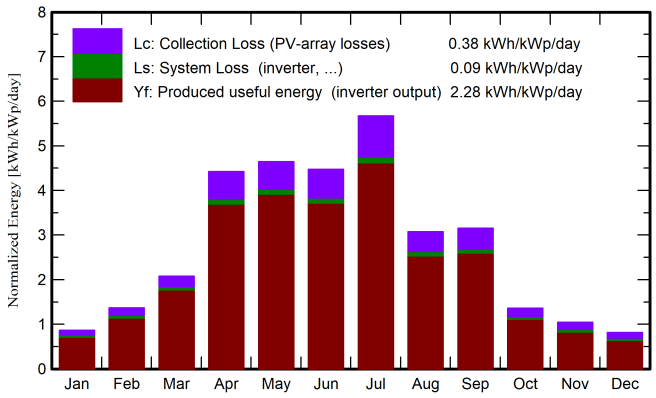


Main results

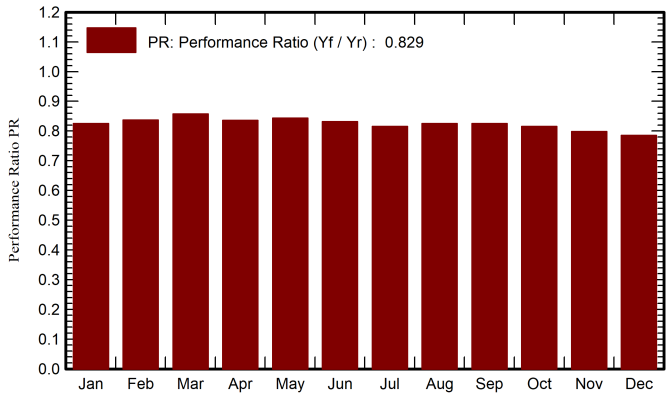
System Production

Produced Energy	5063.77 kWh/year	Specific production	833 kWh/kWp/year
		Perf. Ratio PR	82.87 %

Normalized productions (per installed kWp)



Performance Ratio PR



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June	150.0	83.21	14.75	134.2	125.0	700.1	678.4	0.832
July	188.4	76.77	19.31	175.9	165.0	897.7	871.9	0.815
August	105.8	70.58	16.56	95.2	88.4	496.6	478.0	0.826
September	96.7	56.47	15.84	94.6	87.4	492.0	474.9	0.826
October	45.6	33.44	11.20	42.3	38.8	222.4	209.7	0.816
November	30.3	18.07	8.59	31.3	28.2	162.3	151.7	0.798
December	23.5	12.73	6.41	25.3	22.5	130.8	120.8	0.786
Year	1067.2	579.22	10.85	1005.0	931.9	5257.2	5063.8	0.829

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
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PVsyst V7.4.0
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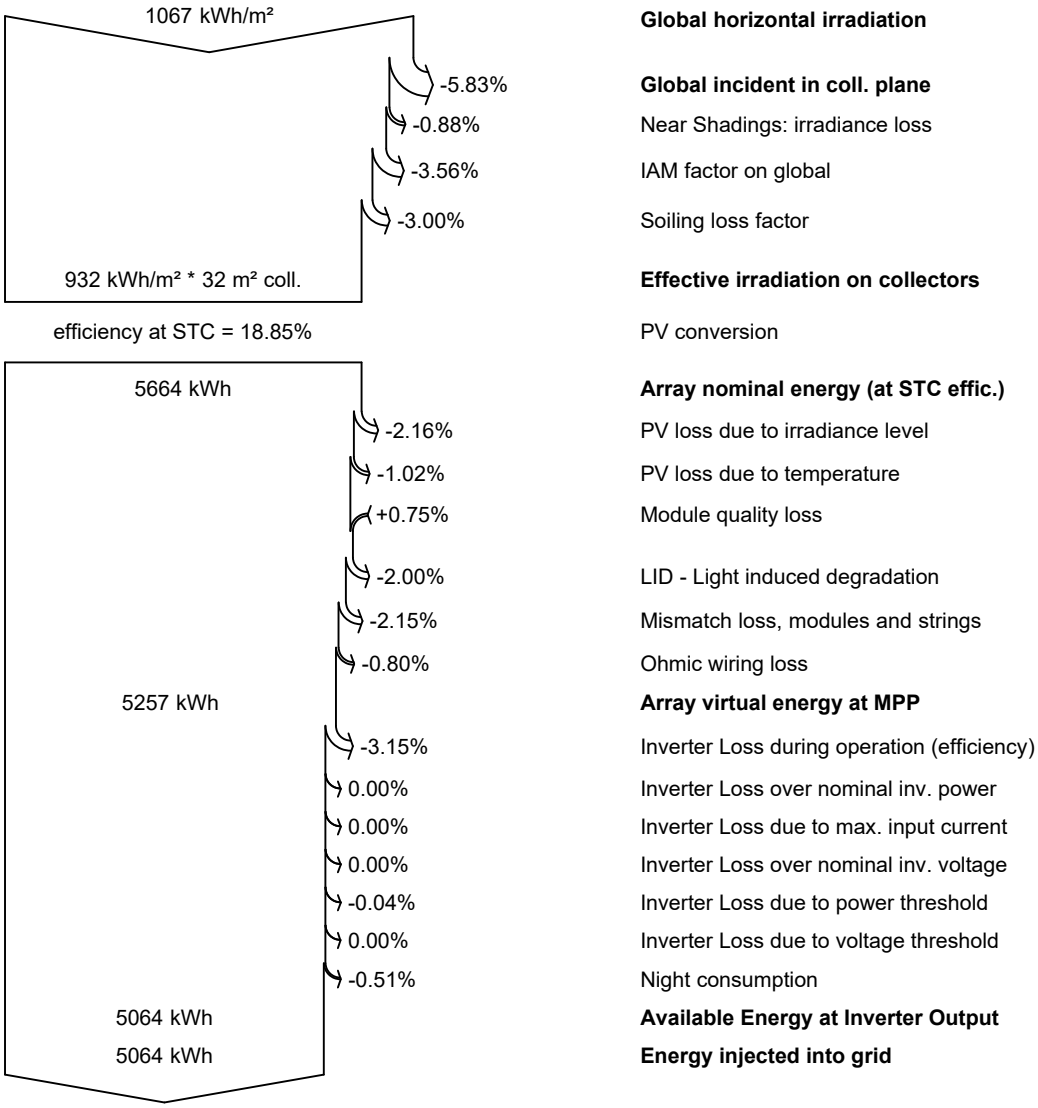
with v7.4.0

Loss diagram



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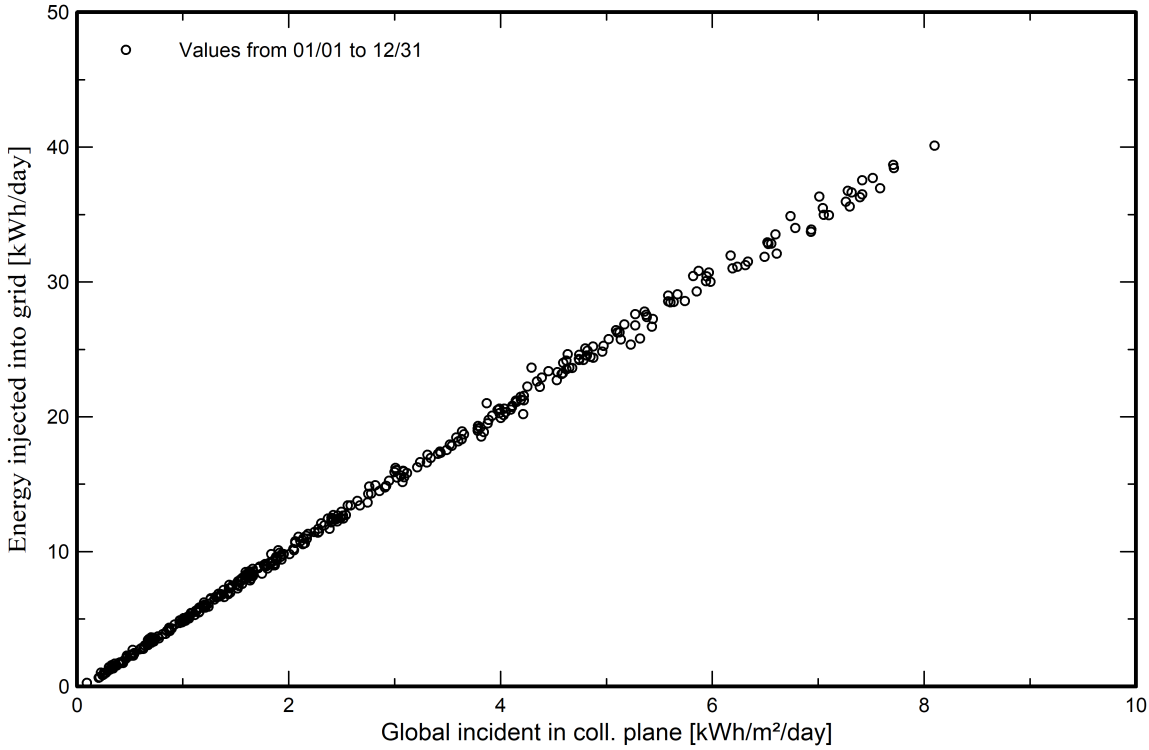
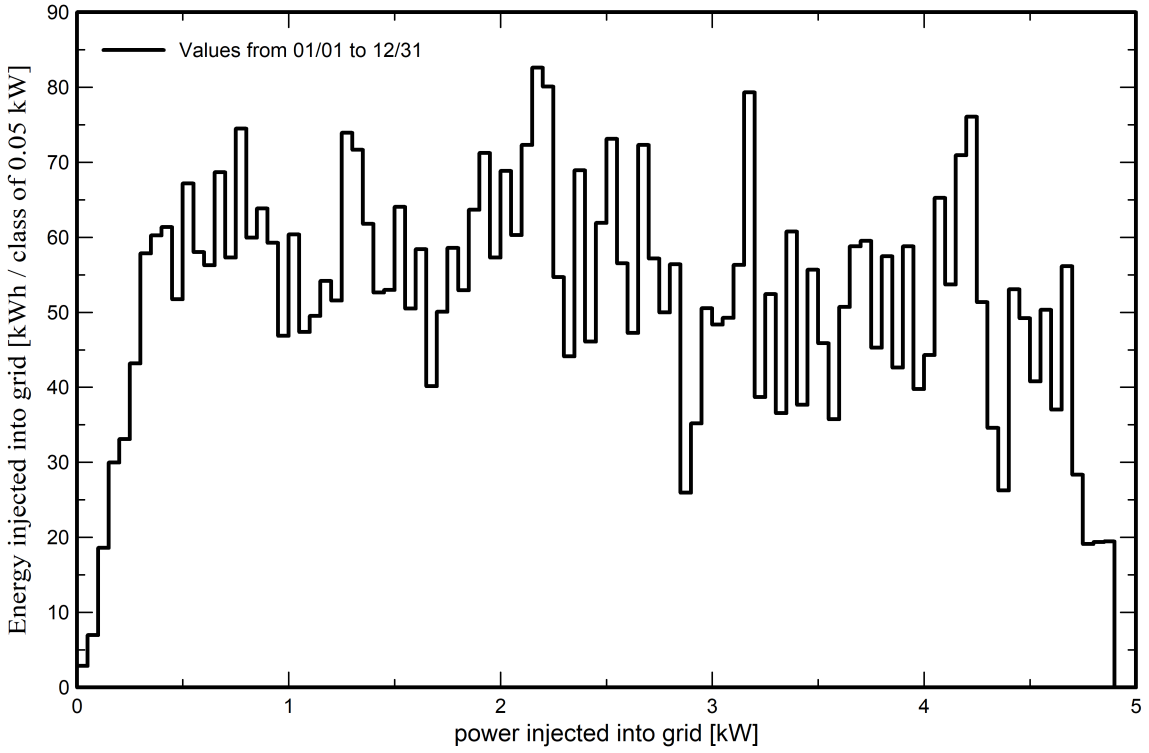
Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



Single-line diagram

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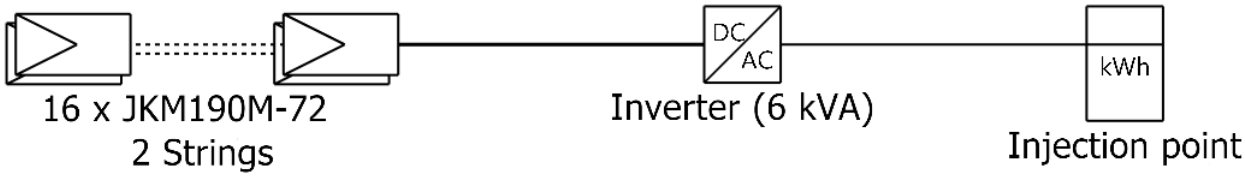

PV module	JKM190M-72
Inverter	SUN2000-6KTL-M1-400V
String	16 x JKM190M-72

	Harefield Road	
	VC0 : New simulation variant	06/04/24