



**Building Services
Consulting Engineers**

**PROPOSED RESIDENTIAL
DEVELOPMENT**

AT

**ARTHUR HILL POOL
225 KING'S ROAD
READING**

FOR

READING BOROUGH COUNCIL

ENERGY STATEMENT



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1 PROJECT DESCRIPTION

1.1 INTRODUCTION

ION Consulting Engineers have been commissioned by Reading Borough Council to prepare this Energy Statement for 'Arthur Hill Swimming Baths' conversion / redevelopment.

1.2 SUMMARY

The proposed development has been designed to have extremely low energy consumption, similar to that to be expected from a PassivHaus building.

Reading Borough Council's Housing Departments aspiration was to apply the principles of PassivHaus to the design of the new flats, therefore a range of enhanced energy efficiency measures, exceeding Building Regulations 2013 minima have been proposed.

These measures include the specification of very low u-values for the building envelope elements such as walls, floors and windows, reduced air permeability, highly efficient air source heating, 100% low energy LED lighting and the minimisation of thermal bridging.

The building fabric elements for the new build Blocks A, B and C meet the minimum requirements for PassivHaus standards, however the existing building (Block D) is locally listed and of high heritage importance, therefore this will be retained.

Due to the retention of this part of the existing building it can only be enhanced in certain specific areas such as the walls and windows to improve standards to Building Regulations 2013 levels.

The supporting text to 'Policy EN4 Locally Important Heritage Assets' encourages the reuse of such buildings and recognises the advantages this can deliver in terms of reducing carbon: "It should be recognised that seeking the reuse of historic buildings and, where appropriate, their modification to reduce carbon emissions and secure sustainable development, without harming the significance of the heritage asset and its setting, helps to mitigate the effects of climate change. Therefore, buildings on the Local List should be re-used, where possible."

Substantial carbon savings (CO₂ emissions) can however be achieved with the new build Blocks A, B and C.

The reduction in the development overall CO₂ emissions achieved by the above fabric enhancements and use of low carbon technology compared to Building Regulations 2013 criteria are as follows:

- Block A = 82%
- Block B = 84%
- Block C = 82%

Total average improvement of CO₂ emissions for proposed development is 83%.

The scheme has potential to incorporate roof mounted photo-voltaic (PV) panels, split over each block of the development to generate electricity at source.

Preliminary calculations indicate that sufficient panels could be installed to generate approximately 4,700 kg/CO₂ per year (by reducing the amount of grid electricity used by the building).

It is anticipated that by the incorporation of PV panels on the roof that the development could achieve (or be very close to) being carbon neutral.



1.3 SITE ADDRESS

Arthur Hill Swimming Pool, 225 King's Road, Reading, RG1 4LS.

1.4 PLANNING POLICY REQUIREMENTS

Chapter 2 of this statement sets out Reading Borough Council's key planning policy requirements in relation to energy / CO₂ emissions.

1.5 ENERGY STATEMENT

Chapter 3 of this statement reports on the energy strategy for the development based on thermal modelling undertaken as part of this energy statement.

Thermal Comfort and Energy Demand Assessment for the proposed development Blocks AB & CD are presented in Appendix 1.

2 PLANNING POLICY REQUIREMENTS

2.1 READING BOROUGH COUNCIL

2.1.1 Local Plan Adopted November 2019

The Local Plan is the main planning document for Reading and replaces all three previous development plan documents. This means that the Core Strategy (adopted 2008, amended 2015), Reading Central Area Action Plan (adopted 2009) and Sites and Detailed Policies Document (adopted 2012, amended 2015) cease to be used now that this Local Plan is adopted.

This Local Plan has been prepared in accordance with the National Planning Policy Framework (NPPF), which sets out the overall national approach to planning. The Local Plan should be consistent with the principles and policies in the NPPF, including the presumption in favour of sustainable development.

Sustainable Design and Construction

Policy CC2: 'Sustainable Design and Construction'. Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

Adaptation to Climate Change

Policy CC3: 'Adaptation to Climate Change'. All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements.
- Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc.
- Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions.
- All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change

Decentralised Energy

Policy CC4: 'Decentralised Energy'. In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.

- 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 an 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.

Standards for New Housing

Policy 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 Regulations.
- c. All major (10 dwellings or more) new-build residential development should be designed to achieve zero carbon homes or if unachievable, a minimum 35% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.
- d. All other new build housing (minor – fewer than 10 dwellings) will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.
- e. All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations, unless it is built in line with M4(3).
- 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'.

2.1.2 Sustainable Design and Construction Supplementary Planning Document Adopted December 2019

This Supplementary Planning Document (SPD) explains planning requirements with regards to energy, climate change, water management and waste reduction. It is intended to supplement the policies of the Local Plan, particularly:

- CC2: Sustainable Design and Construction
- CC3: Adaptation to Climate change
- CC4: Decentralised Energy
- CC5: Waste Minimisation and Storage
- EN18: Flooding and Drainage
- H5: Housing Standards

This SPD provides a sustainable design and construction checklist that should be completed and submitted as part of the planning application in order to demonstrate how the proposals respond to a range of sustainability issues including energy / CO₂, water, materials surface water run-off, waste, pollution, health and well-being, management ecology and transport.

Energy Efficiency

This section outlines some of the methods that may be used to meet the requirements of policies CC2, CC3, CC5 and H5. The elements are not absolute requirements, but should nonetheless be considered by applicants.

- Fabric Improvements
- Solar Gain
- Natural Day Lighting
- Ventilation
- Thermal Mass
- Insulation
- Green and Brown Roofs
- Green Wall and Living Walls
- Landscaping and Energy Efficiency
- Energy Efficiency Appliances

Decentralised Energy and District Heating

This is not relevant, as the application proposal is not over 20 dwellings plus there is no decentralised energy provision present within the vicinity of the application site.

Sustainable Design and Construction Checklists

This SPD provides a sustainable design and construction checklist that should be completed and submitted as part of the planning application in order to demonstrate how the proposals respond to a range of sustainability issues including:

- Energy / CO₂
- Water
- Materials
- Surface Water Run-off
- Waste
- Pollution
- Health and Well-being
- Management
- Ecology

The requirements of the 'Sustainability Checklist' has been addressed within other documentation supporting this application, however as the design evolves, further construction and operational information will be issued.

2.2 SUMMARY OF REQUIREMENTS

In summary, for new planning applications (major - 10 dwellings or more) the following key sustainability and energy / CO₂ targets apply to this development.

- Minimum 35% reduction in CO₂ emissions from energy efficiency measures and on-site low / zero carbon energy generation.
- Completion of Reading Borough Council's Sustainability Checklist.

3 ENERGY STATEMENT

3.1 INTRODUCTION

In order to demonstrate how the whole development can meet Reading Borough Councils' CO₂ reduction target, a detailed 'energy analysis' has been performed providing full dynamic thermal analysis to CIBSE Level 5 certification, using IES approved Dynamic Simulation Modelling Software.

This analysis has been carried out in accordance with user instructions set out in IES manuals and CIBSE AM11 application manual 'Building Energy and Environmental Modelling'. This analysis has been undertaken using the thermal simulation program ApacheSIM Dynamic Simulation and Macroflo (IESVE, 2020) to predict the building's environmental performance. Solar Penetration Analysis was also performed using Suncast (IESVE, 2020).

The IES thermal models for Block AB and Block CD were initially run to achieve a 'baseline' energy performance, fully compliant with current (2013) Part L Building Regulations standards.

Further model iterations were then run to evaluate the energy / CO₂ saving performance of various energy efficiency measures including enhanced building envelope performance to PassivHaus standards to ensure a "Fabric First" approach and additional energy / CO₂ savings allowed through on-site low energy technologies such as the use of heat pump technology.

The 'fabric first' approach concentrates on specifying high levels of insulation with exceptional levels of air tightness and the use of whole house mechanical ventilation in conjunction with natural ventilation via openable windows as part of an overheating prevention strategy for summertime.

3.2 ENERGY HIERARCHY

The proposed development has been designed to have extremely low energy consumption similar to that to be expected from a PassivHaus building.

These measures include the specification of very good (low) u-values for the building envelope elements such as walls, floors and windows, reduced air permeability, 100% low energy lighting and the minimisation of thermal bridging.

Heating, ventilation, hot water and heating is proposed by the use of individual exhaust air heat pumps.

A range of enhanced energy efficiency measures above and beyond Building Regulations 2013 minima are proposed as the first step of the energy hierarchy.

Table 1 below is a summary of the maximum building air permeability and building fabric elements permissible under Building Regulations 2013.

Table 1 Building Regulations 2013

Fabric Element	U-value (W/m².K)	G-value
External Wall	0.26	-
Roof	0.18	-
Exposed Floor	0.22	-
Windows	1.60	0.40
Rooflights	2.30	0.55
Building Air Permeability @ 50PA		
5.0 (m ³ /(h.m ²))		

Table 2 below is a summary of the building air permeability and building fabric elements used in the thermal model.

Note that the building fabric elements for the new building Blocks A, B and C meet the minimum requirements for PassivHaus standards whereas the existing part of the development, Block D which is to remain, can only be enhanced in specific areas.

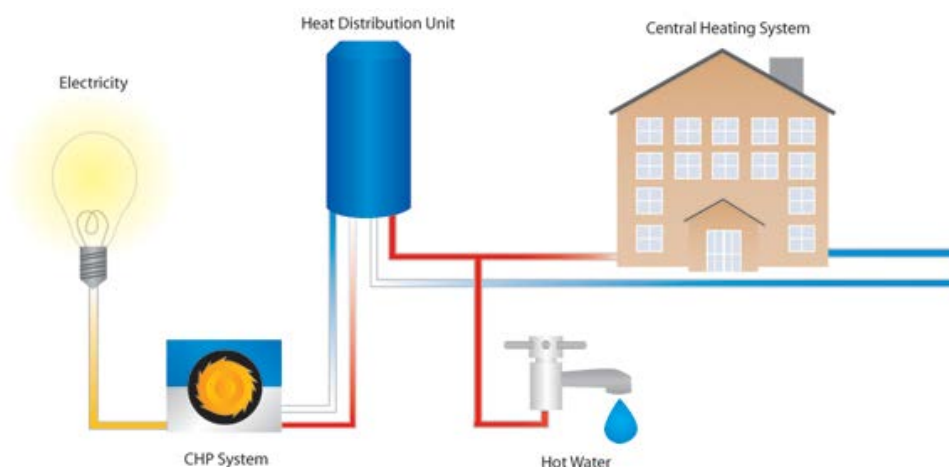
Table 2 Enhanced Building Fabric

Fabric Element	Enhanced U-value (W/m ² .K)	Enhanced G-value
Block ABC External Wall	0.15	-
Block ABC Roof	0.15	-
Block ABC Ground Floor	0.15	-
Block ABC Windows Triple Glazed	0.80	0.30
Block ABC Doors	0.80	-
Block D External Wall	0.23	-
Block D Roof	0.18	-
Block D Ground Floor – Uninsulated concrete slab	1.62	-
Block D Windows	1.60	0.40
Block D Rooflights	2.30	0.55
Block ABC New Build - Building Air Permeability @ 50PA		
2.0 (m ³ /(h.m2))		
Block D Existing Building - Building Air Permeability @ 50PA		
10.0 (m ³ /(h.m2))		

3.3 LOW / ZERO CARBON ENERGY OPTIONS

The following low / zero carbon energy technology options have been considered and assessed as part of the energy strategy for the development.

Combined Heat & Power (CHP)



Combined heat and power (CHP) can provide effective onsite generation of electricity, with the 'waste heat' from the process used for heating and domestic hot water production. CHP is therefore a lot more efficient than separate utility provided electricity and on-site heat generation.

Although CHP is commercially available and widely used, the heat profile and demand of the Arthur Hill development is not appropriate for the operation of a CHP unit. This is due to the lack of continuous heating demand throughout the day. Additionally, CHP plant performs at its most efficient when running continuously, therefore due to intermittent demand only, this technology has been considered but has been dismissed.

Heating can therefore be provided by another low or zero carbon technology, which will have more environmental advantages.

Solar Thermal for Domestic Hot Water



Domestic Hot Water (DHW) production can be generated via solar panel systems, with plate solar collectors widely used. Plate solar collectors have a highly transparent, virtually unbreakable polycarbonate cover, which has been treated to ensure long life. Behind this is the solar absorber, which is made of a metal sheet, covered with a black chromium oxide selective layer.

The solar heated water flows through a heat exchanger, warming the water stored in an internally mounted hot water cylinder. The hot water in the cylinder can then be used for domestic use as normal, with the main heat source providing backup heating when needed.

Whilst solar thermal hot water collectors can sometime have higher energy generation yields per m² than PV panels; for the Arthur Hill development, it has been calculated that greater advantage can be obtained using the roofs for PV generation rather than solar thermal.

This is due to the fact that heating and hot water production will be electrically generated, hence electrical energy savings are more advantageous. For this reason, PV is considered a better renewable technology.

Photovoltaic Panels

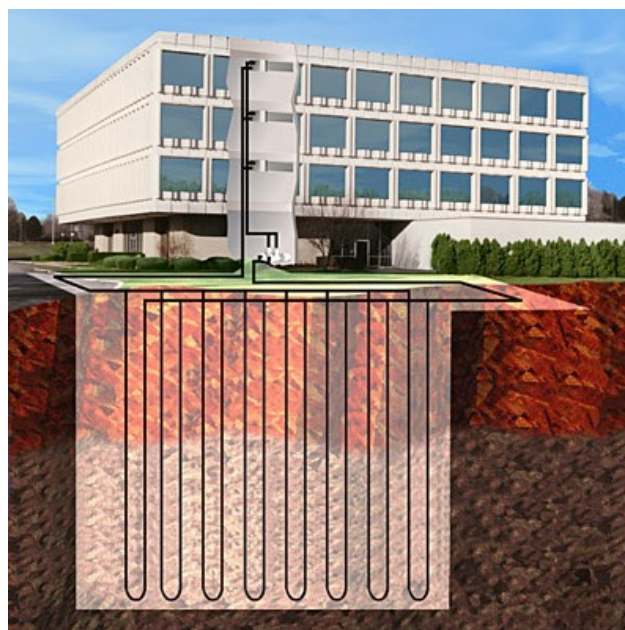


Photovoltaic (PV) cells convert the sun's light energy into electricity, which can be used to supplement the development's energy requirements. The most common types of PV cells available are polycrystalline silicon; monocrystalline silicon and amorphous silicon. These silicon-based cells are electrically linked to form modules, which are then connected to DC to AC inverters to generate useful electricity for building use.

PV modules are rated by the power they generate in kilowatt-hours peak (kW_p). Monocrystalline silicon panels are generally the most efficient type of panel with an efficiency of approximately 15% in good light conditions.

Solar Photovoltaic Panels are well suited for the Arthur Hill development, as they provide electricity, which suit the demands of the site. There are also significant south facing pitched roof areas providing un-shaded accessible space with potential to site a significant number of panels on the roofs of the buildings

Ground Source Heat Pump



Ground Source Heat Pumps (GSHP's) use pipes which are buried within the ground to extract heat from the surrounding soil strata.

This heat can then be used for space heating: i.e. radiators, underfloor or warm air heating systems and also domestic hot water generation. Heat pumps have some impact on the environment as they need electricity to run, but the heat they extract from the ground is constantly being renewed naturally.

Heat from the ground is absorbed at low temperatures into a fluid inside a loop of pipe (a ground loop) buried underground. The fluid then passes through a compressor that raises it to a higher temperature, which can then heat water for heating and hot water circuits within the development.

The cooled ground-loop fluid passes back into the ground where it absorbs further energy in a continuous process as long as heating is required. Below a certain depth, the ground remains at a fairly constant temperature, so the heat pump can be used throughout the year.

Ground loops can either be horizontal (trenches) or vertical (boreholes), with the linear length of pipework being selected to match the heating needs of the development.

Due to the geotechnical demands of excavation and drilling of boreholes, GSHP systems can be significantly more costly than other heating systems.

Preliminary calculations indicate that due to the restricted area of the site, and comparatively high capital cost of installing ground loops, it is considered GSHP is a viable LZC technology for this development.

Biomass



Biomass fuels produce much less carbon emissions compared to fossil fuel, making them a 'carbon lean' technology which has a positive impact on CO₂ reduction. Biomass fuels such as wood chips can be categorised as 'contemporary carbon fuels' which mean that when they are combusted, they release the same carbon levels that were consumed during the growth of the plant.

Currently, the most available fuels are wood chips or pellets. The quality of biomass fuel is important to the efficiency of a boiler. In general, the fuel stock must be of a standard size and moisture content; wood chips should have a moisture content of a maximum of 30%, which represents at least a year of air-drying, if not more.

Biomass boilers need a suitable fuel storage facility and a local supplier of fuel. The storage facility should eliminate any risk of composting and should also be ventilated as per Building Regulations.

Due to the area required for a boiler house, issues associated with delivery access and storage of fuels etc. Biomass technology is not recommended for the development.

Air Source Heat Pumps



Air Source Heat Pumps (ASHP's) are similar to Ground Source Heat pumps with the main difference being that heat is absorbed from the external air instead of the ground. Air Source Heat Pumps come in two categories, either as 'air-to-air' or 'air-to-water' depending on whether the heat distribution system in the building uses air or water.

The main advantage of Air Source Heat pumps over Ground Source Heat Pumps is their lower capital installation cost, hence they are becoming widely used throughout the UK.

With water to water heat pumps, heat is absorbed from the external air via an externally located unit (evaporator). The internally located (condenser) unit then heats water where it is supplied to the building.

The main disadvantages of ASHP is the space needed for the external plant, plus potential noise nuisance caused by the fans within the external units.

At Arthur Hill, reasonable space would be needed externally at ground level to site the external plant, with risers running through the building to incorporate interconnecting refrigerant pipework. This will pose a challenge Architecturally and acoustically.

Exhaust Air Heat Pumps



The challenges of external space and potential noise issues, can be overcome by the use of an 'all in one' exhaust and supply air heat pump. These provide heating, ventilation, heat recovery and hot water generation, all within one internal unit.

The units efficiently re-use energy from discharged warm indoor air as it passes through the ventilation system before being discharged from the building.

The internal heat pump unit incorporates a built-in hot water tank, immersion heater, circulation pump, fans and controls system, which can be located internally within a cupboard within each property.

Inlet and exhaust air ducts then connect from the indoor unit to the exterior of the property via discreet ventilation terminals.

The heat pump is then connected to any low-temperature heating distribution system e.g. radiators, convectors or underfloor heating.

These units are ideally suited to highly insulated, air tight dwellings which have low heat losses, therefore are very well suited to the Arthur Hill development.

3.4 OVERHEATING ANALYSIS

An overheating analysis has been carried out on behalf of Reading Borough Council to show that the proposed multi-residential development meets the thermal comfort criteria as set out in CIBSE TM59 for residential spaces.

This ensures modern well insulated homes do not unduly overheat during the summer period.

Based on the modelling conducted, the results show that the thermal comfort criteria as set out by CIBSE TM59 for residential spaces has been satisfied.

Thermal Comfort Compliance requirements

Within the apartments, thermal comfort has been assessed against the criteria identified within CIBSE TM59:2017 'Design methodology for the assessment of overheating risk in homes'.

Method – CIBSE TM59:2017

Because the apartments within the proposed multi-residential development will be mainly naturally ventilated during summertime via openable windows and doors, Section 4.2 of CIBSE TM59:2017 applies, which requires both of the following two criteria to be met for domestic properties:

Criteria 1 - Hours of Exceedance (He) for Living Rooms, Kitchens and Bedrooms:

The number of hours, during which the temperature difference (between indoor and outdoor) is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours (TM52 Criterion 1: Hours of exceedance).

Criteria 2 – For Bedrooms Only:

To guarantee comfort during sleeping hours, the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms equates to 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

Criteria's 2 and 3 of CIBSE TM52:2013 may fail to be met, but both the above criteria must be met for apartment bedrooms and apartment living and kitchen areas to pass the overheating check.

Unoccupied rooms, such as bathrooms, circulation spaces and store rooms, do not have overheating criteria or a suggested maximum temperature as it is envisaged that no one will occupy these rooms for a significant period of time.

3.5 ENERGY MODELLING RESULTS

The results for the predicted energy demand for the proposed development have been included in this report and **show that the proposed multi-residential development meet the PassivHaus standards for Primary Energy Demand and Space Heating Demand.** (See Table 3 below).

Table 3 Block ABCD Primary Energy Demand and Space Heating Demand

Energy Type	Proposed Multi-Residential Apartment Block ABCD	PassivHaus Standards	Meets PassivHaus Standards?
Primary Energy Demand	43.0 kWh/m ²	≤ 120 kWh/m ²	Yes
Space Heating Demand	7 kWh/m ²	≤ 15 kWh/m ²	Yes

Results for the predicted CO₂ emissions for the proposed development have also been calculated.

Results for the 'baseline' scenario of compliance with 2013 Building Regulations standards are presented below, followed by the improved results from the specification of the energy efficiency measures set out earlier in this report.

Block	Total Energy kWh Electricity		Total Emissions kg / CO ₂	
	Development compliant with Building Regulations 2013	Development compliant with PassivHaus Standards	Development compliant with Building Regulations 2013	Development compliant with PassivHaus Standards
A	19,082	3,476	4,446	810
B	25,900	4,095	6,034	954
C	30,246	5,575	7,047	1,298

The savings in the developments CO₂ emissions achieved by the above enhancements and low carbon technology are as follows:

Reduction (% improvement) in annual carbon emissions:

- Block A = 82%
- Block B = 84%
- Block C = 82%

Total average improvement of CO₂ emissions for proposed development is 83%.

3.6 PHOTOVOLTAICS

The scheme has the potential to incorporate roof mounted photo-voltaic (PV) panels, split over each block of the development as generally indicated on the below plan:



Three distinct PV systems could be installed, all on south facing roofs, based on a total potential PV area of 113m², (Block A: 23m² and Block B: 90m²).

Preliminary calculations indicate that approximately 70 PV panels could be installed giving an approximate system size of 24kWp (kilowatt peak output).

This could provide an estimated total annual generation of 20,800kWh per year or approximately 4,700 kg/CO₂ per year (based on SAP10 carbon factors) by reducing the amount of grid electricity used by the building.

Based on the fabric enhancements and low zero heating technologies incorporated within the design, it is anticipated that by the incorporation of PV panels on the roof that the development could achieve (or be very close to) being carbon neutral.

3.7 SUSTAINABILITY CHECKLIST

Reading Borough Council's Sustainable Design & Construction SPD (2019) includes a 'Sustainable Design Checklist' for residential developments that should be completed and submitted as part of the planning application to demonstrate how the proposals respond to the range of sustainability issues.

The requirements of the 'Sustainability Checklist' has been addressed within other documentation supporting this application, however as the design evolves, further construction and operational information will be issued.



4 APPENDICES

4.1 APPENDIX 1

Thermal Comfort and Energy Demand Assessment (See Separate Document)