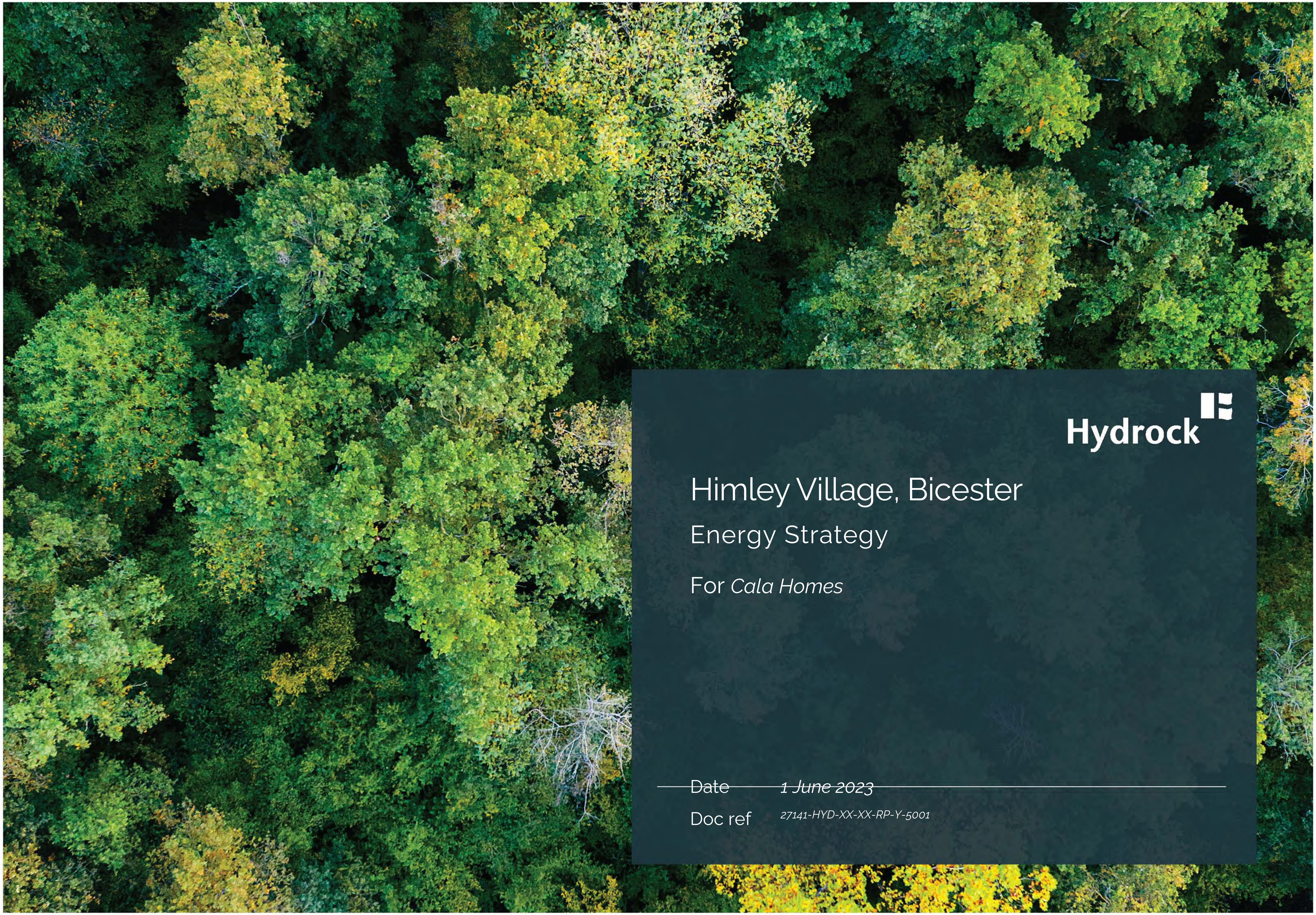

Hydrock

Himley Village, Bicester

Energy Strategy

For *Cala Homes*

Date *1 June 2023*

Doc ref *27141-HYD-XX-XX-RP-Y-5001*

Document control sheet

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Executive Summary

This report provides an overview of the site wide energy strategy at Himley Village, Bicester. The Proposed Development will meet the requirements laid out in national and local policy, including Policy Bicester 1 in relation to the North West Bicester Eco-Town.

The site will aim to meet operational zero carbon (including regulated and unregulated emissions) through a mixture of efficient fabric, a mixture of ground source and air source heat pumps, and ground-mounted PV.

Table 1 shows a breakdown of the carbon emissions for phase 2.

Table 1 - Carbon emissions summary

	Total Carbon Emissions ($kgCO_2/yr$)	Percentage Saving	Energy Use Intensity ($kWh/m^2/yr$)
Baseline	784,900		120
After passive design and GSHP	386,100	50.8%	54.7
After PV	97,000	87.6%	-

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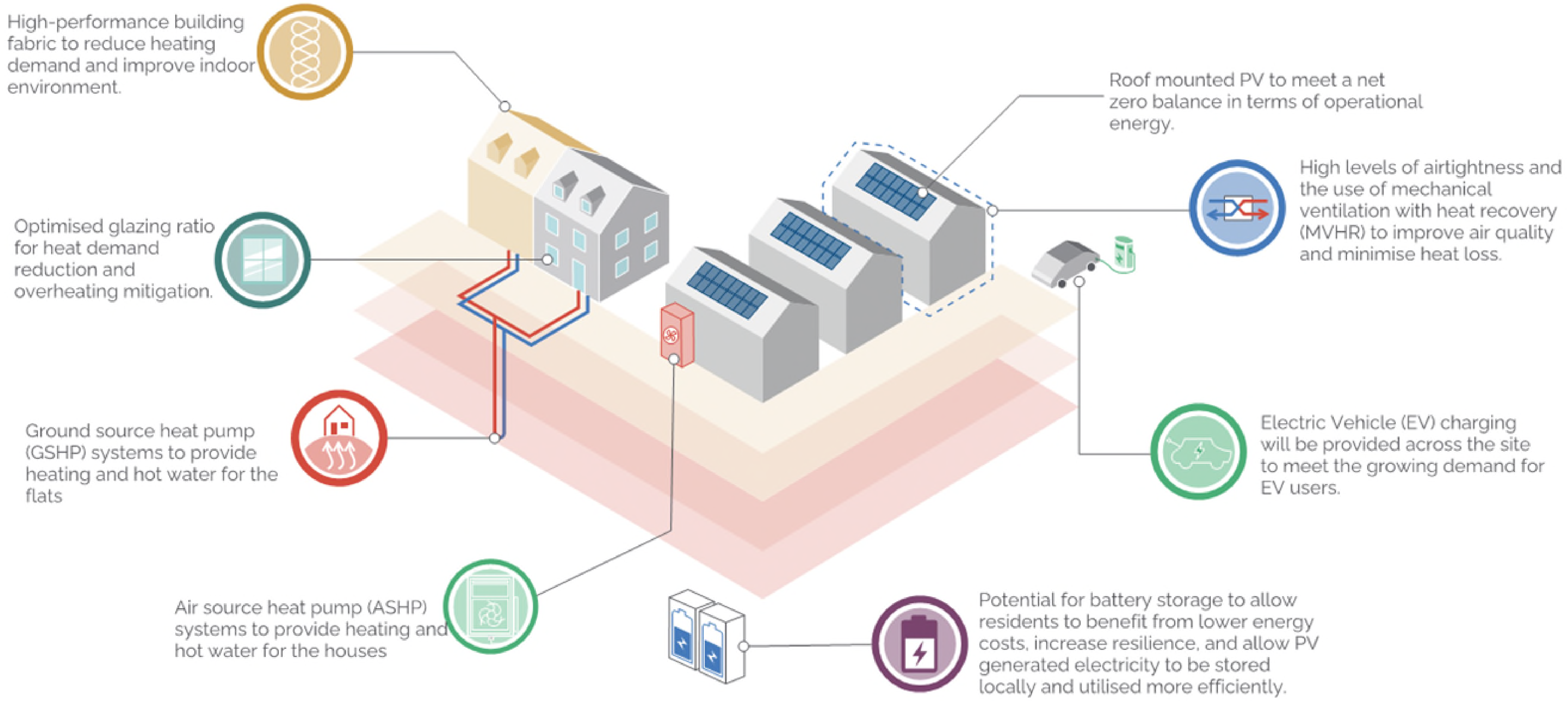
Policy Bicester 1: North West Bicester Eco-Town

A new zero carbon mixed use development including 6,000 homes will be developed on land identified at North West Bicester.

The definition of zero carbon in eco-towns is that over a year the net carbon dioxide emission from all energy use within the building on the eco-town development as a whole are zero or below.

Key site-specific design and place shaping principles for these sites include:

- High quality exemplary development and design standards including zero carbon development, and the use of low embodied carbon in construction materials as well as promoting the use of locally sourced materials.
- All new buildings designed to incorporate best practice on tackling overheating, taking account of the latest UKCP climate projections.
- Proposals should enable residents to easily reduce their carbon footprint to a low level and live low carbon life styles.
- Demonstration of climate change mitigation and adaptation measures including exemplary demonstration of compliance with the requirements of Policies ESD1-5.



Himley Village, Bicester

Hydrock has been appointed by Cala Homes to provide planning stage advisory services in relation to the proposed Himley Village development in Bicester, Oxfordshire.

This report will provide a comprehensive assessment of energy demand and carbon emissions associated with the proposed Phase 2 development.

1. Introduction

1.1 Purpose of Report

This report has been produced predominantly to discharge Condition, 20 and of the Outline Permission 14/02121/OUT. In addition, to this the report seeks to also address the requirements of Conditions 13.

> *Condition 20*
>
> *No phase of development shall commence until a report has been submitted to and approved in writing by the Local Planning Authority outlining how carbon emissions from the construction process and embodied carbon within that phase will be minimised. The phase of development shall thereafter be carried out in accordance with the approved report.*

Throughout this report, carbon emissions are split into the following categories:

- Regulated: Emissions associated with heating, cooling, hot water, lighting, and any other fixed building services equipment (those that are covered under Building Regulations Part L); and
- Unregulated: Emissions that are associated with small power and plug-in items and any other process or plant equipment (these are not covered by Building Regulations Part L).

This document will also provide the information required under Schedule 11 of the Section 106 agreement. This includes:

- Energy demand assessment using SAP/SBEM including regulated and unregulated energy;
- Energy demand reduction proposals;
- Energy generation strategy including anticipated outputs from any proposed technologies;
- Carbon balance using appropriate carbon factors (note S106 references DEFRA 2019, however, carbon factors from SAP10.1 are proposed as these are more up to date.

A separate document will also be provided on upfront embodied carbon emissions reductions (those associated with the manufacturer and transport to site of building materials). However, these are not included within the net zero carbon requirement for Himley Village and will not be quantified in the same manner as operational regulated and unregulated carbon emissions and the net zero carbon requirement is applied only to operational emissions at Himley Village.

1.2 Project Description

The proposed Himley Village development consists of 500 dwellings and forms part of the wider Himley Village masterplan.

The Himley Village site falls within the remit of Cherwell District Council (CDC).

The wider masterplan will provide up to 1,700 homes, schools, and community facilities. The site itself is classified as an EcoTown and will seek to provide a zero-carbon-ready development on the outskirts of Bicester.

Regulations, Policy, and Guidance

This section of the report highlights the relevant national regulations, local policy, and guidance that are applicable to the Himley Village development.

2. National Policy

This section sets out a summary of current national guidance and policy in relation to sustainable developments

2.1 Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive (Directive 2002/91/EC) has been the main policy driver for reducing energy use for heating, cooling, ventilation, hot water and lighting in buildings. The Directive requires the application of a methodological framework for calculating the energy performance of buildings.

2.2 Building Regulations Part L 2022

The development will need to meet the standards set within Building Regulations Approved Document Part L - Conservation of Fuel and Power in New Dwellings/New Buildings other than Dwellings, respectively for the residential and non-residential elements.

These standards 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 Standard Assessment Procedure (SAP) toolkit.

In addition, there are minimum levels of fabric efficiency set by the Target Fabric Energy Efficiency rating (TFEE) under the SAP methodology.

The resulting Dwelling Emission Rate (DER) or Building Emission Rate (BER) must be less than the relevant 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 toolkits.

2.3 Changes to Part L

Building Regulation's Part L was updated on June 15th, 2022, the latest regulations have revised the Part L calculations methodology. This includes much-improved carbon factors which will greatly benefit fully electrified sites' carbon emissions but will require new homes to produce around 31%.

There are several key changes as part of the update, the most significant relating to the fuel emission factors. Gas has remained approximately the same as under the 2012 version but the carbon factor for grid-derived electricity has reduced by 73%.

Table 2 - Carbon Factors for Gas and Electricity

$kgCO_2/kWh$	SAP 2012 (Part L 2013)	SAP 10.2 (Part L 2021)
Gas	0.216	0.210
Electricity	0.519	0.136

These changes are likely to result in electric or heat pump-derived heating and hot water becoming the standard industry approach for future developments, particularly as the country moves away from grid derived gas. This will be a consideration when reviewing appropriate building services strategies for this development.

Table 3 - Part L 2021 notional values

Building Element	Part L 2021 Notional Building Fabric	
	Volume 1 - Dwellings	Volume 2 - Buildings other than dwellings
Roof	0.11 $W/(m^2{\cdot}K)$	0.15 $W/(m^2{\cdot}K)$
Wall	0.18 $W/(m^2{\cdot}K)$	0.18 $W/(m^2{\cdot}K)$
Floor	0.13 $W/(m^2{\cdot}K)$	0.15 $W/(m^2{\cdot}K)$
Glazing	1.20 $W/(m^2{\cdot}K)$	1.40 $W/(m^2{\cdot}K)$
Rooflights	1.70 $W/(m^2{\cdot}K)$	2.10 $W/(m^2{\cdot}K)$
Door	1.00 $W/m^2{\cdot}K)$	1.90 $W/m^2{\cdot}K)$
Air Permeability	5 $m^3/(h{\cdot}m^2)$ @ 50 Pa	5 $m^3/(h{\cdot}m^2)$ @ 50 Pa

2.4 National Planning Policy Framework

The National Planning Policy Framework (NPPF or the Framework) was introduced in March 2012 to set out government planning policy for England, removing all regional level planning policy in favour of a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.'

Several iterations have since been published. The Framework was revised on 20 July 2021, replacing the previous update in February 2019.

All new Local and Neighbourhood Plans and reviews must align with the policies of the Framework 2021.

The Framework states clearly that the purpose of planning is to help deliver sustainable development and defines three mutually dependent pillars that must be equally considered to achieve this:

» Economic;

» Social;

» and Environmental.

» There is a clear focus upon:

» Promoting high-quality design for new homes and places;

» Offering stronger protection for the environment;

» Constructing the right number of homes in the right places; and

» Focusing on greater responsibility and accountability of councils and developers for housing delivery.

3. Local planning policy

3.1 Cherwell Local Plan, 2011-2031 Part 1 (2015)

The Local Plan for Cherwell District was adopted in 2015 and contains several policies relevant to energy and sustainability.

Whilst these policies are outlined below for reference, the expectation for net zero development at Himley Village goes beyond these requirements as a condition of outline planning consent, detail within the S106 agreement and the guidance within the North West Bicester SPD.

Policy ESD1: Mitigating and Adapting to Climate Change

Measures will be taken to mitigate the impact of development within the district on climate change. At a strategic level, this will include:

- Distributing growth to the most sustainable locations as defined in this Local Plan
- Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling, and public transport to reduce dependence on private cars
- Designing developments to reduce carbon emissions and use resources more efficiently, including water
- Promoting the use of decentralised and renewable or low carbon energy where appropriate.

The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:

- Taking into account the known physical and environmental constraints when identifying locations for development.
- Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling
- Minimising the risk of flooding and making use of sustainable drainage methods; and
- Reducing the effects of development on the microclimate (through the provision of green infrastructure including open space and water, planting and green roofs).
- Adaptation through design approaches will be considered in more locally specific detail in the Sustainable Buildings in Cherwell Supplementary Planning Document (SPD).

Policy ESD 2: Energy Hierarchy and Allowable Solutions

In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:

- Reducing energy use by the use of sustainable design and construction measures
- Supplying energy efficiently and giving priority to decentralised energy supply
- Making use of renewable energy
- Making use of allowable solutions (note allowable solutions have since been withdrawn).

Policy ESD 3: Sustainable Construction

All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance, and allowable solutions in line with Government policy.

Cherwell District is in an area of water stress and as such the Council will seek a high level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 l/person/day.

The strategic site allocations identified in this Local Plan are expected to provide a contribution to carbon emissions reductions and wider sustainability.

All development proposals will be encouraged to reflect the high-quality design and high environmental standard, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demands and energy loss
- Maximising passive solar lighting and natural ventilation
- Maximising resource efficiency
- Incorporate the use of recycled and energy-efficient materials
- Incorporating the use of locally sourced building materials
- Reducing waste and pollution and making adequate provision for the recycling of waste
- Making use of sustainable drainage methods
- Reducing the impact on the external environment and maximising opportunities for cooling and shading; and
- Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or development.

Policy ESD 4: Centralised Energy Systems

The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP including consideration of biomass-fuelled CHP will be required for:

- All residential development for 100 dwellings or more;
- All residential developments in off-gas areas for 50 dwellings or more;
- All applications for non-domestic developments above 1000 sqm of floor space.

Policy ESD 5: Renewable Energy

A feasibility assessment of the potential for significant on-site renewable energy provision will be required for:

- All residential developments for 100 dwellings or more;
- All residential developments in off-gas areas for 50 dwellings or more;
- All applications for non-domestic developments above 1000 sqm of floor space.

Where feasibility assessments demonstrate that on-site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit.

3.2 North West Bicester Supplementary Planning Document (February 2016)

This Supplementary Planning Document (SPD) expands upon Policy Bicester 1 of the adopted Cherwell Local Plan 2011- 2031 Part 1.

Policy Bicester 1

Key site-specific design and place shaping principles for these sites include:

- High quality exemplary development and design standards including zero carbon development, and the use of low embodied carbon in construction materials as well as promoting the use of locally sourced materials.
- All new buildings designed to incorporate best practice on tackling overheating, taking account of the latest UKCP climate projections.
- Proposals should enable residents to easily reduce their carbon footprint to a low level and live low carbon life styles.
- Demonstration of climate change mitigation and adaptation measures including exemplary demonstration of compliance with the requirements of Policies ESD1-5.

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4. Voluntary Standards

Due to the lack of progressive targets and updates within the Building Regulations, several independent bodies are heading the roadmap to net zero through their own established energy targets. These standards and benchmarks were created to inform and inspire building design teams to create developments which mitigate against the climate crisis.

The following standards provide guidance on the best practise energy use intensity targets (EUI) for different building types. They further provide recommendations on whole life carbon, including embodied carbon.

4.1 LETI (London Energy Transformation Initiative) Climate Emergency Design Guide

Under LETI, the net-zero operational energy goal must fulfil the following statement:

A new building with net zero operational carbon does not burn fossil fuels, is 100% powered by renewable energy, and achieves a level of energy performance in-use in line with our national climate change targets.

LETI believes that in order to meet the climate targets, all new buildings must operate at net zero carbon by 2030. This is established though the advanced EUI benchmark targets of:

- Residential: 35kWh/m²/yr
- Commercial: 55kWh/m²/yr
- Schools: 65kWh/m²/yr

4.2 UKGBC (UG Green Building Council) Net Zero Carbon Buildings Framework

Within the WKGBC framework, net-zero operational carbon is achieved when:

The amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.

Although UKGBC does not specify minimum energy efficiency requirements, the framework encourages both energy demand and consumption reduction.

4.3 RIBA (Royal Institute of British Architects) Sustainable Outcomes Guide

To ensure that the strong words of the declaration of a climate emergency are matched by actions, the RIBA has set RIBA Chartered Practices a challenge of reducing operational energy demand by at least 75%, before UK offsetting.

RIBA has taken a similar approach to LETI by setting interim EUI targets up to 2030, as seen in Table 3.

Table 4 RIBA building standard targets.

kWh/m²/yr			
Building Type	**Business as usual**	**2025 target**	**2030 target**
Residential	120	<60	<35
Office	130	<75	<55
School	130	<70	<60

4.4 Future Homes Standard (FHS) Part L 2025

Following the 2021 update, the FHS will require a 75% reduction in regulated CO_2 emissions compared to the Part L 2013 requirements. It suggests a slight improvement on the building fabric values compared to Part L 2021 (Table 4). Many argue that this is still not enough to ready a net zero society.

FHS are also to implement a gas ban, favouring heat pumps as the default technology for generating heating and hot water.

5. Outline Planning Consent

The proposed development is subject to outline planning consent 14/02121/OUT which includes the following conditions:

Condition 13

Each reserved matters application shall be accompanied by a statement setting out how the design of buildings and the layout has taken account of future climate impacts, as identified in TSB research 'Future Climate Risks for NW Bicester', or any more recent assessment that has been published, and how the proposed development will be resilient to overheating, changing rainfall patterns and higher intensity storm events.

Condition 20

No phase of development shall commence until a report has been submitted to and approved in writing by the Local Planning Authority outlining how carbon emissions from the construction process and embodied carbon within that phase will be minimised. To ensure development achieves a reduced carbon footprint in accordance with Policy Bicester 1 of the Cherwell Local Plan and guidance contained with Government Eco Town PPS.

Condition 38:

Each dwelling hereby approved shall be provided with real time energy and travel information prior to its first occupation. Details of the provision for each phase shall be submitted to the Local Planning Authority and agreed in writing prior to the commencement of construction of dwellings above slab level."

6. Section 106 Requirements

This document will also provide the information required under Schedule 11 of the Section 106 agreement. This includes:

- Energy demand assessment using SAP/SBEM including regulated and unregulated energy;
- Energy demand reduction proposals;
- Energy generation strategy including anticipated outputs from any proposed technologies;
- Carbon balance using appropriate carbon factors (note S106 references DEFRA 2019, however, carbon factors from SAP 10.2 are proposed as these are more up-to-date).

Baseline Energy Demand

The baseline energy demand is the level from which carbon emissions reduction will be measured for Phase 2.

7. Methodology

Energy modelling for the dwellings has been carried out using Part L accredited software (Elmhurst SAP 10.2). Non-domestic areas will need to be assessed using the Simplified Building Energy Model (SBEM) via IES Virtual Environment.

Both software packages predict the energy demand, energy consumption and carbon dioxide emissions for the proposed development for comparison against a 'notional building'.

The regulated CO_2 emissions of the notional building are used to determine a BER/DER, which will be used to determine a baseline.

The potential CO_2 reductions have been assessed on an aggregate approach across the site, taking into account the orientation, number, size and type of building.

7.1 Operational modelling

As the house types repeat across the site, a representative sample of house types have been assessed, this includes:

» 1 bed flat
» 2 bed flat
» Alder;
» Poplar;
» Everglade; and
» Whitebeam.

7.2 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.

7.3 Building Fabric

The notional building fabric is shown in Table 5.

Table 5 - Notional building fabric properties

Building Element	Part L 2021 Notional U-values
	Volume 1 - Dwellings
Roof	0.11 W/(m²·K)
Wall	0.18 W/(m²·K)
Floor	0.13 W/(m²·K)
Glazing	1.20 W/(m²·K)
Rooflight	1.70 W/(m²·K)
Door	1.00 W/m²·K)
Air Permeability	5 m³/(h·m²) @ 50 Pa

7.4 Building Services

To calculate the baseline carbon emissions the dwellings are assumed to use a gas boiler with heat interface units (HIU) for heating and hot water, and grid derived electricity for all lighting and power.

Dwellings are assumed to be naturally ventilated with mechanical extract for wet areas (kitchens and bathrooms). All equipment efficiencies match the case for a Part L notional building.

8. Baseline carbon emissions and energy use

The baseline regulated carbon emissions for the phase 2 development is **606,800kgCO_2/yr.**

The Part L 2021 notional building Energy Use Intensity (EUI) is **120 kWh/m2/yr**. This value is used as a baseline to assess the energy efficiency of each design stage.

Figure 3 shows the breakdown of each energy use. Heating and hot water are shown to be the biggest contributor of energy demand for the Part L 2021 notional model. The following sections will discuss the proposed passive and active design measures that will be taken to reduce these as far as feasible.

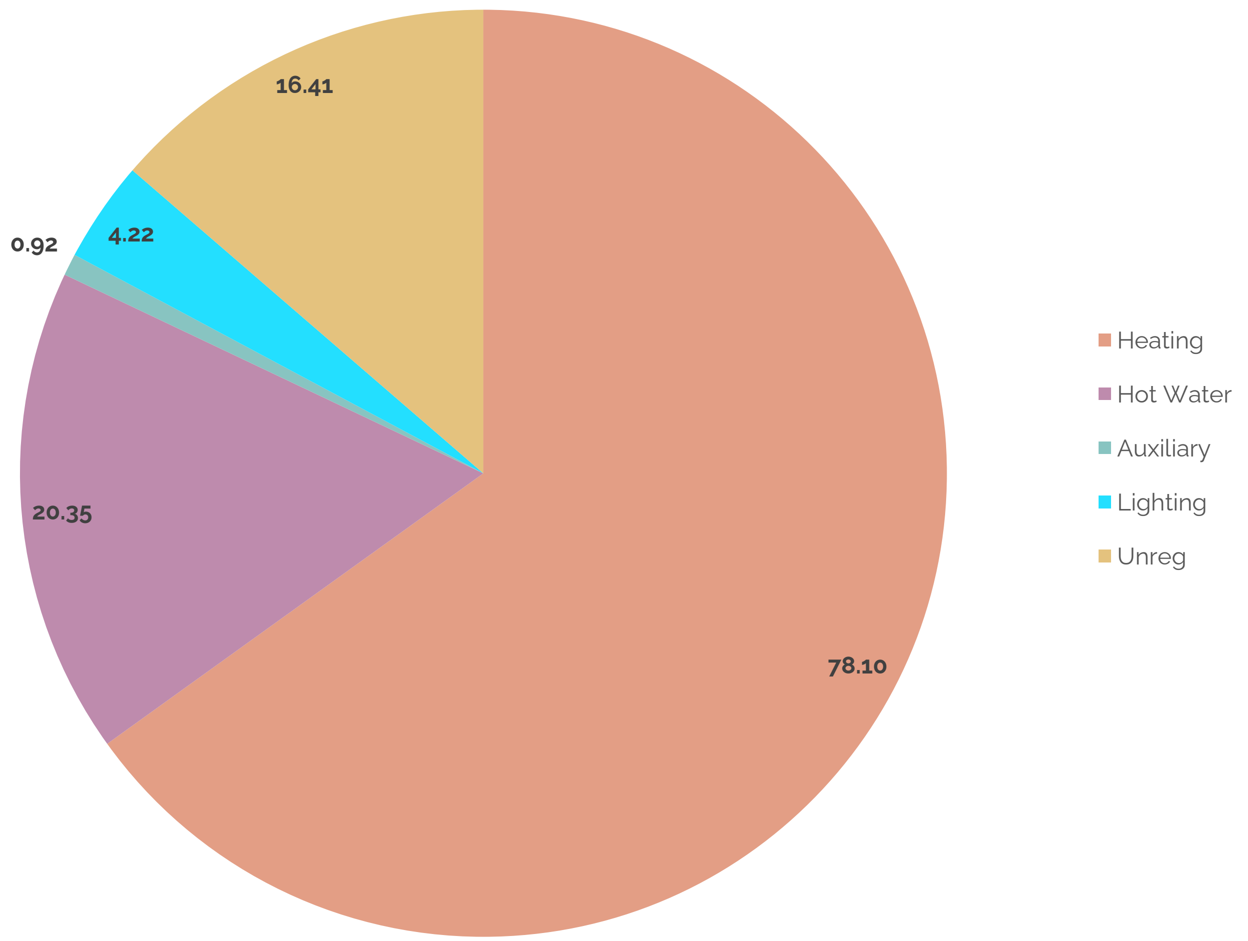

Figure 3 - Breakdown of Part L 2021 EUI

Unregulated Carbon Emissions

Unregulated emissions relate to any energy consuming activities that are not covered under Building Regulations Part L1A. For proposed development, this will include:

- Lifts;
- Small power –Computers and other electrical equipment.
- Kitchen equipment –fridges and dishwashers, etc.
- Laundry equipment –reducing washers and dryers.

The total unregulated carbon emissions baseline for the development is calculated using the BRE Domestic Energy Model (BREDEM) calculation at approximately (1,369,191 kWh/yr) **319,000 kgCO_2/yr.**

The proposed strategy includes measures that will reduce unregulated energy consumption though this is difficult to quantify via energy modelling for Part L.

8.2 Total Baseline Carbon Emissions (phase 2)

The phase 1 carbon emissions rate for both regulated and unregulated energy is **820,800 kgCO_2/yr.**

9. Reaching Net Zero

The development has used the steps in Figure 4 to reach the net zero target.

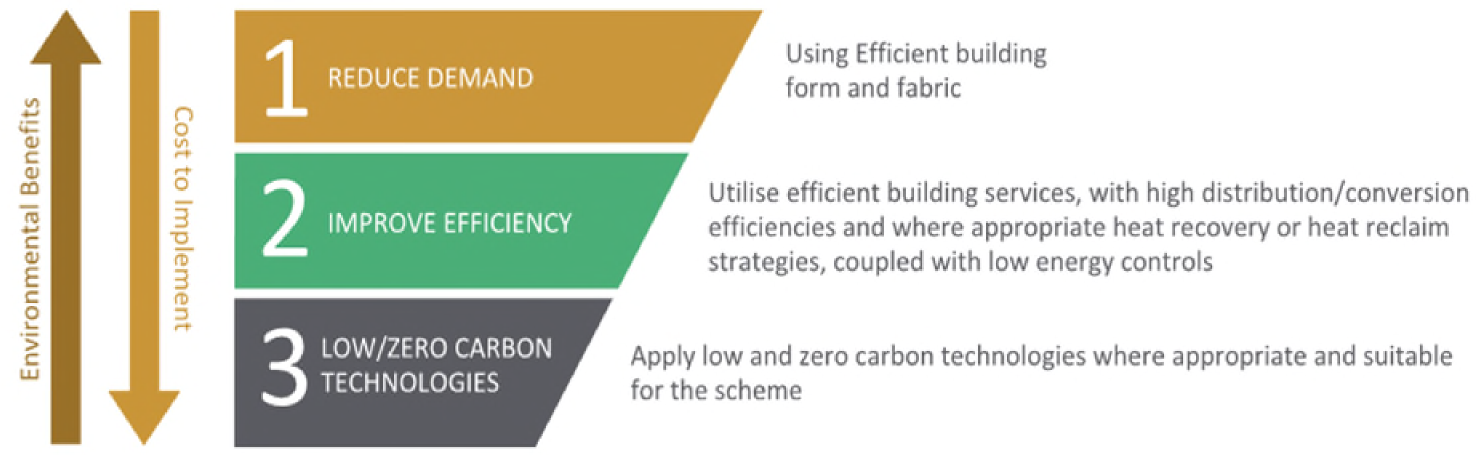

Figure 4 - Operational energy strategy

Be Lean - Reducing the Demand for Energy

The first step in reducing energy use and carbon emissions from development is to reduce demand through passive design and sustainable construction methods.

This section of the report highlights the measures that will be included within the Phase 2 of the Himley Village development to reduce energy demand and subsequent carbon emissions.

10. 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
- Strategic planting of trees to shelter lower-level buildings from high winds and provide shading from the sun.

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

The houses have been orientated with respect to the sun's path where possible maximize solar gain at the appropriate time of the year when required in a cold climate and to minimise solar gain during summer months.

Glazing layout and specification have 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.

The design team has worked hard to improve the project's passive design performance, both the window and external wall U-values have been iteratively improved during the design process. The final U-values for the floor, roof and glazing have also been confirmed as per Figure 5.

Table 6 - Proposed building fabric for the dwellings

Building Element	U-value
Roof	0.10 W/(m²·K)
Wall	0.18 W/(m²·K)
Floor	0.13 W/(m²·K)
Glazing	1.20 W/(m²·K)

Air permeability of 3 m³/hr/m² 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 principal contractor.

Figure 5 - Passive and active design measures towards operational net zero

11. 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 Building Services Compliance Guides (2013).

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

11.1 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 and under floor heating. Hot water delivery will include high levels of insulation, coupled with efficient fittings to minimise water consumption and energy consumption.

Ventilation will be via openable windows for purge ventilation with, mechanical ventilation with heat recovery (MVHR). This will ensure a constant supply of fresh air into dwellings. Ventilation systems will be selected to ensure they have a low specific fan power to reduce energy use.

Generally, all equipment will be specified to achieve a high efficiency (e.g. high thermal conversion efficiency for heating equipment) 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.

11.2 Smart Metering – Real Time Data

To further reduce emissions associated with plug-in devices, all dwellings will be provided with a smart meter to provide real time energy use and cost data.

In line with Condition 38 of the outline consent, smart meters will be coupled with in-home energy display devices allowing residents to visualise their energy use in graphical and cost format will provide instant feedback on the energy and carbon implications of day-to-day plug-in equipment, and thermostat settings.

Be Clean – Supply Energy Efficiently

This section of the report will explore ways in which the developments heating and hot water could be provided via connection to any existing or planned district heating networks.

12. District Heating Network

12.1 Himley Village Site Wide Heat Network

The outline planning application suggests that heating and hot water at the Himley Village development will be provided by a site wide district heating network. This would be served via a single energy centre building and powered by gas combined heat and power as the primary heat source.

No heat network is currently being brought forward by the wider Himley Village development. Furthermore, any heat network powered by gas CHP would be technologically out of date by the time the network became active and a decarbonisation plan would need to be introduced. To maximise the carbon reduction that can be achieved through efficient heating and hot water production, it is proposed that this plot on the Himley Village development would not connect to any site wide heat network.

12.2 Phase Wide Heat Network

As a site wide heat network is not currently being brought forward, a smaller heat network could be developed at phase level. Phase 2 consists of low-density housing and the annual heat load would not be sufficient to support a heat network. Furthermore, to align with the UK Government Future Homes Standard, it is the desire of the development to be gas free and all heat will be provided via electricity. To provide more control in the future to residents over how their heat is produced, heating and hot water infrastructure will be provided at a localised level.

13. Improving Efficiency

13.1 Mechanical Ventilation Systems with Heat Recovery

The design is looking to incorporate Mechanical Ventilation Systems with Heat Recovery (MVHR). MVHR works by extracting air from inside dwellings/buildings and passing it through a central heat exchanger to recover and retain the heat that would otherwise be lost from the extracted air. This heat is then transferred to incoming fresh, filtered air that the unit is resupplying back into the rooms. The technology is highly efficient, minimising heat losses and reducing space heating demand, whilst also significantly improving indoor air quality.

13.2 Energy Efficient Appliances

Energy efficient equipment will be specified (where provided) to follow the principles outlined in CIBSE Guide TM50, where possible. For example, small domestic white goods (such as fridges where provided), will be specified to be A+ rated under the EU Energy Efficiency Labelling scheme.

Due to the high reliance on occupant behaviour patterns, it is difficult to predict the reduction in energy consumption and carbon emissions that can be achieved through the inclusion of these measures.

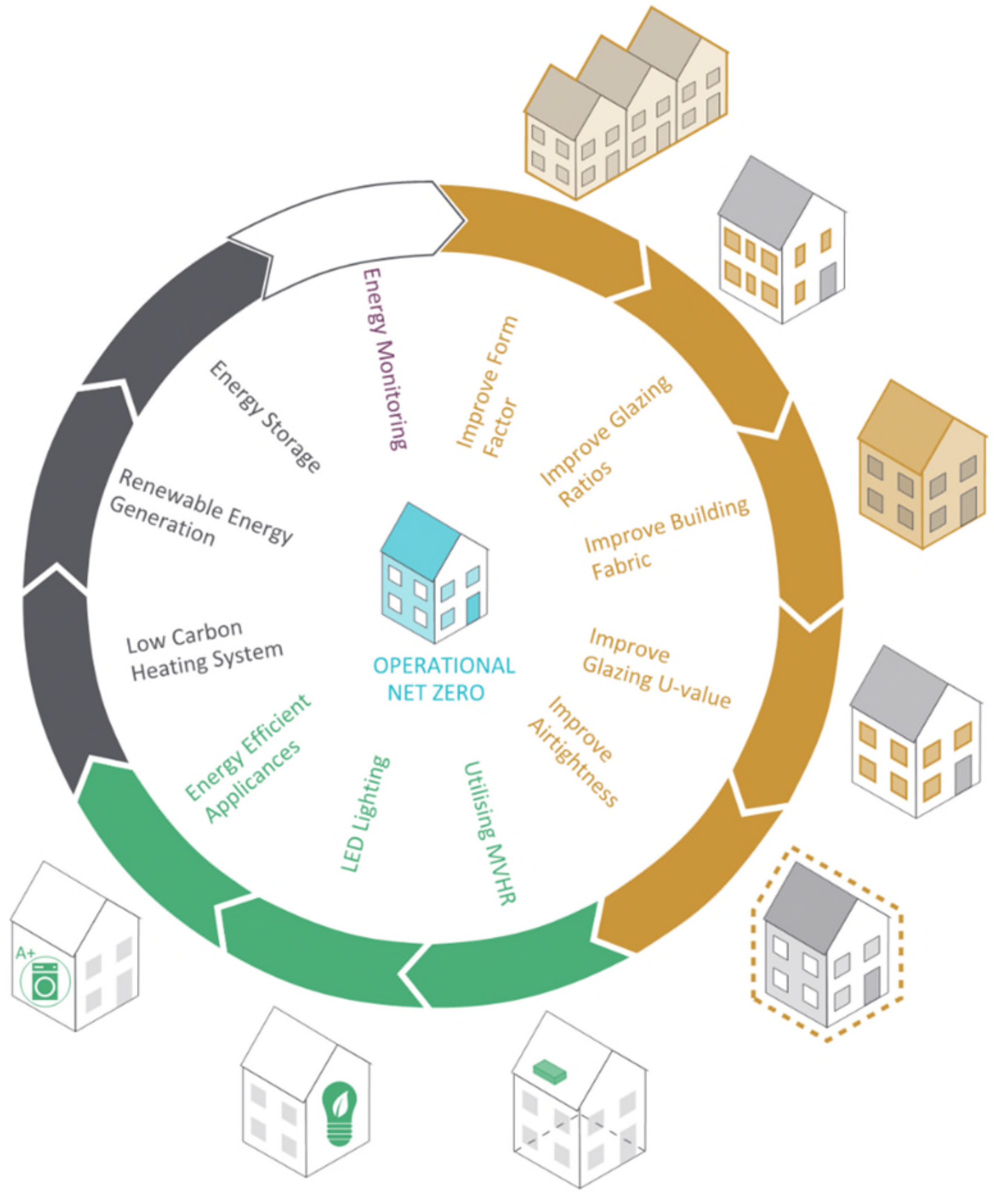

Figure 6 – Energy efficiency measures towards operational net zero

Be Green – Use Low/Zero Carbon Technologies

This section of the report provides a summary of the potential and viable renewable technologies that could be installed at the Himley Village development. In order to meet the requirement of net zero carbon emissions across the year.

14. Heating and hot water generation

As heating and hot water are the main contributors of energy demand for the Part L 202 notional building, ensuring these are energy efficient is vital to reach net zero.

The below sections discuss low carbon technologies which reduce energy demand.

14.1 Heat Pumps

Heat pumps provide a highly efficient method of heat production for site heating and hot water; up to 3-4x as efficient as a conventional boiler. This can significantly reduce carbon emissions associated with space heating and domestic hot water, the two biggest consumers of energy in dwellings.

Heat pumps are powered by electricity, so are considered low-carbon rather than zero-carbon/renewable, however, as the grid decarbonises, they will become more efficient.

They are specified based upon whether they utilise ground, air or water as the source of heat. The proposed strategy combines the use of GSHP and ASHP.

14.1.1.1 Ground Source Heat Pump

GSHPs which use shared ground loop arrays provide further energy savings, compared with ASHPs. In this, ambient water is pumped from the ground loop to individual building heat pumps, where it is converted to a higher temperature for hot water and heating. This can significantly reduce carbon emissions and operational costs for residents.

GSHPs are preferred in instances where there are space restrictions as they take up less room. They are also much quieter than ASHPs as they do not take heat from the air, they do not need a fan. semiconductor

With this technology it is also possible to provide passive cooling with very low energy use as only the pump and compressor is consuming electricity. This offers a key adaptation benefit and would help to mitigate risk of future heat stress.

14.1.2 Air Source Heat Pump

ASHPs utilise the residual heat in external air to produce usable heat for heating and domestic hot water.

14.2 Proposed heating and hot water generation for Himley

It is proposed that heating and hot water will be provided via heat pump technologies.

> *GSHPs will be used to provide heating and hot water for the apartment blocks in Phase 2 of Himley Village.*
>
> *ASHPs will be used to provide heating and hot water for all the terrace, semi-detached, and detached houses in Phase 2 of Himley Village.*

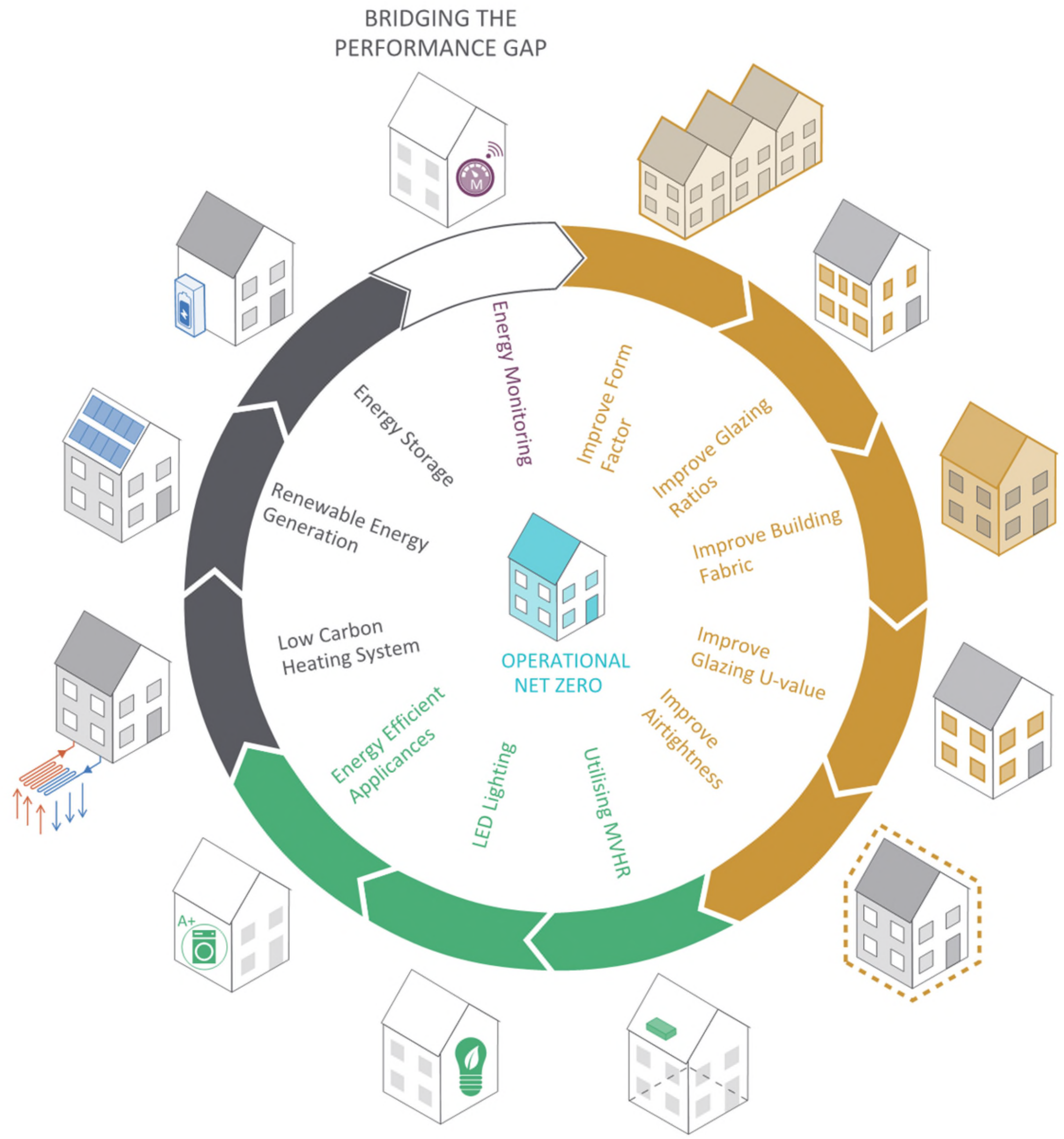

Figure 7 - Operational net zero through low and zero carbon technology

14.3 Waste Water Heat Recovery System

The site will also use Waste Water Heat Recovery Systems (WWHRS) for the showers.

WWHRS is a simple heat recovery device that recycles the heat energy from waste shower water. It uses it to preheat mains cold water and sends the preheated water to the shower and/or water heater. This can reduce the energy required per shower use by up to 55%.

15. Renewable energy generation technology options

To reduce carbon emissions further throughout the year, renewable technologies in addition to the use of GSHPs and ASHPs will be required. The following pages provide an initial options appraisal and highlight the technologies that will be included within the first plot at Himley Village.

15.1 Photovoltaic Panels

Solar PV works by converting light into electricity using a semiconductor material. PV panels don't need direct sunlight to work; electricity can still be generated on a cloudy day.

Solar irradiance, which is the power per unit area (W/m²) received from the sun is measured annually. Monthly irradiation figures are shown in the following figures.

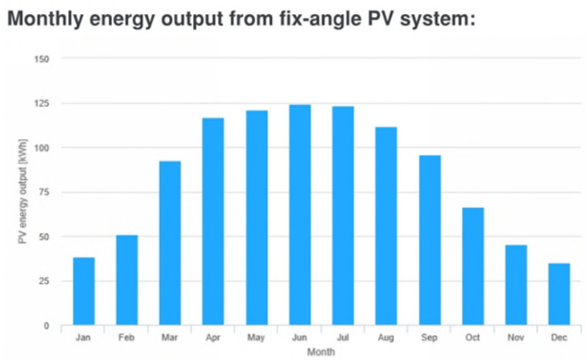

Figure 8: Monthly energy output from solar PV.

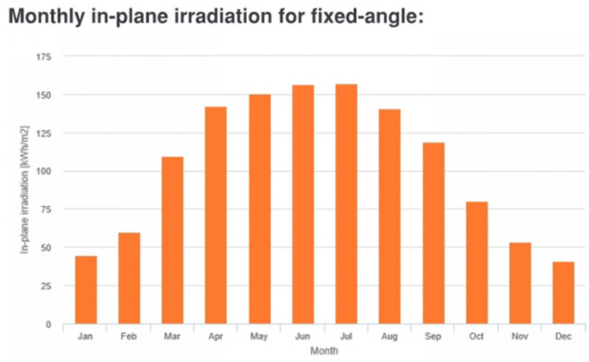

Figure 9: Monthly irradiation for solar PV.

It is anticipated that the site will receive approximately 900 kWh/m²/yr based on the UK irradiance chart, which makes a great case for installing solar.

PV panels themselves vary in efficiency from 15-21% (average) to 23% (most efficient). Panels should face between SE and SW, at an elevation of about 30˚ – 40˚ for maximum output. The spacing of rows of panels should minimise over-shading of each other and also account for the maintenance space required.

In terms of location and orientation, there should be no overshadowing of the panels, as this reduces their overall efficiency. Even shading a small part of a PV panel could significantly reduce its efficiency and the efficiency of other PV panels connected in the string. Overshadowing can be caused by trees, other buildings, roofs of adjacent buildings, dormer windows, roof furniture, etc.

15.2 Solar Thermal Panels

Figure 10: Solar thermal hot water panels.

Solar thermal panels collect heat from the sun via a series of tubes, called collectors, that are filled with a heat transfer fluid. The warm fluid is then pumped through a coil in a water cylinder, warming the water; typically providing a 60˚C output at the tap. Solar thermal is not as flexible as PV in terms of installation location; as it will require a roof. A double coiled hot water storage tank would also be required.

Typically, solar thermal is used in collaboration with a secondary heat source as it cannot provide all of a developments hot water; (typically 50-60%). A heat pump or boiler back-up would also be used to top up the temperature of the water if it isn't high enough, or to provide hot water at night.

Although heat from solar hot water collectors can be stored in hot water cylinders, during the summer, when hot water production will be at its peak, a high proportion of this can be wasted if there is not a dedicated heat sink.

Systems would be sized to meet peak summer hot water demand – for a typical dwelling at Himley Village this is expected to be approximately 150l/day, however, this may be increased for larger family houses.

15.3 Wind Turbines

Wind turbines can provide efficient and cost-effective renewable electricity generation. The annual output from wind turbines is highly dependent on the local wind speeds at the site, and are generally suited to unobstructed developments where good separation distances between turbines and residential dwellings can be achieved.

Whilst a wind turbine would provide a significant portion of the electricity demand at the Himley Village development, other issues associated with wind turbines need to be taken into account:

- Shadow flicker from rotating blades;
- Vibration and noise from generators;
- Environmental impact on local bird species.

16. Proposed renewable technology

The development will utilise photovoltaic panels situated on all roofs that received sunlight (those that are oriented east through west).

The site layout has been designed to maximise the number of roof spaces that will be suitable for installing PV panels. Due to the roofs being pitched, panels can be installed without the need for spacing to account for overshadowing, increasing the overall roof area available.

The details of the proposed PV installation are shown in Table 6.

Table 7 - PV installation details

Energy Supplied	Carbon Emissions Saved
2,474 kWp	289,000 $kgCO_2/m^2/yr$

This PV installation takes advantage of all suitable roof space within the development to maximise carbon emission reduction. The PV proposed will provide a **carbon offset of approximately 289,000 $kgCO_2$/yr**, this is equivalent to a 35% reduction in carbon emissions from PV alone (taking into account both regulated and unregulated carbon).

Please see Appendix A for an assessment of the roof designs/orientations of the different house typologies.

Delivery Net Zero at Himley Village - Site Wide Approach

The section details the proposed strategy across the site to ensure that the Himley Village proposals as a whole will meet the net zero carbon requirement.

17. Importance of Energy Use Intensity (EUI)

Energy efficiency is vital for a rapid transition to zero carbon as it reduces energy demand and therefore, the energy generation capacity required.

Currently, Building Regulations use carbon as the key metric to assess the energy efficiency and sustainability of a building but there are a number of problems with this:

- Carbon factor values used in current Building Regulations are out of date, they do not account for decarbonisation of the grid;
- Carbon factor for electricity is fixed – in reality this fluctuates dependent on power generation technologies at any one time;
- Energy consumption calculations are over-simplified and under-estimate in use consumption;
- Comparison of the predicted performance of a building with its in-use performance is not possible without bespoke metering arrangements.

Energy Use Intensity (EUI) is measured in kilowatt hours per m^2 per year (kWh/m^2/annum) and is the total amount of energy consumed by a building on an annual basis divided by floor area which allows easy and direct comparison of building performance.

EUI removes 'carbon intensity' which has less relevance as fossil fuels are removed for heating and is widely adopted by best practice guidance for achieving Operational Net Zero.

In relation to Net Zero, the EUI of a building is counterbalanced with a renewable generation of electricity equal to the Energy use, commonly referred to as the Net Zero Energy Balance. As EUI is easily measured in-use by totalling the annual energy consumption from utility bills (in kWh), the EUI of a building can be set at the design stage, compared with the in-use values and dynamic energy modelling (where available) to obtain an accurate prediction of energy use in operation.

Using EUI as a metric allows the development to not only reduce carbon emissions but also provide a robust approach to tackling issues such as:

- Net zero
- Grid capacity
- Fuel cost to residents and alleviation of fuel poverty
- Operational efficiency (performance gap)
- Long-term asset value (ESG criteria)
- Autonomy oversupply and resilience (ability to manage and offset grid pricing fluctuations etc).

17.1 Himley Phase 2 EUI

As seen in Table 7, the current combination of GSHP and ASHPs results in a EUI of **54.7 kWh/m^2/yr** for the proposed development.

Figure 11 shows that the main bulk of energy demand is now attributed to the unregulated energy. It is possible that this value will fluctuate depending on the homeowner's behaviours, and in some cases be lower. However, the heating and hot water demand have been significantly reduced, resulting in

Table 8 - Himley Village EUI breakdown comparison to Part L and RIBA 2030.

Domestic EUI	Heating	Hot Water	Ventilation	Lighting	Unregulated energy	Target EUI per phase
	(kWh/m^2/yr)					
Part L 2021	78.1	20.4	4.2	0.9	16.4	**120.0**
RIBA 2025	11.4	14.0	6.0	1.5	27.0	**60.0**
Himley Village phase 2	**8.4**	**17.0**	**4.3**	**1.7**	**23.3**	**54.7**

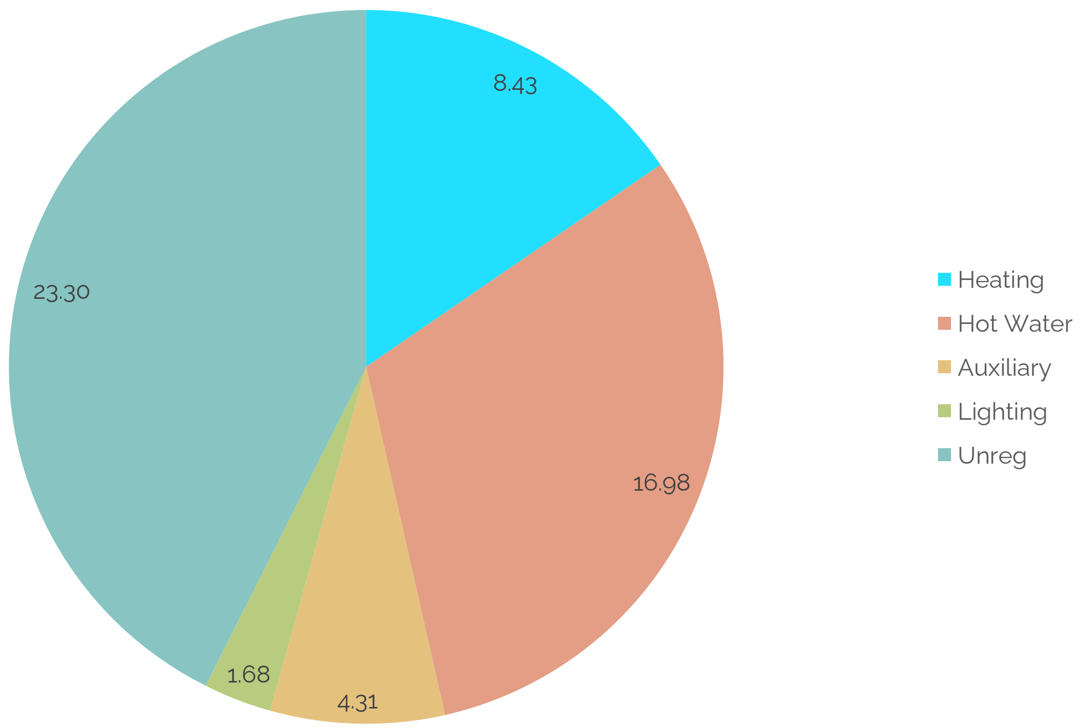

Figure 11 - Breakdown of EUI for Phase 2 of Himley Village

[1]LETI Climate Emergency Design Guide [2020]

an overall saving of 54% compared .to the Part L 2021 notional building.

The strategy has shown that it significantly outperforms current industry benchmarks, as it falls below both the Part L 2021 notional building and the RIBA 2025 EUI target benchmarks.

18. Delivery of Net Zero Site Wide

Although phase 2 does not currently meet net zero, it is likely that the future parcels will have greater potential to reach net zero. This is due to both the green skills gap and the increased opportunity for renewable energy. Both of these are discussed in more detail below.

18.1 Green Skills Gap

Employers are learning that many of the high-performance green buildings built over the last decade are not living up to their energy efficiency potential because there is a green skills gap among building operators and building technicians. Without a skilled workforce, these buildings will not provide the environmental or financial return on investment as expected.

LETI Climate Emergency Design Guides[1] states that, for each dwelling to achieve zero carbon 'on plot' the total EUI (Energy Use Intensity) must be 35kWh/m^2/yr or lower. However, due to the current green skills gap for 'Passivhaus' level performing fabric, this EUI is extremely difficult to achieve in practice and at a scale where optimal orientation to reduce demand may also not be possible for every home.

18.2 Increased renewable energy opportunity

The wider Himley site will include commercial buildings a school and community spaces. These buildings are typically designed to have flat roofs, which means, there will be a larger proportion of available roof area for PV installation.

As the wider site will be able to produce a higher kilowatt peak through PVs per plot, there may be an incentive to include batteries in the design. This will bridge the gap between demand and supply for energy and ensure all energy produced by the PVs is used on-site first before exporting to the grid.

Conclusions

This report has provided an overview of the calculated carbon emissions for phase 2 of the Himley Village development, and the measures in place to reduce on-site carbon emissions.

The development has been designed to minimise on-site energy use and carbon emissions in line with the energy hierarchy and has sought to meet the requirements of Policy Bicester 1 of the Cherwell Local Plan.

19. Reaching Net Zero

The design team has worked to incorporate passive design principles into the scheme from the outset of the project. The building fabric has been specified is in line with the standards contained within the Future Homes Standard 2025.

In addition to good levels of building fabric efficiency, dwellings have been oriented to have south-facing aspects where possible to maximise solar gains and reduce heating demands. Tree planting and green infrastructure throughout the site will provide shading during the summer months to mitigate overheating risk.

19.1 Heating and hot water

To comply with the Future Homes Standard and benefit from the fast decarbonisation of the national grid, the development will not use gas and instead rely on a combination of GSHPs and ASHPs for heating and hot water generation.

GSHPs will be used for the flats with a ground loop array. The heat pump will be sited inside the flats. ASHPs will be used for the houses and will be sited externally. All heat pumps will be sized to provide 100% of the heating and hot water demand.

19.2 PV panels

Following the use of GSHPs, carbon emissions will be reduced further by the installation of photovoltaic panels. The design team has assessed the site layout to maximise the number of available roof spaces. All roofs that are facing east, southeast, south, southwest, and west will have PV panels installed, this equates to a total installed capacity of 2,168 kWp.

19.3 Comparison with North West Bicester Exemplar Scheme

Although Elmsbrook (the North West Bicester Eco Town Exemplar site) has met zero carbon through its energy strategy, this has included the use of a heat network that used gas CHP to provide heating and hot water. The reliance on electricity at Himley rather than gas has made this project more futureproofed than Elmsbrook.

As the grid decarbonises, it will eventually become carbon negative, whilst emissions created by the use of gas will still need to be offset.

Table 9 - Carbon emissions at each stage of the energy hierarchy

	Regulated Carbon Emissions ($kgCO_2/yr$)	Unregulated Carbon Emissions ($kgCO_2/yr$)	Total Carbon Emissions ($kgCO_2/yr$)	Percentage Saving
Baseline	570,900	214,000	784,900	
After passive design and GSHP	225,800	160,300	386,100	50.8%
After PV	0	97,000	97,000	87.6%

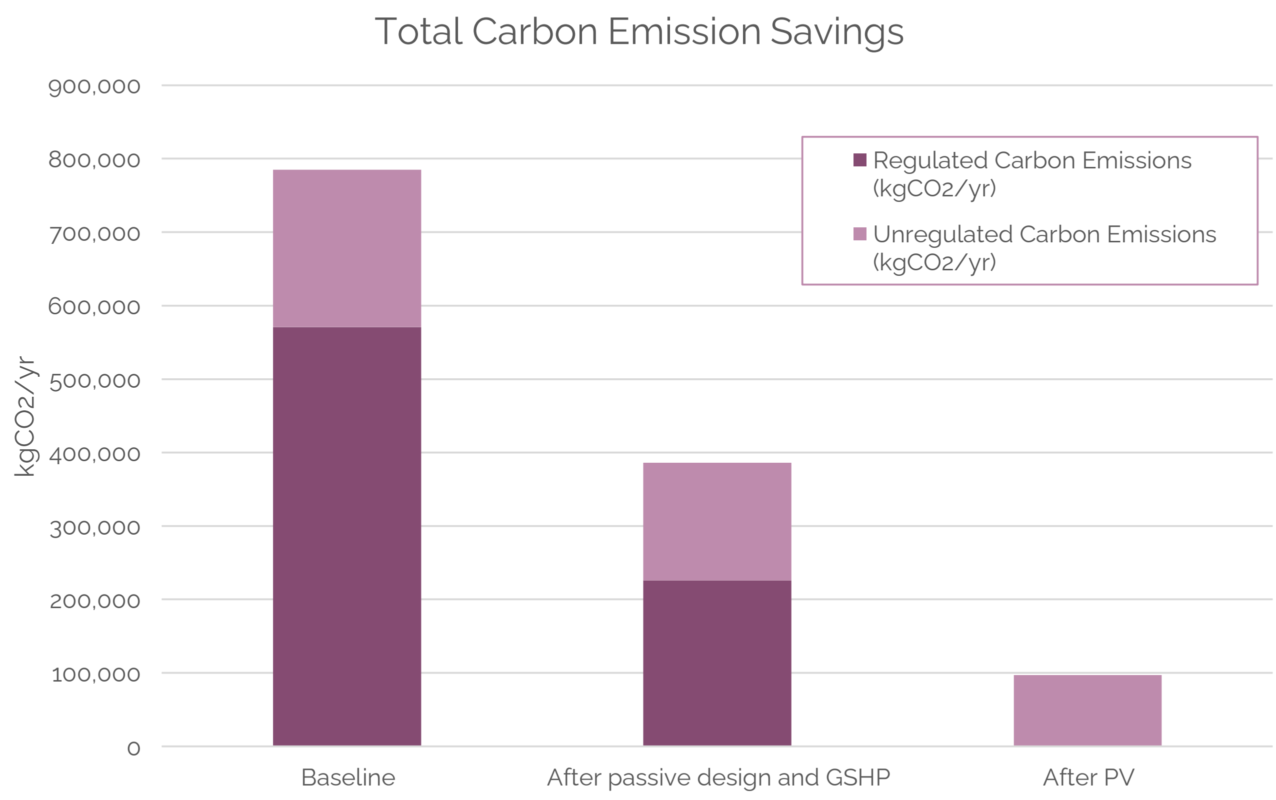

Figure 12 - Total carbon emission savings using GSHPs

Appendix A Roof shading assessment

An assessment has been carried out using Rhino, which is a 3D computer graphics and CAD application software, to show the potential shading on the roofs of the different housing typologies. This assessment was carried out to highlight areas on the roofs that would be unable to have PV.

All roofs facing south, west or east have been assessed for the potential area for PV coverage.

Figure 13 shows the solar irradiation of Tulipwood when facing west to east. The skylights on the west-facing roof mean that there would not to space to fit an array of PV. The East facing roof also has a skylight which would reduce the potential PV area. The extrusion on the East roof has also caused shading which would reduce the cause output from the PV panels to be reduced. Therefore, only the areas marked in green would be suitable for PV panels.

Figure 14 shows the solar irradiation for Wisteria when orientated to face the north and the south. The extrusion on the south roof has caused some shading on either side. This means there is less area for a PV array. However, the area shown marked in green

PV panel installation has been restricted to certain house types due to skylights and extrusions. While it is possible to add PV panels on the garages, they are prone to shading as they are not as elevated as the houses. Additionally, the available space on the garage roofs is limited, resulting in a small PV array.

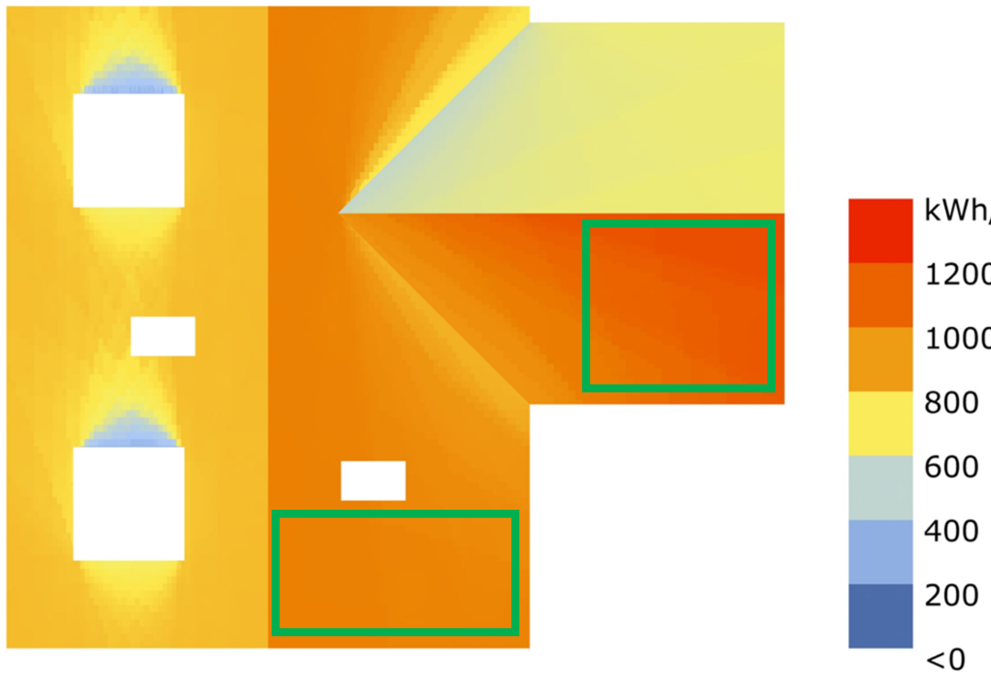

Figure 13 - Solar irradiation for Tulipwood (West-East)

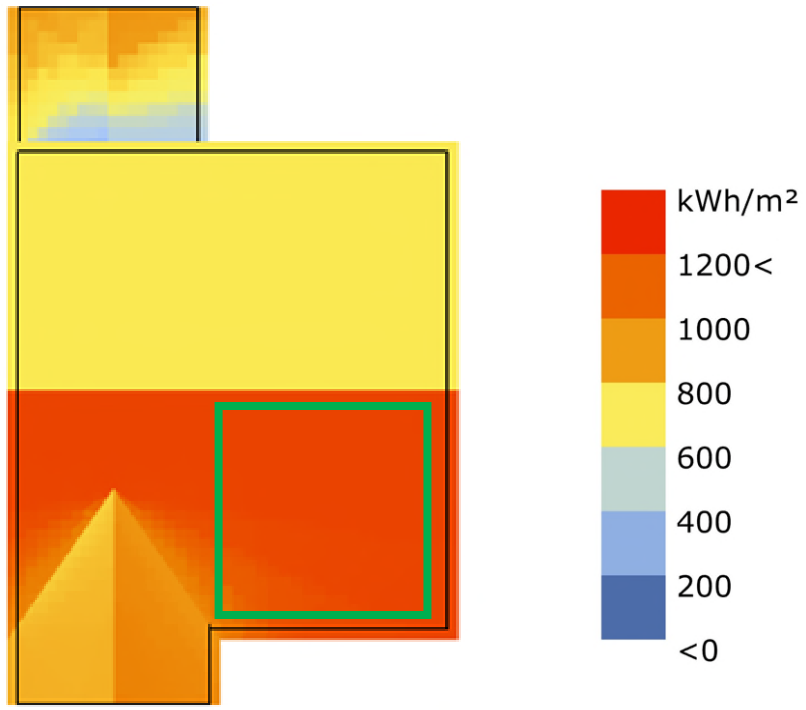

Figure 14 - Solar irradiation for Wisteria (North-South)

Appendix B Allocated PV arrays

The image to the left shows the colour each roof has been allocated for PV. The table on the following page gives detail on the size of the PV array and the subsequent kWp.

1	8.5 W
2	S 25
3	16 W 24 E
4	46 W 34 E
5	23 WE
6	26 S
7	24 S
8	20 W 34 E
9	20 E 8.5 S
10	51.36 S
11	38 S
12	25 S
13	32 S
14	29 W 39 E
15	20 W 8.5 S
16	24.5 W 15 E
17	15 S
18	8.5 WE
19	43 S
20	33 WE
21	75 S
22	29 WE
23	25 W 16 E
24	32 W 42 E
25	22 WE
26	12 S
27	8.5 S
28	10 S
29	20 S 8.5 WE
30	73 W
31	22 WE
32	20 W 14 E
33	20 E 14 W
34	14 E 10 W
35	16 S
36	14.5 S
37	84 S
38	15 WE
39	47 E 34 W
40	88 WE
41	25 W 38 E
42	42 W
43	73 WE
44	29 S
45	25 WE

House Type	No. Roof	Available array area	Area after shading/cleaning	Orientation	No. Panels per roof	Total Panels	Total kWp	kWh p.a.	Total kWh p.a.
1	1	8.50	5.95	W	3	3.00	1.20	777	932
2	32	25	17.50	S	10	320.00	128.00	987	126,336
3	8	16	11.20	W	7	56.00	22.40	777	17,405
3	8	24	16.80	E	10	80.00	32.00	790	25,280
4	7	46	32.20	W	20	140.00	56.00	777	43,512
4	7	34	23.80	E	14	98.00	39.20	790	30,968
5	28	23	16.10	W	10	280.00	112.00	777	87,024
5	28	23	16.10	E	10	280.00	112.00	790	88,480
6	14	26	18.20	S	11	154.00	61.60	987	60,799
7	37	24	16.80	S	10	370.00	148.00	987	146,076
8	3	20	14.00	W	8	24.00	9.60	777	7,459
8	3	34	23.80	E	14	42.00	16.80	790	13,272
9	2	20	14.00	S	8	16.00	6.40	987	6,317
9	2	8.5	5.95	S	3	6.00	2.40	987	2,369
10	3	51.36	35.95	S	22	66.00	26.40	987	26,057
11	7	38	26.60	S	16	112.00	44.80	987	44,218
12	44	25	17.50	S	10	440.00	176.00	987	173,712
13	2	32	22.40	S	14	28.00	11.20	987	11,054
14	4	29	20.30	W	12	48.00	19.20	777	14,918
14	4	39	27.30	E	17	68.00	27.20	790	21,488
15	10	29	20.30	W	12	120.00	48.00	777	37,296
15	10	8.5	5.95	S	3	30.00	12.00	987	11,844
16	7	24.5	17.15	W	10	70.00	28.00	777	21,756
16	7	15	10.50	E	6	42.00	16.80	790	13,272
17	3	15	10.50	S	6	18.00	7.20	987	7,106
18	11	8.5	5.95	W	3	33.00	13.20	777	10,256
18	11	8.5	5.95	E	3	33.00	13.20	790	10,428
19	7	43	30.10	S	18	126.00	50.40	987	49,745
20	4	33	23.10	W	14	56.00	22.40	777	17,405
20	4	33	23.10	E	14	56.00	22.40	790	17,696
21	1	75	52.50	S	32	32.00	12.80	987	12,634
22	2	29	20.30	W	12	24.00	9.60	777	7,459
22	2	29	20.30	E	12	24.00	9.60	790	7,584
23	6	25	17.50	W	10	60.00	24.00	777	18,648
23	6	16	11.20	E	7	42.00	16.80	790	13,272
24	6	32	22.40	W	14	84.00	33.60	777	26,107
24	6	42	29.40	E	18	108.00	43.20	790	34,128
25	2	22	15.40	W	9	18.00	7.20	777	5,594
25	2	22	15.40	E	9	18.00	7.20	790	5,688
26	6	12	8.40	S	5	30.00	12.00	987	11,844
27	21	8.5	5.95	S	3	63.00	25.20	987	24,872
28	5	10	7.00	S	4	20.00	8.00	987	7,896
29	2	20	14.00	S	8	16.00	6.40	987	6,317
29	2	8.5	5.95	E	3	6.00	2.40	790	1,896
29	2	8.5	5.95	W	3	6.00	2.40	777	1,865
30	2	73	51.10	E	31	62.00	24.80	790	19,592
31	3	74	51.80	E	32	96.00	38.40	790	30,336
31	4	75	52.50	E	32	128.00	51.20	790	40,448
31	7	22	15.40	W	9	63.00	25.20	777	19,580
31	7	22	15.40	E	9	63.00	25.20	790	19,908
32	11	20	14.00	W	8	88.00	35.20	777	27,350
32	11	14	9.80	E	6	66.00	26.40	790	20,856
33	15	20	14.00	E	8	120.00	48.00	790	37,920
33	15	14	9.80	W	6	90.00	36.00	777	27,972
34	6	14	9.80	E	6	36.00	14.40	790	11,376
34	6	10	7.00	W	4	24.00	9.60	777	7,459
35	20	16	11.20	S	7	140.00	56.00	987	55,272
36	2	14.5	10.15	S	6	12.00	4.80	987	4,738
37	6	84	58.80	S	36	216.00	86.40	987	85,277
38	2	15	10.50	W	6	12.00	4.80	777	3,730
38	2	15	10.50	S	6	12.00	4.80	987	4,738
39	2	47	32.90	E	20	40.00	16.00	790	12,640
39	2	34	23.80	W	14	28.00	11.20	777	8,702
40	1	88	61.60	W	38	38.00	15.20	777	11,810
40	1	88	61.60	E	38	38.00	15.20	790	12,008
41	1	25	17.50	W	10	10.00	4.00	777	3,108
41	1	38	26.60	E	16	16.00	6.40	790	5,056
42	2	42	29.40	S	18	36.00	14.40	987	14,213
43	1	73	51.10	W	31	31.00	12.40	777	9,635
43	1	73	51.10	E	31	31.00	12.40	790	9,796
44	2	29	20.30	S	12	24.00	9.60	987	9,475
45	45	25	17.50	W	10	450.00	180.00	777	139,860
45	45	25	17.50	E	10	450.00	180.00	790	142,200

TOTALS	Energy Supplied	2,125,340	kWh/yr
		2,125	MWh/yr
		2,474	kWp
	Carbon Emissions Saved	289,046	kgCO2/m2/yr

South	987 kWh/kWp
West	777 kWh/kWp
East	790 kWh/kWp