Appendix F – Photovoltaic Design Suitability and Considerations Appraisal

A detailed analysis is provided in this Appendix to summarise the applicable financial support available, and design & maintenance requirements for the deployment of PV onto Warrender Primary School.

Feed-In Tariffs

The key advantages of a PV system is that cost can be offset through Government's incentives. This is coupled with the fact that the system benefits from the Feed-in Tariff (FIT) scheme. Solar PV is eligible for Feed-in Tariffs and you will earn a tariff for each kWh of electricity generated by your system. The client will also receive another tariff for each kWh of electricity you export.

The Feed-in Tariffs (FITs) scheme is a UK Government scheme designed to encourage uptake of a range of small-scale renewable and low-carbon electricity generation technologies and receive payments for the electricity you generate if you install or have installed an eligible system like solar PV. The energy regulator Ofgem currently administers the scheme.

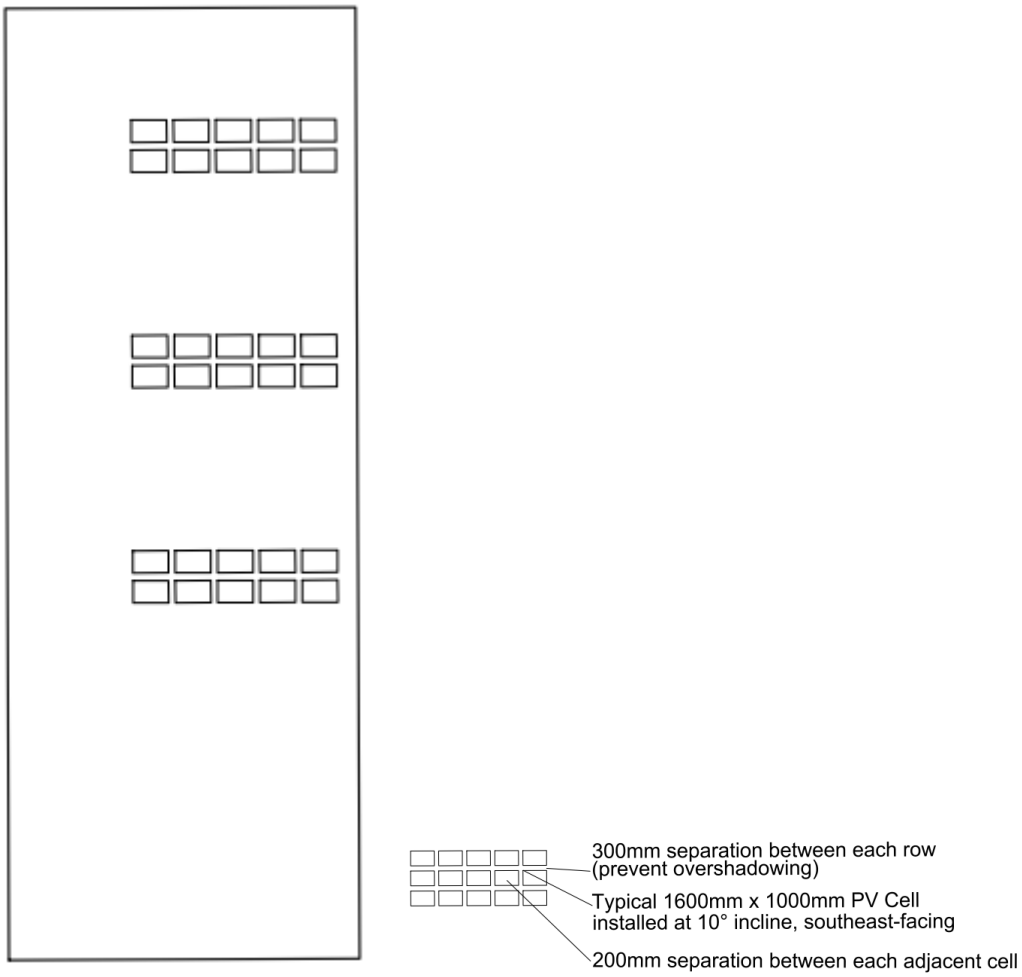
Warrender Primary School can benefit from three types of FITs payments:

- **Generation tariff**: your energy supplier will pay you a set rate for each unit (or kWh) of electricity you generate. Once your system has been registered, the tariff levels are guaranteed for the period of the tariff (up to 20 years) and are index-linked.
- **Energy bill savings**: the site will be making savings on electricity bills due to generating electricity on site.
- **Export tariff:** your energy supplier will pay you a further rate for each unit you export back to the electricity grid. Systems above 30kWp will require a meter. However, it is unlikely that the site will benefit from export tariffs.

Design Guidance

Several manufacturers were contacted to provide realistic advice on the expected annual electricity generation to design guidance to install safely.

- Guidelines on roof area to panel area requirements advises a maximum utilisation factor (the ratio of panel area to roof area) of 0.33 to be considered for a typical development. This good practice should allow for sufficient space between rows to prevent overshadowing and provide adequate access space for future maintenance.
- To maximise the annual CO_2 savings, it is recommended to install the PV at a tilt of 10° in the southeast. Mounting the PV in such an orientation will also minimise the wind loadings, thereby reducing stresses onto the building's roof structure.
- For the new build Warrender construction, 3 pre-assembled banks of 10 no. 1.6m² panels can be realistically installed on the flat roof available, as shown in the figure below. The PVs can be arranged onto an aluminum frame.



- Further consideration should be made for ballast masses required to anchor the PV module arrays frame onto the building's roof. A detailed load analysis should be undertaken to size an appropriate ballast mass, and should be located in a position acceptable to the structural engineer.

Our feasibility raised the following points regarding PV:

- The proposed site is not in close proximity to the surrounding residential and commercial buildings. In addition, all the surrounding buildings are of heights which are comparable or lower than the proposed development. There are a few trees, but they have located some distance away and therefore not expected to constitute a major overshading challenge. Considering these factors, a <20% overshading has been used in the calculations even though it is expected to be practically below this level.
- As with every renewable energy system, Photovoltaic (PV) system is limited by the amount of visual impact it creates. But for the system proposed for the current development, the high efficiency coupled with high power panels would substantially reduce the visual impact. More power per panel means fewer panel per install. This reduces the total area of panel arrays and hence the visual impact compared to conventional panels.

Maintenance Requirements

Minimal maintenance is generally required for PV technologies. A suitably designed PV installation, as per design guidance above, should ensure suitable drainage of rainfall, shall have self-cleaning film to reduce light staining, and the whole assembly is constructed of UV-protected materials.

To ensure a high electrical generation output, the panels should be accessible to ensure 6 monthly cleaning, and landscaping is managed to ensure no tree overshadowing. As it is recommended to install the panels at

a tilt of 10°, the panels may not be able to be cleaned by rainfall, as such, debris accumulated should be removed.

A 6 monthly maintenance check should also include checks of the main inverter fault signals and key troubleshooting guidance.

The panels are estimated to last 25 years or more (usually covered by warranty for 25 years from most manufacturers). The inverter is likely to need replacing sometime during this period (estimated the lifespan of 10-15 years) at a cost of about £800.

Appendix G – Full Energy Analysis

	Baseline	Lean	Clean	Green	% Improvement
	(Part L 2013)	(After Energy Efficiency Measures)	(with Additional Proposed Clean Technology)	(with Additional Proposed Green Technology)	(Green over Part L 2013 Baseline)
Regulated Energy	30,835 kWh/yr	50,998 kWh/yr	50,998 kWh/yr	50,998 kWh/yr	-65.4%
Unregulated Energy	24,249 kWh/yr	24,249 kWh/yr	24,249 kWh/yr	24,249 kWh/yr	0.0%
Total Energy	55,084 kWh/yr	75,247 kWh/yr	75,247 kWh/yr	75,247 kWh/yr	-36.6%
Regulated CO2	17,266 kgCO2/yr	13,660 kgCO2/yr	13,660 kgCO2/yr	10,999 kgCO2/yr	36.3%
Unregulated CO2	12,585 kgCO2/yr	12,585 kgCO2/yr	12,585 kgCO2/yr	12,585 kgCO2/yr	0.0%
Total CO2	29,851 kgCO2/yr	26,245 kgCO2/yr	26,245 kgCO2/yr	23,584 kgCO2/yr	21.0%

Energy calculations below summarises the energy consumption for the building with/without a PV system.

	Without PV (Clean)	With PV (Green)	% Improvement
	(without Proposed Green Technology)	(after Proposed Green Technology contribution)	(Zero-carbon green contribution to site)
Regulated Energy	50,998 kWh/yr	50,998 kWh/yr	0.0%
Unregulated Energy	24,249 kWh/yr	24,249 kWh/yr	0.0%
Total Energy	75,247 kWh/yr	75,247 kWh/yr	0.0%
Regulated CO2	13,660 kgCO2/yr	10,999 kgCO2/yr	19.5%
Unregulated CO2	12,585 kgCO2/yr	12,585 kgCO2/yr	0.0%
Total CO2	26,245 kgCO2/yr	23,584 kgCO2/yr	10.1%

		Regulated	Unregulated
(A)	Baseline: Part L 2013 of the Building Regulations Compliant Development	17.3 tCO2/yr	12.6 tCO2/yr
(B)	After renewable energy	13.7 tCO2/yr	12.6 tCO2/yr
(C)	After CHP	13.7 tCO2/yr	12.6 tCO2/yr
(D)	After renewable energy	11.0 tCO2/yr	12.6 tCO2/yr

		Savings	%Savings
(A-B)	Savings from energy demand reduction	3.6 tCO2/yr	20.9%
(B-C)	Savings from CHP	0.0 tCO2/yr	0.0%
(C-D)	Savings from renewables	2.7 tCO2/yr	15.4%
(E=A-D)	Total cumulative savings	6.27 tCO2/yr	36.3%
(F=(A*0.35))	Total Target Savings	6.04 tCO2/yr	35.0%
(G=E-F)	Annual Surplus	0.22 tCO2/yr	

Arcadis (UK) Limited

Arcadis House
34 York Way
London N1 9AB
United Kingdom

T: +44 (0)20 7812 2000

arcadis.com