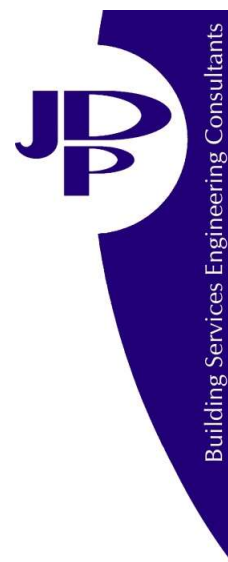


Delivering buildings that work efficiently



**Hanslink Ltd.
Trinity Hall
South Street
Reading**



Energy Statement

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REPORT AMENDMENTS

PARAGRAPH	AMENDMENT
ISSUE 01	
	Draft Issue
ISSUE 02	
1.1	Paragraph amended
1.2	Paragraph amended
2.2	New paragraph added and subsequent paragraph's renumbered
2.4 (2)	Paragraph amended
6.2 (2)	Paragraph amended
7.2 (4)	Paragraph amended
8.0	New section added and subsequent sections renumbered
10.0 (5)	New paragraph added
ISSUE 03	
	Planning Issue

EXECUTIVE SUMMARY

This energy statement has been prepared on behalf of Hanslink Ltd, the Applicant, in support of a planning application for the proposed residential development at Trinity Hall, South Street, Reading, Berkshire, RG1 4QU.

Reading Borough Council's strategic policy for minimising carbon emissions in accordance with the Local Plan, sets out their intention to implement national policy and ensure net-zero carbon emissions are achieved by no later than 2050.

The requirement is to achieve a minimum 35% carbon reduction under the Building Regulations (Part L2A:2013). The Energy Strategy follows the energy hierarchy and the fundamental approach adopted is as follows:

- a) Minimising carbon dioxide emissions in accordance with the following energy hierarchy: Be lean; use less energy, Be clean; supply energy efficiently, Be green; use renewable energy
- b) Achieve a minimum 35% reduction on emissions against Part L of Building Regulations 2013.
- c) Assess feasibility of connecting to existing heat network, if not feasible investigate the practicality of including a CHP¹ and a DHN². The feasibility of connecting to an existing heat network will be assessed and an outline given of potential CHP and related DHN network at the site. The feasibility of including on-site renewables should be carried out.

The site is not located within an 'Opportunity Area' for the implementation of a heat network and there are no existing heat networks nearby.

The energy strategy will adopt a 'fabric first' approach to reducing the anticipated energy demand and CO₂ emissions. Passive measures will achieve a significant site-wide reduction in regulated CO₂ emissions beyond the Building Regulations Part L (2013) requirements. Therefore, the Development is anticipated to achieve CO₂ emissions well below the Building Regulations Part L (2013) baseline through passive design and energy efficiency measures, i.e., before including any Low or Zero Carbon (LZC) technologies.

In addition to the above, the Development will seek to further reduce the CO₂ emissions by implementing renewable and low carbon technologies. These include incorporating air-source heat pumps as the primary heat source with additional offset provided by solar PV array (subject to LPA contribution calculation) to locally generate renewable electricity instead of relying solely on grid-supplied electricity.

Using the SAP 10 carbon factors and an ASHP for space heating and hot water, the development can be expected to achieve a CO₂ saving of approx. 67% over baseline and policy compliant with LPA requirements.

¹ Combined Heat and Power

² District Heat Network

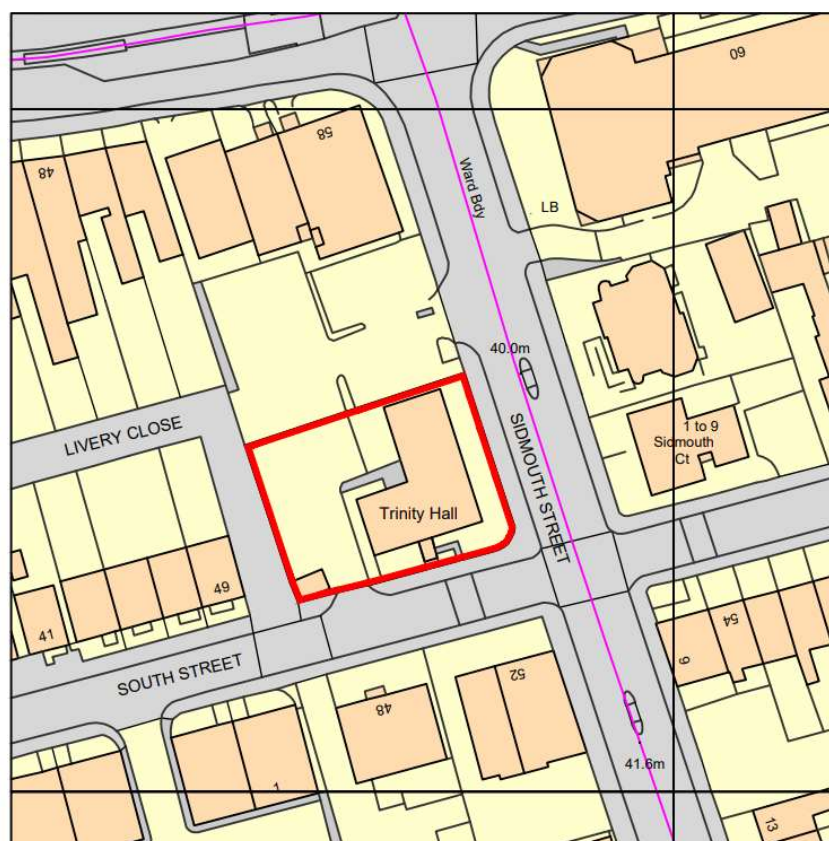
1.0 INTRODUCTION

1.1 The Application

JDP has been instructed by Hanslink Ltd. hereafter referred to as the Applicant, to prepare an energy strategy planning statement in support of a planning application for the proposed redevelopment of an existing site known as 'Trinity Hall,' hereafter referred to as the Development.

1.2 Development Description and Site Context

The site for development is located within Reading Central Area and comprises an existing three-storey residential building (Trinity Hall) with private (off-road) car park comprising 12 bays. The site is located on the corner of South Street and Sidmouth Street with access via South Street. See location map in Figure 1 (below). It is proposed to demolish the existing building and construct a new part 4-storey, part 5-storey building accommodating 22 apartments including external refuse and cycle stores. The proposed dwelling types include 1-Bed and 2-Bed apartments, most of which are located above a residential car park at ground floor level, providing up to 11 new car parking spaces.



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Figure 1, Site Location Map

1.3 Aim

This Energy Statement aims to detail a robust energy demand reduction and energy supply strategy to enable the Development to demonstrate that pertinent policy targets detailed within Reading Borough Council's planning requirements can be met.

1.4 Approach

This document sets out the proposed energy strategy for the development. Reading Borough Council's Local Plan sets out the Council's intention to implement national policy and ensure net-zero carbon emissions are achieved by no later than 2050.

To demonstrate the project can achieve a carbon emission reduction in excess of the minimum 35% over that of the Part L (2013) Building Regulations required by The Local Plan.

This Energy Strategy follows the energy hierarchy and the fundamental approach adopted is as follows:

- a) Minimising carbon dioxide emissions in accordance with the following energy hierarchy: Be lean; use less energy, Be clean; supply energy efficiently, Be green; use renewable energy
- b) Achieve a minimum 35% reduction on emissions against Part L of Building Regulations 2013.
- c) Assess feasibility of connecting to existing heat network, if not feasible investigate the practicality of including a CHP³ and a DHN⁴. The feasibility of connecting to an existing heat network will be assessed and an outline given of potential CHP and related DHN network at the site. The feasibility of including on-site renewables should be carried out.
- d) The potential risk of overheating and the need for cooling should be mitigated.

The Local Plan requires that applications demonstrate how the zero-carbon target for developments will be met including proposals for making up the shortfall to achieve zero carbon, where required. If the zero-carbon target cannot be met on site, then an offset payment must be made.

The financial contribution towards carbon offsetting will be secured through a S106 agreement at £1,800 per remaining tonne (calculated as £60/tonne over a 30 year period) based on the 'Zero Carbon Hub' guidance.

The current Local Plan states that it is expected that all new developments will seek to reduce carbon emissions by 20% through the use of renewable technologies alone.

A Water Efficiency assessment will also be required using the methodology set out in Approved Document G (2015 with 2016 amendments).

³ Combined Heat and Power

⁴ District Heat Network

2.0 POLICY CONTEXT

2.1 Planning Policy

Planning documents referenced for this report are as follows:

- a) National Planning Policy Framework July 2021
- b) Reading Borough Local Plan 2036
- c) Reading Design SPD 2019

The council's planning policy is set out in the Reading Borough Local Plan, adopted in 2019, and supplementary planning guidance in response to the climate emergency. Key policies relating to energy consumption and CO₂ emissions include the following.

2.1 Policy CC2 - Sustainable Design and Construction

Major residential developments (10 dwellings or more) to achieve 'Zero Carbon' (or a minimum 35% improvement in the dwelling emission rate over the target emission rate as defined in the 2013 Building Regulations and planning contribution to offset remaining carbon emissions to zero).

Water Efficiency in residential development, including replacements, conversions and sub-divisions, achieve water efficiency of 110 litres per person per day through compliance with the Building Regulations and where feasible, provide rainwater harvesting techniques

2.2 Policy CC3 – Adaption to Climate Change

The development will demonstrate how design measures have been incorporated to adapt to climate change including the following:

- a) Orientation to maximise opportunities for natural heating, ventilation and daylighting whilst reducing exposure to wind and other elements.
- b) Maximise resistance and resilience to climate change.
- c) Use of trees and planting to provide shading.
- d) Minimise the impact of surface water run-off.

2.3 Policy CC4 – Decentralised Energy

Developments of more than 20 dwellings to consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not feasible for this form of energy provision. It also expects developments of over 10 dwellings or more to link into an existing district energy network, where one is present within the vicinity of an application site or demonstrate why this is not feasible.

2.4 Policy H5 – Housing Standards

This policy outlines standards for new-build housing to help deliver high-quality new homes and achieve Reading's emissions targets, as well as mitigate the effects of climate change.

All major new-build residential development should be designed to achieve zero carbon homes.

3.0 BUILDING REGULATIONS, PART L (CONSERVATION OF FUEL AND POWER)

3.1 Building Regulations Part L 2013 (with 2016 Amendments)

Compliance with Part L 2013 benchmarks is achieved by demonstrating compliance with the following criteria:

- a) Criterion One - requires that, as designed, the anticipated CO₂ emissions do not exceed the calculated notional building Target Emission Rate (TER). Additionally, the building fabric energy efficiency for domestic buildings must be no worse than the Target Fabric Energy Efficiency (TFEE).
- b) Criterion Two places upper limits on the efficiency of controlled fittings and services.
- c) Criterion Three requires that spaces are not subject to excessive solar gains causing rooms to overheat.
- d) Criterion Four requires that the 'As-built' performance of the building should be consistent with the DER. This includes air-permeability testing and appropriate commissioning of building services systems.
- e) Criterion Five requires that provision should be made for energy-efficient operation by providing the building owner with information enabling them to operate the building in a way that uses no more fuel and power than is reasonable. This can be achieved by preparing operating and maintenance manuals (O&Ms) and producing a building logbook.

3.2 Upcoming Building Regulations Part L 2021

The Government has legislated to achieve net zero carbon by 2050 at the latest and this necessarily will have considerable impact on how new homes are constructed and heated. In January 2021 the Government published its response to the Future Homes Standard (FHS) consultation. In the response document the Government confirmed it would proceed with the Standard in 2025, subject to a public consultation on the full technical specification. The Standard is expected to deliver a 75% reduction in CO₂ emissions and require new homes to be heated from a low carbon heat source such that homes will be "zero carbon ready". It is expected that the Standard will represent the final step for the house building industry and further decarbonisation will be delivered because of the decarbonisation of the National Grid network.

- 3.3 National Building Regulations are set to become more stringent in 2021, increasing the reduction of CO₂ emissions required. New homes will be expected to reduce emissions by demanding increase in fabric standard (thermal insulation and glazing) and the use of onsite renewable and low carbon energy technology. In anticipation of the 2025 Standard the Government has published Part L 2021, which comes into effect in June 2022, to deliver a saving of 31% in CO₂ emissions from domestic buildings and 27% from non-domestic buildings. The revisions are expected to provide the industry and supply chains with the incentive, skills and time to prepare for the FHS in 2025. In accordance with best practice of sustainable design for new homes, in this document it is recommended that thermally insulated fabric, improved glazing, air Source Heat Pumps (ASHP) and on site solar PV electrical generation, is incorporated to achieve a significant reduction of emissions below the Target Emissions Rate (TER).

4.0 METHODOLOGY

4.1 Energy Hierarchy

This statement outlines how the Development will have a reduced impact on climate change by reducing CO₂ emissions associated with the energy use of the Development. The Energy strategy is based on the Energy Hierarchy approach (Be Lean, Be Clean and Be Green), as indicated in Figure 2 (below).

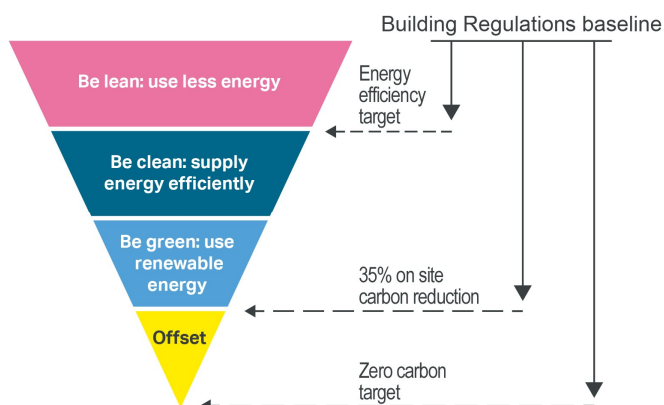


Figure 2, Energy Hierarchy Illustrated

In line with the energy hierarchy, the strategic approach is to control the energy demand of the development, through a 'fabric first' approach. This is the most effective way of reducing energy consumption and CO₂ emissions in line with the government's strategy for reduction in energy and associated CO₂ emissions as described in Part L 2021.

Further energy reduction will be ensured through the specification of high efficiency building services to limit losses in energy supply, storage and distribution. Following the demand deduction, further reduction in CO₂ emissions is then achieved by clean energy sources, where possible, and the integration of suitable renewable and low carbon technologies.

The feasibility of renewable and low carbon technologies has been investigated in line with the planning policy aspirations.

4.2 Limitations

Occupants may operate their systems differently, and/or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy requirements.

Unregulated energy includes the small power electricity use such as domestic appliances, televisions, computers and other portable devices. Unregulated energy is not currently included within the Part L energy and carbon assessments but can form a significant part of overall energy consumption and carbon emissions from developments.

5.0 DEMAND REDUCTION (BE LEAN)

5.1 Passive Design Measures

Developments must meet the requirements of Building Regulations (Part L) Requirements through demand reduction measures. These measures include passive design measures (i.e., architectural and building fabric) and active design measures (energy efficient services). This section outlines the proposals for specifying building fabric and services beyond the requirements of Building Regulations.

Passive design measures are the most effective and robust measures for reducing CO₂ emissions as the performance of the solutions (eg. wall insulation), is unlikely to deteriorate significantly with time or be subject to change by future property owners and therefore it is likely that the benefits of these measures will continue at a similar level for the duration of their installation.

The Development will adopt a 'fabric first' approach to reducing the anticipated energy demand and CO₂ emissions.

Glazing

Glazing ratio will be optimised to achieve a balance between providing natural daylighting to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands and limit the likelihood of high internal temperatures. Glazing on the south, east and west facing facades can lead to beneficial solar gains in winter months, whilst glazing on northerly orientations will typically lose heat.

Solar gains can be beneficial in winter months as a means of avoiding the need for active heating to maintain comfortable internal temperatures. However, in summer months excessive solar gains can lead to the potential for high internal temperatures. The solar energy transmittance (g-value) of the glass will be targeted to allow solar gains in winter but control solar gains in summer. A value of no more than 70% is targeted.

Maximising the amount of natural daylight available in each internal space also reduces the need for artificial light sources but the risk of overheating in occupied spaces due to excessive solar gains must be considered.

Thermal Insulation

Demand for space heating can be significant but will be reduced through the provision of an efficient thermal envelope, by reducing the thermal transmittance of the building envelope where appropriate and reducing heating and cooling requirements. The building fabric will consist of high-performing materials using accredited construction details to reduce heat lost through thermal bridging.

The passive energy design principles adopted in the proposed design include good thermal performance of the building's construction components such as high insulation levels, improved airtightness, elimination of thermal bridging and maximising winter solar gain to offset heat loss, all proven techniques to reduce energy consumption and emissions.

Airtightness

Significant heat is lost in winter through air leakage from a building (also referred to as infiltration or air permeability), often through poor sealing of joints and openings in the building. Building Regulations Part L 2013 set a minimum standard for air permeability at 10 m³ of air per hour per square meter of envelope area, as measured at 50Pa. For Part L 2021, at limit of 8 m³ of air per hour per square meter of envelope area, as measured at 50Pa is given. The building will be constructed to the 'Accredited Construction Details' as compiled by the Department of Communities and Local Government (DCLG) or similar details. This will assist the buildings in meeting the required target. It is proposed to achieve a permeability of no more than 5 m³/hr/m².

Thermal Bridging

Accredited Construction Details (ACD's) will be developed to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations. Based on the ACD's, the thermal bridging is assumed with a maximum Y-value of 0.08 W/m²K.

Water efficiency

The requirement G2 and Regulation 36 of AD Part G 2015 (with 2016 amendments) of the current Building Regulations requires reasonable provision to be made by installing fittings and fixed appliances that use water efficiently to prevent excessive water consumption. Therefore, careful selection of appliances, sanitary ware and fittings will be undertaken to reduce water consumption to better the requirement of Part G to not exceed 110 litres per person per day. The measures will include:

- a) Low volume dual flush WCs
- b) Low flow taps/mixers (for basins and baths)
- c) Low flow shower mixers and heads
- d) Fill limitation on baths
- e) Low water consumption Washing machines
- f) Low water consumption Dishwashers (where fitted).

Appliance Efficiency

Where provided, white goods will be selected with an EU Energy Efficiency Rating equal to (or better than) the following:

APPLIANCE	EFFICIENCY RATING
Fridges and fridge freezers	Rating of A +
Washing machines	Rating of A + +
Dishwashers	Rating of A +
Washer-dryers	Rating of A
Tumble-dryers	Rating of A

Table 1 – Summary of Proposed Appliance Efficiency

6.0 HEATING INFRASTRUCTURE (BE CLEAN)

6.1 Infrastructure

The following section discusses the infrastructure and clean energy supply measures to be considered for the Development in order to further reduce regulated CO₂ emissions and outline the technologies that may be financially viable and suitable for implementation.

6.2 Decentralised Energy Networks

In line with recommendations of The Local Plan to connect new developments to existing district heating schemes where possible, the Reading Heat Map was consulted. See Figure 3 (below).

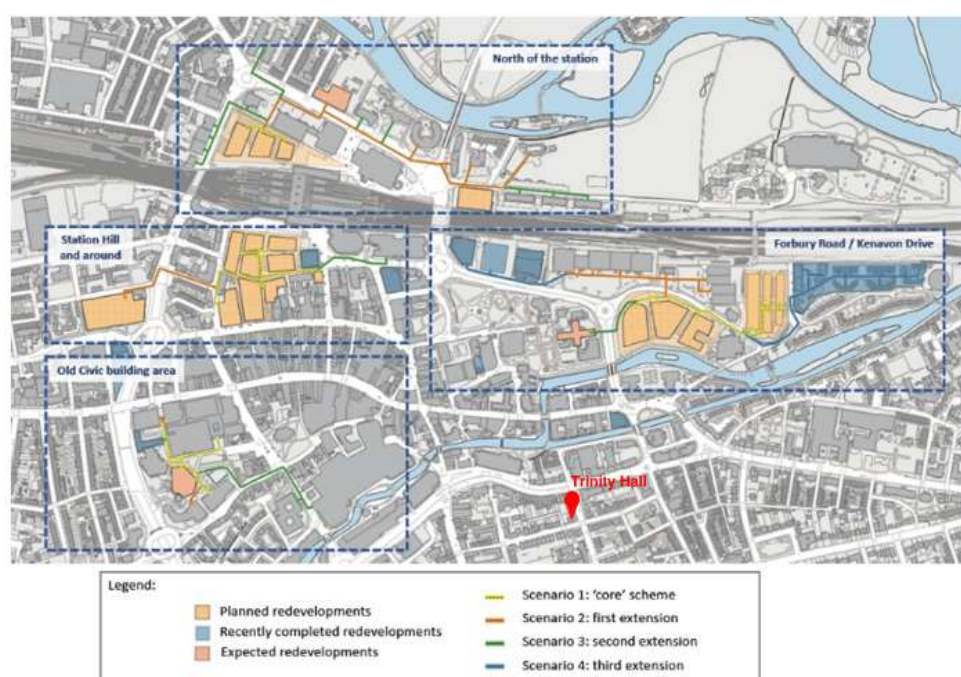


Figure 3, Reading Heat Map

The Development is not within an 'Opportunity Area' for the implementation of a heat network and there are no existing heat networks nearby.

6.3 On-site Technologies

This section considers the relative merits of providing a stand-alone on-site heat network served by a dedicated energy centre through a dedicated Combined Heat and Power (CHP) system. For efficient operation, a CHP engine requires a high base heating load. A CHP engine does not operate in the same manner as a traditional gas boiler and is not well suited to highly variable loads. Where thermal demand is adequate, CHP can achieve reductions in primary energy demand relative to traditional sources. The benefit of a CHP engine is based on the heat carbon factor, which is derived from CHP efficiency, gas carbon factor and electricity carbon factor of the national grid.

A CHP would not suit this project due to the lack of a substantial baseload and the proposed development's likely viable energy use pattern. In addition, CHP engines typically operate on natural gas and can significantly affect the local air quality. Furthermore, in line with the wider UK Government strategy to reduce our impact on the environment by steadily moving away from fuel combustion to produce energy, it is not proposed for this Development to be connected to the local gas distribution network. For these reasons, a CHP local heat network will not be considered further.

Consequently, the use of heat sources for new developments offers no carbon saving measures to be implemented at the Be Clean stage.

7.0 RENEWABLE ENERGY (BE GREEN)

Once energy demand has been reduced during the "Be Lean" stage and consideration has been made to supply energy efficiently and connect to a DHN, the final step of the energy hierarchy is to incorporate renewable energy to further reduce emissions. Renewable technologies harness energy from natural and renewable resources such as sunlight, wind, tides and geothermal heat that is naturally replenished, to supply renewable energy or supplement grid-supplied electricity or energy from fossil fuels in buildings.

There are many renewable technologies available. However, not all of these are commercially viable or suitable for urban/city-centre locations or appropriate for this Development in particular. The following technologies have been considered as part of this assessment:

- a) Heat Pumps
- b) Photovoltaics
- c) Wind turbines
- d) Solar Thermal Water Heating
- e) Biomass

Heat Pumps

Heat pumps absorb heat from renewable sources such as the ambient air, the ground or bodies of water. The low-grade heat is absorbed from the renewable resource into the system (through the principles of refrigeration), where work is carried out by the system (vapour compression) to upgrade the heat to a more useable level. This heat is then transferred to the heating system via heat exchangers for space heating or domestic hot water production. The main benefit of this type of technology is the high efficiencies achieved. Heat pumps are a good option for sites not connected to the gas network (as proposed for this Development) or to replace existing electric or oil-fuelled heating systems. When assessed against a gas central heating system on cost versus potential CO₂ savings, a heat pump will perform less favourably when using SAP 2012 carbon emission factors but more favourably if using SAP 10.

Ground Source Heat Pumps

GSHPs have three common varieties:

- f) Horizontal, closed-loop
- g) Vertical, closed-loop
- h) Vertical, open-loop.

The performance characteristics and technical requirements of each vary. Typically, vertical open-loop GSHP systems operate at the highest efficiencies and can produce the highest thermal output. Open-loop boreholes require an abstraction license from the Environment Agency. To gain a licence, a scheme is typically required to operate in balance, such that over the year, the amount of heat extracted from the ground is equivalent to the amount of heat rejected to the ground. Given that there is no cooling proposed for the Development, if a large amount of heat were to be extracted in winter, there would be a large imbalance between the amount of heat extracted and heat rejected to the ground over a yearly cycle, leading to permafrost. That will render the system unusable and potentially damage nearby structures and local ecology. Impacts on ground conditions are also valid considerations for all GSHP technologies, meaning a balanced heating and cooling strategy should be applied. A horizontal loop option would require a significant amount of excavation and require a large installation area, which will not be practical for the proposed site location. A vertical loop will require significant ground investigations and there must be no obstructions in the ground such as buried services or underground structures. With the proposed site located within the central area, it is improbable that the above condition could be met. Further to the considerations above, the installation of a GSHP system will require a significant amount of plant space, which given the small envelope of the proposed development, the site spatial constraints, the high capital cost and the complexities of installing a GSHP, the use of GSHP will not be a practical or economically viable solution for this Development.

Air Source Heat Pump

ASHPs have two common varieties:

- i) Air to Water
- j) Air to Air

ASHPs have a slightly lower seasonal efficiency than GSHP. However, the seasonal efficiency of ASHP is still typically greater than that of gas-fired boilers. It can still offer significant CO₂ savings, even using the SAP 2012 carbon factors, which are generally considered outdated and are due to be updated and implemented for the new SAP10 procedure. Furthermore, ASHP requires significantly less space than GSHPs. Given the advantages of air-source heat pumps, they will be included in the proposed Development for space heating and domestic hot water heating as an enhanced building service in the 'Be Green' scenario.

Photovoltaics

Photovoltaic panels (PV) capture the sun's energy using photovoltaic cells and convert sunlight into electricity. The cells do not need direct sunlight to work and can still generate some electricity on a cloudy day. Because the output of PV panels depends on many uncontrollable variables, the annual generation is estimated using calculations based on test data for the panels and local weather data. An appraisal has been undertaken of the suitability of implementing a PV array in order to reduce the CO₂ emissions by the Development using the MCS calculation methodology. Refer to Appendix A, based on the available roof area and solar irradiance data for London, an array with a capacity of approximately 32 kWp (approx. 88 panels) has been considered. This system could generate approximately 30,000 kWh of renewable electricity per annum, reducing CO₂ emissions by around 15 tonnes CO₂ per annum.

The electricity generated could offset the grid-supplied energy used for the building's heating network with ASHPs as the primary energy source.

Wind Turbines

Wind turbines harness the power of the wind and use it to generate electricity. About 40 per cent of all wind energy in Europe blows over the UK, making it an ideal country for domestic turbines (known as micro-wind or small-wind turbines). There are two types of domestic-sized wind turbine: Pole mounted and building mounted. Pole mounted turbines are free standing and are erected in a suitably exposed position and are often about 5kW to 6kW in size. Building mounted turbines are smaller and can be installed on the roof of a home where there is a suitable wind resource. Often these are around 1kW to 2kW in size. Large scale turbines in exposed locations offer one of the best financial returns of all renewable energy systems as the system's payback increases dramatically with the size of the turbine. However, small-scale systems offer much lower levels of performance and recent studies have questioned the viability and output from such systems, particularly in urban environments

For efficient operation and to yield high energy output, wind turbines require a smooth laminar flow of air. The Development is located within a suburban environment and therefore, the wind flow profile is likely to be erratic and, consequently, not conducive to high annual yields. Moreover, mounting wind turbines on the roofs of the Development could result in unacceptable vibration and resonance being felt within dwellings. The turbines are also likely to generate noise which may be a nuisance to neighbouring properties. This scenario is likely to result in the turbines being switched off. Given the above, micro wind turbines will not be considered for implementation for this Development.

Solar Thermal

Solar thermal panels operate by capturing solar energy and transferring this via glycol to a thermal store to generate hot water. These systems can operate at efficiencies up to 75%; thus, a high energy yield can be derived from small collector areas. Solar Thermal systems can be challenging to design and install and require significant maintenance to keep the system functioning as designed. Solar thermal systems are most appropriate for buildings with high year-round domestic hot water demand. Although a typical solar thermal system will offset some of the annual hot water demand for a building, the heat network is proposed to use electricity to the AHSPs and circulation pumps within the system. This means the resultant CO₂ and cost savings will be relatively low. Furthermore, due to the complex nature of a solar thermal system, the high maintenance requirement and associated access requirements, this system will not be selected for implementation.

Biomass

Biomass boilers burn wood fuel or other renewable/sustainable bio-fuel sources to generate heat instead of grid-supplied natural gas, a finite resource. Biomass boilers can operate at high efficiencies, comparable to commercial condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. Because of this, Biomass Boilers require substantial amounts of plant space. Furthermore, fuel deliveries in urban and suburban locations increase the required vehicle movements and increase greenhouse gas emissions.

Furthermore, Biomass boilers also result in higher emissions levels of Nitrous Oxide (NOx) compared to gas boilers. This can negatively impact the local air quality. It is likely that the use of a biomass boiler could yield significant regulated CO₂ emissions savings. However, this would also likely result in an increase of NOx emissions from the Development, require significant space for fuel storage and add the complication of regular fuel deliveries. Therefore, biomass boilers will not be considered for implementation at this Development.

8.0 SYSTEM RECOMMENDATIONS FOR FURTHER CONSIDERATION

Generally, in residential buildings with a high space heating and hot water demand, space heating is the primary source of carbon dioxide emissions, and hot water is the second.

Due to the high demand of the heating and hot water, the most efficient energy strategy would be to reduce the carbon emissions by specifying a higher efficiency system such as an Air Source Heat Pump (ASHP) as the primary heat source would have the highest percentage CO₂ reduction, approx. 2.5 times the savings of SAP 2012.

Calculations showing the benefit of the ASHP using the SAP 10 carbon factors:

A notional gas boiler has an efficiency of 89.5 and a mid-level efficiency ASHP has a CoP of 3. Using the SAP 2012 carbon dioxide emission factors the ASHP would have an improvement on the heating carbon dioxide emissions of approximately 28% over the gas boiler scenario.

*Gas boiler: heating demand / 0.895 * 0.216 = Energy demand * 0.241 kg CO₂/year
ASHP: heating demand / 3 * 0.519 = Energy demand * 0.173 kg CO₂/year
Percentage improvement = (energy demand * 0.173) / (energy demand * 0.241) = **28%***

Using the same efficiencies and the SAP 10 figures, the ASHP would have an improvement on the heating carbon dioxide emissions of approximately 67%

*Gas boiler: heating demand / 0.895 * 0.210 = energy demand * 0.234 kg CO₂/year
ASHP: heating demand / 3 * 0.233 = energy demand * 0.077 kg CO₂/year
Percentage improvement = (energy demand * 0.077) / (energy demand * 0.234) = **67%***

The system will consist of ASHP(s) connected to a building heat network serving each of the residential apartments. The heating water will be circulated via centralised pipework distribution throughout the building, with each flat receiving heating through a Heat Interface Unit (HUI). See Figure 6 (overleaf).



Figure 5, Typical HIU Packaged Utility Room

The HIU in each apartment will provide space heating and domestic hot water in a similar way to combi-boilers and are very compact and could be installed within a dedicated cupboard in each apartment or as part of a packaged utility cupboard as shown in Figure 5.

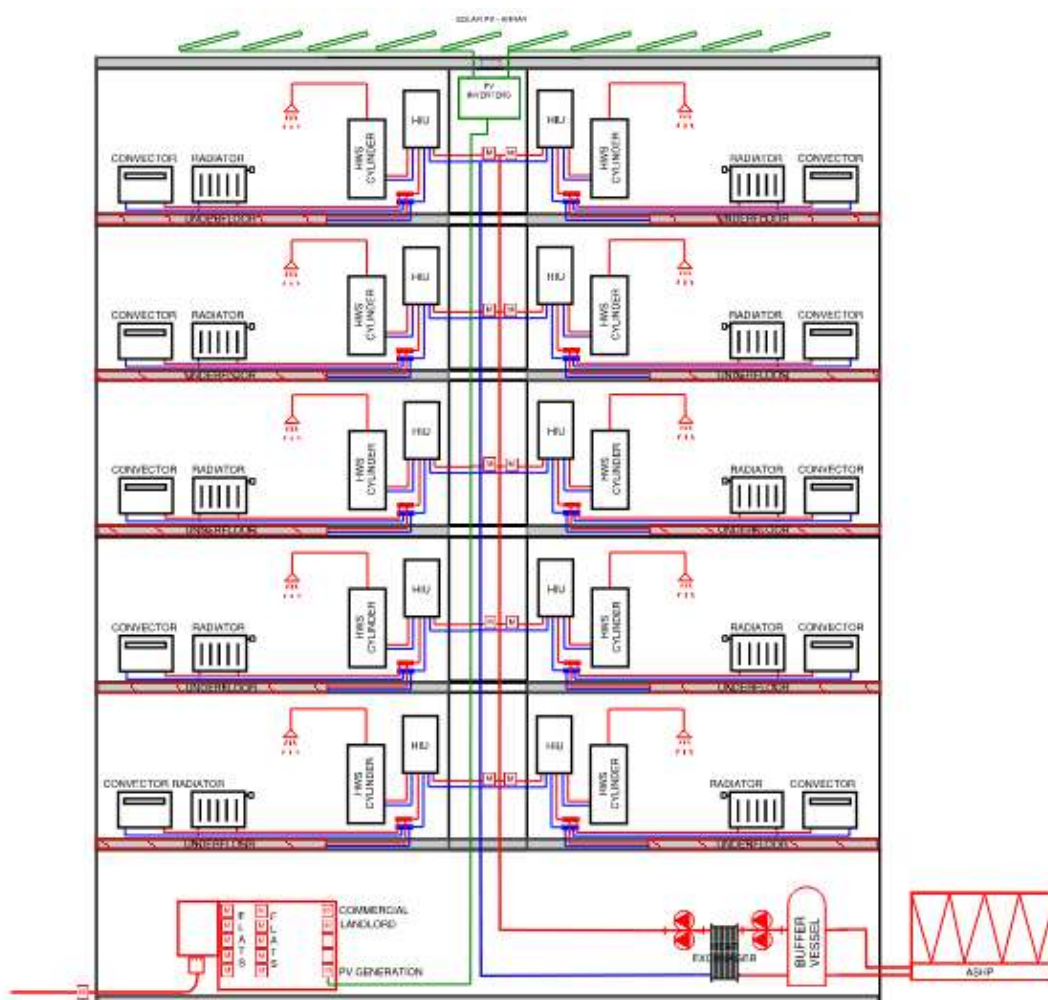


Figure 6, Communal ASHP and PV Systems Illustrated

Underfloor heating would be a good pairing with this system due to the reduced distribution temperatures. Traditional radiators are still an option albeit they may be slightly larger than normal. This will further improve system efficiency as the heat loss from pipework will be lower and therefore the risk of summertime overheating will also be reduced.

If the zero-carbon target cannot be met on site utilising ASHP(s) alone, proposals for making up the shortfall to achieve zero carbon comprise an additional photovoltaic array subject to offset payment calculation (calculated as £60/tonne over a 30 year period), whichever cost is lower. Refer to Appendix A for PV cost information.

These systems would offer the most benefits in terms of energy use and carbon emissions and/or energy cost that are most suited to the type and layout of the building.

9.0 WATER EFFICIENCY

More than 20% of the UK's water is used domestically, with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water. The water efficiency measures included will ensure that the water use target of 110litres per person per day is achieved. Water efficient devices will be fully evaluated and installed wherever possible. The specification of such devices will be considered during Stage 3 and 4 of the design. Each will be subject to an evaluation based on technical performance, cost and market appeal and compliance with the water use regulations. The following devices will be incorporated within the dwellings to achieve the water efficiency requirements.

- a) water efficient taps
- b) water efficient toilets
- c) low output showers
- d) flow restrictors to manage water pressures to achieve optimum levels
- e) water meters

Building Regulations Approved Document Part G – G2 and Appendix B set out the methodology for assessing water efficiency in buildings. Below is a typical specification, which would achieve the 110 Litres per person per year target (including 5L for external use).

APPLIANCE	FLOW RATE / CAPACITY
WC	5/3 L (dual Flush)
Basin Taps / Basins	4 L/min
Bath	180 L
Shower (Without plug)	8 L/min
Kitchen Taps / Sink	6 L
Washing Machine	8.17 L/kg
Dishwasher	1.25 L/place setting
Water use	103.3 L/person/day

Table 2, Appliances Consumption Data

In addition to the above, sanitary fittings and appliances will all comply with the maximum consumption of fittings as set out in Building Regulation Approved Document G.

No greywater or rainwater systems are proposed. Therefore, calculated wholesome water consumption per person per day is 103.3 litres which is less than the maximum permitted 105 litres for internal use in accordance with the planning policy.

10.0 CONCLUSION

When reviewing the energy strategy for this development, careful consideration has been given to the context of the site, local planning policy and Building Regulations. The approach taken for the proposed energy strategy for the development has followed the policies contained within the Reading Borough Local Plan and SPD's. A sequential approach will be adopted in line with the Energy Hierarchy, assessing in turn, the feasibility of reducing the energy demand of the building, using energy more cleanly and finally applying renewable technologies. This Energy Statement defines a strategy to reduce emissions by 35% (minimum) using energy efficiency measures compared to the regulated emissions from a building designed to meet Building Regulations (2013) Part L1A.

This can be achieved by adopting an efficient building envelope solution together with efficient mechanical and electrical plant and equipment throughout the building, including the following energy reduction measures to be considered within the design:

- a) High thermal performance of construction elements, including glazing
- b) Low building air leakage rate ($5\text{m}^3/\text{hr}/\text{m}^2$ at 50 Pa)
- c) Natural Ventilation and daylighting
- d) Variable speed fans and pumps
- e) Low energy lighting
- f) Automatic lighting control with occupancy controls
- g) ASHP communal heat network
- h) Solar PV microgeneration

These measures will achieve a significant site-wide reduction in regulated CO₂ emissions beyond the Building Regulations Part L (2013) requirements. Therefore, the Development is anticipated to achieve CO₂ emissions well below the Building Regulations Part L (2013) baseline through passive design and energy efficiency measures, i.e., before including any Low or Zero Carbon (LZC) technologies.

In addition to the above, the Development will seek to further reduce the CO₂ emissions by implementing renewable and low carbon technologies. These include incorporating air-source heat pumps as the primary heat source with additional offset provided by solar PV array to locally generate renewable electricity instead of relying solely on grid-supplied electricity.

Using the SAP 10 carbon factors and an ASHP for space heating and hot water, the development can be expected to achieve a CO₂ saving of approx. 67% over baseline and policy compliant with LPA requirements.

APPENDIX A – ESTIMATED PV OUTPUT CALCULATIONS

Building/Site Information**Site Location**

Reading, Berkshire, United Kingdom

Coordinates:

51.4551,0.9787

Google Maps link:

<https://goo.gl/maps/ghXZ9XwoGBNeeH9t7>

Address

Trinity Hall
South Street
Reading
Berkshire
RG1 4QU

Azimuth Angle (Degrees from South)

27 °

Roof Pitch

15 °

Irradiance Data**Zone**

1

Description

London

* Use Fig 21

Type

Urban/Town/City

Energy / Fuel Tariff (p/kWh)

Electricity 19

Gas 7

Carbon Factor (kgCO₂/kWh)

Electricity 0.519

Gas 0.216

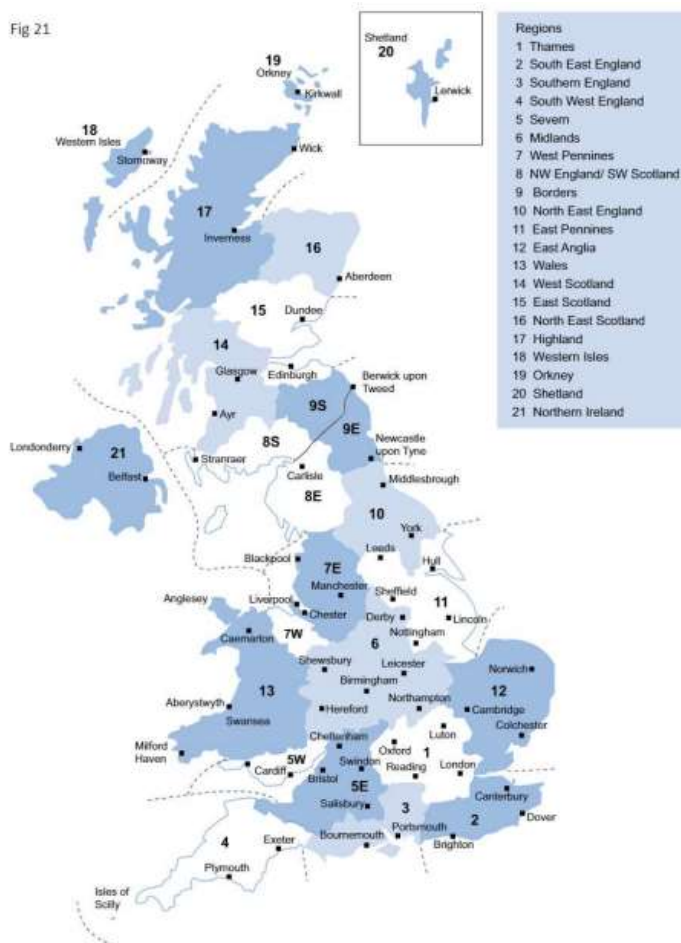
*SAP 2012

Electricity 0.233

Gas 0.183

*SAP 10

Fig 21



Energy Contribution and Carbon Savings

Parameter	Units	Whole Block
Panel Peak Output	<i>Wp</i>	360
Number of Panels	<i>Qty</i>	88
Array Peak Output	<i>kWp</i>	31.7
Array Inclination (Pitch)	°	15
Array Orientation (Azimuth)	°	25
KK	<i>kWh/kWp</i>	914
Shading Factor (SF)	%	< 20%
	<i>Factor</i>	1
Annual AC Output	<i>kWh</i>	28956
Array Capacity Factor	%	10.4%
Annual Carbon Saving	<i>kgCO₂</i>	15028
	<i>Tonnes CO₂</i>	15.0
System Cost	<i>£/kWp</i>	£1,077
Capital Cost	<i>£</i>	£34,119
Expected On-site Use	%	80%
Displaced Electricity	<i>kWh</i>	23164
Grid Electric Tariff	<i>p/kWh</i>	19
	<i>£/kWh</i>	0.19
Annual Energy Cost Savings	<i>£</i>	£3,520.99
% Exported Energy	%	20%
Exported Energy	<i>kWh</i>	5791
Expected Export Rate	<i>p/kWh</i>	4
	<i>£/kWh</i>	0.04
Annual Export Income	<i>£</i>	£231.64

PV System Summary

Panels	<i>Qty</i>	88
Arrays	<i>Qty</i>	1
Total Array Area	<i>m²</i>	140.8
Total Array Capacity	<i>kWp</i>	31.7
Total Annual Energy Generation	<i>kWh</i>	28956
System Capacity Factor	%	10.4%
Total PV Cost	<i>£</i>	£34,119
Annual Energy Cost Savings	<i>£</i>	£3,521
Annual Export Income	<i>£</i>	£232
Total Annual Carbon Saving	<i>Tonnes CO₂</i>	15.0

Financial Appraisal/Analysis

System Cost	£34,119.36
Annual Savings & Income (After 1st Year)	£3,752.64
Simple Payback	9.9 years
Equity Payback	7.0 years
IRR%	16%
NPV	£105,080
Absolute Return on Investment (NPV/Investment)	308%
Levelised Cost of Energy (LCOE)	£0.07 £/kWh
	6.9 p/kWh

Project Cash Flow

Year	Output (kWh)	Cost Savings	Export Income	Total Savings	Running Cost	Savings less O&M	Cumulative Savings	NPV of Savings
0						£34,119	£34,119	£34,119
1	28956	£4,401	£232	£4,633	£320	£4,313	£29,806	£4,228
2	28753	£4,589	£237	£4,826	£330	£4,496	£25,310	£4,322
3	28552	£4,785	£242	£5,027	£339	£4,688	£20,623	£4,417
4	28352	£4,989	£248	£5,237	£350	£4,887	£15,736	£4,515
5	28153	£5,202	£253	£5,455	£360	£5,095	£10,641	£4,615
6	27956	£5,423	£259	£5,683	£371	£5,312	£5,329	£4,717
7	27760	£5,655	£265	£5,920	£382	£5,538	£208	£4,821
8	27566	£5,896	£271	£6,167	£394	£5,773	£5,982	£4,928
9	27373	£6,147	£277	£6,425	£405	£6,019	£12,001	£5,037
10	27182	£6,409	£284	£6,693	£418	£6,276	£18,277	£5,148
11	26991	£6,683	£290	£6,973	£430	£6,543	£24,820	£5,262
12	26802	£6,968	£297	£7,265	£443	£6,822	£31,642	£5,379
13	26615	£7,265	£304	£7,569	£456	£7,112	£38,754	£5,498
14	26428	£7,575	£310	£7,885	£470	£7,415	£46,169	£5,620
15	26243	£7,898	£318	£8,216	£484	£7,731	£53,901	£5,745
16	26060	£8,235	£325	£8,560	£499	£8,061	£61,962	£5,872
17	25877	£8,586	£332	£8,918	£514	£8,405	£70,367	£6,002
18	25696	£8,952	£340	£9,292	£529	£8,763	£79,130	£6,136
19	25516	£9,334	£348	£9,682	£545	£9,137	£88,266	£6,272
20	25338	£9,732	£355	£10,088	£561	£9,526	£97,793	£6,411
21	25160	£10,147	£364	£10,511	£578	£9,933	£107,726	£6,553
22	24984	£10,580	£372	£10,952	£595	£10,357	£118,082	£6,699
23	24809	£11,031	£380	£11,412	£613	£10,798	£128,881	£6,848
24	24636	£11,502	£389	£11,891	£632	£11,259	£140,140	£7,000
25	24463	£11,992	£398	£12,390	£650	£11,740	£151,879	£7,156
							NPV	£105,080

Calculation Inputs/Assumptions

Tariff Retail Price Index (Interest Rate)

3%

Assumed % annual increase in value of displaced electricity:

5%

Panel degradation

0.70%

Discount Factor

2%

*O&M costs - Based on £10/kWp as advised on a phone call with Spirit Energy. Annual check and clean with minor repairs

*20 - 25 years life expectancy for Panels as advised on a phone call with Spirit Energy

*10 years life expectancy for Inverter (CIBSE Guide M)

