

BATTLE STREET REDEVELOPMENT

Central Pool, Battle Street, Reading, RG1 7NU

7. ENERGY EFFICIENCY STATEMENT

In Support of Planning Application

Project no: E05077

Issue: Final

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7.1 Executive Summary

This Energy Efficiency Statement has been developed to assist the planning application stage to demonstrate how energy will be considered and incorporated as part of the proposed development and to show that the current policies and sustainability requirements set by the Client (Reading Borough Council) have been considered and how these will be met.

The following Assessments and reports show that the planning requirements related to the energy efficiency have been met.

1. **SAP Calculation;** this demonstrates that with the incorporation of PV the residential development meets a 100% carbon reduction requirement. See Appendix A.
2. **Passivhaus PHPP calculation:** Blocks A- F on the proposed development at Battle Street in Reading have been modelling in PHPP and tested against the demanding Passivhaus Classic and Low Energy building standard with the following results;
 - Block A, D, E1 and E2 and F meet all the requirements of the Passivhaus Classic Standard
 - Block C meets all the requirements of the Passivhaus Low Energy Building Standard
 - Block B meet all the standards of Passivhaus Classic except for heat load, which is linked to the form factor and on-site shading. Here the target is missed by between +1W/m²/year. See Appendix B.
3. **Part L2A (BRUKL) calculation;** demonstrates the non-residential Old Persons Day Care Centre achieves 35% carbon reduction. See Appendix C.

Refer also to the Sustainability Report.

7.2 Introduction

Pre-planning consultation with the Planners that the Passivhaus principles exceed the required BREEAM standard and therefore this approach can be considered as acceptable to achieve an improved outcome in terms of sustainability.

"It is agreed by officers that for the proposed mixed-use scheme that designing all the use types to Passivhaus principles, with the residential elements achieving a minimum 35% improvement in the dwelling emission rate, with planning contributions to offset the remaining carbon emission to zero, is acceptable."

The development aim is to achieve a net zero carbon in operation by adopting Passivhaus principles which include the following:

- Very low U-values of all external elements by introducing high levels of insulation and high-quality triple glazed windows
- minimal thermal bridging
- high levels of air tightness
- mechanical ventilation with heat recovery (MVHR)
- On-site renewable energy generation and storage via photovoltaic panels and battery storage
- Combination exhaust air heat pumps (including heating, hot water and MVHR)

Refer to Appendices A and B for further details.

7.3 Proposed Development

The Battle Street development will be constructed on the site of the former Central Swimming Pool site on Battle Street in central Reading.

Please refer to layout drawings which form part of the planning application for more details.

7.4 RBC Planning Policies and Energy Efficiency Requirements and Guidance

7.4.1 Policies Overview

Reading's existing Climate Change Strategy, entitled 'Reading Means Business on Climate Change – Reading's Climate Change Strategy 2013 – 2020' set a target of reducing the Borough's carbon footprint in 2020 by 34% compared with 2005 levels. This aim has been achieved, with CO₂ emissions in the Borough falling by 41% since 2005, within the top 5% of authorities in Great Britain.

Reading Borough Council has declared a Climate Emergency and sets out its commitment to working to achieve a carbon neutral Reading by 2030. However, it recognises that this aim can only be fully achieved with policy changes from local government.

Reading is also a signatory to UK100 'aiming to have 100% clean energy by 2050

To help increase the use and supply of renewable and low carbon energy, RBC local planning authorities have a positive strategy to promote and maximise use of energy from renewable and low carbon sources, while ensuring that any adverse impacts (including visual impacts) are addressed satisfactorily.

The strategic priorities identified and relevant to planning policy are as follows:

- Energy supply – reduce electricity consumption, develop heat supply networks to deliver low carbon heat in Reading and increase the amount of energy generated locally using renewable technologies;
- Low carbon development – buildings in Reading to be built to high standards of energy efficiency incorporating on-site renewable energy where possible, retrofit energy efficiency measures into Reading's buildings, minimise the 'embodied carbon' incorporated in construction projects and continue to develop planning policies that support the reduction of greenhouse gas emissions directly and indirectly from the Borough and reduce the risks of climate change to the communities of Reading;
- Natural environment – improve the quality and connectivity of natural habitats;
- Water supply and flooding – Manage demand for and supply of water to reduce the expected impact of water shortages on consumers and on wildlife and reduce the risk of damage due to flooding;
- Transport – develop a transport infrastructure which supports more low carbon travel options for people in Reading and encourage non-car travel for all sectors of the population; and
- Purchasing, supply and consumption – reduce waste by supporting the re-use and repair of products and materials.

7.4.2 Energy Efficiency Planning Requirements

Major planning applications like Battle Street Development are required to provide an Energy statement which demonstrate how the energy related aspects of the proposed development will meet requirements of Policies CC2, CC4 and H5 of the Reading Borough Local Plan (2019):

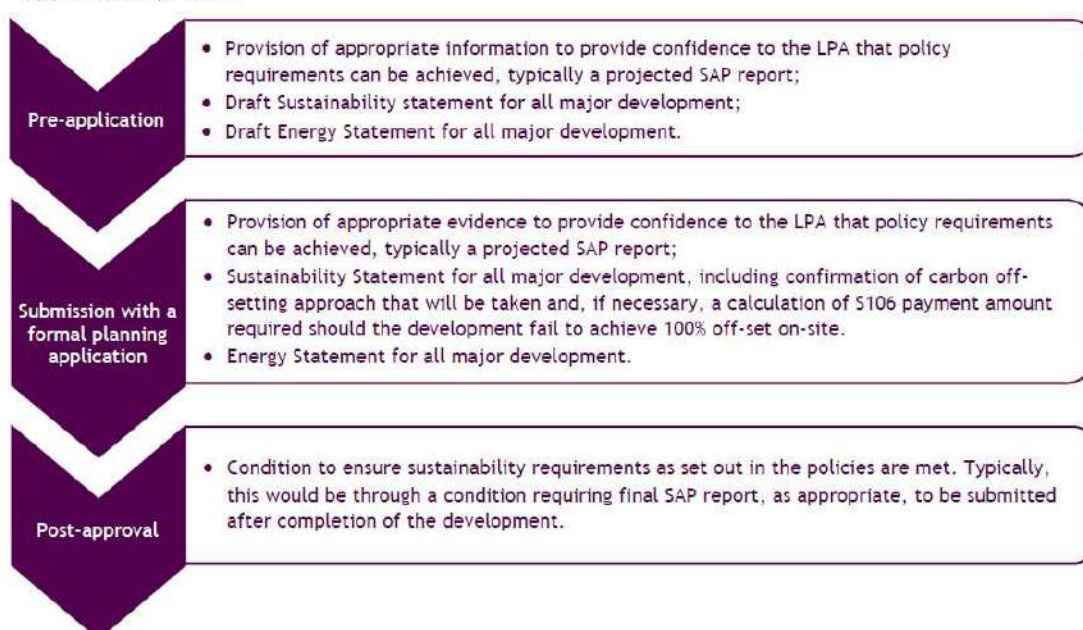
The Local Plan requires BREEAM Excellent standards to be achieved for all non-residential development with the floor area greater than 1000m².

For residential development of ten dwellings or more, the Local Plan requires 'Zero Carbon' development, unless it can be clearly demonstrated that this would render a development unviable.

Residential Development

- 3.9 For residential development of ten dwellings or more, the Local Plan requires 'Zero Carbon' development, unless it can be clearly demonstrated that this would render a development unviable. Zero carbon homes is an achievable standard that, until recently, was intended to be a national requirement in the Building Regulations. It is required through planning policy for major residential new build development, and the viability of this approach was tested through the Local Plan and was not found to place an unreasonable burden on development. The paragraphs below describe the requirements in more detail.

Table 3.3: Summary of Zero Carbon Homes submission requirements at each stage of the application process



In achieving Zero Carbon Homes for major residential developments, the preference is that new build residential of ten or more dwellings will achieve true carbon neutral development on-site. If this is not achievable, it must achieve a minimum of 35% improvement in regulated emissions over the Target Emissions Rate in the 2013 Building Regulations, plus a Section 106 contribution of £1,800 per remaining tonne towards carbon offsetting within the Borough (calculated as £60/tonne over a 30 year period). £60 per tonne of carbon is a nationally-recognised price of carbon and reflects the amount established by the Zero Carbon Hub¹⁵.

Energy Statements demonstrate how the energy related aspects of the proposed development actually meets the requirements of local planning policy and BREEAM energy and emissions standards. An energy statement would typically include the following information:

- Energy efficiency of the building;
- Baseline annual predicted energy demand of the development (regulated and unregulated);
- Baseline annual predicted carbon emissions of the development (regulated and unregulated), the Target Emission Rate (TER);
- The contribution of each proposed renewable energy technology;
- Cost information of technically feasible low or zero carbon renewable technologies, including additional insulation, low carbon de-centralised energy, heat pumps etc;
- Feasibility of district or community heating;
- Summary of the benefits of various energy technologies;
- The total estimated reduction in the development's baseline carbon and/or energy emissions.

Please refer to Appendices A, B and C for details how these have been met.

7.4.2.1 CC2: Sustainable Design and Construction

Requirements:

This policy seeks improved sustainability performance of buildings by setting the requirement that all major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible. All minor non-residential developments or conversions to residential must meet the most up-to-date BREEAM 'Very Good' standards as a minimum.

Proposal:

Although the BREEAM is part of the requirements for non-residential part of the development it has been agreed that by following the principles of BREEAM and Passivhaus the full BREEAM assessment will not be required.

During the pre-planning consultation It has been confirmed by the planners that the Passivhaus principles exceed the required BREEAM standard and therefore this approach can be considered as acceptable to achieve an improved outcome in terms of sustainability.

"It is agreed by officers that for the proposed mixed-use scheme that designing all the use types to Passivhaus principles, with the residential elements achieving a minimum 35% improvement in the dwelling emission rate, with planning contributions to offset the remaining carbon emission to zero, is acceptable."

For further details on overall sustainability measures related to Battle Street development refer to separate Sustainability Report as well as to Appendices A, and B for details how these have been met.

7.4.2.2 CC4: Decentralised Energy

Requirements:

Policy CC4 requires that any development of more than 20 dwellings and/or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision. Where there is existing decentralised energy provision present within the vicinity of the application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.

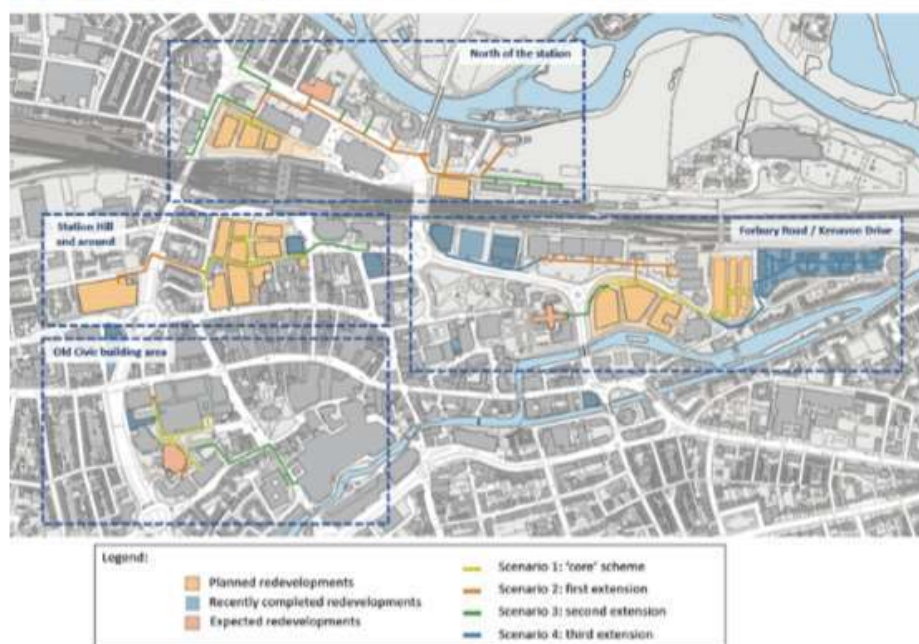
Proposal:

The following technologies have been reviewed and assessed at the feasibility stage:

Biomass boiler – assessed as not viable due to large biomass plant required as well as suitable storage and access for biomass fuel (wood chip/pallets etc.)

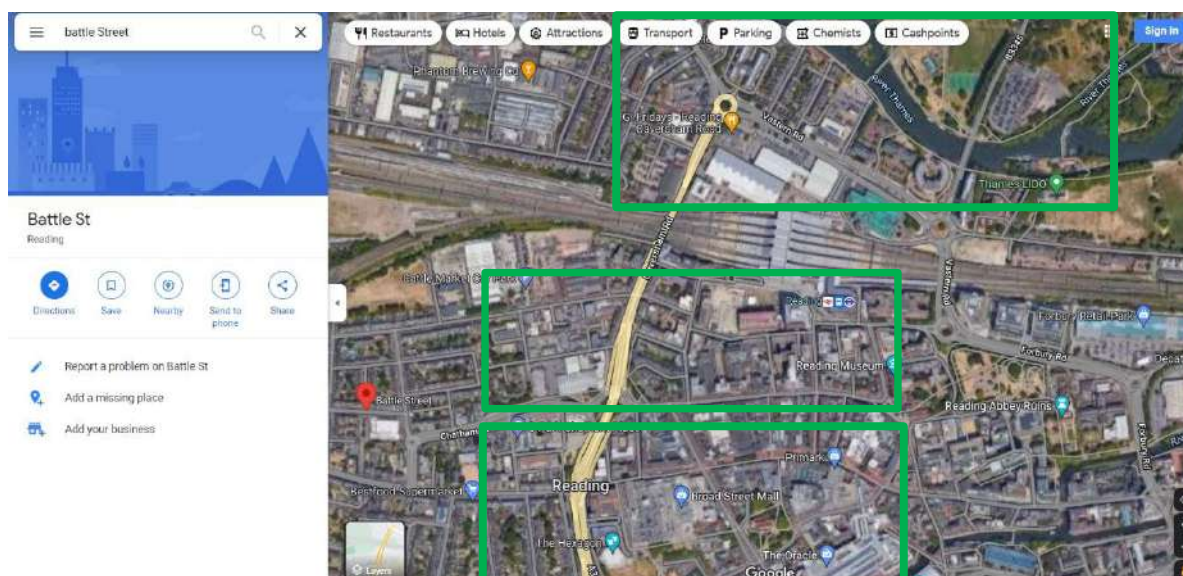
District Heating - not available in close proximity to the new development site and the general requirement is to not to use fossil fuels, so an all-electric approach has been adopted with ASHP and on-site PV panels providing a proportion of the annual energy demand.

Figure 8.1: Overview of the four identified clusters (Element Energy)



Based on the heat mapping and energy master planning study for reading town centre the four clusters highlighted on the above map have been identified as potentially suitable for heat network Street.

Battle Street development lays outside of these cluster and therefore is considered as not viable for connection to a Reading district heating network.



Wind Turbine – not suitable for installation in the proximity to site location

Solar thermal - not feasible due to nature of the building and heating and hot water strategy

PV panels – feasible and extensively used for the development to provide net zero carbon development. The PV panels will be supplemented by storage batteries to store unused electricity rather than sent to the grid.

GSHP (Ground Source Heat Pumps) – the technology has been discounted due to land constraints to accommodate horizontal arrays and proximity to the existing utility services which imposed constraints on works associated with vertical boreholes

ASHP (Air Source Heat Pumps) - The proposed strategy is based on the individual electrically driven high efficiency exhaust heat pumps which will provide heating and hot water to each flat.

The alternative exhaust air source heat pumps have been selected based on the following;

- Very good seasonal efficiency
- Very low heating demands of each property due to improved building fabrics and building air tightness and applying Passivhaus standards
- Provision of dedicated PV panels and battery storage to enable provision of zero carbon building with the aim of meeting 100% of operational energy via on-site generation. The proposed solution will provide net zero carbon strategy for each individual flat.

Please refer to SAP calculation reports for sample residential properties and BRUKL calculation for the non-residential Day Care Centre for details of seasonal efficiencies and building carbon emissions of the Battle Street development.

4.2.1 H5: Standards for New Housing

Requirements:

H5 - Policy H5 requires all major new build residential development to be designed to achieve 'zero carbon homes' as defined in the Sustainable Design and Construction SPD. All other new build housing will achieve at a minimum a 35% improvement on the dwelling emission rate over the target emission rate (TER) as defined in the 2013 Building Regulations.

Proposal:

The SAP calculation and Associated Energy Efficiency Report Appendix A confirms that the new domestic properties will achieve a 100% improvement with PV panels.

Table 8 from the SAP Report (Appendix A) indicates the minimum annual on-site energy generation required from the proposed PV panel system to achieve the 100% CO₂ reduction.

Table 8 shows the PV demand that must be apportioned to each dwelling type in order to achieve net zero, along with floor area of the dwelling. Note that larger dwellings tend to have higher energy demand

Dwelling Type	Floor area (m ²)	PV Demand kWh/year	% carbon reduction
1 Bed FF End North	54	1650	100.31
1 Bed FF Mid North	54	1650	102.80
1 Bed FF Mid West	69	1950	100.12
1 Bed GF Cat3 East	65	2300	101.17
1 Bed GF East	54	1800	101.81
1 Bed GF Mid South	50	1550	100.12
1 Bed Grd End East	77	2200	100.54
1 Bed TF North	54	1700	100.25
2 Bed 3F End East	75	2000	100.30
2 Bed TF South	58	1850	100.31
3 Bed 2F Mid East	114	2300	100.12
3 Bed Semi	55	2850	100.80
Total	779	23800	

Table 8 - PV Apportion to achieve carbon zero per dwelling type.

The quote from the proposed PV panels system manufacturer (See Appendix D) confirms that the annual electricity generation over the next 30 years from the proposed 6No panels arrangement for single bedroom flat will be in order of 2,300-2,480 kWh per annum. These is a comfortable margin above the minimum 1,650-2,200 kWh required to achieve the zero carbon for this type of flat as per table above. See Appendix D for further details.

Please refer to Appendices A, B and D for further details on how these have been met.

The Old Persons Day Care Centre will achieve the 35% improvement over Part L2A 2021 building regulation. Refer to Appendix C for further detail

APPENDIX A

SAP CALCULATIONS AND ENERGY EFFICIENCY REPORT



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ENERGY STRATEGY

Battle Street

REPORT STATUS: 1.0



Document Control Sheet

REPORT STATUS: 1.0

Client	MACE		
Development	Battle Street		
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About Sadler Energy and Environmental Services Ltd.

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry from the concept and planning stage through to the completion of the project.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for energy efficiency, quality and practical on-site applications.



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1. Executive Summary

Energy strategy for affordable housing development in Battle Street, Reading, RG1 7NU. Project includes elderly person's day centre, sheltered, general needs, and supported living apartments, all comprising 62 units. Reading Local Plan states that large-build projects must aim for 35% reduction on carbon emissions (measured in tonnes of CO₂ per year), meaning DER (dwelling emission rate) must be at least 35% less than TER (target emission rate) as modelled in SAP software. The project is designed to Passivhaus standards and so has low carbon emissions. SAP calculations, based on Passivhaus standards and two energy options, were used to calculate carbon emissions and energy demand, and are based on modelling twelve dwelling types from the project in SAP 2012. calculations in this report were carried out using SAP2012, with 35% DER reduction target, as outlined in section 2.1, based on BR 2013. Future iterations for this property will use SAP10.

This project has potential to reach Reading Local plan 35% target (using PKOM combination units), and even surpass the target as carbon-zero or even "plus energy", if energy strategy includes use of MCHR with air source heat pumps (PKOM), along with PV apportioned from communal PV on roof. Sophisticated solar siting is necessary for the most accurate techno-financial evaluation.

2. Information and Background

This Energy Strategy has been produced to identify the measures and technologies necessary to exceed the requirements of Reading Borough Council, as well as ensure that the homes meet the need to reduce reliance on fossil fuels, while reducing carbon emissions arising from new developments and slow the rate of climate change.

The application site, which lies south of Battle Street and is intersected by James Street, seeks permission for construction of a high-density development, which will deliver family houses, general-needs housing, sheltered housing, supporting living housing and an adult day care centre, plus green roofs and landscaping. The old Central Swimming Pool site will be redeveloped as part of this project.

In summary:

Block A1	Adult day care centre
Block A2	4x3 bed flats 8x2 bed flats 38x1 bed flats
Block B	3x1 bed flats
Block C	1x1 bed bungalow
Block D, E1, E2	6x1 bed flats
Block F	2x3 bed houses
Total	62 dwellings



2.1 Planning targets

The Reading Borough Council Local Plan was adopted in November 2019 and sets measures to respond to their declared climate emergency. A supporting Sustainable Design and Construction SPD was subsequently adopted in December 2019.

Policy H5 details the required standard for new housing, as detailed below.

"H5: STANDARDS FOR NEW HOUSING

New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:

- a. All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally-described space standard.*
- b. All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations⁷⁹.*
- c. All major new-build residential development should be designed to achieve zero carbon homes.*
- d. All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building f. On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'."*

Reading Local Plan 2019, General Policies, section 4.4.46 further states,

"where homes are not designed to be carbon neutral, this will mean as a minimum a 35% improvement in the dwelling emission rate over the 2013 Building Regulations."

This report will demonstrate workings towards Reading's zero-carbon ambition and 35% reduction on TER in SAP 2012 calculations, with aim to achieve zero-carbon.

2.2 Key Policy Targets

-  To provide a water usage rate of under 110 Liters per person per day
-  Achieve a minimum of 35% improvement in regulated emissions over the Target Emissions Rate in the 2013 Building Regulations.

The buildings have also been designed to Passivhaus standard, with Passivhaus design report carried out in August 2022.



3. Energy Efficiency – Demand Reduction

The developer aims to provide homes with as close to zero carbon emissions resulting from regulated energy usage (heating, hot water, ventilation and lighting) as possible. This is achieved by applying a fabric first approach, followed by energy supply and renewable energy options (see energy hierarchy in 3.1).

3.1 Methodology

This report uses the energy hierarchy to minimise onsite carbon emissions, the stages are:

-  Use Renewable Energy – assess the feasibility of renewable energy systems
-  Supply Energy Efficiently – Use low-carbon technology to significantly reduce energy consumption
-  Use less Energy – the incorporation of low energy design and passive measures to promise the reduction of energy use

Indicative calculations have also been carried out using the SAP 2012 carbon emissions for each fuel type. This is intended to demonstrate that the proposals remain consistent with the expectation of both current and future regulations.

3.2 Building Energy Modelling

Site was modelled using SAP2012 calculations (see SAP summary), to predict energy demands and CO₂ emissions.

4. Energy Efficiency

A fabric first approach has been adopted to minimise energy demand as much as practical. Energy efficiency features that were proposed include: Built form, Insulation standards, Glazing, Heating systems, Ventilation, Lighting, Controls, Heat recovery, Free cooling, and Equipment. In this chapter we have detailed the most effective energy efficient measures.

Three main sources of heat loss:

-  Thermal Envelope
-  Thermal Bridging
-  Uncontrolled Air Leakage

4.1 Thermal Envelope

Table 1 summarises the proposed performance of the thermal envelope. It is proposed that all areas significantly improve upon the minimum building fabric standards stated within BR Part L 2013.



Thermal Element	BR U-value (Part L 2013) W/m ² K	Proposed target values (Block A) W/m ² K	% Improvement over BR 2013 (Block A)	Proposed target values (Block B, C, D, E & F) W/m ² K	% Improvement over BR 2013 (Block B, C, D, E & F)
Ground Floor	0.25	0.12	48	0.09	36
Heat loss floor (upper)	0.25	0.14	56	n/a	n/a
External wall	0.30	0.14	46.67	0.11	36.67
Cold roof	0.20	0.11	55	0.09	45
Flat Roof	0.20	0.10	50	0.09	45
Warm Roof	0.20	n/a	n/a	0.12	60
External Doors	2.00	0.85	42.5	0.85	42.50
Windows & Glazed Doors	2.00	0.85	42.5	0.85	42.50

Table 1 - Proposed Fabric Standard

These proposed U-values show more than 35% improvement on BR 2013 standards and are conducive to energy efficiency within built form and insulation standards.

4.2 Thermal Bridging

Thermal bridging occurs at the junction between fabric elements, where the continuous insulation line is broken. Through careful detailing of junctions, it is possible to mitigate against the impact of thermal bridges.

This property aims for minimal thermal bridging according to Passivhaus standard, with thermal bridging for all blocks well below BR 2013, see Table 2.

	Block A	Block B, C, D, E & F	Minimum Standards for Part L1A 2013
Thermal bridges (W/m ² K)	0.02	0.02	0.15

Table 2 - Thermal bridging Battle Street

It is proposed that the dwellings benefit from the use of enhanced thermal bridging detailing such as those provided by the LABC, Concrete Block Association (CBA) or Aircrete Product Association (APA). Specific detailing required include:

- ✎ mark-up of the insulation layer for all thermal elements of the building
- ✎ Detailed build ups of all external elements and detailed U value calculations
- ✎ Identification of potential thermal bridges and working with the structural engineer on columns and masonry supports
- ✎ Thermal bridge calculations for a selection of the most important/ worst performing junctions including the window installations
- ✎ Clear definition of the airtight layer on all plans and sections

4.3 Uncontrolled Air Leakage and Ventilation



As buildings become more insulated, uncontrolled air leakage represents an increasing proportion of dwelling heat loss. As such, it is critical to ensure that any unwanted leakage is minimised. Table 3 details ventilation at Battle Street, including air tightness and air permeability for each block.

Under current Building Regulations a dwelling must have an infiltration rate of less than $10\text{m}^3/\text{hm}^2@50\text{Pa}$. The air permeability targets for Battle Street will vary for each building type and will be much lower than 10, as seen in Table 3.

Building	Block A	Block B	Block C	Block D, E1, E2	Block F
Air Tightness (Ach_{n50})	0.6	0.6	0.6	0.6	0.6
Air Permeability ($\text{m}^3/\text{hm}^2 50\text{Pa}$)	0.8	0.4	0.3	0.4	0.4

Table 3 Air permeability and air tightness for Blocks A-F

There is a relationship between the size of the building and the level of air permeability needed to achieve the 0.6 air changes at n50. Generally smaller buildings need to be more airtight to achieve the target air change rates. This can be seen with the bungalow which needs to achieve an air permeability of $0.3 \text{ m}^3/\text{hm}^2 50\text{Pa}$, compared to $0.4\text{--}0.8 \text{ m}^3/\text{hm}^2 50\text{Pa}$ for the other buildings.

4.4 Mechanical Ventilation Heat Recovery

With this level of airtightness, additional controlled ventilation is required to provide fresh air and to remove stale, moist air. The dwellings will be mechanically ventilated with heat recovery (MVHR), via (PKOM4) compact units located within each dwelling.

The Pichler PKOM4 heat pump combination unit is a Passivhaus certified ventilation unit which not only provides ventilation, heating, and cooling of low-energy houses, but also warm water treatment. For the Adult Day Care Centre, ventilation will be provided by a series of Passivhaus-certified MVHR units. The MVHR will extract warm moist air from kitchens and bathrooms and supplies fresh air to bedrooms and living rooms via a balanced system. Purge ventilation can be provided by the system when operating in 'boost' mode.

To assist in the management of overheating risk, the MVHR units will have a summer bypass mode, which switches off heat recovery when temperatures outside increase. Thorough commissioning of the MVHR units is part of the quality assurance process, to ensure the units are operating with the correct flow rates for each room. MVHR units do require additional maintenance with filters needing to be replaced annually. Units to be located as close to an outside wall as possible to maintain efficiency with rigid ducting to reduce friction and noise, plus sound attenuators between rooms.

4.5 Lighting

Low energy fittings are defined as fittings that can only be used with lamps having a luminous efficacy greater than 45 lumens per circuit watt. All buildings will have 100% low energy lights fitted internally. Externally, property will



have low energy light fitting or standards with light and motion sensors.

4.6 Appliances

Where supplied, any white goods will achieve the following ratings (or better) under the EU Energy Efficiency Labelling Scheme:

-  Fridges, fridge-freezers: A+ rating
-  Washing machines: A++ rating
-  Dishwashers: A+ rating
-  Washer-dryers: A rating
-  Tumble-dryers: A rating (Where possible external drying lines will be included to reduce the need for tumble dryers)

Where not provided as part of the build specification, guidance regarding energy-efficient appliances will be provided to the occupant.

4.7 Water Efficiency

In accordance with policy H5(b) it is proposed that all dwellings achieve a minimum water efficiency standard of 110 litres/person/day as set out in Building Regulations Part G. It is recommended that maximum water consumption criteria, as stated in table 2.2 of approved document Part G is followed, see Table 4 below.

Water Fitting	Maximum Consumption
WC	4/2.6 litres dual flush
Shower	8 l/min
Bath	170 litres
Basin Taps	5 l/min
Sink Taps	6 l/min
Dishwasher	1.25 l/place setting
Washing Machine	8.17 l/kilogram dry load

Table 4 - (Part G2 Table 2.2) Maximum fittings consumption optional requirement level

4.8 Primary Heating

Space heating demand will be low, and the greater energy demand will be for hot water. In line with the phasing out of gas as the main form of energy for heating and hot water and the Decarbonisation of the National Grid (see chapter 5), electricity will be used for space and hot water. Within the domestic units, space heating and hot water will be provided by a PKOM 4 compact unit; this is a heat pump, which combines an MVHR with hot water, space heating and if cooling if necessary. Heating and cooling will be provided within the PKOM4 unit and distributed via the internal supply air ducting. A PKOM4 unit is designed to be used in dwellings with a low space heating demand. For the adult day care centre, heating and hot water will be provided by an Air Source Heat Pump (ASHP).

Table 5 summarizes space heating and hot water delivery at Battle Street.



Building	Block A	Block B	Block C	Block D, E1, E2	Block F
Space heating and hot water	PKOM 4 unit to flats and ASHP to day care centre	PKOM 4 unit	PKOM 4 unit	PKOM 4 unit	PKOM 4 unit
Heat emitter	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators
Hot water tank	Within PKOM unit separate tank for day care centre	Within PKOM unit	Within PKOM unit	Within PKOM unit	Within PKOM unit

Table 5 - Space heating and water delivery at Battle Street

By providing individual heating and hot water heating systems to each dwelling, this eliminates the need for a heat distribution network within the buildings. Distribution of hot water, especially in the summer and in larger buildings, can contribute to overheating risk. This is one of several strategies to reduce overheating.

4.9 Secondary Heating

There will be an electric towel rail in the bathrooms to provide additional heating if needed.

5. Supply Energy Efficiently

In recent years, the electricity grid has undergone de-carbonisation with coal power stations decommissioned and electricity generation moving to cleaner fuel sources and renewable energy such as wind and solar (see Fig 1).

SAP10 is the first version of SAP which reflects this, with emissions from grid electricity being quarter of what they were previously, which removes the significant benefit that a fossil fuel natural gas heated dwelling used to

benefit from. This will encourage a move to alternative low-carbon heating systems such as heat pumps. This project has been designed with SAP 10 regulations in mind and so uses Passivhaus approved MVHR with air source heat pump.

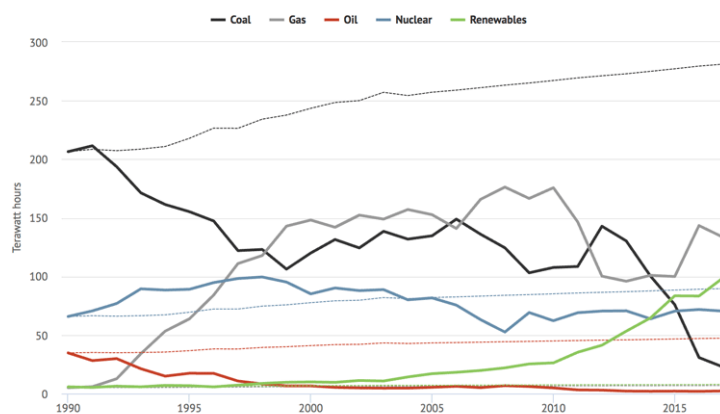


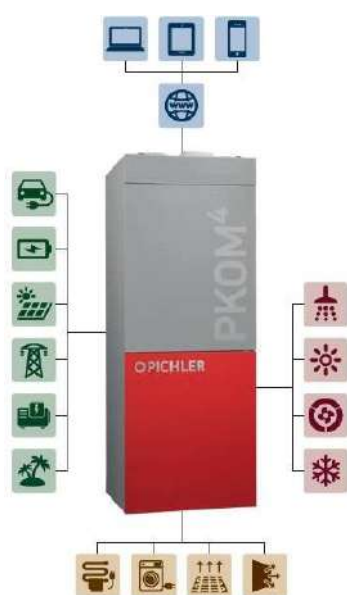
Figure 1 UK electricity generation by fuel (source: Carbon Brief 2019)



6. Low and zero carbon (LZC) energy generation and results

Energy strategy options have been chosen based on Passivhaus standards; these are capable of meeting and exceeding the requirements of national and local planning policy while offering viability under future Building Regulations and SAP10 criteria. To meet Reading Local Plan zero carbon goals, heating choice for this property will combine with PV panels, apportioned according to property size, to achieve 35% reduction or even carbon-zero. Solar PV will be deployed in addition to a suitably sized storage batteries per property.

6.1 Option 1 – PKOM Heat Pump Combination Unit



PKOM4 compact heat pump combination unit not only provides for the ventilation, heating, and cooling of low-energy houses, but also for warm water treatment. Through its heat pump technology (air-heating pump) and its intelligent heat recovery system, it achieves optimum efficiency values. Furthermore, the PKOM4 can be ideally combined with an intelligent energy management system and renewable energies (photovoltaics). In this way, further operating costs can be reduced.

The Passivhaus certified super combination unit presents itself in a compact, efficient, cost-effective, low-maintenance, and environmentally-friendly fashion. As a compact ventilation unit, the heat pump combi unit PKOM4 replaces a full-featured heating/cooling/service water system.

6.1.1 Considerations

Pros:

- ✂ Reduce energy demand and carbon emissions
- ✂ Touch screen and app
- ✂ Space saving (<0.75m²)
- ✂ Low running cost
- ✂ Currently eligible for the Renewable Heat Incentive (RHI)
- ✂ Significantly lower emissions when calculated using updated SAP 10.1 emissions factors

Cons:

- ✂ Higher capital cost
- ✂ Maintenance



6.1.2 Energy Demand and Emissions

Table 6 below show the percentage reduction in energy demand and TER as modelled in SAP 2012. Twelve building types were modelled with Passivhaus designs and PKOM heat pump.

	Part L 2013 TFEE Energy Demand (kWh/m ² /year)	Predicted Energy Demand DFEE (kWh/ m ² /year)	Energy Demand Reduction (kWh/m ² /year)	Demand Reduction (%)
1 Bed FF End North	50.24	24.06	26.18	52.11
1 Bed FF Mid North	43.25	19.69	23.56	54.47
1 Bed FF Mid West	43.73	24.3	19.43	44.43
1 Bed GF Cat3 East	62.64	34.99	27.65	44.14
1 Bed GF East	49.16	27.25	21.91	44.57
1 Bed GF Mid South	30.56	20.58	9.98	32.66
1 Bed Grd End East	41.01	26.04	14.97	36.50
1 Bed TF North	47.55	25.81	21.74	45.72
2 Bed 3F End East	36.98	22.18	14.8	40.02
2 Bed TF South	51	28.09	22.91	44.92
3 Bed 2F Mid East	25.4	16.62	8.78	34.57
3 Bed Semi	51.82	29.89	21.93	42.32
	Part L 2013 TER Emissions (tonnes.CO ₂ /year)	Predicted CO ₂ Emissions DER (tonnes.CO ₂ /year)	CO ₂ emission reduction (tonnes.CO ₂ /year)	CO ₂ emissions reduction (%)
1 Bed FF End North	29.16	15.76	13.4	45.95
1 Bed FF Mid North	27.47	15.09	12.38	45.07
1 Bed FF Mid West	25.69	14.64	11.05	43.01
1 Bed GF Cat3 East	31.75	18	13.75	43.31
1 Bed GF East	29.33	16.77	12.56	42.82
1 Bed GF Mid South	24.65	15.95	8.7	35.29
1 Bed Grd End East	24.07	14.5	9.57	39.76
1 Bed TF North	28.56	16.14	12.42	43.49
2 Bed 3F End East	23.16	13.73	9.43	40.72
2 Bed TF South	29.04	16.45	12.59	43.35
3 Bed 2F Mid East	16.75	10.4	6.35	37.91
3 Bed Semi	24.85	13.42	11.43	46.00

Table 6 SAP2012 results for TER and TFEE, with DER and DFEE per dwelling type. Modelled using Option1 – PKOM. Energy demand and CO2 reductions expressed in percentage.

The results table shows that through using just PKOM, Passivhaus design, and no PV. The dwelling types show a range of carbon savings from 35.29% to 46%, and so would meet the carbon 35% target set by policy H5. This is a very promising sign for this development. This led to Option 2 which combines PKOM with communal PV on the dwelling roofs, apportioned to each dwelling as energy use necessary to achieve 100% carbon reduction.



6.2 Option 2 – PKOM4 Heat Pump Combination Unit and PV

By combination with renewable energy such as photovoltaics and energy management, the PKOM4 presents an efficient, cost-effective system solution, by means of which operating costs are reduced to a minimum, thus making it possible to implement a zero-energy building, or even a “plus energy” building. The PV array will be situated on the roof, and so it is likely to be apportioned to dwellings relative to their size, and so their overall energy demand.

6.2.2 Energy Demand and Emissions with PV for Net-Zero

The tables show the Energy demand and carbon emissions with apportioned PV energy demand in kWh per year, along with the percentage reduction in carbon emissions (DER < TER).

	Part L 2013 TFEE Energy Demand (kWh/m ² /year)	Predicted Energy Demand DFEE (kWh/ m ² /year)	Energy Demand Reduction (kWh/m ² /year)	Demand Reduction (%)
1 Bed FF End North	50.24	24.06	26.18	52.11
1 Bed FF Mid North	43.25	19.69	23.56	54.47
1 Bed FF Mid West	43.73	24.3	19.43	44.43
1 Bed GF Cat3 East	62.64	34.99	27.65	44.14
1 Bed GF East	49.16	27.25	21.91	44.57
1 Bed GF Mid South	30.56	20.58	9.98	32.66
1 Bed Grd End East	41.01	26.04	14.97	36.50
1 Bed TF North	47.55	25.81	21.74	45.72
2 Bed 3F End East	36.98	22.18	14.8	40.02
2 Bed TF South	51	28.09	22.91	44.92
3 Bed 2F Mid East	25.4	16.62	8.78	34.57
3 Bed Semi	51.82	29.89	21.93	42.32
	Part L 2013 TER Emissions (tonnes.CO ₂ /year)	Predicted CO2 Emissions DER (tonnes.CO ₂ /year)	CO2 emission reduction (tonnes.CO ₂ /year)	CO2 emissions reduction (%)
1 Bed FF End North	29.16	-0.09	29.25	100.31
1 Bed FF Mid North	27.47	-0.77	28.24	102.80
1 Bed FF Mid West	25.69	-0.03	25.72	100.12
1 Bed GF Cat3 East	31.75	-0.37	32.12	101.17
1 Bed GF East	29.33	-0.53	29.86	101.81
1 Bed GF Mid South	24.65	-0.03	24.68	100.12
1 Bed Grd End East	24.07	-0.13	24.2	100.54
1 Bed TF North	28.56	-0.07	28.63	100.25
2 Bed 3F End East	23.16	-0.07	23.23	100.30
2 Bed TF South	29.04	-0.09	29.13	100.31
3 Bed 2F Mid East	16.75	-0.02	16.77	100.12
3 Bed Semi	24.85	-0.2	25.05	100.80

Table 7 SAP2012 results for TER and TFEE, with DER and DFEE per dwelling type. Modelled using Option1 – PKOM with PV. Energy demand and CO2 reductions expressed in percentage.



Table 8 shows the PV demand that must be apportioned to each dwelling type in order to achieve net zero, along with floor area of the dwelling. Note that larger dwellings tend to have higher energy demand

Dwelling Type	Floor area (m ²)	PV Demand kWh/year	% carbon reduction
1 Bed FF End North	54	1650	100.31
1 Bed FF Mid North	54	1650	102.80
1 Bed FF Mid West	69	1950	100.12
1 Bed GF Cat3 East	65	2300	101.17
1 Bed GF East	54	1800	101.81
1 Bed GF Mid South	50	1550	100.12
1 Bed Grd End East	77	2200	100.54
1 Bed TF North	54	1700	100.25
2 Bed 3F End East	75	2000	100.30
2 Bed TF South	58	1850	100.31
3 Bed 2F Mid East	114	2300	100.12
3 Bed Semi	55	2850	100.80
Total	779	23800	

Table 8 - PV Apportion to achieve carbon zero per dwelling type.

These calculations are based on dwelling type, and not the whole project. When SAP10 calculations are carried out for Building Regulations and Part L compliance, there will be more accurate PV apportion and overall design. The dwelling types are a fair representation of the average buildings in this project.

7. Energy Comparison

The objective of this energy strategy is to demonstrate compliance with Reading's carbon reduction ambitions, as well as Local Plan H5, which specifies 35% reduction on TER in SAP 2012 calculations, with aim to achieve zero-carbon. The Passivhaus design of this project (option 1) already achieves between 35 to 46% reduction in TER without the need for PV. This indicates that this project will not only reach Part L compliance, it has potential to exceed H5 and become carbon-zero, even "plus-energy", feeding electricity back into the grid.

To reach carbon neutrality, total PV generated power for these 12 dwelling types would be around 24000kWh. This would average at 2000kWh per dwelling, and so scales to about 124000 kWh per year, provided by PV, in order to reach carbon zero for the whole Battle Street development.

For reference, a typical 3 kWh solar system in the UK has twelve 250W panels, with surface area of 19.2m². A 3 kWh system generates about 2500 kWh per year, resulting in about 12 panels needed. For the whole project, it is feasible to have about 120 solar panels on the roofs of the blocks in this project, taking surface area of about 192m².

Sophisticated solar siting and calculations at design stage will hopefully improve on this estimation.



7.1 SAP 10.1 and Electrical Heating

The UK is currently transitioning to newer Building Regulations (2021) and SAP calculations (SAP10), and it should be noted that calculations in this report were carried out using SAP2012, with 35% DER reduction target, as outlined in section 2.1, based on BR 2013. Future iterations for this property will use SAP10.

8. Conclusion

Reading Borough Council require that new major developments (over 10 dwellings) achieve zero-carbon emissions, with a minimum 35% reduction in carbon emissions, delivered through energy efficient design and renewable energy on-site, with emissions offset.

SAP calculations have been carried out for energy strategy options using SAP 2012, in future SAP10 will be used with stricter carbon emission limits. We conclude that currently the best options for Battle Street are:

- Option 1 – PKOM4 Heat Pump Combination Unit
- Option 2 – PKOM4 Heat Pump Combination Unit and PV

Each of these options will be reviewed in more detail at detailed design stage for technical and economic feasibility, at which point one or a combination of the strategies will be selected.



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**Sadler Energy and Environmental Services Ltd
(SEES)**

**Stonemarth Barn, Staff Road, Michelmersh
Romsey, Hampshire. SO51 0NX**

Telephone: 01962 718870

Email: hello@sees.co.uk

Website: www.sadlerenergy.co.uk

APPENDIX B

PHPP CALCULATION AND ASSESSMENT





green**box**
associates

**Proposed Development Battle Street Reading
Passivhaus Design and
Employees Requirements
August 2022**

GREENBOX ASSOCIATES CONTACT DETAILS

This report was prepared by Rachel Mitchell of Greenbox Associates Ltd, an architectural engineering consultancy which specialises in building modelling and energy demand reduction. Rachel Mitchell is a Passivhaus Designer, Elmhurst Energy SAP assessor and thermal bridge modeller.

Main Contact: Rachel Mitchell

Email: rachel@greenboxassociates.co.uk

Tel: 02392 655652

Website www.greenboxassociates.co.uk

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INTRODUCTION

Greenbox Associates Ltd has been appointed by Hampshire County Council, on behalf of Reading Borough Council, to review the proposed designs at Battle Street Reading, and model the dwellings and non-domestic building in Passive House Planning Package (PHPP) to evaluate against the demanding Passivhaus Classic Standard.

This large-scale high-density development, located in the center of Reading, will deliver family houses, general needs housing, sheltered housing, supporting living housing and an adult day care center.



Figure 1. Proposed mixed use development at Battle Street as shown in Sketchup

Decarbonisation of the built environment is a critical element on the path to net zero carbon in 2050, and whilst decarbonising the National Grid supply is a key part of that strategy, it is cheaper and easier to save energy than to produce it. Driving down energy demand in a building is the best way to reduce both carbon emissions and peak demand on the electricity grid. Reducing demand also protects the occupant against rising fuel costs, as homes need less energy to maintain a comfortable and healthy internal temperature, which means bills remain affordable. This is particularly important in the switch from gas to electricity as the main energy source for heat as, at present there is a fourfold cost difference per kWh between the two fuels, which no doubt will be subject to change and further increases.

To drive down energy demand, the dwellings have been designed using the principles of Passivhaus, a standard which consistently delivers energy efficient, comfortable, and affordable homes. All the buildings within the development have been modelled in Passive House Planning Package (PHPP) to show how they compare with the standard and summary of the outputs from these assessments can be found in Appendix one.

The specification provided within this document will form part of the Employees Requirements and the appointed contractor will be required to meet both the Passivhaus Criteria outlined and the results generated by Passivhaus Planning Package (PHPP) software.

PHPP MODELLING PROGRAM

The following buildings were modelling in Passivhaus Planning Package (PHPP). The main block A was split between the Adult Day Care Centre and the residential units, as these would operate in a different way and be serviced by different heating and ventilation systems. Therefore, the result of this building will be reported separately.

BATTLE STREET PHPP MODELLING	
Block A 1	Adult Day Care Centre
Block A2	8 x 2 bed flats 4 x 3 bed flats 38 x 1 bed flats
Block B	3 x 1 bed flats
Block C	1x 1 bed bungalow
Block D and E1 E2	6 x 1 bed flats
Block F	2 x 3 bed houses

Table 1 - Summary of buildings modelled in PHPP

PASSIVHAUS STANDARD

Passivhaus buildings provide a high level of occupant comfort while using very little energy for heating and cooling. Typically, a Passivhaus built in the UK will use half the energy compared to a home built to meet current building regulations. They are built with meticulous attention to detail and rigorous design and construction according to principles developed by the Passivhaus Institute in Germany and can only be certified through an exacting quality assurance process on site.

Evidence shows that UK Passivhaus buildings are performing in use to their design energy standard, which is crucial, given that the discrepancy between design aspiration and as-built performance (the performance gap) for many new buildings in the UK can be as much as 50-100%. This means many non-Passivhaus homes are using much more energy than predicted, which is a problem for developers, occupants and government as bills are higher and energy and carbon targets are being missed. With no performance gap, Passivhaus buildings consistently perform in-use as predicted at the design stage.

A Passivhaus is designed to deliver super insulated and airtight comfortable buildings, that have a low space heating demand. There are minimum requirements for U-values, thermal bridges, air permeability, primary energy use and overheating risk as shown in Table 2 below.

PASSIVHAUS CLASSIC DESIGN ELEMENTS	
Low space heating demand	Less than 15 kWh/m ² /year (as measured in PHPP)
Low U Values	Less than 0.15 W/m ² K
High levels of air tightness	Less than 0.6 ach _{n50}
Triple glazed windows	Whole window U value less than 0.85W/m ² K
Reduced thermal bridges	Less than 0.01W/mK
Overheating risk	Less than 10% of hour above 25°C UK guidance 5% of hours Best practice 0% of hours
Primary energy targets	Less than 135 kWh/m ² /year
Primary energy renewable	Less than 60 kWh/m ² /year
Quality assurance	Evidence of construction and commissioning to be given before certification

Table 2 - Summary of the Passivhaus Classic Standard

The key design elements of a Passivhaus are:

- High levels of insulation
- Minimal thermal bridges
- High levels of air tightness
- Mechanical ventilation with heat recovery (MVHR)
- Protection from overheating risk.

These elements provide the following benefits:

- Lower space heating bills
- Good internal air quality and a healthy internal environment
- Comfortable internal temperatures all year
- Protection against fuel poverty and cold homes
- Meeting zero carbon targets
- Reduce the requirements for renewable energy
- Durable homes with longer lasting components

The Passivhaus standard therefore gives a robust method to help achieve the government's net zero carbon targets for 2050, protect against rising fuel prices and provide a comfortable healthy home.

FABRIC FIRST

The better and more economical way to get to zero carbon is to save energy rather than generate it. By investing in the fabric of the structure, the carbon and energy benefits are locked in for the lifetime of the building, while bolted on technologies can fail and need to be replaced. Increasing insulation levels and reducing air tightness lowers heat loss from the building and therefore space heating demand, which in turn reduces energy bills. In addition, attention to detail to the building fabric, though insulation and reduced thermal bridges, increases internal surface temperatures, which if kept above 17°C, will eliminate condensation risk and mould growth. This provides a healthy indoor environment and protects the structure, which prolongs the life of the building.

All the dwelling types will have a much-improved fabric compared to current building regulations and are better than the proposed Future Homes Standard 2025. The Passivhaus specification for Building 5 and Building 6 will be the same, but a different approach is needed for the small detached single-story bungalow.

FORM FACTOR

Most energy standards are presented as the annual energy needed e.g., space heating demand or total energy to run the dwelling for the year, divided by the internal floor area. This allows different dwelling types and sizes to comply to the same standard. However, the size and shape of the building will affect how much the building fabric needs to be improved to meet that standard set. This is called form factor. Form factor is the ratio of external heat loss surface areas (floors, walls, roofs, windows etc) to the internal floor area. The lower the form factor, i.e., the lower the amount of heat loss surface area compared to the internal floor area, the easier it will be to meet the standard.

Another way to think about it is compactness. The more compact the building is, the more energy efficient it is. If you change the shape of a building with protrusions and recesses, without increasing the floor area, the form factor will increase, as you have increased the heat loss surfaces areas, but there is no increase in floor area. The figure below shows the impact on increasing the external surface area, without increasing the internal floor area.

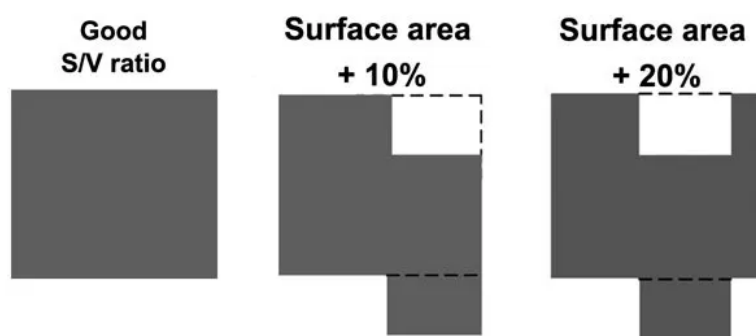


Figure 1. Impact of increasing surface area

Once the form factor is over 3 -3.5 then it will hard reduce the U values and increase air tightness sufficiently to meet the Passivhaus space heating targets of 15 kWh/m²/year.

FORM FACTOR AT BATTLE STREET	
Block	Form Factor
Block A	2.0
Block B (3 x 1 bed flats)	3.4
Block C (bungalow)	4.6
Blocks D, E1 and E2 (2 x 1 bed flats)	3.5
Block F (houses)	3.1

Table 3 - Summary of form factors at Battle Street

Table 3 gives a summary of the form factors of the building types at Battle Street being considered in this report. Large blocks of flats tend to have a lower form factor, followed by rows of terraced houses, semi-detached homes, detached houses, and bungalows, which have the highest form factor.

The small blocks of flats (Block B, D E1 and E2) have relatively high form factor, and this was a planning requirement to break up the massing and scale building within the development site, however this will mean that meeting the Passivhaus Classic standard will be more difficult for these blocks.

The bungalow (Block C) at Battle Street has a form factor of 4.6, which means that it cannot realistically meet the Passivhaus Classic standard because of the shape and style of the building typology. This building type has been included in the development in response to planning feedback and the desire for smaller building near the perimeter of the site, adjacent to existing residential development.

It is therefore, proposed that this dwelling be designed to meet the Passivhaus Low Energy Building Standard described on the following page. This is still a very stringent building standard which retains many of the elements of Passivhaus design but allows for more flexibility if there are site or planning constraints.

PASSIVE HOUSE LOW ENERGY BUILDING STANDARD

In addition to the Passive House classis standard, the Passive House Institute has created the Low Energy Building Standard, which is suitable for buildings which do not fully comply with the standard Passive House criteria because of site or building type constraints. This standard allows for a higher space heating demand of 30 kWh/m²/year compared to the Passivhaus Classic standard of 15 kWh/m²/year. In addition, there is a slightly less stringent air tightness target (see table 4). These are the *only* differences between the two standards and all other element of Passivhaus design would have to be met.

This approach will be applied to Block C, the bungalow, as this building type cannot meet the Passivhaus Classic Standard, because of the poor form factor.

PASSIVHAUS LOW ENERGY BUILDING DESIGN ELEMENTS	
Space heating demand *	30 kWh/m ² /year
Low U Values	Less than 0.15 W/m ² K
High levels of air tightness *	Less than 1 ach _{n50}
Triple glazed windows	Whole window U value less than 0.85W/m ² K
Reduced thermal bridges	Less than 0.01W/mK
Mechanical ventilation with heat recovery	With a minimum efficiency level of 75% or more based on Passive House Institute assessments
Overheating risk	Less than 10% of hour above 25°C UK guidance 5% of hours Best practice 0% of hours
Primary energy targets	Less than 135 kWh/m ² /year
Primary energy renewable	Less than 60 kWh/m ² /year
Quality assurance	Evidence of construction and commissioning to be given before certification

Table 4 - Summary of the Passivhaus Low Energy Building Standard

*The starred elements are the only differences between the two Passivhaus standards

Table 5 on the following page, shows the proposed U values for the 6 Block types at Battle Street compared the maximum allowable under Part L1A 2013. All the blocks will be constructed using the same specification, except for the floor in Block A which reflects the size of the building.

FABRIC FIRST - TABLE OF U VALUES BATTLE STREET			
	Block A	Block B, C D and E	Minimum Standards for Part L1A 2013
Ground Floor	0.12 W/m ² K	0.09 W/m ² K	0.25 W/m ² K
Heat loss floor (upper)	0.14 W/m ² K	n/a	0.25 W/m ² K
External Walls	0.14 W/m ² K	0.11 W/m ² K	0.30 W/m ² K
Cold roof	0.11 W/m ² K	0.09 W/m ² K	0.20 W/m ² K
Flat roof	0.10 W/m ² K	0.09 W/m ² K	0.20 W/m ² K
Warm roof	n/a	0.12 W/m ² K	0.20 W/m ² K
Windows	0.85 W/m ² K	0.85 W/m ² K	2.0 W/m ² K
External Doors	0.85 W/m ² K	0.85 W/m ² K	2.0 W/m ² K
Thermal Bridges	0.02 W/m ² K	0.02 W/m ² K	0.15 W/mK

Table 5 - Summary of Passivhaus U values at Battle Street compared to Part L1A 2013

AIR PERMEABILITY AND VENTILATION

Once insulation levels have been increased, the heat losses from uncontrolled ventilation and infiltration can be considerable. Under current Building Regulations a dwelling must have an infiltration rate of less than 10 m³/hm²@50Pa. The air permeability targets will vary for each building type will be much lower than this and the targets are shown in the table on the following page

With this level of airtightness, additional controlled ventilation is required to provide both fresh air and to removed stale and moist air. The dwellings will be mechanically ventilated with heat recovery (MVHR), via the PKOM 4 compact units located within each dwelling (see section on heating and hot water). For the Adult Day Care Centre, ventilation will be provided by a series of Passivhaus certified MVHR units

MVHR extracts warm moist air from kitchens and bathrooms and supplies fresh air to bedrooms and living rooms via a balanced system. Purge ventilation can be provided by the system when operating in 'boost' mode.

The Passivhaus standard sets maximum limits for the energy required to run the fans in the unit and minimum standards for the efficiency of the heat exchanger within the unit. This ensures that energy consumption is reduced, and the maximum amount of heat is recovered. By setting these standards it also means the fans are better quality and designed to operate at optimum speeds, and therefore will be quieter.

To assist in the management of overheating risk, the MVHR units will have a summer bypass mode, which switches off heat recovery when temperatures outside increase. Thorough commissioning of the MVHR units is part of the quality assurance process, to ensure the units are operating with the correct flow rates for each room.

Table 6 below outlines the design stage ventilation strategy at Battle Street.

VENTILATION AT BATTLE STREET					
Building	Block A	Block B	Block C	Block D, E1 E2	Block F
Air tightness	0.6 Ach _{n50}	0.6 Ach _{n50}	0.6 Ach _{n50}	0.6 Ach _{n50}	0.6 Ach _{n50}
Air permeability	0.8 m ³ /hm ² 50Pa	0.4 m ³ /hm ² 50Pa	0.3 m ³ /hm ² 50Pa	0.4 m ³ /hm ² 50Pa	0.4 m ³ /hm ² 50Pa
Design infiltration rate	0.043 1/h	0.045 1/h	0.039 1/h	0.039 1/h	0.036 1/h
Design flow rate	0.50 1/h	0.60 1/h	0.56 1/h	0.60 1/h	0.57 1/h
MVHR units	PKOM4 compact units and decentralised MVHR units	PKOM4 compact unit	PKOM4 compact unit	PKOM4 compact unit	PKOM4 compact unit
Summer bypass	Yes	Yes	Yes	Yes	Yes

Table 6 - Summary of ventilation rates at Battle Street

There is a relationship between the size of the building and the level of air permeability needed to achieve the 0.6 air changes at n50. Generally smaller buildings need to be more airtight to achieve the target air change rates. This can be seen with the bungalow which needs to achieve an air permeability of 0.3 m³/hm² 50Pa, compared to 0.4-0.8 m³/hm² 50Pa for the other buildings.

It is advisable to engage an air testing company at an early stage for Block A, which is complex, to agree the air testing regime as Passivhaus will test the whole building rather than individual units. This may require a bespoke approach as the building may have to be compartmentalised, to allow for the building to be pressurised correctly.

The following elements should be incorporated into the MVHR design to optimise the efficiency and effective running of the system:

- Select a Certified Passivhaus component
- Locate the MVHR unit as close to an outside wall as possible to maintain efficiency
- Use rigid ducting to reduce friction and noise
- Place sound attenuators between rooms
- Have a simple interface with the user and a clear boost setting
- Replace filters regularly as specified by the manufacturer

It is a common assumption that windows cannot be opening in a Passivhaus. This is incorrect and there will be opening windows in all habitable rooms. These will provide additional day time ventilation and more importantly, night-time cooling in summer (subject to any acoustician reports) to assist in reducing overheating risk.

SPACE HEATING AND HOT WATER

As the dwellings are designed to meet the Passivhaus Classic Standard, the space heating demand will be low, and the greater energy demand will be for hot water. In line with the phasing out of gas as the main form of energy for heating and hot water and the Decarbonisation of the National Grid, electricity will be used for space and hot water.

Within the domestic units, space heating and hot water will be provided by a PKOM 4 compact unit. This is a heat pump, which combines an MVHR with hot water, space heating and if needed cooling. Heating and cooling will be provided within the PKOM4 unit and distributed via the internal supply air ducting. This is a certified Passivhaus component, which means it meets minimum standards for energy use and noise and well as the efficiency of the heat exchange. A PKOM 4 unit is designed to be used in dwellings with a low space heating demand. There will be an electric towel rail in the bathrooms to provide additional heating if needed. For the adult day care center, heating and hot water will be provided by an Air Source Heat Pump (ASHP)

The heating and hot water strategy for each building type is outlined in Table 7.

SPACE HEATING AND HOT WATER DELIVERY AT BATTLE STREET					
Building	Block A	Block B	Block C	Block D, E1 E2	Block F
Space heating and hot water	PKOM 4 unit to flats and ASHP to day care center	PKOM 4 unit	PKOM 4 unit	PKOM 4 unit	PKOM 4 unit
Heat emitter	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators	Supply air and electric radiators
Hot water tank	Within PKOM unit separate tank for day care center	Within PKOM unit	Within PKOM unit	Within PKOM unit	Within PKOM unit

Table 7 - Summary of heating and hot water strategy Battle Street for each building type.

By providing individual heating and hot water heating systems to each dwelling, this eliminates the need for a heat distribution network within the buildings. Distribution of hot water, especially in the summer and in larger buildings, can contribute to overheating risk. This is one of several strategies to reduce overheating, which is discussed in more detail in the next section.

OVERHEATING RISK ASSESSMENT

Many new and existing homes are at risk of overheating. This can be as a result of building design, e.g., large areas of glass, building services, e.g., poorly insulated hot water pipes or low ventilation rates, e.g., lack opening windows. User behaviour such as not opening windows at night, can also exacerbate overheating

As homes become more insulated and airtight, there is a concern this risk could increase, as once warm air becomes trapped in a building, it can be more difficult to purge. Therefore, considering overheating and reducing risk is critical at the design stage. The Good Homes Alliance have produced overheating risk guidance, which identifies the following factors as contributing to overheating risk:

- Location in the UK (Southeast is a high risk).
- Urban location (Heat Island effect).
- Lack of openable windows (security, noise, design).
- Community heating schemes (heat losses from the distribution pipes).
- Large areas of glazing especially to the west.
- Single aspect dwellings (no cross ventilation).

Overheating risk can be reduced by

- The proximity to areas of trees and/or water.
- Light coloured surrounding surfaces.
- Shading from trees and buildings.
- High exposed thermal mass.
- Higher ceilings to allow the retrofit of ceiling fans.
- External shading devices.
- Opening windows preferably with cross ventilation.
- Reducing the areas of glazing, without compromising daylighting (especially roof lights)

The health implications of summer overheating in our homes are significant. It is estimated that there are currently around 2000 heat-related deaths in the UK every year and that this could rise to more than 7000 by 2050 as summer temperatures are predicted to rise.

PHPP requires designers to model the impact of glazing areas, window openings, shading, internal gains, and ventilation options so they can minimise the risk of overheating. New guidance developed by the Passivhaus Trust now also requires Passivhaus designers to “stress test” designs in future climates and situations where, for example, occupants fail to open windows or deploy shading.

The development at Battle Street creates its own shading, with Block A shading itself and the surrounding dwellings and site itself is surrounded by four storey buildings. This makes the design to reduce overheating risk a balance between good daylighting, overheating and winter heat loss from glazing areas.

Whilst PHPP can measure overheating risk, for a large and complex building such as Block A, this should be accompanied by a more comprehensive CIBSE TM59 assessment.

An overheating risk assessment has been made for each block type and the result are described on the following page. These assessments may be subject to further revision following the completion of the CIBSE TM59 overheating risk calculations.

BLOCK A ADULT DAY CARE AND RESIDENTIAL FLATS



Figure 2. Block A shading strategy

Building A is orientated north/south on the north boundary of the site. To the rear of the building (south) there are 4 story buildings, and the building is surrounded by residential development. In addition, the building shades itself on all four sides of the internal courtyard.

These features provide some shading to the site. However, there is a potential overheating risk to the south, east and west facades as all the flats are single aspect, which means there can be limited cross ventilation (windows opening on an opposite façade) which is particularly effective at removing excess heat, especially at night.

In Block A, the following measures have been modelled to reduce overheating risk:

- Solar glass to all facades with lower g values (except the north)
- Shading from balconies on the east facade
- Juliette balconies will provide some shading to the upper floor residential units
- 1000mm brise soleil to the south elevation to all windows without overhangs
- Vertical fin shading to the east and west façades
- Increase ventilation rates via the MVHR system
- Secure window opening both day and night (restrictors on the ground floor)

BLOCK B 1 BED FLATS 3 STOREY



Figure 3- Block B shading strategy

Block B is orientated north/south. To the south and east and west of the buildings there are three and four storey buildings. These features provide shading to the site and reduce the risk of overheating. In addition, all the flats can be cross ventilated (windows opened on an opposite façade), and this greatly improves natural ventilation rates and can provide night-time ventilation.

The following measures have been modelled to reduce overheating risk

- Balconies providing shading to the south façade
- Brise soleil on the other windows to the south
- Increase ventilation rates via the MVHR system
- Cross ventilation in flats
- Secure window opening both day and night (restrictors on the ground floor)

BLOCK C BUNGALOW

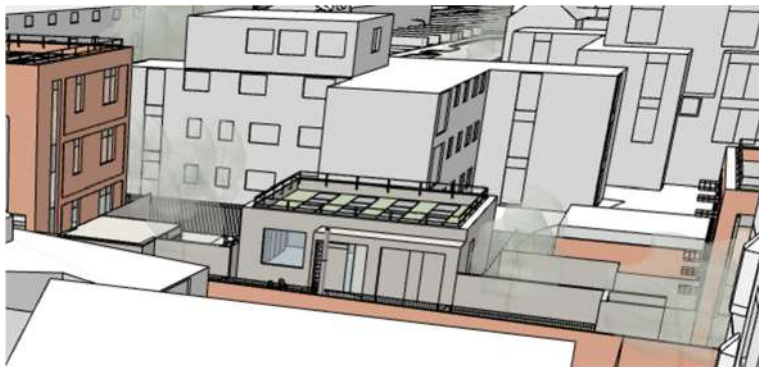


Figure 4 – Block C shading strategy

The bungalow is heavily shaded from surrounding buildings which reduce the risk of overheating and can be cross ventilated, provided there is secure night-time window opening.

The following measures have been modelled to reduce overheating risk

- Increase ventilation rates via the MVHR system
- Cross ventilation (with secure night-time ventilation)
- Opening window both day and night

BLOCK D, E1 AND E1 2 X 1 BED FLATS



Figure 5 - Block D, E1 and E2 shading strategy

The three blocks are located to the west of Block A and are also shaded by the surrounding buildings. The flats can be cross ventilated (windows opened on an opposite façade), which greatly improves natural ventilation rates and can provide night-time ventilation.

The following measures have been modelled to reduce overheating risk

- Brise soleil to windows on the south facade
- Increase ventilation rates via the MVHR system
- Cross ventilation in flats
- Opening window both day and night (secure ventilation on the ground floor)

BLOCK F 2 X 2 BED HOUSES



Figure 6 - Block F shading strategy

Block F is located on the North side of the site, and it is again surrounded by both buildings on the proposed development and existing buildings on all four sides.

The following measures have been modelled to reduce overheating risk

- Brise soleil to windows on the south façade
- Vertical fins to the west facade
- Increase ventilation rates via the MVHR system
- Cross ventilation
- Opening window both day and night

In addition, an opening rooflight has been introduced to provide both light and additional ventilation via the 'stack effect', as hot air rises and can be exhausted out of the top of the dwelling, creating a through flow of air



Figure 7 - Block F room lights

An overheating risk assessment is made in PHPP for the whole building for each building type and reported in the summary section, this must be read in conjunction with the TM59 assessment, which will give a more accurate picture of overheating especially in

PRIMARY ENERGY VALUES

In addition to meeting the space heating demand element of Passivhaus design, there are also limits to the total primary energy demand of the building. Primary energy calculations consider not only regulated energy use (space heating, hot water and building services) but also unregulated energy use (household electricity demand, cooking etc). To meet the Primary Energy targets, it is proposed to provide hot water and heat the dwellings using individual PKOM compact units and an Air Source Heat Pump (ASHP) system for the adult day care services. This means the projects meet the Primary Energy Renewable (PER) requirement, which has a target of 60 kWh/m²/year.

The PER value will be directly affected by the efficiency of the final choices of the ASHP unit(s) and the design of the total system. In addition, assumptions about potential consumer appliances need to be refined. These metrics will be further update as these details emerge.

MEETING THE PASSIVHAUS STANDARD

At the site in Battle Street, two site constraints will impact on the ability to meet the Passivhaus Classic Standard for space heating or heat load:

1. The form factor of the block types, with those dwellings with a higher form factor (Blocks B-D) finding it most difficult to achieve the space heating targets
2. Many of the windows are shaded by the surrounding buildings, which means winter solar gains are reduced and this can make achieving the heating targets more challenging.

The building modelling has considered the balance between, daylighting, winter heat loss through the windows and doors and overheating risk. The current design considers these sometimes opposing factors, which means most of the blocks meet the Passivhaus Classic standard only meet the space heating load target but not the space heating demand target (which is acceptable for certification) . Only Block B fails to meet both space heating targets, and only misses the space heating load by the very small margin of 1 W/m². This is a result of higher levels of shading from surrounding buildings, which means that overheating risk is low. All other elements of Passivhaus design are met which includes:

- Very low U values 0.09 W/m²K to 0.12 W/m²K
- Very low levels of air tightness 0.3m³/hm²@50 Pa to 0.5m³/hm²@50 Pa
- Triple glazed windows 0.85W/m²K
- Reduced overheating risk at +2°C
- Low space heating loads that can be met via the supply air
- Summer and winter comfort standards met

With the better form factor, Blocks A, E1, E2 and D and F are currently meeting the Passivhaus Classic standard. Block C, the bungalow has been tested against the Passivhaus low energy building standard.

MAIN OUTPUTS FROM PHPP

The tables in this section give a summary of the main outputs from PHPP. To take into account rising summer temperature because of climate change, the buildings have been modelling using current climate data plus 2°C. All the of the blocks are meeting the overheating risk standard for Passivhaus at this higher temperature.

To meet the Passivhaus classic standard either space heating demand must be less than or equal to 15 kWh/m²/year or space heating load must be less than or equal to 10 W/m²K. For all the buildings on the site at Battle Street both the space heating demand and the space heating load have been assessed, and all blocks meet one of these criteria, apart from Block B.

PHPP outputs for Block A1 Adult Day Care Centre

	PHPP output	Target	Target met?
Space heating demand	16 kWh/m ² /year	≤15 kWh/m ² /year	NO
Space heating load	10 W/m ² /year	≤10 W/m ² /year	YES
Frequency of overheating +2C	0 % of hours	≤10% of hours	YES
PER demand	56 kWh/m ² /year	60 kWh/m ² /year	YES

Table 8 - Summary of PHPP outputs Block A1 Passivhaus Classic Standard

PHPP outputs for Block A2 Residential flats

	PHPP output	Target	Target met?
Space heating demand	12 kWh/m ² /year	≤15 kWh/m ² /year	YES
Space heating load	9 W/m ² /year	≤10 W/m ² /year	YES
Frequency of overheating + 2C	9 % of hours	≤10% of hours	YES
PER demand	41 kWh/m ² /year	60 kWh/m ² /year	YES

Table 9- Summary of PHPP out puts Block A2 Passivhaus Classic Standard

PHPP outputs for Block B 3 x 1 bed flats

	PHPP output	Target	Target met?
Space heating demand	19 kWh/m ² /year	≤15 kWh/m ² /year	NO
Space heating load	11 W/m ² /year	≤10 W/m ² /year	NO by 1 W/m ² /year
Frequency of overheating	3 % of hours	≤10% of hours	YES
PER demand	41 kWh/m ² /year	60 kWh/m ² /year	YES

Table 10 - Summary of PHPP outputs Block B Passivhaus Classic Standard

PHPP outputs for Block C Bungalow – Target Passivhaus Low Energy Building Standard			
	PHPP output	Target	Target met?
Space heating demand	26 kWh/m ² /year	≤39 kWh/m ² /year	YES
Frequency of overheating	10 % of hours	≤10% of hours	YES
PER demand	55 kWh/m ² /year	75 kWh/m ² /year	YES

Figure 8 - Summary of PHPP outputs Block C Passivhaus Low Energy Building Standard

PHPP outputs for Blocks E1, E2 and D 1 x 2 bed flats			
	PHPP output	Target	Target met?
Space heating demand	14 - 17 kWh/m ² /year	≤15 kWh/m ² /year	In some cases,
Space heating load	10 W/m ² /year	≤10 W/m ² /year	YES
Frequency of overheating	4-9 % of hours	≤10% of hours	YES
PER demand	44-45 kWh/m ² /year	60 kWh/m ² /year	YES

Figure 9 - Summary PHPP outputs Blocks D, E1 and E2 Passivhaus Classic Standard

PHPP outputs for Block F 2 x 3 bed houses			
	PHPP output	Target	Target met?
Space heating demand	14 kWh/m ² /year	≤kWh/m ² /year	YES
Space heating load	10 W/m ² /year	≤10 W/m ² /year	YES
Frequency of overheating	4 % of hours	≤10% of hours	YES
PER demand	39 kWh/m ² /year	60 kWh/m ² /year	YES

Figure 10 - Summary of PHPP outputs Block F Passivhaus Classic Standard

MOVING TO DETAILED DESIGN STAGE

As the design develops and moves forward the following are recommended for more detailed consideration

- Clear mark-up of the insulation layer for all thermal elements of the building
- Detailed build ups of all external elements and detailed U value calculations
- Identification of potential thermal bridges and working with the structural engineer on columns and masonry supports

- Thermal bridge calculations for a selection of the most important/ worst performing junctions including the window installations
- Clear definition of the airtight layer on all plans and sections
- MVHR location and layouts for sample dwellings
- Hot water and heating pipe layouts where applicable
- Choice of ASHP units
- Definition of the air tightness strategy in conjunction with the air testing company and define the air testing regime
- TM59 overheating risk assessment and refinement of the overheating strategy f

SUMMARY AND CONCLUSION

Blocks A- F on the proposed development at Battle Street in Reading have been modelling in PHPP and tested against the demanding Passivhaus Classic and Low Energy building standard with the following results

- Block A,D, E1 and E2 and F meet all the requirements of the Passivhaus Classic Standard
- Block C meets all the requirements of the Passivhaus Low Energy Building Standard
- Blocks B, meet all the standards of Passivhaus Classic except for heat load, which is linked to the form factor and on-site shading. Here the target is missed by between $+1\text{W/m}^2/\text{year}$

All the dwellings are meeting the summer and winter comfort requirements and the buildings have been tested using future climate data to design in resilience to overheating risk

These are early PHPP assessment and will be refined as the designs develop and recommendations for further work have been made as the project moves forward.

APPENDIX ONE PHPP OUTPUTS

BLOCK A1 GROUND FLOOR

Passive House Verification									
Photo or Drawing				Building		Ground floor only Battle Street non residential			
				Street					
Architecture:		Street:		Postcode/City:		Reading			
Postcode/City:		Province/Country:		Province/Country:		GB-United Kingdom/ Britain			
Province/Country:		Building type:		Climate data set:		ud-00-GB0002a-Silsoe, with 2K summer correction			
Energy consultancy:		Greenbox Associates Ltd		Climate zone:		3: Cool-temperate		Altitude of location:	
Street:		61 Bristol Road		Altitude of location:		40 m			
Postcode/City:		PO4 9QH Southsea		Home owner / Client					
Province/Country:		Hampshire GB-United Kingdom/ Britain		Street					
Year of construction:		2022		Postcode/City:					
No. of dwelling units:		1		Province/Country:					
No. of occupants:		40.0		Mechanical engineer:					
				Street					
				Postcode/City:					
				Province/Country:					
				Certification:		Block A Ground floor non residential			
				Street					
				Postcode/City:					
				Province/Country:					
				Interior temperature winter [°C]:		20.0		Interior temp. summer [°C]:	
				Internal heat gains (IHG) heating case [W/m²]:		2.8		IHG cooling case [W/m²]:	
				Specific capacity [Wh/K per m² TFA]:		132		Mechanical cooling:	
Specific building characteristics with reference to the treated floor area									
The PHPP has not been filled completely; it is not valid as verification									
Treated floor area m²		607.2		Criteria		Alternative criteria		Fulfilled? ²	
Space heating	Heating demand kWh/(m²a)	16		≤	15	-		yes	
	Heating load W/m²	10		≤	-	10			
Space cooling	Cooling & dehum. demand kWh/(m²a)	-		≤	-	-		-	
	Cooling load W/m²	-		≤	-	-			
	Frequency of overheating (> 25 °C) %	0		≤	10			yes	
	Frequency of excessively high humidity (> 12 g/kg) %	0		≤	20			yes	
Airtightness	Pressurization test result n ₅₀ 1/h	0.6		≤	0.6			yes	
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	119		<	-			-	
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	55		≤	60	60		yes	
	Generation of renewable energy (in relation to pro- kWh/(m²a) projected building footprint area)	24		≥	-	-			
² Empty field: Data missing; -: No requirement									
I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.									
Task:		First name:		Surname:		Passive House Classic?		yes	
						Signature:			
				Issued on:		City:			

BLOCK A2 RESIDENTIAL UNITS ONLY

Passive House Verification									
Photo or Drawing				Building: Battle Street Residential units only Street: Postcode/City: Reading Province/Country: GB-United Kingdom/ Britain Building type: Multi Family Climate data set: ud-00-GB002a-Silsoe, with 2K summer correction Climate zone: 3: Cool-temperate Altitude of location: 40 m					
				Home owner / Client: Street: Postcode/City: Province/Country:					
Architecture: Street: Postcode/City: Province/Country:				Mechanical engineer: Street: Postcode/City: Province/Country:					
Energy consultancy: Greenbox Associates Ltd Street: 61 Bristol Road Postcode/City: PO4 9QH Southsea Province/Country: Hampshire GB-United Kingdom/ Britain				Certification: BLOCK A2 RESIDENTIAL Street: Postcode/City: Province/Country:					
Year of construction: No. of dwelling units: 50 No. of occupants: 95.2				Interior temperature winter [°C]: 20.0 Interior temp. summer [°C]: 25.0 Internal heat gains (IHG) heating case [W/m²]: 2.8 IHG cooling case [W/m²]: 2.8 Specific capacity [Wh/K per m² TFA]: 132 Mechanical cooling:					
Specific building characteristics with reference to the treated floor area									
The PHPP has not been filled completely; it is not valid as verification									
		Treated floor area m²		3673.3					
Space heating	Heating demand kWh/(m²a)		12		≤		Criteria		Fulfilled? ²
	Heating load W/m²		9		≤		Alternative criteria		
Space cooling	Cooling & dehum. demand kWh/(m²a)		-		≤		-		-
	Cooling load W/m²		-		≤		-		
	Frequency of overheating (> 26 °C) %		9		≤		10		yes
	Frequency of excessively high humidity (> 12 g/kg) %		0		≤		20		
Airtightness	Pressurization test result n ₅₀ 1/h		0.6		≤		0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)		102		<		-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)		41		≤		60		yes
	Generation of renewable energy (in relation to pro- kWh/(m²a) projected building footprint area)		54		≥		-		
² Empty field; Data missing; ∅: No requirement									
I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.									
Task:		First name:		Surname:		Passive House Classic?		yes	
						Signature:			
		Issued on:		City:					

BLOCK B 3 X 1 BED FLATS

Passive House Verification																																																																																
					Building: Battle Street BLOCK B																																																																											
					Street:																																																																											
					Postcode/City:																																																																											
					Province/Country: Berkshire GB-United Kingdom/ Britain																																																																											
Building type: Multi-Family					Climate data set: ud-00-GB002a-Silsoe, with 2K summer correction																																																																											
Climate zone: 3: Cool-temperate					Altitude of location: 39 m																																																																											
Home owner / Client:																																																																																
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BLOCK C BUNGALOW

PHI Low Energy Building Verification																																																																																				
				Building: Battle Street 1 Bed Bungalow Street: _____ Postcode/City: _____ Province/Country: Berkshire GB-United Kingdom/ Britain Building type: Single Family Climate data set: ud-00-GB0102a-Silsoe, with 2K summer correction Climate zone: 3: Cool-temperate Altitude of location: 39 m																																																																																
				Home owner / Client: _____ Street: _____ Postcode/City: _____ Province/Country: GB-United Kingdom/ Britain																																																																																
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Architecture: _____ Street: _____ Postcode/City: _____ Province/Country: GB-United Kingdom/ Britain Energy consultancy: _____ Street: _____ Postcode/City: _____ Province/Country: GB-United Kingdom/ Britain Year of construction: 2023 No. of dwelling units: 1 No. of occupants: 1.5				Interior temperature winter [°C]: 20.0 Internal heat gains (IHG) heating case [W/m²]: 3.1 Specific capacity [Wh/K per m² TFA]: 108 Interior temp. summer [°C]: 25.0 IHG cooling case [W/m²]: 3.3 Mechanical cooling: _____																																																																																
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BLOCK D

Passive House Verification																																																																																
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1-Designer		Rachel		Mitchell		yes																																																																										
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Project data imported from designPH 2.0.09 PHPP9 display code																																																																																

BLOCK F

Passive House Verification																																																																																	
					Building: Battle Street BLOCK F 2 x 3 bed houses																																																																												
					Street																																																																												
					Postcode/City																																																																												
					Province/Country: Berkshire GB-United Kingdom/ Britain																																																																												
Building type: Multi-Family					Climate data set: ud-00-GB002a-Silsoe, with 2K summer correction																																																																												
Climate zone: 3: Cool-temperate					Altitude of location: 39 m																																																																												
Home owner / Client:																																																																																	
Street					Street																																																																												
Postcode/City					Postcode/City																																																																												
Province/Country: GB-United Kingdom/ Britain					Province/Country: GB-United Kingdom/ Britain																																																																												
Mechanical engineer:																																																																																	
Street					Street																																																																												
Postcode/City					Postcode/City																																																																												
Province/Country: GB-United Kingdom/ Britain					Province/Country: GB-United Kingdom/ Britain																																																																												
Certification: BLOCK F																																																																																	
Street					Street																																																																												
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Architecture:																																																																																	
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Energy consultancy:																																																																																	
Street					Street																																																																												
Postcode/City					Postcode/City																																																																												
Province/Country: GB-United Kingdom/ Britain					Province/Country: GB-United Kingdom/ Britain																																																																												
Year of construction: 2023					Interior temperature winter [°C]: 20.0																																																																												
No. of dwelling units: 2					Interior temp. summer [°C]: 25.0																																																																												
No. of occupants: 4.7					IHG heating case [W/m²]: 2.6																																																																												
					IHG cooling case [W/m²]: 2.6																																																																												
					Specific capacity [Wh/K per m² TFA]: 132																																																																												
					Mechanical cooling:																																																																												
Specific building characteristics with reference to the treated floor area																																																																																	
<table border="1"> <thead> <tr> <th colspan="2"></th> <th>Treated floor area m²</th> <th></th> <th>Criteria</th> <th>Alternative criteria</th> <th>Fulfilled?²</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Space heating</td> <td>Heating demand kWh/(m²a)</td> <td>14</td> <td>≤</td> <td>15</td> <td>-</td> <td rowspan="2">yes</td> </tr> <tr> <td>Heating load W/m²</td> <td>10</td> <td>≤</td> <td>-</td> <td>10</td> </tr> <tr> <td rowspan="2">Space cooling</td> <td>Cooling & dehum. demand kWh/(m²a)</td> <td>-</td> <td>≤</td> <td>-</td> <td>-</td> <td rowspan="2">-</td> </tr> <tr> <td>Cooling load W/m²</td> <td>-</td> <td>≤</td> <td>-</td> <td>-</td> </tr> <tr> <td></td> <td>Frequency of overheating (> 26 °C) %</td> <td>5</td> <td>≤</td> <td>10</td> <td>-</td> <td>yes</td> </tr> <tr> <td></td> <td>Frequency of excessively high humidity (> 12 g/kg) %</td> <td>0</td> <td>≤</td> <td>20</td> <td>-</td> <td>yes</td> </tr> <tr> <td>Airtightness</td> <td>Pressurization test result n₅₀ 1/h</td> <td>0.6</td> <td>≤</td> <td>0.6</td> <td>-</td> <td>yes</td> </tr> <tr> <td>Non-renewable Primary Energy (PE)</td> <td>PE demand kWh/(m²a)</td> <td>97</td> <td><</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Primary Energy Renewable (PER)</td> <td>PER demand kWh/(m²a)</td> <td>39</td> <td>≤</td> <td>60</td> <td>60</td> <td rowspan="2">yes</td> </tr> <tr> <td></td> <td>Generation of renewable energy (in relation to pro- kWh/(m²a) projected building footprint area)</td> <td>71</td> <td>≥</td> <td>-</td> <td>-</td> </tr> </tbody> </table>												Treated floor area m²		Criteria	Alternative criteria	Fulfilled? ²	Space heating	Heating demand kWh/(m²a)	14	≤	15	-	yes	Heating load W/m²	10	≤	-	10	Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	-	Cooling load W/m²	-	≤	-	-		Frequency of overheating (> 26 °C) %	5	≤	10	-	yes		Frequency of excessively high humidity (> 12 g/kg) %	0	≤	20	-	yes	Airtightness	Pressurization test result n ₅₀ 1/h	0.6	≤	0.6	-	yes	Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	97	<	-	-	-	Primary Energy Renewable (PER)	PER demand kWh/(m²a)	39	≤	60	60	yes		Generation of renewable energy (in relation to pro- kWh/(m²a) projected building footprint area)	71	≥	-	-
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² Empty field: Data missing; -: No requirement																																																																																	
I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.																																																																																	
Passive House Classic? yes																																																																																	
Task: 1-Designer First name: Rachel Surname: Mitchell Signature:																																																																																	
Issued on: City:																																																																																	
Project data imported from designPH 2.0.09 PHPP9 display code																																																																																	

APPENDIX C

PART L2A CALCULATION (BRUKL) FOR OPDC & NON-RESIDENTIAL AREAS



Project name

Battle St - Landlord Areas

As designed

Date: Fri Jul 15 13:08:35 2022

Administrative information

Building Details

Address: Battle St, Reading,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Neil Boardman

Telephone number: 01962 845362

Address: Three Minsters House, 76 High St, Winchester, SO23 8UL

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	12.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	12.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	8
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.13	1.13	G1b louvre-frame
Floor	0.25	0.11	0.11	Ground Floor
Roof	0.25	0.1	0.1	Roof
Windows***, roof windows, and rooflights	2.2	1.07	1.11	G13a door (o)
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	1.5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Natural vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types ≤12 kW output, refer to EN 14825 for limiting standards.					

2- MVHR (30 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	-	1.1	0.85
Standard value	2.5*	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types ≤12 kW output, refer to EN 14825 for limiting standards.					
^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.5	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers ≤30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
OPDC GF Admin	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Lobby Area	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Medical Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF DIS WC 1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Group Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]										HR efficiency	
	ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
OPDC GF 1:1 Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Assisted Shower	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Laundry	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Quiet Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Penninsular WC 1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF DIS WC 2	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Bin Lobby	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Penninsular WC 2	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Hairdressers	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Craft	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Dining	-	1.1	-	-	-	-	-	-	-	-	-	N/A
OPDC GF Lounge	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SH FF DIS WC	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SH FF Staff 1:1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SH SF Community Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF Lounge	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF DIS WC 1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF Medical Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF 1:1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF Office	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL GF WC/Shower	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL FF Group Rm	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SL FF DIS WC	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SH SF DIS WC 1	-	1.1	-	-	-	-	-	-	-	-	-	N/A
SH TF DIS WC	-	1.1	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
OPDC GF Admin	-	-	-	-	233
OPDC GF Lobby Area	-	-	-	-	47
OPDC GF Medical Rm	-	-	-	-	109
OPDC GF DIS WC 1	-	-	-	-	34
SH GF Scooter St	-	-	-	-	43
OPDC GF Group Rm	-	-	-	-	261
OPDC GF 1:1 Rm	-	-	-	-	73
OPDC GF Assisted Shower	-	-	-	-	60
OPDC GF Ex Store	-	-	-	-	10
OPDC GF Laundry	-	-	-	-	36
OPDC GF Quiet Rm	-	-	-	-	81
OPDC GF Penninsular WC 1	-	-	-	-	101
OPDC GF DIS WC 2	-	-	-	-	35
OPDC GF Bin Lobby	-	-	-	-	22

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
OPDC GF Penninsular WC 2		-	-	-	63
OPDC GF Hairdressers		-	-	-	234
OPDC GF Craft		-	-	-	417
OPDC GF Kitchen		-	-	-	748
OPDC GF Dining		-	-	-	586
OPDC GF Lounge		-	-	-	639
OPDC GF Circulation 1		-	-	-	293
OPDC GF Circulation 2		-	-	-	117
OPDC GF Circulation 3		-	-	-	135
OPDC GF Plant 1		-	-	-	360
OPDC GF Plant 2		-	-	-	195
OPDC GF Stair 1		-	-	-	99
SH FF Stair 1		-	-	-	122
SH FF Stair 2		-	-	-	99
SH FF DIS WC		-	-	-	43
SH FF Circulation		-	-	-	450
SH FF Lift Lobby 1		-	-	-	69
SH FF Lift Lobby 2		-	-	-	39
SH FF Staff 1:1		-	-	-	210
SH SF Stair 1		-	-	-	110
SH SF Lift Lobby		-	-	-	62
SH SF Circulation 1		-	-	-	262
SH SF Stair 2		-	-	-	124
SH SF Lift Lobby 2		-	-	-	38
SH SF Community Rm		-	-	-	427
GN GF Stair 1		-	-	-	85
GN GF Entrance Lobby		-	-	-	65
GN GF Corridor		-	-	-	382
GN GF Stair 2		-	-	-	71
GN FF Circulation 1		-	-	-	393
GN FF Circulation 2		-	-	-	23
GN FF Stairs 1		-	-	-	125
GN FF Stairs 2		-	-	-	71
GN FF Stairs 2 Lobby		-	-	-	96
GN FF Clnrs Store 1		-	-	-	3
GN SF Stairs 1		-	-	-	125
SL GF Circulation 1		-	-	-	329
SL GF Stair 1		-	-	-	80
SL GF Lounge		-	-	-	535
SL GF Cycle Store		-	-	-	52
SL GF Clnr		-	-	-	6
SL GF DIS WC 1		-	-	-	36
SL FF Circulation 1		-	-	-	308

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
SL FF Circulation 2		-	-	-	99
SL GF Stair 2		-	-	-	104
SL GF Lift Lobby		-	-	-	25
SL GF Bin Store		-	-	-	19
SL GF Medical Rm		-	-	-	137
SL GF 1:1		-	-	-	144
SL GF Office		-	-	-	158
SL GF WC/Shower		-	-	-	33
SL GF Elec Switch Rm		-	-	-	103
OPDC GF Stair 2		-	-	-	140
OPDC GF Stair 1 Lobby		-	-	-	35
OPDC GF Stair 2 Lobby		-	-	-	22
SL FF Group Rm		-	-	-	427
SL FF Stairs 1		-	-	-	110
SL FF Stairs 2		-	-	-	115
SL FF DIS WC		-	-	-	39
SL FF Circulation 3		-	-	-	117
GN SF Circulation 1		-	-	-	393
GN SF Circulation 2		-	-	-	23
GN SF Stairs 2		-	-	-	71
GN SF Stairs 2 Lobby		-	-	-	96
GN SF Cleaners Store		-	-	-	3
GN TF Stairs 1		-	-	-	125
SH SF DIS WC 1		-	-	-	39
SH SF Circulation 2		-	-	-	419
SH SF Circulation 3		-	-	-	21
SH SF Stair 3		-	-	-	99
SH SF Stair 3 Lobby		-	-	-	69
SH SF Store 2		-	-	-	8
GN TF Circulation 1		-	-	-	393
GN TF Circulation 2		-	-	-	23
GN TF Stairs 2		-	-	-	167
GN TF Clhrs Store		-	-	-	3
SH TF Stair 1		-	-	-	43
SH TF Lift Lobby 1		-	-	-	56
SH TF DIS WC		-	-	-	37
SH TF Clhrs St		-	-	-	3
SH TF Circulation 1		-	-	-	75
SH TF Stair 2		-	-	-	99
SH TF Lift Lobby 2		-	-	-	69
SH TF Circulation 2		-	-	-	397
SH TF Store 1		-	-	-	8
SH TF Circulation 3		-	-	-	20

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
OPDC GF Admin	NO (-74%)	NO
OPDC GF Group Rm	NO (-74%)	NO
OPDC GF 1:1 Rm	NO (-45%)	NO
OPDC GF Quiet Rm	NO (-51%)	NO
OPDC GF Hairdressers	NO (-67%)	NO
OPDC GF Craft	NO (-63%)	NO
OPDC GF Dining	NO (-60%)	NO
OPDC GF Lounge	NO (-62%)	NO
SH FF Staff 1:1	N/A	N/A
SH SF Community Rm	NO (-76%)	NO
SL GF Lounge	NO (-64%)	NO
SL GF 1:1	N/A	N/A
SL GF Office	NO (-44%)	NO
SL FF Group Rm	NO (-82%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	2226	2226
External area [m ²]	3837	3837
Weather	SWI	SWI
Infiltration [m ³ /hm ² @ 50Pa]	2	3
Average conductance [W/K]	892	1656
Average U-value [W/m ² K]	0.23	0.43
Alpha value* [%]	26.54	26.54

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Institutions: Hospitals and Care Homes
C2 Residential Institutions: Residential schools
C2 Residential Institutions: Universities and colleges
C2A Secure Residential Institutions
Residential spaces

100

D1 Non-residential Institutions: Community/Day Centre

D1 Non-residential Institutions: Libraries, Museums, and Galleries
D1 Non-residential Institutions: Education
D1 Non-residential Institutions: Primary Health Care Building
D1 Non-residential Institutions: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs, and Theatres
Others: Passenger terminals
Others: Emergency services
Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	2.44	4.76
Cooling	0	0
Auxiliary	1.64	1.38
Lighting	13.72	10.92
Hot water	6.4	7.84
Equipment*	20.48	20.48
TOTAL**	24.2	24.9

* Energy used by equipment does not count towards the total for consumption or calculating emissions

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	8.76	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	29.16	43.88
Primary energy* [kWh/m ²]	74.3	74.52
Total emissions [kg/m ²]	8	12.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	107.7	0	9	0	1.1	3.33	0	3.5	0
Notional	163.1	0	18.6	0	1.1	2.43	0	----	----
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	53.1	0	4.4	0	5.9	3.33	0	3.5	0
Notional	79.3	0	9.1	0	5.1	2.43	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.13	External Wall 515mm
Floor	0.2	0.11	Ground Floor
Roof	0.15	0.1	Roof
Windows, roof windows, and rooflights	1.5	0.9	G16b (o) North
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	1.5

APPENDIX D

PV PANELS SPECIFICATION





Solar PV Quote



Mr Haysam Albaroudi
1 Battle Street

Reading street

RG1 7EU

June 23, 2022
Install Price: £7005
Estimated Return on Investment: £64385.02



In2gr8ted Solutions Ltd Registered in England No: 6453642 V.A.T No: 924 9372 02
Head Office: Northway, 25 Cuerdale Lane, Walton-le-Dale, Preston PR5 4BJ, Tel: 01772 697 910
MCS Registration No: ISLA0122

Dear Mr Albaroudi ,

Thank you for choosing In2gr8ted Solutions to provide you with a quotation for your proposed Solar PV installation.

In2gr8ted Solutions strive to provide our customers with the highest quality products available in the UK at the best price. Choosing the correct products when considering purchasing a Solar PV system is vitally important to protect your investment for the next 20-25 years. Our experience and knowledge of the solar PV and battery storage industry dates back to 2011 and having installed thousands of PV systems throughout the UK, enables us to select and offer only the best tried and tested products.

Within this quotation you will find:

- Your Investment returns table for the next 20-25 years
- How a Solar PV system works
- Selected Solar Panel datasheet
- Selected Inverter datasheet
- Details on our Accreditations
- Full Breakdown of costs for your system
- Predicted system performance explained
- What payments you will receive for generating your own electricity
- Guarantee and Insurance details
- Order form
- Cancellation and Waiver Form

I would recommend installing the Sunpower Max 6 AC with Enphase solar panels with Enphase Micro Inverters. We know from experience that this system works very well together.

Kind regards,

Paul Caffrey

Your consultants name: Paul Caffrey

Phone: 07889948252

Email: paul.caffrey@in2gr8tedsolutions.com

Return on Investment

Period	Yield	Fuel Savings (£)	Smart Export (£)	Solar iBoost	VO	Boiler ES	Battery Savings	Total Benefit (£)	Running Total (£)	Annual ROI %
1	2480	309.96	92.99	0	0	0	0	402.95	402.95	5.8%
2	2473	330.83	95.54	0	0	0	0	426.37	829.32	6.1%
3	2467	353.1	98.16	0	0	0	0	451.26	1280.58	6.4%
4	2461	376.87	100.85	0	0	0	0	477.72	1758.3	6.8%
5	2455	402.25	103.62	0	0	0	0	505.87	2264.17	7.2%
6	2449	429.33	106.46	0	0	0	0	535.79	2799.96	7.6%
7	2443	458.23	109.38	0	0	0	0	567.61	3367.57	8.1%
8	2437	489.08	112.38	0	0	0	0	601.46	3969.03	8.6%
9	2431	522.01	115.46	0	0	0	0	637.47	4606.5	9.1%
10	2424	557.15	118.63	0	0	0	0	675.78	5282.28	9.6%
11	2418	594.67	121.88	0	0	0	0	716.55	5998.83	10.2%
12	2412	634.7	125.22	0	0	0	0	759.92	6758.75	10.8%
13	2406	677.43	128.66	0	0	0	0	806.09	7564.84	11.5%
14	2400	723.04	132.18	0	0	0	0	855.22	8420.06	12.2%
15	2394	771.72	135.81	0	0	0	0	907.53	9327.59	13%
16	2388	823.67	139.53	0	0	0	0	963.2	10290.79	13.8%
17	2382	879.13	143.36	0	0	0	0	1022.49	11313.28	14.6%
18	2376	938.32	147.29	0	0	0	0	1085.61	12398.89	15.5%
19	2370	1001.49	151.33	0	0	0	0	1152.82	13551.71	16.5%
20	2365	1068.91	155.48	0	0	0	0	1224.39	14776.1	17.5%
21	2359	1140.88	159.75	0	0	0	0	1300.63	16076.73	18.6%
22	2353	1217.69	164.13	0	0	0	0	1381.82	17458.55	19.7%
23	2347	1299.67	168.63	0	0	0	0	1468.3	18926.85	21%
24	2341	1387.17	173.25	0	0	0	0	1560.42	20487.27	22.3%
25	2335	1480.56	178	0	0	0	0	1658.56	22145.83	23.7%
26	2329	1580.24	182.89	0	0	0	0	1763.13	23908.96	25.2%
27	2323	1686.63	187.9	0	0	0	0	1874.53	25783.49	26.8%
28	2318	1800.18	193.05	0	0	0	0	1993.23	27776.72	28.5%
29	2312	1921.38	198.35	0	0	0	0	2119.73	29896.45	30.3%
30	2306	2050.73	203.79	0	0	0	0	2254.52	32150.97	32.2%
31	2300	2188.8	209.38	0	0	0	0	2398.18	34549.15	34.2%
32	2295	2336.16	215.12	0	0	0	0	2551.28	37100.43	36.4%
33	2289	2493.44	221.02	0	0	0	0	2714.46	39814.89	38.8%
34	2283	2661.31	227.08	0	0	0	0	2888.39	42703.28	41.2%
35	2277	2840.49	233.31	0	0	0	0	3073.8	45777.08	43.9%
36	2272	3031.72	239.71	0	0	0	0	3271.43	49048.51	46.7%
37	2266	3235.83	246.28	0	0	0	0	3482.11	52530.62	49.7%
38	2260	3453.69	253.04	0	0	0	0	3706.73	56237.35	52.9%
39	2255	3686.21	259.98	0	0	0	0	3946.19	60183.54	56.3%
40	2249	3934.38	267.1	0	0	0	0	4201.48	64385.02	60%
		57769.05	6615.97	0	0	0	0	Total:	64385.02	

Assumptions

--	--

Inflation	3.00%
Fuel Savings	7.00%
Yearly Panel Efficiency Degradation	0.25%
VAT Rate	0%

VAT will be charged at the current rate at the time of invoicing.



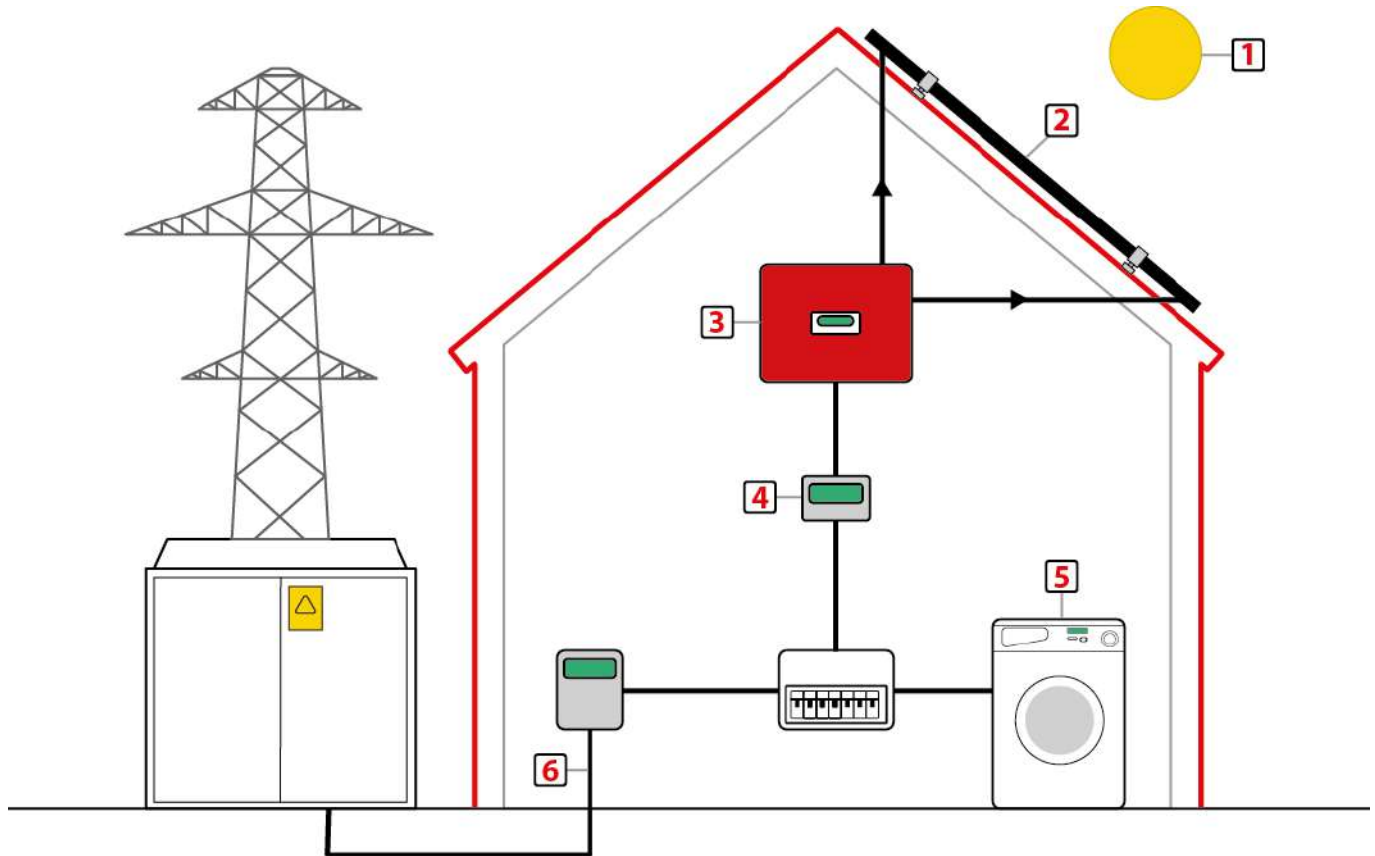
These figures are validated by EPVS (Energy Performance Validation Scheme)

The table above shows potential savings based on manufacturers savings statistics and should be used as a guideline only. The assumptions for electricity and heating fuel price RPI inflation of 7% per year. Savings are based on case studies of products and the information you have provided about your current bills.

These savings figures are in no way guaranteed by In2gr8ted Solutions or the product Manufacturer. Savings will vary based on changes in your lifestyle and size of solar PV system that you have installed.

How a Solar PV system Works

The diagram below explains what you need to know about how Solar PV systems work.



1 Light

The sun gives off light, even on cloudy days

2 The Panels

PV cells on the panels turn the light into DC electricity

3 The Inverter

The current flows into an inverter, which converts it to AC electricity ready to use.

4 The Electricity

The current is fed through a meter and then into your home's consumer unit.

5 Powering the home

Plug in and switch on. Your system will automatically use the free electricity you've generated, then switch back to the grid as needed.

6 The National Grid

Any electricity you don't use is exported to the grid for others to use.

Making the right decision when it comes to Solar is Crucial.

Solar is a 20-30 year INVESTMENT OPPORTUNITY and should be balanced against a number of factors, assurances and guarantees to avoid problems further down the line.

In2gr8ted Solutions are an accredited member of HIES. This ensures our customers are protected before and after the installation. The scheme covers and protects consumers against conduct regarding cancellations, unfair contract clauses, arbitration, deposit etc. Choosing a HIES member gives you added peace of mind.

Our company and the products we use are governed and registered with the Micro generation Certification Scheme (MCS) which is an internationally recognised quality assurance scheme, supported by the Department of Energy and Climate Change.

MCS is an eligibility requirement for financial incentives, which include the Smart Export Guarantee (SEG) and the Renewable Heat Incentive.

Experience and Knowledge – Exclusively focussing on Solar Energy since 2011 we believe our experience and knowledge of this industry places us in the best position to empower our customers and design unique systems based on individual requirements and environmental factors. We have been a member of Elecsa for the past 8 years who conduct annual assessments on our installation to ensure electrical competence and safety.

All our selections, recommendations, predictions and product choices are back by some of the most comprehensive guarantees in the industry offering our customers triple protection.

In2gr8ted Solutions have national service capability to protect your future returns long after the sale.

Solar PV Quote

Description of Goods & Service	Quantity	Total
Goods		
Panels: Sunpower Max 6 AC with Enphase 420w	6	
Enphase Envoy S metered	1	
	Subtotal (ex VAT)	£5954.25
Services		
Full installation, certification & registration	1	£1050.75
	Subtotal (ex VAT)	£7005
	VAT (0%)	£0
	Total (inc VAT)	£7005

This Quotation is valid for 30 days

If you are happy with the Quotation and terms of the Contract and wish to proceed with the Order then Please fill in the Order Form and return. We will then contact you to arrange a professional survey and organise a future date for the installation.

SUNPOWER | FROM MAXEON
SOLAR TECHNOLOGIES

MAXEON 6 AC SOLAR PANEL

420-440 W | Up to 22.8% Efficient

 Factory-integrated
AC microinverter

 White backsheet,
black frame

More Lifetime Energy

Designed to maximise energy generation through leading efficiency, enhanced performance in high temperatures, and higher energy conversion in low-light conditions like mornings, evenings and cloudy days.

Uncompromising Reliability

Engineered to power through all types of weather conditions with crack-resistant cells and reinforced connections that protect against fatigue and corrosion. Each panel's microinverter enables independent panel operation to mitigate the impact of shade while improving system performance.



Superior Sustainability

Clean ingredients, responsible manufacturing, and lasting energy production for 40 years make SunPower Maxeon panels the most sustainable choice in solar.



The Industry's Longest Warranty

SunPower Maxeon panels are covered by a 40-year warranty¹ backed by extensive third-party testing and field data from more than 33 million panels deployed worldwide.

Product and power coverage	40 Years
Year 1 minimum warranted output	98.0%
Maximum annual degradation	0.25%

Microinverter limited product warranty covered by Enphase	25 Years
---	----------



Learn more about the SPR-MAX6-XXX-E3-AC
sunpower.maxeon.com

MAXEON 6 AC POWER: 420-440 W | EFFICIENCY: Up to 22.8%

AC Electrical Data	
Inverter Model: IQ 7A	@230 VAC
Peak Output Power	366 VA
Max. Continuous Output Power	349 VA
Nom. (L-N) Voltage/Range	219 – 264 V
Max. Continuous Output Current	1.52 A
Max. Units per 20 A (L-N) Branch Circuit	10
Weighted Efficiency ²	96.5%
Nom. Frequency	50 Hz
Extended Frequency Range	45-55 Hz
AC Short Circuit Fault Current Over 3 Cycles	5.8 A rms
Overvoltage Class AC Port	III
AC Port Backfeed Current	18 mA
Power Factor Setting	1.0
Power Factor (adjustable)	0.8 lead. / 0.8 lag.

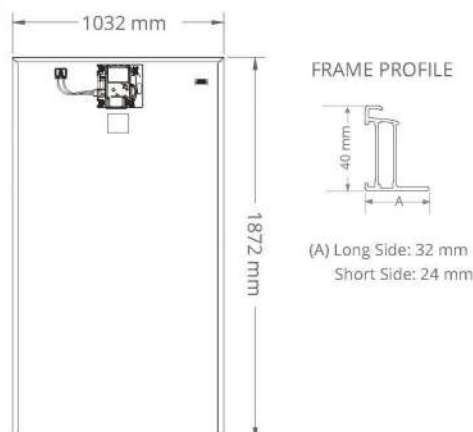
DC Power Data				
	SPR-MAX6-440-E3-AC	SPR-MAX6-435-E3-AC	SPR-MAX6-425-E3-AC	SPR-MAX6-420-E3-AC
Nom. Power ³ (Pnom)	440 W	435 W	425 W	420 W
Power Tol.	+5/0%	+5/0%	+5/0%	+5/0%
Module Efficiency	22.8%	22.5%	22.0%	21.7%
Temp. Coef. (Power)	-0.29%/°C			
Shade Tol.	Integrated module-level max. power point tracking			

Mechanical Data	
Solar Cells	66 Maxeon 6 Cells
Tempered Glass	High-transmission tempered anti-reflective
Environmental Rating	Microinverter Outdoor rated - IP67 (UL: NEMA type 6)
Frame	Class 1 black anodized
Weight	21.8 kg



Tested Operating Conditions	
Operating Temp.	-40°C to +60°C
Max. Ambient Temp.	50°C
Relative Humidity	4% to 100% (Condensing)
Max. Altitude	2000 m
Design Load ⁴	Wind: 3600 Pa, 367 kg/m ² back Snow: 5400 Pa, 551 kg/m ² front
Impact Resistance	25 mm diameter hail at 23 m/s
Microinverter enclosure	Class II double-insulated, corrosion resistant polymeric enclosure

Warranties, Certifications and Compliance	
Panel Warranties ¹	40-year limited power warranty 40-year limited product warranty
Microinverter Warranty	25-year limited product warranty covered by Enphase warranty⁵
Certifications and Compliance	- IEC 61215, 61730⁶ - IEC 62109-1, 62109-2 - IEC 61000-6-3 - AS4777.2, RCM - IEC/ EN 50549-1:2019, G98/G99 - VDE-AR-N-4105
Quality Management Certs	ISO 9001:2015, ISO 14001:2015
PID Test	1000 V: IEC 62804
LeTID Test	Draft version IEC 61215 ⁷
Available listing	TUV ⁶ , EnTest
Green Building Certification contribution	Panels can contribute additional points towards LEED and BREEAM certifications
EHS Compliance	RoHS, OHSAS 18001:2007, REACH SVHC-201



1 40-year warranty is not available in all countries or all installations and requires registration, otherwise our 25-year warranty applies. Service availability varies by country and installation provider.

2 Tested per EN 50530 (EU).

3 Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25°C). NREL calibration standard: SOMS current, LACCS FF and voltage. All DC voltage is fully contained within the module.

4 Safety factor 1.5 included.

5 AC modules shall be connected to Enphase Monitoring hardware (ENVOY) to enable Enphase product warranty.

6 Refer to the DC module, Class C fire rating per IEC 61730.

7 Panels degraded 0% in extended LeTID testing conducted by PVEL. Test report R10124977G-1, 2020.

Made in Malaysia (Cells)

Assembled in Malaysia (Module)

Specifications included in this datasheet are subject to change without notice.

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View warranty, patent and trademark information at maxeon.com/legal.



Please read the safety and installation instructions.
Visit www.sunpower.maxeon.com/int/InstallGuideACModules
Paper version can be requested through
techsupport.ROW@maxeon.com

SUNPOWER
FROM MAXEON SOLAR TECHNOLOGIES

544435 REV A / A4_EN
Publication Date: January 2022

Predicted System Performance

The Micro generation Certification Scheme sets out how an estimate of system performance must be arrived at. This is known as the standard MCS procedure. Whenever a quotation is issued, it is a requirement that we also issue the following “disclaimer”:

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 and is given as guidance only. It should not be considered as a guarantee of performance.

In addition, if the data has been estimated or taken remotely, the following must also be included on the Quotation:

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.

And/or if any shading whatsoever is present the following disclaimer must be added We have established that the system will be subject to some shading; therefore we are required to issue you with the following disclaimer:

This shade assessment has been undertaken using the standard MCS procedure – it is estimated that this method will yield results within 10% of the actual energy yield for most systems.

A. Installation Data			
	Aspect 1	Aspect 2	Aspect 3
Installed capacity of PV system – kWp (stc)	2.52		
Orientation of the PV System – degrees from South	0°		
Inclination of system – degrees from horizontal	35°		
Postcode region	1		
B. Calculations			
Kwh/kwp (kk) from table	984		
Shade Factor (SF)	1		
Estimated annual output (Kwp x Kk x SF)	2479.68		
Total Estimated annual output (kWh)	2479.68		

What does this mean in terms of payments?

A. The savings from the 50% that we are required to assume you use yourself would be calculated dependent on the average price you currently pay for your electricity. We have used an estimated 25 pence per kilowatt hour.

B. You will receive a Smart Export Guarantee payment for electricity fed back into the grid.

The Figures

If the system performs in line with our predictions the following would apply, remember, we have assumed that you will use 50% of your generated electricity at home.

Income/Benefits

A	Electricity Savings (50% of 2479.68 kWh x 25p estimated Electricity Tariff)	£309.96
B	Exported to grid (Octopus Energy @ 7.5p/kwh)	£92.99
	Combined Export & Electricity savings (A+B)	£402.95

Savings from Additional Equipment

C	Savings from Extras/Battery	£0
	Estimated first year total system benefit (A+B+C)	£402.95

The table above shows potential savings based on manufacturers savings statistics and should be used as a guideline only. The assumptions for electricity and heating fuel price RPI inflation of 7% per year. Savings are based on case studies of products and the information you have provided about your current bills. These savings figures are in no way guaranteed by In2gr8ted Solutions or the product Manufacturer. Savings will vary based on changes in your lifestyle and size of solar PV system that you have installed.

Other Usage Estimates

The MCS guidelines accept that on average you will use around 50% of the solar energy you produce. But some finance and accreditation companies would like us to show you a scenario where you only use 25% of the electricity you produce. The table below shows you the first-year estimate based on this.

Estimated first-year total if 50% of electricity generated is used.	£402.95
Estimated first-year total if 25% of electricity generated is used.	£247.97

Inflation

We have estimated the returns you will receive based on 3% inflation and 7% fuel price rises per year as **£64,385**. There may be a scenario where these figures differ. Below is a table that shows the returns for these scenarios.

0% inflation & 0% fuel price rises	1.5% inflation & 1.5% fuel price rises	3% inflation & 3% fuel price rises
£11,813	£15,947	£22,053

Important Notes Concerning this Quotation

Deposits and Advance Payments

Any deposit or advance payment you have made to us, or will make to us according to the timescales set out in the quotation, will be placed in a "Client Bank Account". These deposits and advance payments can only be used to carry out work under this contract.

Should we cease trading because of receivership, administration or bankruptcy the monies in that bank account will be returned to you or will be given to another MCS Approved Contractor to complete the work.

We are required under the HIES Consumer Code to also protect these deposits and advance payments with an insurance policy. We will give to you the name and contact details of this insurance company with the quotation. You will be entitled to claim on this policy should we fall into receivership, bankruptcy or administration. Insurance policy details will be sent to you. If you do not wish to register these details please inform us.

Guarantees

Your equipment is guaranteed by its manufacturer but you should contact us in the first instance if anything appears to be wrong. The guarantees are 25 year output warranty for the solar panels and 25 years for the Enphase Micro inverter(s), see Order Form for warranty extension information.

Should we cause any damage, either to installed equipment or to your property we will rectify such damage without charge to you.

We guarantee our workmanship for 2 years from the date of the installation. We are Accredited members of HIES – Home Insulation & Energy Systems Quality Assured Contractors Scheme and take out an insurance policy included as part of your contract. This policy will cover you in the unlikely event that you have an issue with your system during the workmanship warranty period, and we are no longer trading.

You also have the manufacturer's warranty for each of the separate products purchased. Please refer to the warranty information provided on completion.

In2gr8ted Solutions Ltd are regulated by the Financial Conduct Authority. We are not a Credit Broker and not a Lender, we offer Credit facilities from a Panel of Lenders.

Insurance

It is recommended that you inform your property insurers about the proposed installation to check if it will increase your buildings insurance premium.

As members of HIES, we must have appropriate insurance to cover possible third-party damage, which may be caused by any of our activities in supplying a small-scale energy generator to you.

Commissioning the system

The Solar PV system will be commissioned according to MCS installation standards to ensure that the system is safe, has been installed in accordance with documented procedures and manufacturer's requirements and is operating correctly in accordance with the system design. We will also make any required Building Control notifications and you will be forwarded the documentation within 30 days.

Following the testing and commissioning of the system, a detailed operating manual will be provided to you within 7 days.

After Sales Support and Maintenance

If, following installation, the system does not appear to be operating correctly please refer to the operating instructions. We will explain to you, at the handover stage, the safe operation of the system.

If you are still in doubt as to any aspect of the systems operation please contact us.

We will issue to you at Handover information as to shading and maintenance.

We can, should you require it, provide servicing and/or maintenance contracts at additional cost.

Order Form

Customer Name	Mr Haysam Albaroudi
Site Address	1 Battle Street
	Reading street
	RG1 7EU
Phone Number	0750 4745213
Email Address	haysam.albaroudi@hants.gov.uk
Ref Number	IN2-PC-HARG17EU
Date of Quotation	June 23, 2022

Description of Goods & Service	Quantity	Total
Goods		
Panels: Sunpower Max 6 AC with Enphase 420w	6	
Enphase Envoy S metered	1	
	Subtotal (ex VAT)	£5954.25
Services		
Full installation (Concrete tile, 3-Storey), certification & registration	1	£1050.75
	Subtotal (ex VAT)	£7005
	VAT (0%)	£0
	Total (inc VAT)	£7005

VAT will be charged at the current rate at the time of invoicing.

Notes:

Payment Terms	
Payment 1:	
Deposit on Order	£100
Payment 2:	
Balance payable on satisfactory completion	£6905

If you are happy with this quotation and wish to proceed please sign and return this order form to us at the address above.

We/I agree to the Quotation and confirm the order for the products and installation services specified.

We/I agree to the total cost and payment terms set out above.

We/I have read and agree to abide by the terms and conditions of the Contract provided with the Quotation.

Metering will be required in order for you to obtain financial incentives.

Planning Permission Confirmation:

By signing this Order Form, you are confirming that you have received Planning Permission or a Building Warrant for the proposed installation, or ascertained that these are not required. We cannot be held responsible for any installations where Planning Permission or a Building Warrant was required but not obtained, and no refunds will be offered.

We can accept payment by Bank Transfer or Cash. From 1st May 2022, we will charge a 1% fee on all Visa and Mastercard payments. This is due to charges incurred by Worldpay and card issuers. Our bank details are as follows: **Sort code: 01-00-53, Account number: 12541656.**

Due to shortages of PV equipment, we may offer other brand products of the same quality and cost if any items listed in your quote are not available at the time of installation.

If your quote includes battery storage and Solar PV, we may install the Solar PV on the first stage and the battery on the second stage. In these circumstances, 80% of the overall balance will be charged and become payable on completion of stage one. 20% of the overall balance will become payable on completion of stage two.

Name:	Mr Haysam Albaroudi
Signature:	
Date:	June 23, 2022

Thank You!

To claim SEG payments, you must contact your energy supplier after your solar installation. They will inform you of the available tariffs and how to make a claim.

We are authorised & regulated by the Financial Conduct Authority FRN: 666732. We are a Credit Broker and not a Lender. We offer Credit Facilities from a Panel of Lenders.

In2gr8ted Solutions is a trading name of In2gr8ted Solutions Ltd.

In2gr8ted Solutions Ltd, Northway, 25 Cuerdale Lane, Walton-Le-Dale, Preston, Lancashire, UK, PR5 4BJ

Company Number: 06453642

/1655982444>MK100/PC-CC500/#mk

Instructions for Cancellation (for contracts agreed in the home)

ISSUE DATE:

Right to Cancel

You have the right to cancel this contract within fourteen days without giving any reason.

The cancellation period will expire after 14 days from the day on which you acquire, or a third party other than the carrier and indicated by you acquires, physical possession of the last good.

To exercise the right to cancel, you must inform us (you will find our full contact details at the head of this form) of your decision to cancel this contract by a clear statement (e.g. a letter sent by post, fax or e-mail). You may use the attached model cancellation form, but it is not obligatory.

To meet the cancellation deadline, it is sufficient for you to send your communication concerning your exercise of the right to cancel before the cancellation period has expired.

Effects of Cancellation

If you cancel this contract, we will reimburse to you all payments received, including the costs of delivery (except for the supplementary costs arising if you chose a type of delivery other than the least expensive type of standard delivery offered by us).

We may make a deduction from the reimbursement for loss in value of any goods supplied, if the loss is a result of unnecessary handling by you.

We will make the reimbursement without undue delay, and not later than:

- a) 14 days after the day we receive back from you any goods supplied, or
- b) (if earlier) 14 days after the day you provide evidence that you have returned the goods, or
- c) If there were no goods supplied, 14 days after the day on which we are informed about your decision to cancel this contract.

We will make the reimbursement using the same means of payment as you used for the initial transaction, unless you have expressly agreed otherwise; in any event, you will not incur any fees as a result of the reimbursement.

We will collect the goods.

You are only liable for any diminished value of the goods resulting from the handling other than what is necessary to establish the nature, characteristics and functioning of the goods.

Work begun prior to the expiry of the Cancellation Period

If you have agreed in writing that installation work will commence before the fourteen day cancellation period expires, and you subsequently cancel in accordance with your rights, you are advised that reasonable payment may be due for any work carried out. You must confirm in writing that work may commence before your cancellation period expires.

Related Credit and Other Agreements

If you decide to cancel your contract for our goods and services then any credit agreement and any other ancillary contracts related to the main contract will be automatically cancelled.

Cancellation Notice

Complete, detach and return this portion ONLY IF YOU WISH TO CANCEL THE CONTRACT

To: In2gr8ted Solutions Ltd
Northway
25 Cuerdale Lane
Walton-le-Dale
Preston
PR5 4BJ
01772 697910
paul.caffrey@in2gr8tedsolutions.com

Name of Person Dealing:	
Contract Reference or name and address of customer:	

I/We (delete as appropriate) hereby give notice that I/We wish to cancel my/our contract of sale of the following goods

Ordered on:	
Received on (if applicable):	
Name:	
Address:	
Signed:	
Date:	

Express Request for Work to Commence

(Contracts agreed away from trade premises or at distance)

In2gr8ted Solutions Ltd
Northway
25 Cuerdale Lane
Walton-le-Dale
Preston
PR5 4BJ

Tel: 01772 697 910

Email: paul.caffrey@in2gr8tedsolutions.com

The Consumer Contracts (Information, Cancellation and Additional Charges) Regulations 2013 came into effect in June 2014 and are relevant to domestic/consumer contracts.

Where contracts are considered to have been agreed away from trade premises or at distance the cancellation period begins when the customer signs the contract and ends 14 days after all of the goods relating to the contract are delivered to the customer's home.

There can be occasions however, when both the company and the consumer want the work to start within the cancellation period. Under the regulations the consumer can make an "express request" confirming that they are happy for work to begin within the "cancellation period".

Please Note: If you make an "express request" for the work to start, you can still cancel within the cancellation period as long as the installation is not completely finished. However, if you do cancel after making the express request you will be liable for any work performed up to the point of cancellation.

By signing and returning this document you are providing your agreement in writing to enable us to commence work within the cancellation period which starts when the customer signs the contract and ends 14 days after all of the goods relating to the contract are delivered to the customer's home.

Please Note: If you consent for work to begin within the cancellation period and you later exercise your right to cancel you will be liable for the cost of work performed up to the point of cancellation. You will also lose the right to cancel the contract within the cancellation period when the installation is completely finished. When this occurs the company can charge the full contract price.

I/We understand that signing of this document does not affect my/our right to cancel the contract in the cancellation period which starts when I/we sign the contract and ends 14 days after all of the goods relating to the contract are delivered to my/our home.

I/We hereby give express consent for In2gr8ted Solutions Ltd to commence work on the agreed installation date.

Name(s):	Mr Haysam Albaroudi		
Address:	1 Battle Street Reading street RG1 7EU		
Signature(s):		Date:	June 23, 2022

DNO Letter of Authority

Name: Mr Haysam Albaroudi

Address: 1 Battle Street

Reading street

RG1 7EU

June 23, 2022

Dear Sir/ Madam

I Mr Haysam Albaroudi as the landowner would like to confirm that I am happy for the following company to make an application for a grid connection at the above address on my behalf:

Third party/Business party name: In2gr8ted Solutions Ltd

Company registration number: 6453642

Registered office/ full address: 25 Cuerdale Lane, Walton le Dale, Preston PR5 4BJ

Main contact / Full name: Paul Caffrey

Should I wish to amend the application, In2gr8ted Solutions Ltd will retain the right to accept/change any offer that is given for a grid connection at this site.

Signature:	
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(Name of land owner): Mr Haysam Albaroudi

Should you require either this Contract or any other information we have supplied to you in large print, please contact us.

This Contract has been prepared to comply with all our obligations under the Renewable Energy Consumer Code (HIES) and the Microgeneration Scheme

This contract details our obligations to you, and your obligations to us, if there is any point that we can clarify for you, please contact us.

1. The Quotation

The quotation we have given you is valid for 30 days from the date of issue. To confirm your order, you will need to sign both copies of this contract; you should keep one copy for your records and return the other copy to us at the address on the quotation. No contract will be in place until we confirm the order with you.

The quotation will document all goods and services we propose to supply, along with the total price for these goods and services including VAT.

We will provide you with a timetable for supplying the goods and carrying out the installation.

The quotation will include information as to the performance of the technology we have proposed to install. These performance estimates will be calculated according to the requirements of the appropriate MCS Standard.

We will discuss with you and provide you with information as to the location of key components. You will be given the opportunity to approve the site designs before work commences.

Where we are unable to supply the main energy generator that was specified in the quotation, we will inform you of this in writing and you will have the right to cancel this contract.

We will advise you on approvals and permissions that may be required for the work; however, it will be your responsibility to ensure that such approvals and permissions are in place.

If there are additional payments that you may have to make, such as planning costs or if you need to consult a Structural Engineer, we will offer assistance and advice, but you will be responsible for these costs.

If there is a particular service or item of equipment that would normally be considered as part of the installation and you have requested that this not be included, then we will have documented this on the quotation.

Please take time to acquaint yourself with this contract, if there is anything you do not understand, or if you require clarification on any point, please contact us.

2. Right to Cancel

Your rights under this contract

The "Cancellation Period" begins when the contract is agreed and will end 14 days from the day on which you acquire, or a third party other than the carrier and indicated by you acquires, physical possession of the last good.

You have the right to cancel this contract during the cancellation period without giving any reason.

To exercise the right to cancel, you must inform us of your decision to cancel this contract by a clear statement (e.g. a letter sent by post, fax or e-mail). You may use the Cancellation Form we have supplied but it is not obligatory.

To meet the cancellation deadline, it is sufficient for you to send your communication concerning your exercise of

the right to cancel before the cancellation period has expired.

You may also cancel this contract if there is an unreasonable delay in the installation being carried out, if this has not been caused by you. You would also be entitled to a full refund if that delay has been caused by something outside of our direct control but not caused by you.

If you cancel this contract outside the cancellation period you may have to pay to us reasonable costs for any losses we may have incurred. We will attempt to keep these costs to a minimum. If you have paid us a deposit or any advance payments we may retain all or part of these payments as a contribution.

You will be entitled to cancel this contract if there is a serious delay in our ability to carry out the agreed work that is outside of your control, but within our control. You will be entitled to a full refund.

If we are in serious breach of our obligations as detailed in this contract then you will be entitled to cancel this contract, request a repair or replacement or you may be entitled to request compensation.

You can only recourse to these actions if the goods or services are incorrectly described or not fit for purpose. You will not be entitled to seek these remedies if you have changed your mind about the goods and services agreed to.

3. Effects of cancellation

If you cancel this contract, we will reimburse to you all payments received, including the costs of delivery (except for the supplementary costs arising if you chose a type of delivery other than the least expensive type of standard delivery offered by us).

We may make a deduction from the reimbursement for loss in value of any goods supplied, if the loss is a result of unnecessary handling by you.

We will make the reimbursement without undue delay, and not later than:

- a) 14 days after the day we receive back from you any goods supplied, or
- b) (if earlier) 14 days after the day you provide evidence that you have returned the goods, or
- c) If there were no goods supplied, 14 days after the day on which we are informed about your decision to cancel this contract.

We will make the reimbursement using the same means of payment as you used for the initial transaction, unless you have expressly agreed otherwise; in any event, you will not incur any fees as a result of the reimbursement.

We will collect the goods at our expense. You are only liable for any diminished value of the goods resulting from the handling other than what is necessary to establish the nature, characteristics and functioning of the goods.

4. Work begun prior to the expiry of the cancellation period

If you have agreed in writing that installation work will commence before the cancellation period expires, and you subsequently cancel in accordance with your rights, you are advised that reasonable payment may be due for any work carried out. You must confirm in writing that work may commence before your cancellation period expires.

You will be entitled to cancel this contract if there is a serious delay in our ability to carry out the agreed work that is outside of your control, but within our control. You will be entitled to a full refund. If we are in serious breach of our obligations as detailed in this contract then you will be entitled to cancel this contract, request a repair or replacement or you may be entitled to request compensation.

You can only recourse to these actions if the goods or services are incorrectly described or not fit for purpose. You will not be entitled to seek these remedies if you have changed your mind about the goods and services agreed to outside of any required cancellation periods.

5. Related credit and other agreements

If you decide to cancel your contract for our goods and services then any credit agreement and any other ancillary contracts related to the main contract will be automatically cancelled.

6. Our rights under this contract

If, within fourteen days of us informing you in writing of a serious breach of your obligations to us you have failed to rectify this breach, we will have the right to cancel this contract.

Should we suffer any losses due to a breach of this contract then we will be entitled to reasonable compensation to cover these losses. We are required to attempt to keep all losses to a minimum.

7. Timetable for works

We will have agreed with you a timetable for carrying out the installation. By signing this contract you are confirming that you agree with this timetable.

There can be occasions that this timetable may need to be varied, due to, for example, poor weather or unavailability of goods and services. We will inform you of any delay we become aware of at the earliest possible opportunity. We would then arrange a new mutually agreeable timetable.

In the case of severe delays to the delivery of goods then you may be offered different products of equivalent specification, value and quality, so long as they are MCS certified. You can either accept that offer, wait for the products you ordered or choose to cancel the contract without penalty.

Should the delay be caused by us, or by our suppliers, and that delay could be considered as severe by a reasonable person, you would be entitled to cancel this contract without penalty to you.

Should the delay be caused by you, we will attempt to accommodate that delay without cost to you. However, if the delay incurs us in extra costs, for example scaffolding, we will require that you cover these costs.

8. The Installation

The installation will be carried out strictly in line with the MIS Standard relevant to the technology, and to any document referred to within that standard. In addition, we will ensure at all times that we meet all our obligations under the HIES Consumer Code.

The goods we supply will be of merchantable quality and fit for the purpose. They will operate as we have described to you.

We will have insurances in place which will cover any loss or damage caused by us or our agents. You will be required to supply to us normal services free of charge; this would include toilet, washing, water facilities and electricity. You should also ensure we have safe and easy access to the installation area.

Any work to prepare for the installation, carried out by you or a third party that you employ should be carried out in line with the agreed start date for the installation. If this work has not been completed and a consequent delay is caused you may be liable for any costs incurred by us for such a delay.

The work will be carried out by personnel trained in each of the tasks they are assigned. You will be given warranties for both the installation itself and for the installed goods. The terms of these warranties will be given to you in writing and we will explain them to you verbally.

Within seven days of the completion of the installation we will hand over to you all documentation required as set out within the appropriate Microgeneration Installation Standard.

9. Deposits, advance payments and goods purchased with deposits and advance payments

Any deposits and advance payments that you make to us can only be used to carry out work under this contract.

We are required under the Renewable Energy Consumer Code to protect any deposits and advance payments you make to us, as well as the Workmanship Warranty, with an insurance policy. We will give to you the name and contact details of this insurance company with the quotation. You will be entitled to claim on this policy should we fall into receivership, bankruptcy or administration.

When we purchase goods for use under this contract the legal title to those goods or the proportion of which you have paid us for will pass to you. We will either deliver them to you or we will store them for you and mark them as your property. They will be kept separate from other goods. We will ensure that these goods are insured until they are delivered to you. You may make arrangements to inspect the goods or to remove them from our premises if you wish. If we have requested a deposit, then this deposit will not exceed 25% of the total contract price set out in the quotation. Should you decide to cancel this contract within the cancellation period, then this deposit will be returned to you promptly.

If we have requested advance payments in addition to a deposit, the total of all advance payments and deposits will not exceed 60% of the total contract price.

We will not request advance payments to be made any more than 3 weeks from the agreed delivery or installation date. If we have requested a deposit before a full technical assessment of your property has been made, and we are unable to proceed because of something discovered during that technical inspection, then any deposits or advance payments will be returned.

The quotation will set out in detail when invoices will be sent and the amounts due for each payment.

10. Goods belonging to us

Any goods belonging to us that have been delivered to you should remain clearly identifiable as our property. Until the title to the goods is transferred to you the goods should be stored in such a way as they are protected from damage. They should be kept in their original packaging. Should you fear for the safety of the goods in any way, or you feel that the goods are causing any form of hazard you should contact us.

Should you terminate the contract for any reason, then we will make arrangements with you to collect the goods. If this happens then we will reimburse you if any of your money was used to purchase a proportion of the goods. If you do not make adequate and reasonable arrangements with us to allow the goods to be collected, we retain the right to take legal proceedings to recover the goods or their value. The amount of any reimbursement may be reduced by any reasonable costs we may have incurred.

11. Changes to the planned work

If you decide to make changes to any planned work after you have signed this contract you should contact us without delay. Wherever possible we will incorporate your changes and if we are not able to do so we will inform you as to why it is not possible for us to do so.

Where we are able to agree to your changes we will require that you set out, in writing and within fourteen days, confirmation of your request.

You need to be aware that any changes to the original design may mean an adjustment to the cost of the installation. Any adjustment in the cost, either in addition or subtraction will be dealt with as a Variation of Contract and we will adjust the price by written agreement with you.

There can be occasions when we come across unexpected work. Should this arise, we will discuss this with you. If it is an area of work in which we are competent to operate, we will issue you with a quotation to complete that work. We will have documented on the quotation the normal rate for the work of our installers. If the work is outside our area of competence, we will assist you in finding a suitably qualified contractor to carry out the work. If this unexpected work causes a delay in the installation process, we may need to make reasonable charges for this delay.

12. Late payment

You should make the payments agreed on the quotation as they become due. The final payment will be due on completion of the installation. If you fail to make any agreed payment we may cease work. If you fail to pay the amount specified in an invoice sent to you by the agreed due date then we reserve the right to charge you interest until you pay the amount due. The interest rate we will charge will be 3% above the Bank of England base rate.

It is not permissible under this contract to withhold any more than a proportionate amount of the outstanding balance for any alleged defect. If you do withhold any amount after a payment has become due, you should give us notice of your intention before the final date on which payment is due. You should also, with that notice, state the reasons for withholding payment.

If we intend to cease work, we will give you notice of this in writing. If you are in breach of this contract because you have not made a payment that was due to us and we have ceased work, you may have to compensate us for any additional costs we have incurred.

Dependent on the circumstances, we may require that the goods are returned to us. If necessary, we will take legal proceedings to recover the goods or/and any outstanding amounts due to us.

13. Conciliation and arbitration

Note: The HIES conciliation and arbitration process only covers unresolved disputes arising from issues connected to the sale and installation of small scale renewable technologies.

If at any time a dispute arises between you and us that cannot be resolved you can refer the matter to be handled through HIES's dispute resolution procedure, provided it falls within their remit. We must agree to follow this procedure if that is your wish. HIES is certified through the Chartered Trading Standards Institute as an Alternative Dispute Resolution provider. You can find further information on the HIES website: www.hiesscheme.org.uk

If you register a dispute with HIES it will be allocated to a HIES caseworker, who will mediate between both parties in order to resolve the dispute. Mediation aims to reach a non-legal solution to the dispute in a reasonable timescale. If an agreement is not reached through mediation for any reason, you can refer the matter to HIES's independent arbitration service and we must agree to arbitration if that is your wish. You would have to pay a small fee directly to the arbitration provider which may be refunded to you if the arbitrator finds in your favour.

You can find more information on the HIES website: www.hiesscheme.org.uk An award made under the independent arbitration service will be final and legally binding on you and us. You and we may only challenge the award on certain limited grounds under the Arbitration Act 1996.

Disputes that relate to the MCS Installer Standards can be referred to our MCS Certification Body. We will supply their contact details to you on request.

We recommend that you read the HIES Renewable Energy Consumer Code, it is available at www.hiesscheme.org.uk

14. Your Data

By signing this contract, you understand and agree that your data can be stored in a secure database. Your data will not be shared with third parties apart from for the purposes of warranty and product insurance purchases. Your information may also be used for EPC surveys and certification of your installation. If you have purchased an online site monitoring service you agree that your information may also be used.

15. Finance Agreement

If you have chosen a finance option:

(a) The Validation Sheet that has been provided to you separately in respect of your purchase forms part of the agreement between us and together the Validation Sheet and this agreement constitute the entire agreement

("Renewable Energy Contract") between us and supersedes and extinguishes all previous agreements, promises, assurances, warranties, representations and understandings between us, whether written or oral, relating to its subject matter.

(b) Each party acknowledges that in entering into this Renewable Energy Contract it does not rely on, and shall have no remedies in respect of, any statement, representation, assurance or warranty (whether made innocently or negligently) that is not set out in this Renewable Energy Contract but this does not affect your rights and our liability in relation to any fraud or fraudulent misrepresentation for which we are responsible.

(c) Each party agrees that it shall have no claim for innocent or negligent misrepresentation or negligent misstatement based on any statement in this Renewable Energy Contract

16. Disclaimers

(a) As part of our commitment to reducing our carbon footprint and control of waste, we kindly ask our clients to dispose of any packaging that come as part of the delivery of your solar pv or battery system. This may consist of Cardboard and a wooden pallet, which will be left neat and tidy for clients to recycle or dispose of at your local amenity tip.

(b) Some installations require our equipment to be connected to the internet through the customers router. The maintenance of Wifi connection between our equipment and your internet router is the responsibility of the customer. In some extreme cases where clients do not have access to an internet connection, or for some reason the equipment is blocked from access (maybe through a firewall), we shall install all equipment as per the contract and advise of potential steps to be taken for the client to access the internet. It will not be the responsibility of In2gr8ted Solutions Ltd to create, operate or maintain the clients internet connection.

(c) The income and savings figures detailed in this quote are the only income and savings that are applicable in relation to the purchase and installation of energy generating/saving equipment from In2gr8ted Solutions Ltd. By signing and accepting our Contract and order form you will be confirming that you fully understand the benefits within the order and that they are not associated with any other company and/or individual.

(d) If you do not speak or understand English you must have somebody present to explain the products and services you may be purchasing. By signing the Contract and order form you will be confirming that you fully understand the purchase of goods and services detailed. You will also be confirming you fully understand the income and savings benefits and the terms of payment.

(e) If the client has decided to pay for the system by way of a loan through a Finance Company, any Loan Agreement is completely separate from our contract. Clients must pay the loan company instalments as per the Loan Agreement.

17. G98 and G99

G98 is the Engineering Standard whereby the installed generation equipment rated 4kw or below single phase or 12kw three phase must meet in the UK. This includes Solar PV systems and battery storage systems as they can both provide power.

G99 is the Engineering Standard whereby the installed generation equipment rated over 4kw single phase, over 12kw three phase, must meet in the UK. This includes Solar PV and Battery storage systems.

In both cases we complete the required paperwork and submit to your local DNO for approval.

G98 applications generally get approved fairly quickly, G99 applications take a while longer.

If you require a system larger than 4kw or a system that includes PV and Battery Storage with a potential to export more than 4kw, which falls under G99 and requires export limiting, we can install this for you however some DNOs may request to witness test the system in order to prove operation. This can cost between £250 - £800 in some cases, which the DNO charge to send an engineer to site and complete the approval process.

In signing this contract you are agreeing to cover these potential costs should they arise. We do not include them within our pricing as we have less than 5% chance of these costs being charged. We would like to make everyone aware of this potential charge prior to signing the contract. The DNO companies who charge are: SSE, SCOTTISH POWER and NORTHERN POWERGRID

This Contract is agreed between:	
In2gr8ted Solutions Ltd	
Of: Northway 25 Cuerdale Lane Walton-le-Dale Preston Lancashire PR5 4BJ	
And:	
Customer Name:	Mr Haysam Albaroudi
Address:	1 Battle Street Reading street RG1 7EU
Signature of the Customer:	
Date of contract agreement:	June 23, 2022