BS23-0002 SHADING ANALYSIS

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ACCREDITATIONS

RECC RENEWABLE ENERGY CONSUMER CODE

tsi APPROVED CODE TRADINGSTANDARDS.UK

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1. Introduction

This report lays out the full solar shading analysis carried out on the property of 25 The Street, Surlingham, NR14 7AJ. It covers subjects on the importance, process, outcomes and recommendations from the shading analysis.

Shading analysis is crucial for solar panels for several reasons:

1. Impact on Energy Production:

   Shading significantly affects the energy output of solar panels. Even a small amount of shading on a panel can lead to a significant reduction in its energy production.

2. Efficiency Optimisation:

   By conducting a thorough shading analysis, it's possible to optimise the placement and configuration of solar panels to minimise shading impact. This ensures that each panel operates at its maximum efficiency.

3. System Reliability:

   Shading issues can lead to uneven wear and tear on panels, as shaded panels can operate at different temperatures and voltages compared to unshaded panels. This can potentially lead to reduced system reliability and longevity.

4. Return on Investment (ROI):

   A well-designed solar energy system with minimal shading issues will generate more electricity over its lifetime, providing a better return on the investment made in the system.

5. Avoiding Hotspots and Damage:

   Shading can lead to the formation of hotspots on solar cells, which can cause damage over time. By addressing shading issues, you reduce the risk of potential damage and ensure the longevity of the panels.

6. Optimising Panel Layout and Orientation:

   Shading analysis helps in determining the best layout and orientation of panels to minimise shading impact. This can include adjusting the tilt, azimuth, and spacing of panels to maximise energy production.

7. Performance Guarantees and Warranties:

   Many solar panel manufacturers offer performance guarantees or warranties. Shading issues can impact the ability to meet these guarantees, so optimising the system to minimise shading is important for maintaining warranty coverage.

8. Environmental Impact:
   Solar energy is a sustainable and environmentally friendly power source. Maximising energy production through proper shading analysis helps reduce reliance on fossil fuels, leading to a positive environmental impact.

9. Customer Satisfaction:

   Ensuring that a solar energy system operates at its highest potential builds customer satisfaction. It provides peace of mind for homeowners or businesses knowing they are getting the most out of their investment.

Overall, shading analysis is a critical step in the design and implementation of a solar energy system. It helps to maximise energy production, ensure system reliability, and optimise return on investment, making it an essential consideration for any solar project.

2. Process of Shading Analysis

Shade analysis for solar panels is a crucial step in designing an effective solar energy system. It helps determine potential shading obstructions that can reduce the system's overall efficiency. This is a step-by-step description of the process:

1. Site Assessment:

   We start by conducting a thorough site assessment. This includes taking measurements and images, noting the orientation of the site (north, south, east, west), and identifying potential shading sources like trees, buildings, chimneys, or other structures.

2. Solar Path Diagram:

   We then use a software tool that can generate solar path diagram. This diagram helps visualise the sun's path throughout the day and year for your specific location. It considers factors like latitude, time of year, and local obstructions.

3. Shade Analysis Tools:

   We then run this solar path through out analysis tool. This tool can simulate how shading objects (e.g., trees, buildings) cast shadows over the site at different times of the day and year.

4. 3D Modelling or Aerial Imagery:

   Following this, we utilise 3D modelling to create a detailed representation of the site. This allows for a more accurate assessment of potential shading issues.

5. Time-Lapse Simulation:

   After this, we run a time-lapse simulation to model the sun's movement throughout the day and year. This simulation considers the latitude, azimuth, and altitude angles.

6. Shading Analysis Software:

   This data is run along with the analysis software which incorporates factors like topography, surrounding structures, and vegetation to provide accurate results.

7. Shadow Profiles:

   This then generates shadow profiles for the objects causing shading. This helps visualise how the shadows move over the course of a day or a year.

8. Loss Estimation:

   We calculate the estimated energy loss due to shading. This involves assessing the percentage of time the panels will be shaded and the degree of shading (partial or full) at different times.

9. Panel Configuration and Layout:

   Based on the shading analysis, we adjust the layout and configuration of the solar panels. This may involve tilting or orienting the panels differently or moving them all together to minimise shading impact.

10. Optimisation and Inverter Selection:

    We then choose an inverter system that supports partial shading scenarios, such as microinverters or power optimisers. These devices can help mitigate the impact of shading on the overall system performance.

3. Analysis

The first round of analysis was carried out to check the feasibility of having the solar array close to the property. After the initial site visit at 1100hrs on the 15th of May 2023, the large trees to the south of the property were immediately identified as a potential problem. Considering the time of day and date of year, there was notable shading across the rear lawn encroaching on the area initially identified as the array area.

After running the full analysis, there were some notable findings:

1. September – March

   From September 30th at 1200hrs to March 30th at 1200hrs, the array would come under some level of shading from the tree line. Below are two figures: figure 1 and figure 2, depicting the shade at midday on both these days. There is visible shading being cast just to the south of the panels. This is the first day and last day of the year where the panels are unaffected by shade when the sun is at its peak:

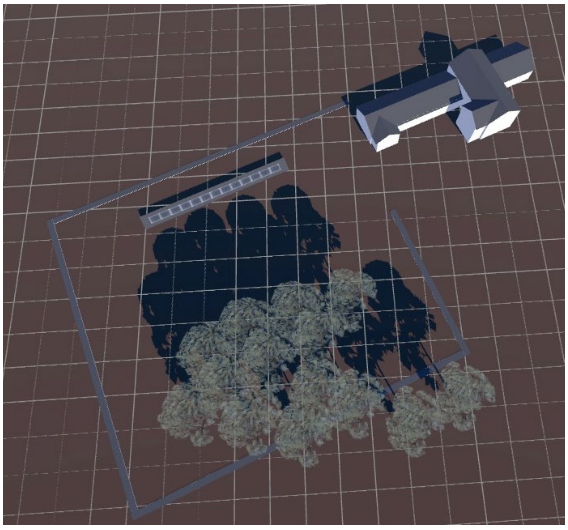

Figure 1 - Shading at 1200hrs, 30th September.

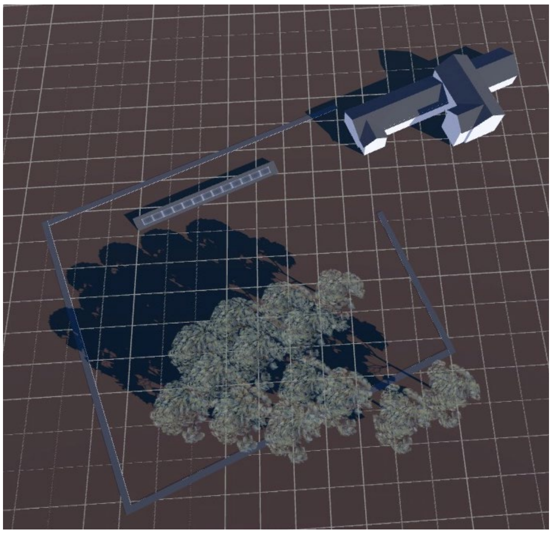

Figure 2 - Shading at 1200hrs, 30th March.

2. November – February

   The largest finding was the complete lack of sunlight upon the array for four total months. During the period of November through to February, the array was cast in shadow throughout every hour of the day, effectively rendering the array ineffective and not producing any notable energy.

3. April – September

   For the transitional period of April and September, shading was found to impact the array in the early mornings as the sun rose behind the tree line cutting the efficiency of the array and reducing the output.

4. May – August

   These 4 months have been shown to be the best for solar generation, however, still impacted by shading from the early morning sun rises.

Figure 3 shows the raw data presented in Sunpath Diagrams. The red areas show the times of day and months in which the array is within shade.

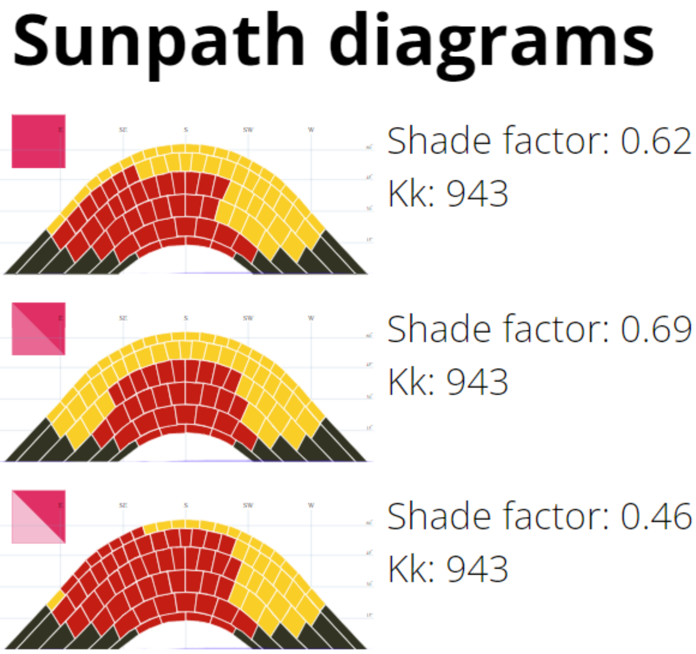

Figure 3 - Sunpath Diagrams of Array Near Property

Following these findings, a second round of analysis was run to find the best location on the premises to place the solar array by prioritising solar output whilst reducing the visual impact of the array from the surrounding areas. The solar model was run to mimic the winter solstice, the shortest day of the year, when the sun is lowest in the sky. The shading was tracked across the garden space, and an area, which gave a few hours of unshaded sunlight, was identified. Please see figures 3, 4 & 5 bellow which show the shaded zones across a 2hr period.

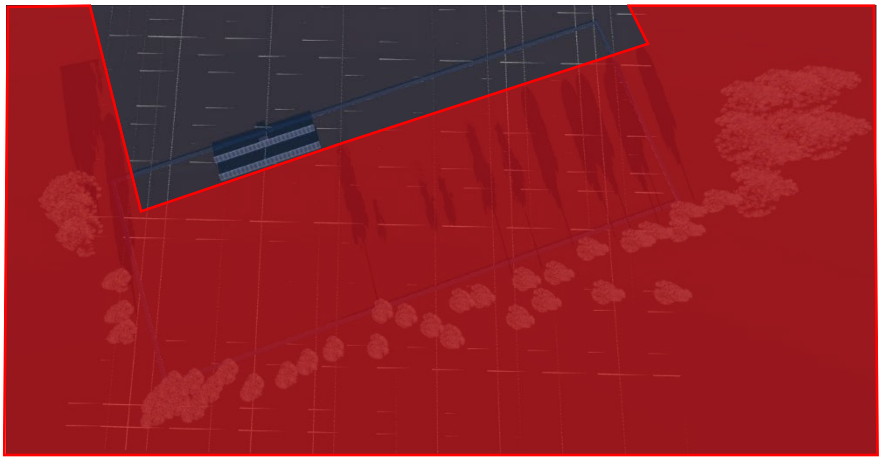

Figure 4 - Shading at 1100hrs, 21st December.

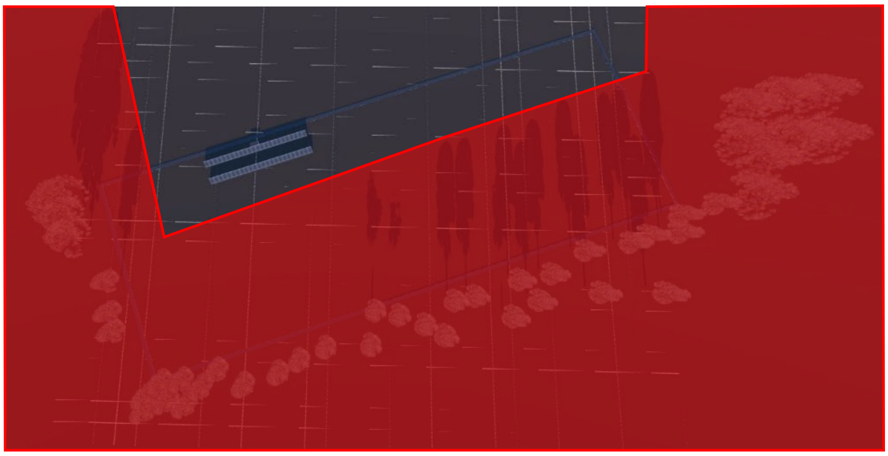

Figure 5 - Shading at 1200hrs, 21st December.

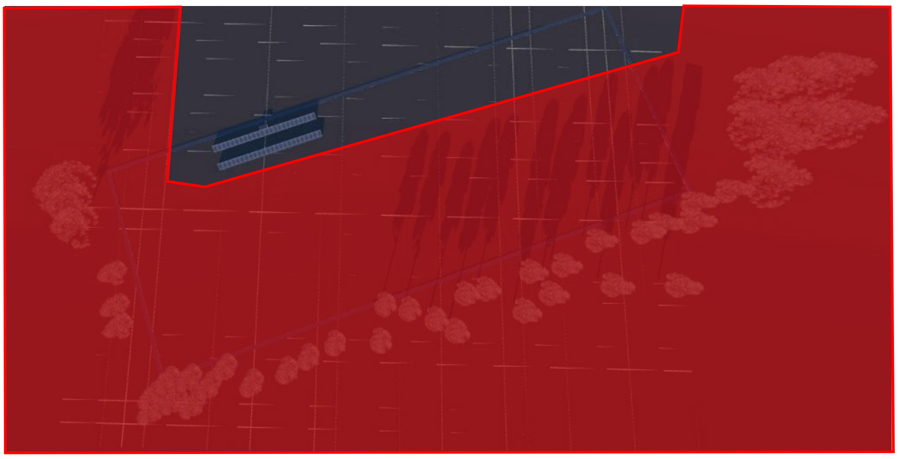

Figure 6 - Shading at 1300hrs, 21st December.

As the 21st of December is considered the worst day for solar output, we can simply extrapolate from here that the rest of the year will have a greater solar output. The array has been placed further left to avoid early morning shading caused by the sun rising to the east of the larger tree line by the house. This identified location captures the highest percentage of the available sunlight throughout the year.

Financial Impacts

Feasibility of this project must consider the financial impact of having such a project installed. The purpose of this project is to secure stability and longevity within the turbulent market of energy over the coming 25 years, providing peace of mind and an insurance against radical changes in energy prices and availability.

The two arrays have been compared for their energy output, its impact on current bills, expected export income and payback period. Table 1 below shows a comparison of these.

	Close to Property (A)		Further from Property (B)		Delta (B-A)		%
Energy Generation	11,351	kWh	18,147	kWh	6,796	kWh	+59.9
Self-Consumption	6,556	kWh	7,546	kWh	990	kWh	+15.1
Export	4,680	kWh	10,468	kWh	5,788	kWh	+123.7
Import	4,389	kWh	3,418	kWh	-971	kWh	-22.1
Energy Bill before PV	£3,240		£3,240		£0		
Energy Bill after PV	£1,273		£976		-£297		-23.3
Export Income	£717		£1,586		£869		+121.2
Payback Period	11 years		8 years		-3yrs		-27.3

Table 1 - Comparison of Array Locations

Comparing these results, the location has a significant impact on the efficiency and output of the array with factors such as exported energy increasing 123.7%.

With a task of creating a balanced energy system that will bring a net positive impact including insurances against energy price fluctuation, an array close to the property is not feasible.

4. Recommendation

This document has laid out a very brief overview of the extensive task of shading analysis for the property of 25 The Street, Surlingham, NR14 7AJ.

After reviewing the data, the recommendation is to have the solar array placed 25 metres from the west end of the garden space. This will optimise the amount of solar irradiance captured by the solar array to maximise the energy output of the system, reducing the reliance on grid imported power, and ensuring the capability of the system to generate a net positive output.

Any movement of the solar array from this position will start to significantly impact the efficiency of the system, it's ROI, energy output, reliability and environmental impact.