



Weldale St buildings B1 & B2, Reading Energy and Sustainability

For Ropemaker Properties

Date: 23 February 2022

Doc ref: 20219-HYD-XX-XX-RP-Y-5001

DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Merchants House Wapping Road Bristol BS1 4RW Tel: 01179 459225 www.hydrock.com	Client	Ropemaker Properties
		Project name	Weldale St buildings B1 & B2, Reading
		Title	Energy and Sustainability
		Doc ref	20219-HYD-XX-XX-RP-Y-5001
		Project no.	C-20218
		Status	For information
		Date	23/02/2022

Document Production Record		
Issue Number	P02	Name
Prepared by		Graeme Smith
Checked by		Stefan Nardini
Approved by		Graeme Smith

Document Revision Record			
Issue Number	Status	Date	Revision Details
P01	For information	06/08/2021	
P02	For Information	24/01/2022	
P03	For Information	23/02/2022	

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

CONTENTS

INTRODUCTION..... 1

1. CONTEXT 1

2. PURPOSE OF REPORT 1

2.1 Development Details..... 1

3. PLANNING POLICY AND REGULATION REQUIREMENTS..... 2

3.1 Building Regulations (Part L) 2

4. LOCAL POLICY 2

4.1 Reading Borough Council Policy CS1 - Sustainable Design and Construction 2

4.2 Reading Borough Council - Current Sustainable Design and Construction (adopted in 2019):..... 2

ENERGY AND CARBON BASELINE 3

5. SAP ENERGY MODELLING 3

5.1 Solar Gains 3

5.2 Internal gains 3

5.3 Building Fabric 3

5.4 Building Services 3

5.5 Weather data 3

BE LEAN – REDUCE THE DEMAND FOR ENERGY 1

6. PASSIVE DESIGN MEASURES 1

7. ACTIVE DESIGN MEASURES..... 2

8. ALTERNATIVE HEATING STRATEGIES..... 1

8.1 Site wide combined heat and power and Boilers..... 1

8.2 Decentralised hot water Air Source heat pumps 2

8.3 Centralised Heating and hot water Air Source Heat Pumps 3

8.4 Heating and Hot Water Ground Source Heat Pumps..... 4

8.5 PHOTOVOLTAICS..... 5

9. CARBON EMISSIONS OF ENERGY OPTIONS..... 5

10. WATER USE 6

10.1 Potable Water Use..... 6

6

10.2 Greywater Recycling 6

CONCLUSIONS..... 7

Tables

Table 1 - Proposed building fabric properties..... 1

Table 2 - Summary of Advantages/Disadvantages of Central Boilers/CHP 1

Table 3 - Summary of Advantages/Disadvantages of Decentralised Air Source Heat Pumps 2

Table 4 - Summary of Advantages/Disadvantages of Centralised Air Source Heat Pumps 3

Table 5 - Summary of Advantages/Disadvantages of Ground Source Heat Pumps 4

Table 6 - Summary of SAP Carbon emission results of Phase 2 apartments samples. 5

Figures

Figure 1 - Site location plan 1

Figure 2 - UK Energy Supply carbon dioxide emissions 2009 to 2020 2

Figure 3- Passive design measures 1

Figure 4 - Typical Apartment with CHP/Boiler led design (as per Phase 1)..... 1

Figure 5 - Typical Apartment with MVHR Ventilation and ducted Air Source Heat Pump for hot water 2

Figure 6 - Sketch arrangement of roof mounted Central Air Source heat pumps on Block B1..... 3

Figure 7 - diagrammatic arrangement of ground loops and typical decentralised 'shoebox' heat pump unit. 4

Figure 8 - Sketch arrangement of likely requirement for vertical loop boreholes for GSHP system under basement slab.
4

Figure 9 - Diagrammatic arrangement of Greywater Harvesting System 6

Introduction

1. CONTEXT

Hydrock previously prepared an Energy and Sustainability report in January 2017 (reference: C161063) to support Planning application reference 170326 at land between Weldale Street and Chatham Street, Reading. That report was based on best practice, building regulations and planning policy guidance at the time.

Blocks A1 and A2 of the above consented scheme are currently under construction (hereafter referred to within this document as 'Phase 1' of the development) in line with that approved Energy and Sustainability report. Phase 1 also includes the inclusion of photovoltaic panels (PV) at the roof level of Block A2 (fronting Chatham Street), which was approved via a non-material amendment to planning permission 170326 in December 2020 under reference 201602.

Hydrock has now been engaged to review the proposals for Blocks B1 and B2 of the consented scheme (hereafter referred to as 'Phase 2'), with a view to enhancing the Energy and Sustainability measures within this phase of the development before construction of this second phase commences.

2. PURPOSE OF REPORT

The objective of this report is to review the performance of the energy proposals for the consented scheme in respect of Blocks B1 and B2 only.

In addition, it is to review against updated best practices for design outline how alternative energy efficiency, low carbon and renewable technologies can be considered as part of the energy strategy.

The relevant phase of the development hereby permitted (a) phase 2- block A1, b) Phase 3- Block A2, c) Phase 4- Block B2, d) Phase 5- block B1) shall not be occupied until written documentary evidence has been submitted to , and receipt acknowledged in writing by the LPA demonstrating 50% of the dwelling permitted within each phase has achieved a minimum of a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the Building Regulations for England Approved Document L1a: Conservation of Fuel and Power in New Dwellings (2013 edition). Such evidence shall be in the form of an as built standard Assessment Procedure, produced by an accredited energy assessor.

Throughout this report reference to carbon emissions calculations is in the context of SAP calculations used to benchmark the building fabric and building services performance.

The SAP calculation models relate only to regulated carbon emissions. i.e. emissions associated with heating, cooling, hot water, lighting and any other fixed building services equipment (those that are covered under Building Regulations Part L).

Unregulated emissions that are associated with small power and plug-in items and any other process or plant equipment are not included in the calculated emissions.

2.1 Development Details

The proposal is for a development of 164 residential units for private rental, with shared communal facilities. The phase 2 site area is located over a basement car parking provision for the entire site however it is a self-contained facility with separate utility supplies and building services installations for Blocks B1 and B2.



Figure 1 - Site location plan

3. PLANNING POLICY AND REGULATION REQUIREMENTS

The 2017 report summarised national and local planning policy relevant to the scheme and building regulations requirements based on Approved Document L1A/L2A.

As a consented scheme based on building regulations that are still relevant for the current proposed development of Phase 2 the same strategy requirements apply subject to any planning amendments.

3.1 Building Regulations (Part L)

All areas of the proposed development will need to meet Energy Performance standards are set for dwellings/non-dwellings by Building Regulations Approved Document Part L1A/L2A, Conservation of Fuel and Power in Dwelling/New Buildings other than Dwellings.

It is the role of Part L of the Building Regulations to include a minimum level for regulated carbon emissions defined by the Target Emission Rate (TER) which relates to a 'Notional Building', automatically generated as part of the SAP and Simplified Building Energy Model (SBEM) toolkits.

The resulting Dwelling Emission Rate (DER) and Building Emission Rate (BER), must be less than the TER in order to comply. A benchmark Energy Performance Certificate (EPC), rated A (most efficient) through G (least efficient) will also be calculated as part of this assessment via comparison of each building assessed to a 'Reference Building', also automatically generated as part of the SAP and SBEM toolkits.

These changing national regulations will drive energy efficiency and carbon reduction improvements in new buildings. It was the intention via progressive changes to Part L to require zero carbon homes by 2016. However, in July 2015 the Government Productivity Plan ("Fixing the Foundations") announced that it would not proceed with the zero-carbon

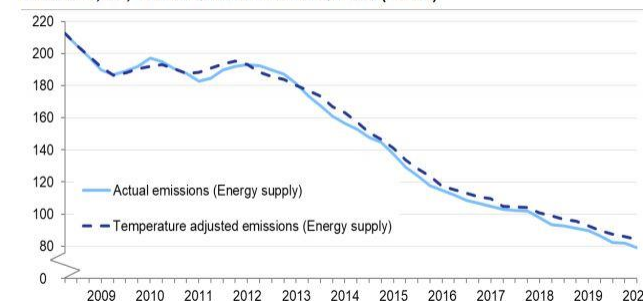
allowable solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, committing instead to keeping standards 'under review'.

On this basis, an update to Part L for new homes is proposed for 2021/22 having undergone consultation in 2020 including those for the national 'Future Homes Standard' to come into effect in 2025.

Developments should be aware of proposed changes and any transitional arrangements that may come into effect before works have started on site.

The calculations used for Weldale Street development were based on SAP 2012, which was the relevant method at the time of the original submission. These are still used for the purposes of any alternative proposals however its also important to note that due to decarbonisation of the UK grid in recent years the forthcoming changes to the carbon emissions within the new SAP10 have been updated which will replace the existing figures in SAP 2012. The emissions emission factors demonstrate the significant decarbonisation of the national grid and confirm that natural gas will have a higher carbon factor than electricity going forward.

Figure 9: Actual and temperature adjusted energy supply carbon dioxide territorial emissions, UK, Year to Q1 2009 - Year to Q4 2020 (MtCO₂)



4. LOCAL POLICY

Figure 2 - UK Energy Supply carbon dioxide emissions 2009 to 2020

Key energy policies of the Core Strategy for Reading Borough Council at the time of the consented scheme application in 2017 are detailed below.

4.1 Reading Borough Council Policy CS1 - Sustainable Design and Construction

Policy CS1 sought to ensure that the design of buildings use energy, water, materials and other natural resources appropriately to these requirements developments should:

- On larger developments of more than 10 dwellings or 1,000 m² of floor space, ensure that 50% of the provision meets the most up to date Eco-Homes and BREEAM Excellent standards;
- All new developments maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
- All developments of more than 10 dwellings or 1000m² floor space incorporate on-site generation of energy from renewable sources and energy efficient design measures (including the use of CHP where appropriate) to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development;
- All developments reduce mains water use and demonstrate that water conservation measures are incorporated so that predicted per capita consumption does not exceed the appropriate levels set out in the Code for Sustainable Homes or BREEAM Standards.

In addition the policy at the time encouraged the application of CHP led heating solutions and compatibility with future district heating networks.

4.2 Reading Borough Council - Current Sustainable Design and Construction (adopted in 2019):

The current Policy sought to ensure that the design of buildings and site layouts uses energy, water, minerals, materials and other resources appropriately, efficiently and with care and take account of the effects of climate change to these requirements developments should:

- All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;
- All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost-effective.
- All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change.
- All development of more than 20 dwellings and/ or non-residential development of over 1000m² floor space 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.

Energy and Carbon Baseline

This section establishes the baseline energy consumption and associated CO₂ emissions for the scheme based upon a Building Regulations 2013 Part L compliant development.

This baseline will then be used as the comparison for carbon emissions reduction throughout this report. The requirements for this baseline are specified by the UK Building Regulations.

5. SAP ENERGY MODELLING

The dwellings on site have been assessed under Part L 2013 using the Government’s Standard Assessment Procedure (SAP). The apartments have been assessed using Stroma FSAP software.

For the purposes of this assessment a sample of approx one third of all apartments in the Phase 2 developments has been modelled in FSAP to understand the impact of energy performance.

5.1 Solar Gains

Solar gains are calculated automatically by the modelling software and are based on the orientation of the building, the transmission coefficients of the glazing and the solar angles. SAP also takes into account shading devices.

5.2 Internal gains

Gains from lighting, appliances, cooking and from the occupants are estimated from the floor area.

5.3 Building Fabric

In order to reduce the overall heating demand for the development, building fabric that is in excess of the notional building requirements has been specified. This is shown in detail below:

Table 1 - Notional building fabric (Part L1A)

Building Element	Notional Building Fabric
Roof	0.13 W/m²k
External Wall	0.18 W/m²k
Glazing (g-value)	1.4 W/m²k (0.65)
Air Permeability	5 m³/m²/hr @ 50 Pa

Additionally, it has been assumed that the party walls between the apartments and communal corridors are cavity filled/ solid construction.

5.4 Building Services

To calculate the baseline CO₂ emissions the dwellings are assumed to use a communal gas boiler system with lead combined heat and power engine with low pressure hot water heating to heat interface units (HIU) for heating and hot water, and grid derived electricity for all lighting and power.

Dwellings are assumed to provided with local Mechanical Ventilation with heat recovery.

All efficiencies match the case for the notional building.

5.5 Weather data

Weather data is based on the climatic data provided by SAP for the dwellings, the weather file used for the exercise is the London Test Reference Year (TRY) as required by the National Calculation Methodology (NCM).

Be Lean – Reduce the Demand for Energy

This section of the report responds to the first stage of the energy hierarchy (Be Lean) and discusses both passive and active design measures that could be included within the development to reduce energy use and subsequent carbon emissions.

Design strategies typically include building form and fabric measures (passive design) and energy efficient building services (active design). Focusing on form and fabric in particular at an early stage in the build process is often the most cost-effective way to reduce energy consumption and CO₂ emissions.

6. PASSIVE DESIGN MEASURES

Passive design options are those which utilise building form, massing and glazing ratios to exploit the natural surroundings of the site to help reduce energy demand. The proposed design includes the following:

- Optimising daylight through higher floor to ceiling heights or dual aspect buildings;
- Control of solar gain to benefit from heat when required without causing overheating in summer via the size and depth of windows on different elevations;
- Increased efficiency of building fabric, particularly the roof and walls to reduce heat loss;
- Maximising air tightness to minimise the impacts of uncontrolled air infiltration; and

Passive design measures have been carefully considered within the development proposals as appropriate to the construction type and end use.

Glazing layout and specification has been strongly influenced by the passive design goals of the project, with windows placed to increase the amount of natural daylight and reduce the reliance on artificial lighting.

Table 1 - Proposed building fabric properties

Building Element	Part L1A Notional U-value	Proposed U-value
Roof	0.13 W/m ² k	0.13 W/m ² k
Floor	0.13 W/m ² k	0.13 W/m ² k
Walls	0.18 W/m ² k	0.18 W/m ² k
Glazing	1.40 W/m ² k	1.40 W/m ² k

Air permeability of 3 m³/m²/hr at 50 Pa has been utilised at this stage within modelling for the actual building though this may be improved upon during detailed design with inputs from the operator and principal contractor.

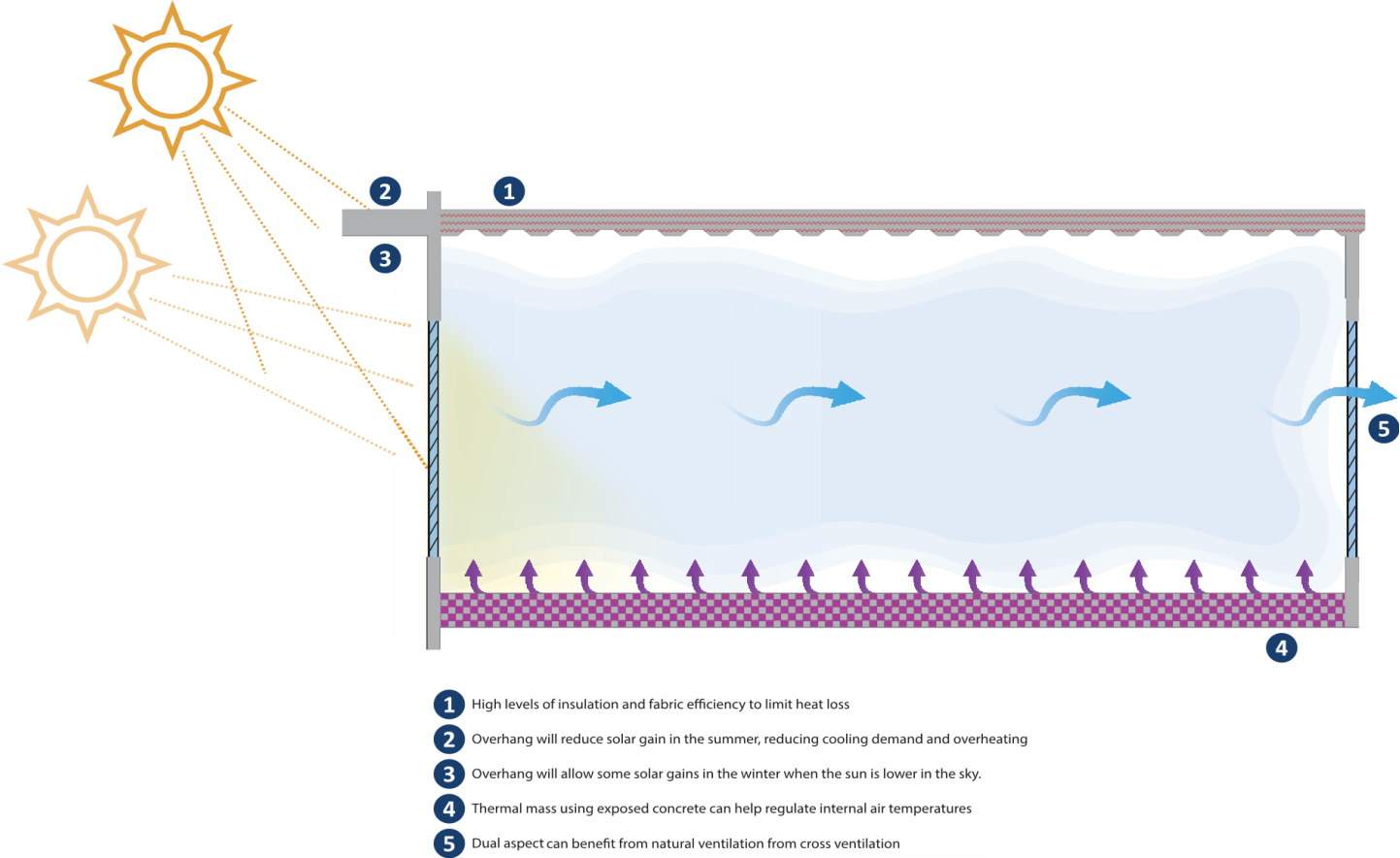


Figure 3- Passive design measures

7. ACTIVE DESIGN MEASURES

Active design relates to energy efficiency measures that can be included within the building services specification to reduce energy consumption. All services will be designed to meet at least the minimum recommended performance requirements contained in the UK Government Domestic and Non-Domestic Building Services Compliance Guides (2013).

The following active design measures are recommended for inclusion within the scheme:

7.1 Regulated Energy

The heating system will ensure appropriate zoning and segregation of internal spaces to allow effective temperature control by residents as appropriate.

The heat emitters in all residential areas will be low surface temperature radiators. Hot water delivery will include high levels of insulation, coupled with efficient fittings to minimise water consumption and energy consumption.

A natural ventilation strategy via openable windows is provided to the dwellings whereas the noise and indoor air quality targets can be met without the need for mechanical ventilation.

Wet areas such as kitchens and bathrooms will be provided with intermittent extract fans to ensure there is not moisture build up and to prevent odours from leaking into the other rooms. Circulation areas will be naturally ventilated.

Generally, all equipment will be specified to achieve a high efficiency (e.g. high thermal conversion efficiency for boilers) and low distribution losses (low fan and pump power, insulation in accordance with relevant standards), with pumps utilising variable speeds.

To reduce energy, demand all lighting installed will be high efficiency LED type and communal areas will also be provided with absence detection to avoid lights being on in unoccupied spaces. Both measures will further reduce building energy use.

External lighting has been designed to minimise impact on the surrounding areas and will be controlled by daylight photocell dimming and a timeclock to ensure lower lighting levels for set periods to minimise any potential effects on wildlife or the local environment.

8. ALTERNATIVE HEATING STRATEGIES

This section of the report will explore ways in which the developments heating and hot water could be provided using low or zero carbon energy systems.

8.1 Site wide combined heat and power and Boilers.

The baseline strategy in the consented scheme is to use gas fired boiler plant and combined heat and power engines for each building.

The apartment blocks will be served through a communal system. These will be located at ground floor level within the apartment blocks with flow and return pipework to individual apartments.

Each apartment will be provided with a heat interface unit (HIU) to allow individual metering and billing, and provide hydraulic separation from the rest of the system.

Combined heat and power works by utilising the waste heat from electricity production to provide heat for domestic heating and hot water purposes. This is more efficient than grid supplied electricity as distribution losses are minimised.

CHP is suited to high density, mixed used developments where there is a high, constant baseload hot water demand.

Furthermore, whilst CHP can be an effective way of reducing a developments carbon emissions, the scale of carbon reduction is dependent on the carbon intensity of the grid. As the grid becomes decarbonised, the carbon reduction potential of CHP will also reduce.

Whilst not currently applicable, the proposed changes to the carbon factors of gas and electricity in the next iteration of SAP and the UK Building Regulations will essentially wipe out any carbon reductions that could be achieved by the installation of a CHP engine on this site.

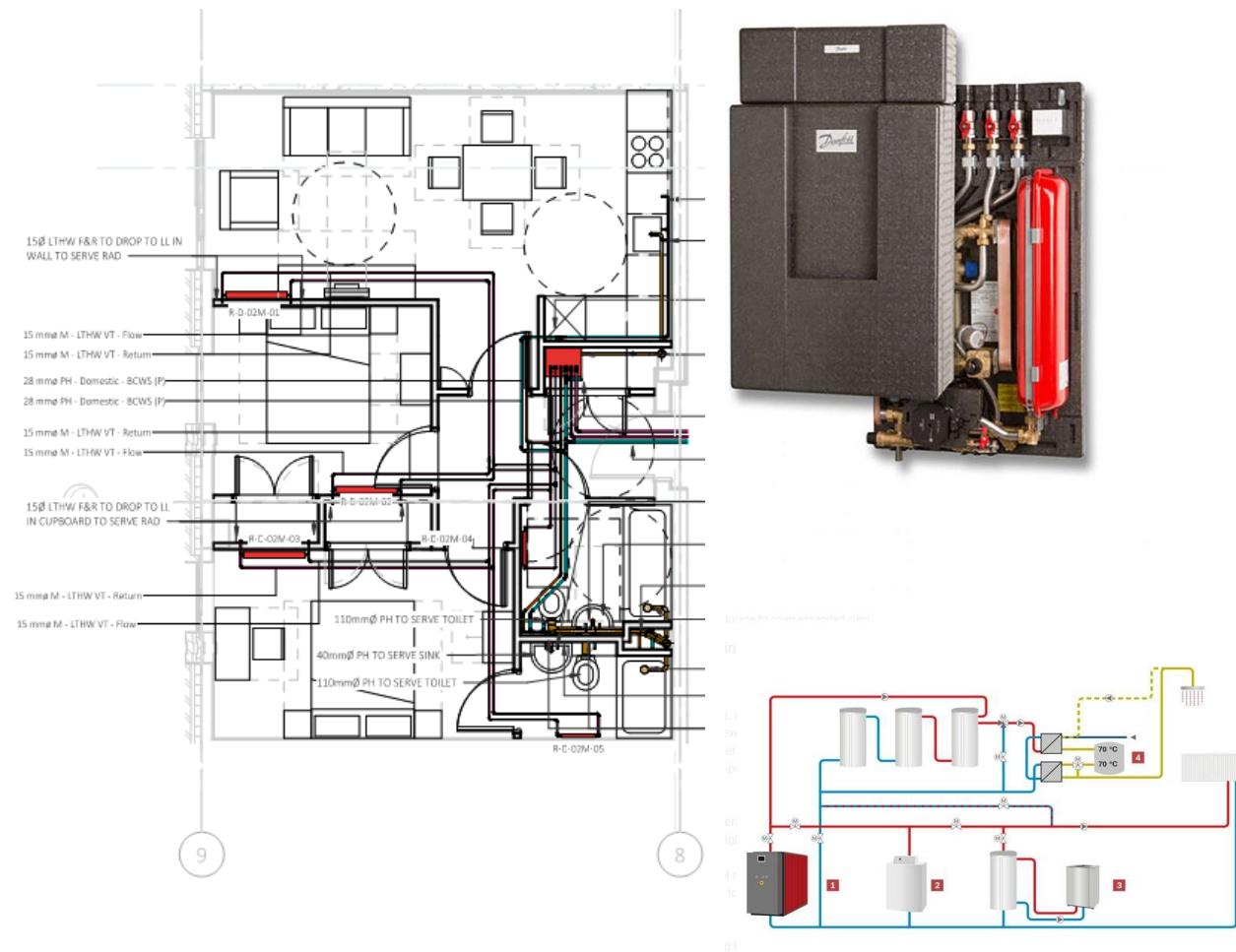


Figure 4 - Typical Apartment with CHP/Boiler led design (as per Phase 1)

Table 2 - Summary of Advantages/Disadvantages of Central Boilers/CHP

Advantages:	Disadvantages:
Economic – capital and operational Compact plant Quality – traditional wet system, pipes and rads	Direct Fossil fuels used – not aligned with decarbonisation Hence now discouraged by planning, not considered renewable energy Requires heat metering management

8.2 Decentralised hot water Air Source heat pumps

Heat pumps use a refrigeration cycle to transfer low grade heat to useful higher grade heat. This proposal would be to use heat pumps purely for domestic hot water generation. Products are available to achieve this discreetly using a hot water storage cylinder with integral heat pump.

The air source heat pumps in this arrangement absorb heat from ambient air via ducted connections to external louvres.

Space heating for this option would be via direct electric panel radiators.

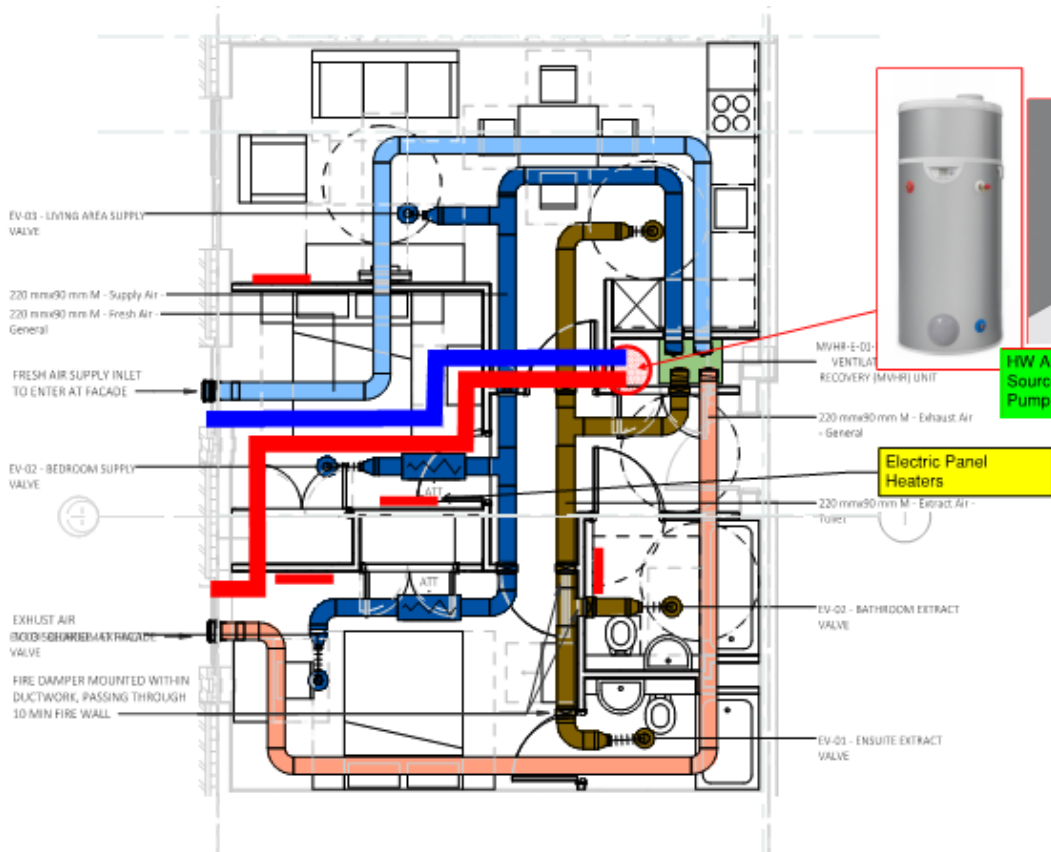


Figure 5 - Typical Apartment with MVHR Ventilation and ducted Air Source Heat Pump for hot water

Table 3 - Summary of Advantages/Disadvantages of Decentralised Air Source Heat Pumps

Advantages:	Disadvantages:
Renewable Hot Water Solution (main load) All Electric – works with decarbonisation strategy Economic alternative – circa £5k/apartment No heat metering required No Central plant – reduction in floor area/build cost	Increase in utility space required Electric Panel heaters – higher heating costs, offset in building fabric performance Additional ductwork/façade louvres required integrated into head of windows. Additional design co-ordination in ceilings in already congested apartments.

8.3 Centralised Heating and hot water Air Source Heat Pumps

Centralised air source heat pumps work in the same way as the decentralised units, however the plant is on a larger scale and generates heating energy at a central source, distributed around the building using an LPHW heating network in a similar way to the CHP/Boilers option with heat interface units and LPHW radiators.

Despite the location of heat generation plant externally there will still be a requirement for internal plant space for pumps, control panels, and thermal stores to serve the system,

The most feasible location for the Air Source heat pumps would be at Roof level.

Due to the impact of the roof mounted plant on the development this option has not been explored beyond initial discussion.

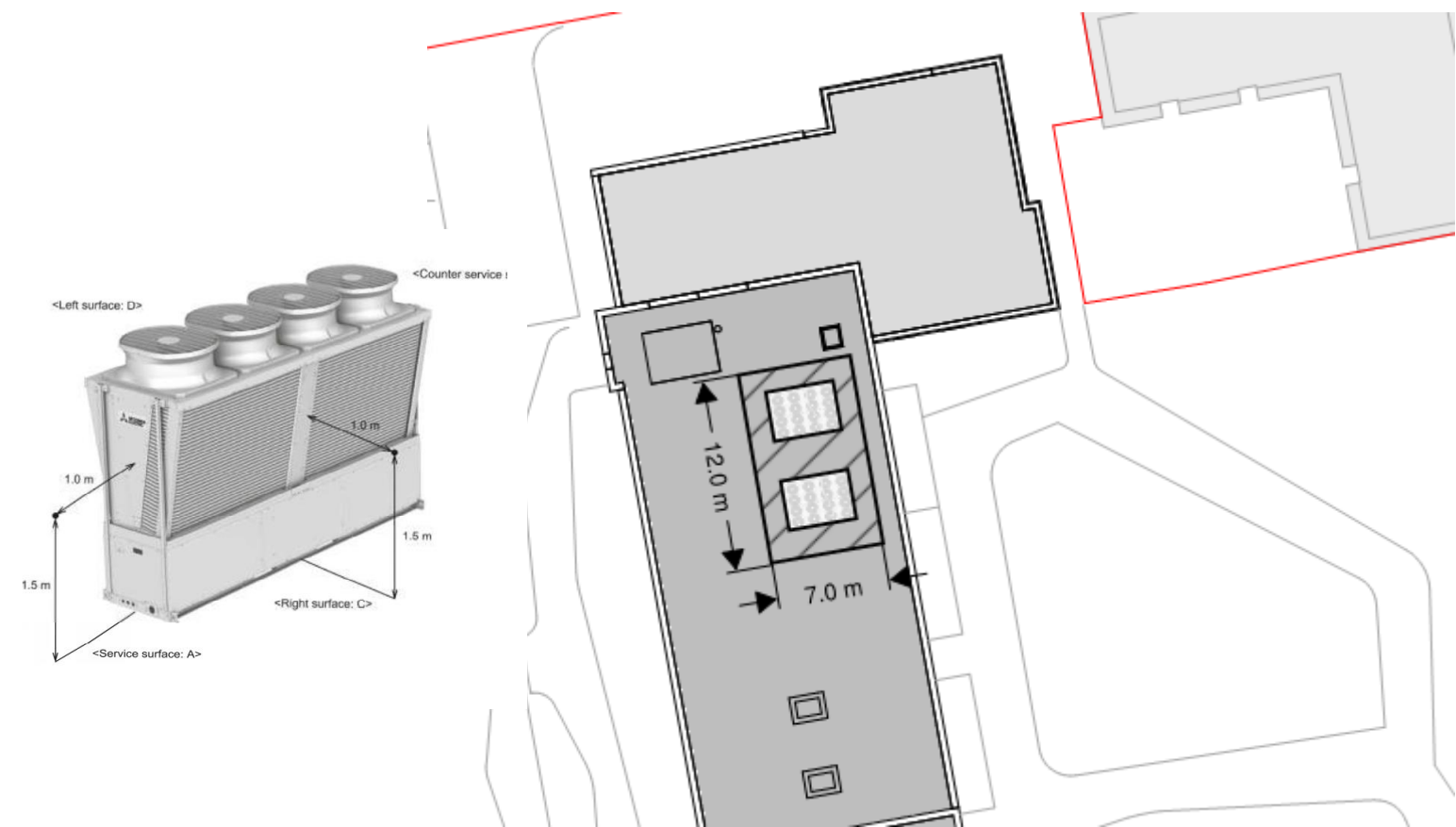


Figure 6 - Sketch arrangement of roof mounted Central Air Source heat pumps on Block B1

Table 4 - Summary of Advantages/Disadvantages of Centralised Air Source Heat Pumps

Advantages:	Disadvantages:
End Product looks as per phase 1 boilers/CHP All Electric – works with decarbonisation strategy Reduced Central plant – reduction in floor area/build cost	Large External Plant space required – visuals/. Unlikely to be sufficient to meet planning without additional measures Increased capital cost over CHP/Boilers Requires central heat metering and management.

8.4 Heating and Hot Water Ground Source Heat Pumps

Ground source heat pumps operate in the same fashion as air source heat pumps, however instead of using ambient air as the low grade heat source they use a water/glycol pipe loop to absorb heat from the ground. Below approx 1.5m depth ground temperatures remain stable year round, at circa 10degC, also the specific heat capacity of water is approx 3.5 times that of air. Therefore it requires less work to extract the same amount of heat from a ground source loop than an air to water heat exchanger with lower ambient winter temperatures. Resulting in a more efficient heat pump system.

However the additional energy in pumping water through an ambient ground loop needs to be considered and can make the ground source system efficiency not significantly better.

Ground source heat pumps can either be local within each apartment connected to an ambient condenser loop or can be centralised as per the CHP/Boiler system with local heat interface units. Unlike a boiler system, heat pumps are better suited to underfloor heating solutions due to lower operating temperatures.

Either option will still have a requirement for internal plant space for pumps, control panels, and thermal stores to serve the system. With a centralised heat pump option taking up space previously assigned for boilers.

One of the challenges of ground source is location of ground source loops. Due to heat transfer significant numbers of vertical boreholes will be required for this development to serve the requirements of a heat pump system, which can impact cost, programme and structural co-ordination. For this scheme initial estimates indicate that a central ground source heat pump will require more boreholes than available in the basement floor area due

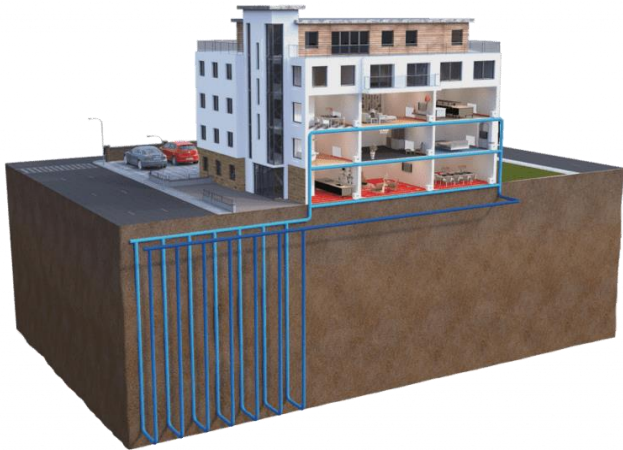


Figure 7 - diagrammatic arrangement of ground loops and typical decentralised 'shoebox' heat pump unit.

between each loop.



Table 5 - Summary of Advantages/Disadvantages of Ground Source Heat Pumps

Advantages:	Disadvantages:
Renewable Heating and Hot Water Solution	Subject to specialist Geo thermal engineering feasibility
All Electric – works with decarbonisation strategy	Unlikely to be sufficient to meet planning without additional measures
No heat metering required on decentralised GSHP – compressors within each flat	Increased utility space required for HW cylinders
Reduction in energy/carbon vs Air Source	High Cost – circa £15k/apartment up to the utility cupboard
Reduced internal Central plant – no external plant	Insufficient space for boreholes – circa 200 No. 100m deep boreholes required at 5-6m spacing
No External plant or flues – uses boiler space for heat pumps in centralised option	

8.5 PHOTOVOLTAICS

Solar photovoltaics can be used to provide a low maintenance method of onsite electricity generation.

These have a very low visual impact and when installed at a low pitch cannot be seen from street level.

An outline assessment indicates that approx 225m2 of south facing PV panels could be installed on the roofs of Blocks B1 and B2.

Consideration into the final design of the roof space and overshadowing from adjacent structures will be needed to maximise the area and efficiency of the PV installation.

PV's can contribute significantly to the site energy reduction requirements and reductions in carbon emissions and operating costs.

9. CARBON EMISSIONS OF ENERGY OPTIONS

Using the SAP calculation models, the results in table 6 have been obtained.

The initial results indicate that under the current 2013 Part L regulations the Boiler/CHP option on phase 2 as a standalone development does not meet the 20% improvement required for planning, however with further assessment of the energy calculations and integration of photovoltaics the results in the final design should be capable of exceeding this. However, using the 2020 SAP and carbon emissions factors suggests that the use of gas boilers and CHP which fail building regulations compliance by a 3% margin.

For Heat pumps, either air or ground source, the use of direct electric heating significantly increases the target emission rates, therefore under 2013 building regulations even though the carbon emissions without PV are higher than those of CHP/Boilers, it still exceeds the 20% requirement due to the higher targets. Heat pumps under forthcoming building regulations however indicate that not only are the target carbon emissions significantly lower due to decarbonisation of the grid, but the actual performance without PV still meets the current planning requirement of 20% improvement and typically has nearly half the carbon emissions of the boiler/CHP option.

Table 6 - Summary of SAP Carbon emission results of Phase 2 apartments samples.

	TEff	DEff	%	TER (2013)	DER (2013)	% Savings	TER 2021	DER 2021	% Savings
				Part L 2013 electricity-0.519 Gas-0.216			New Part L 2020 electricity-0.233 Gas-0.216		
00 CHP	105.51	106.05	-1%	51.2	45.7	11%	44.46	45.92	-3%
01 HP				75.61	48.31	36%	34.84	21.69	38%
01 HP no PV				75.61	59.83	21%	34.84	26.86	23%
02 GSHP				73.77	44.85	39%	33.12	20.17	39%
02 GSHP no PV				73.77	56.36	24%	33.12	25.34	23%

10. WATER USE

10.1 Potable Water Use

The quality and availability of potable water resources are under increasing pressure as a result of population growth and a changing climate.

The development as a whole will seek to reduce water use where possible using efficient fittings. Water saving initiatives that will be implemented include:

- Low and dual flush WC's – Dual flush cisterns with low effective flush volume
- Taps – Wash hand basins and sinks will be WRAS approved and water efficient to comply with DEFRA WTL scheme in terms of flow performance (4litres per minute).
- Showers – Aerated or low flow shower heads will be included to help reduce water consumption.

10.2 Greywater Recycling

As part of the study into further improving sustainability for the development consideration is given into Grey Water Recycling.

Grey Water Recycling systems require separate drainage collection of waste water from showers and wash basins. The water recovered from this then is discharges into a basement level multistage filtration system to treat the water so that it can be recycled and piped to the WC's to provide water for toilet flushing.

Based on a fully occupied building, a greywater recovery system has potential to provide all the WC flush water, potentially saving up to 10.44m³ of water per day. 3810m³ per annum.

With main water costs at circa £2.12/m³ this offers a £7738/pa saving.

Estimated costs of greywater recycling plant are circa £50,000.00. However, the capital cost of additional collection and distribution pipework also needs to be considered in any financial/payback appraisal.

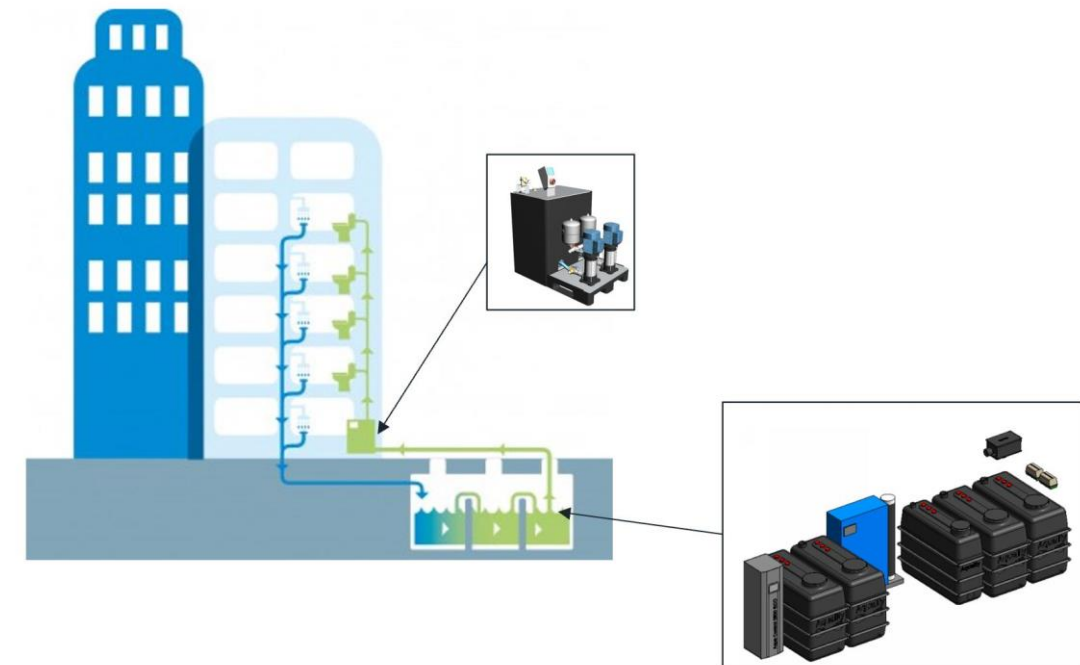


Figure 9 - Diagrammatic arrangement of Greywater Harvesting System

Conclusions

The proposed development and consented scheme with gas boilers and CHP as the central heat source is a viable solution for the development, and under the consented scheme would meet the planning policy requirements.

This supplementary feasibility study has indicated that a alternative approach using heat pumps and Photovoltaics can yield a substantial reduction in carbon emissions when current carbon emission factors are used

Therefore, Hydrock's recommendation to reduce carbon emissions, whilst also simplifying the heating strategy, would be to implement the decentralised hot water air source heat pump approach, providing readiness for a future decarbonised UK grid.

In addition, this approach is unlikely to have a negative impact on construction costs (subject to QS cost appraisal) with construction cost reductions due to omission of central plant space, flues, risers and distribution pipework in common areas.

Another benefit with the omission of central heating distribution is reduced risk of overheating in circulation spaces.

The implementation of greywater harvesting has a less compelling commercial reason to implement it, as it brings negligible benefits in carbon emissions reductions to the scheme and return on investment when factoring all issues is likely to be in excess of 15 years. Therefore it is not recommended grey water harvesting is implemented.