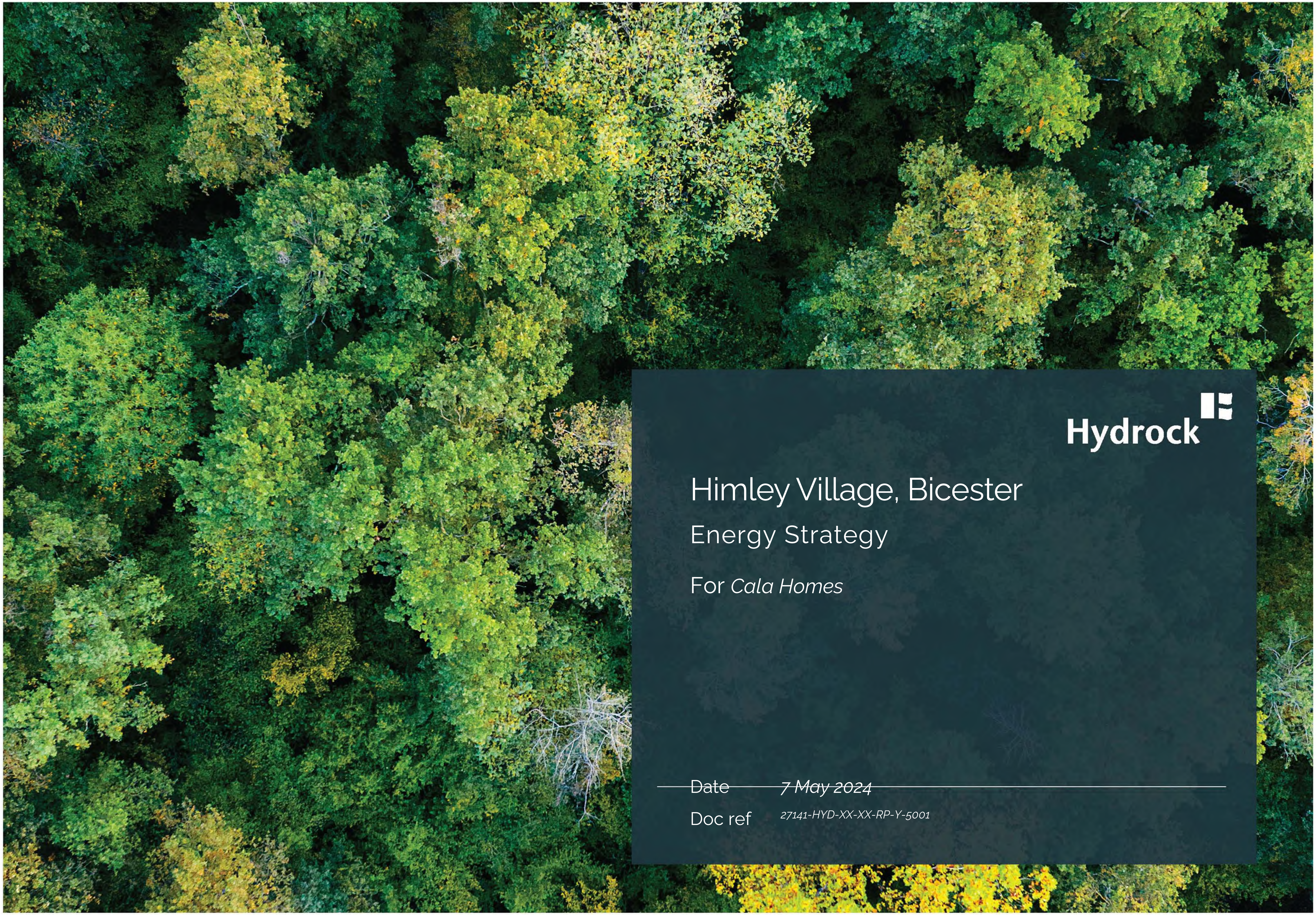

Hydrock

Himley Village, Bicester

Energy Strategy

For *Cala Homes*

Date 7 May 2024

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

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Executive Summary

This report intends to provide an overview of the site wide energy strategy at Himley Village, Bicester. The proposed development will meet the planning requirements laid out in Policy Bicester I.

The site has been designed to be 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 roof mounted PV.

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

Table 1 - Carbon emissions summary

	Total Carbon Emissions ($kgCO_2$/yr)	Percentage Saving
Baseline	175,200	
After passive design and GSHP	71,500	59%
After PV	0	100%

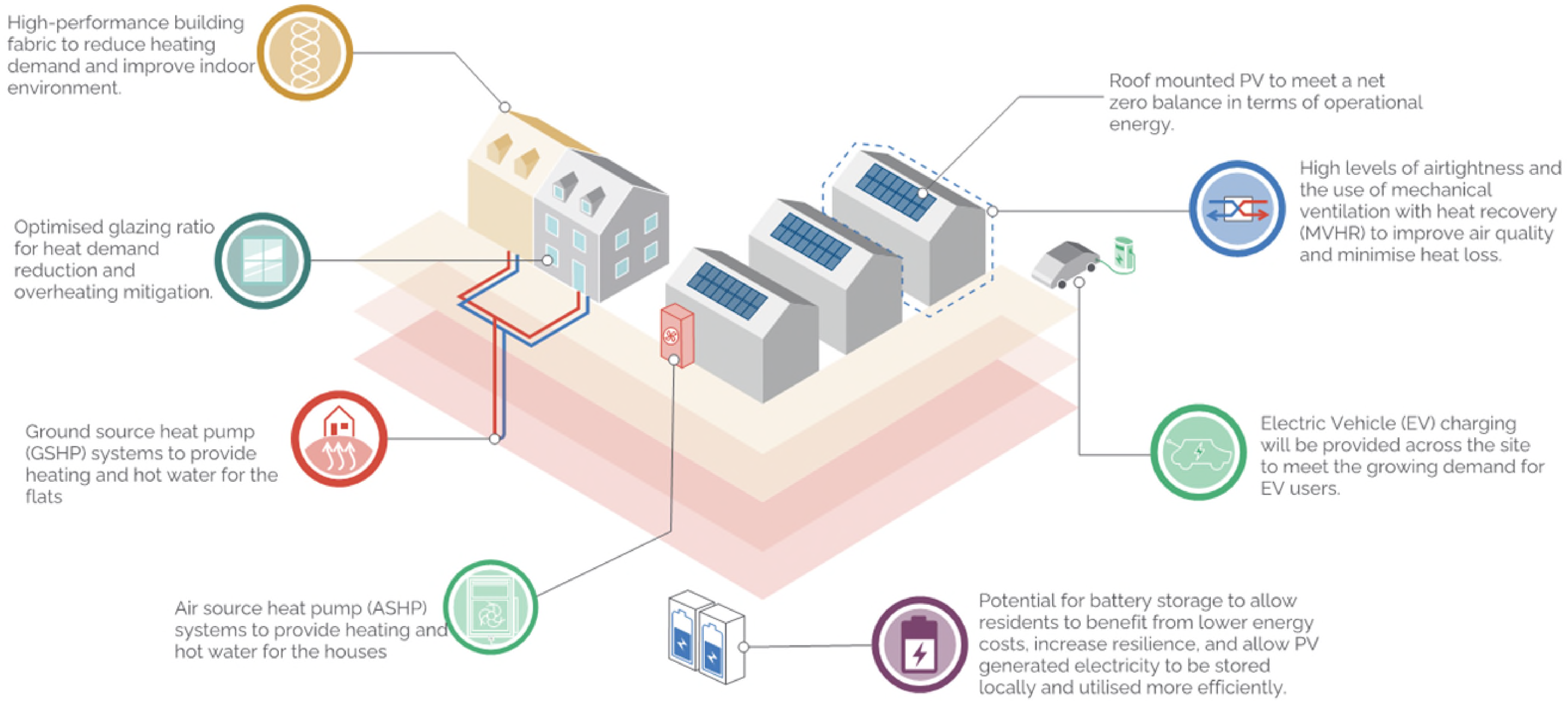
Energy Balance for Phase 2A

The energy use intensity (EUI) for the dwellings has been reduced as far as practical through passive design and energy efficient technologies including MVHR, ASHPs and GSHPs. The energy strategy for the site is shown in Figure 1.

The resulting EUI for the development is **45 kWh/m²/yr**.

To reduce the carbon emissions at the site to zero, this EUI has been balanced with the proposed renewable energy generation at the site.

The resulting EUI from PV panels is **46 kWh/m²/yr** - **resulting in a net zero carbon development.**



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 2A 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 SAP10.2 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.

Figure 2 - Proposed site masterplan

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, these 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

kgCO2/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/(m²·K)	0.15 W/(m²·K)
Wall	0.18 W/(m²·K)	0.18 W/(m²·K)
Floor	0.13 W/(m²·K)	0.15 W/(m²·K)
Glazing	1.20 W/(m²·K)	1.40 W/(m²·K)
Rooflights	1.70 W/(m²·K)	2.10 W/(m²·K)
Door	1.00 W/m²·K)	1.90 W/m²·K)
Air Permeability	5 m³/(h·m²) @ 50 Pa	5 m³/(h·m²) @ 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.

4. 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."

5. 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.

6. Methodology

Energy modelling for the dwellings has been carried out using Part L accredited software (Elmhurst SAP 10.2).

This software package predicts 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.

6.1 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.

6.2 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.

6.3 Building Fabric

The notional building fabric is shown in Table 4.

Table 4 - 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

6.4 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.

7. Baseline carbon emissions and energy use

The baseline regulated carbon emissions for phase 2A is **128,100 kgCO_2/yr.**

7.1 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 (346,485 kWh/yr) **47,122 kgCO_2/yr**.

The proposed strategy has included for detailed operational energy modelling to provide a more accurate depiction of energy use and associate carbon emissions.

7.2 Total Baseline Carbon Emissions (phase 2)

The phase 1 carbon emissions rate for both regulated and unregulated energy is **175,200 kgCO_2/yr.**

8. Reaching Net Zero

The development will follow the steps in Figure 3 to reach the net zero target.

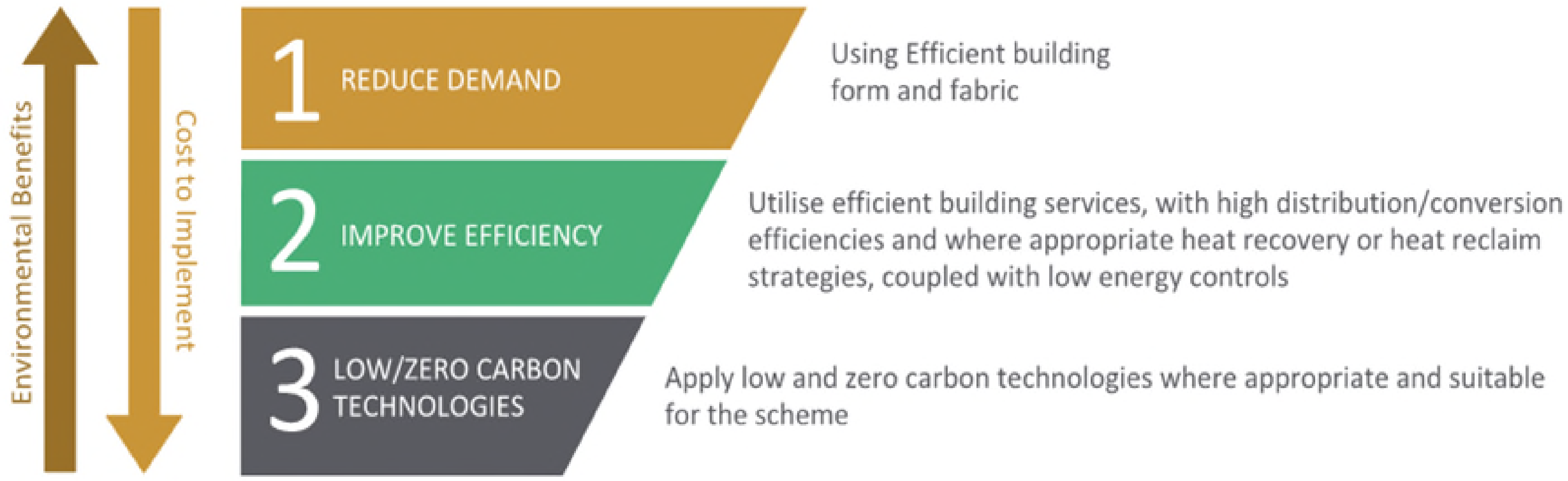


Figure 3 - Operational energy strategy

Be Lean - Reducing the Demand for Energy

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

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

9. Baseline carbon emissions and energy use

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

Table 5.

Table 5 - 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 $m^3/hr/m^2$ 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 4 - Passive and active design measures towards operational net zero

10. 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.

10.1 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.

10.2 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.

11. District Heating Network

11.1 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.

11.2 Plot Wide Heat Network

As a site wide heat network is not currently being brought forward, a smaller heat network could be developed at plot level. The first plot 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.

The following need to be considered:

- Whilst the outline application stated that a district heat network should be installed on-site, this is significantly out of date (2014).
- Technology has significantly changed in that time and there is no longer a significant carbon benefit from gas-powered CHP (as suggested in the outline application).
- Locking the wider 1,700 homes into a heat network may lock developers into stranded technology, particularly as the electricity grid decarbonises.
- Embodied carbon implications of DH network pipework and temporary plant need to be considered as well as any operational carbon savings that may be achieved.
- In Hydrock's experience, recent calculations and feasibility studies undertaken on sites in the UK indicate that connection to a DHN can result in higher carbon emissions than localised ASHPs in the region of 15-20% depending on the losses occurred in transmission.

12. Improving Efficiency

12.1 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.

12.2 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.

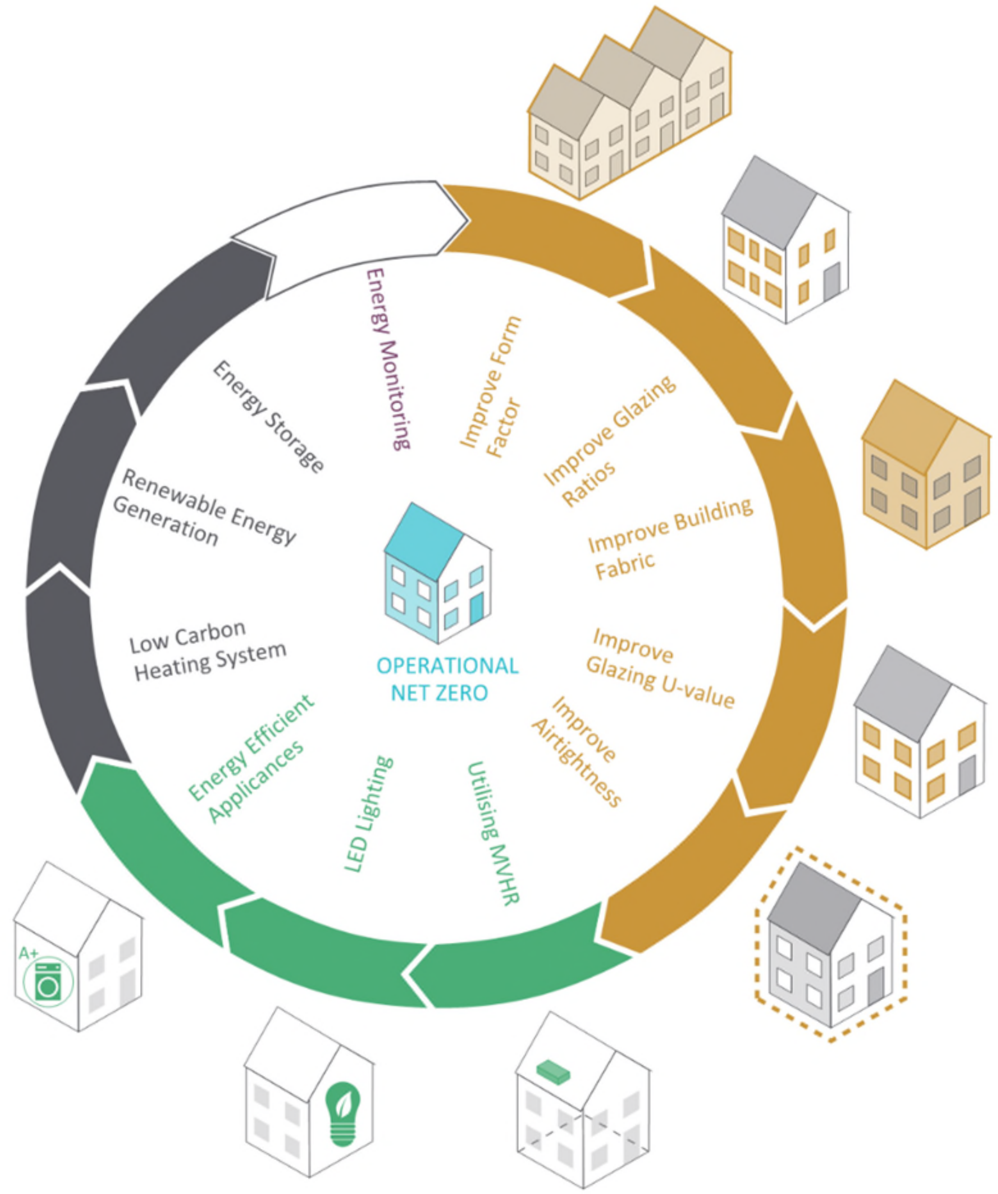


Figure 5 – Energy efficiency measures towards operational net zero

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.

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.

13. Proposed heating and hot water generation

It is proposed that heating and hot water will be provided via combined strategy of GSHP and ASHP.

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.

13.1 Ground Source Heat Pump

GSHPs will be used to provide heating and hot water for the flats in Himley Village.

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.

13.2 Air Source Heat Pump

ASHPs will be used to provide heating and hot water for all the houses in Himley Village.

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

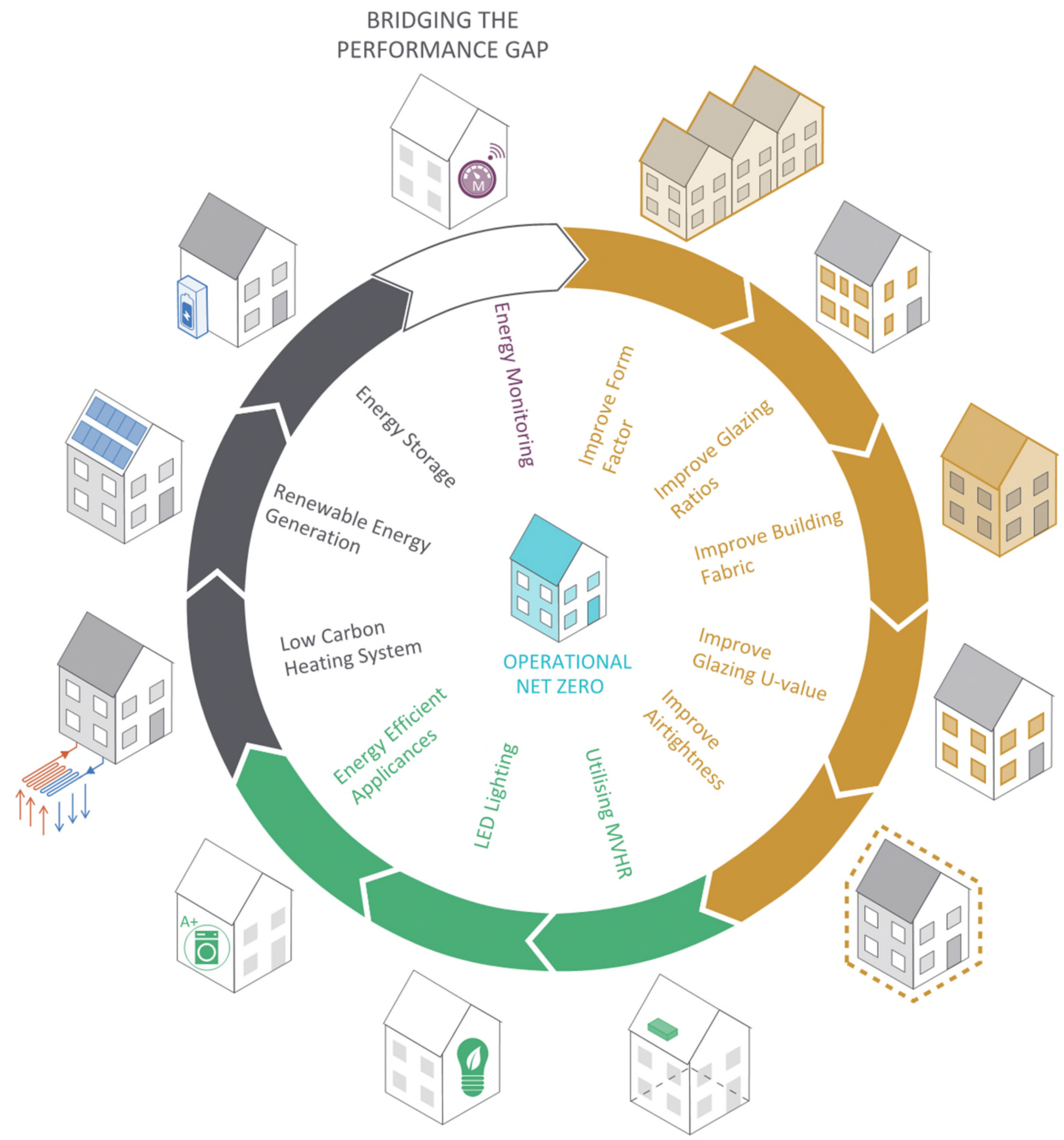


Figure 6 - Operational net zero through low and zero carbon technology

For Phase 2A an ASHP with a winter efficiency of 3.42 (Daikin Altherma ERG 04DAV3a+) has been chosen to maximise energy efficiency and potential carbon reduction.

13.3 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%.

14. Renewable 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.

14.1 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/m^2) received from the sun is measured annually. Monthly irradiation figures are shown in the following figures.

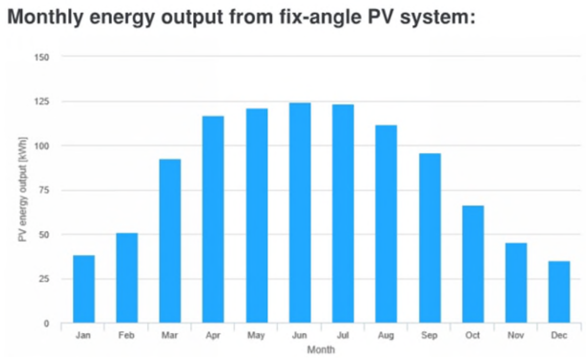


Figure 7: Monthly energy output from solar PV.

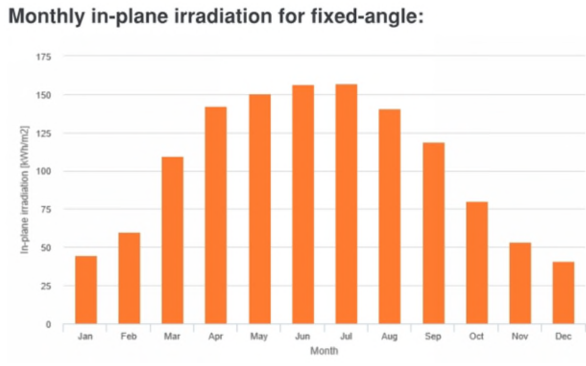


Figure 8: Monthly irradiation for solar PV.

It is anticipated that the site will receive approximately 900 kWh/m^2/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.

14.2 Solar Thermal Panels

Figure 9: 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.

14.3 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.

15. 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 6 - PV installation details

Energy Supplied	Carbon Emissions Saved
772 kWp	71,150 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 71,150 kgCO_2/yr**, this is equivalent to a 41% reduction in carbon emissions from PV alone (taking into account both regulated and unregulated carbon). This equates to an EUI from PV of **46.9 kWh/m^2/yr.**

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

Delivering Net Zero at Himley Village - Site Wide Approach

The section details the proposed strategy across the site to ensure that Phase 2A of the Himley Village development proposals as a whole will meet the net zero carbon requirement.

16. 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).

16.1 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.

[1]LETI Climate Emergency Design Guide [2020]

17. Himley Phase 2A EUI

As seen in Table 7, the current combination of GSHP and ASHPs results in an EUI of 45.7 kWh/m²/yr for the proposed development.

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

17.1 Calculating Unregulated Energy Use

The unregulated energy use for the development has been calculated using CIBSE TM54 methodology. Initial calculations indicated that the unregulated EUI for the site was 23.3 kWh/yr, however these estimates were refined and recalculated during the design process.

The original EUI was reduced by refining a number of the assumptions within the calculation as follows:

- Changing assumed occupancy from 365 days a year to allowing for two weeks of holiday in the summer.
- Accounting for the intermittent nature of fridge/freezers rather than having them running 100% of the time.
- Rationalisation of white goods i.e tumble dryers which are not common in the UK.

Table 7 - 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/m²/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	**6.4**	**14.7**	**4.3**	**1.8**	**18.7**	**45.7**

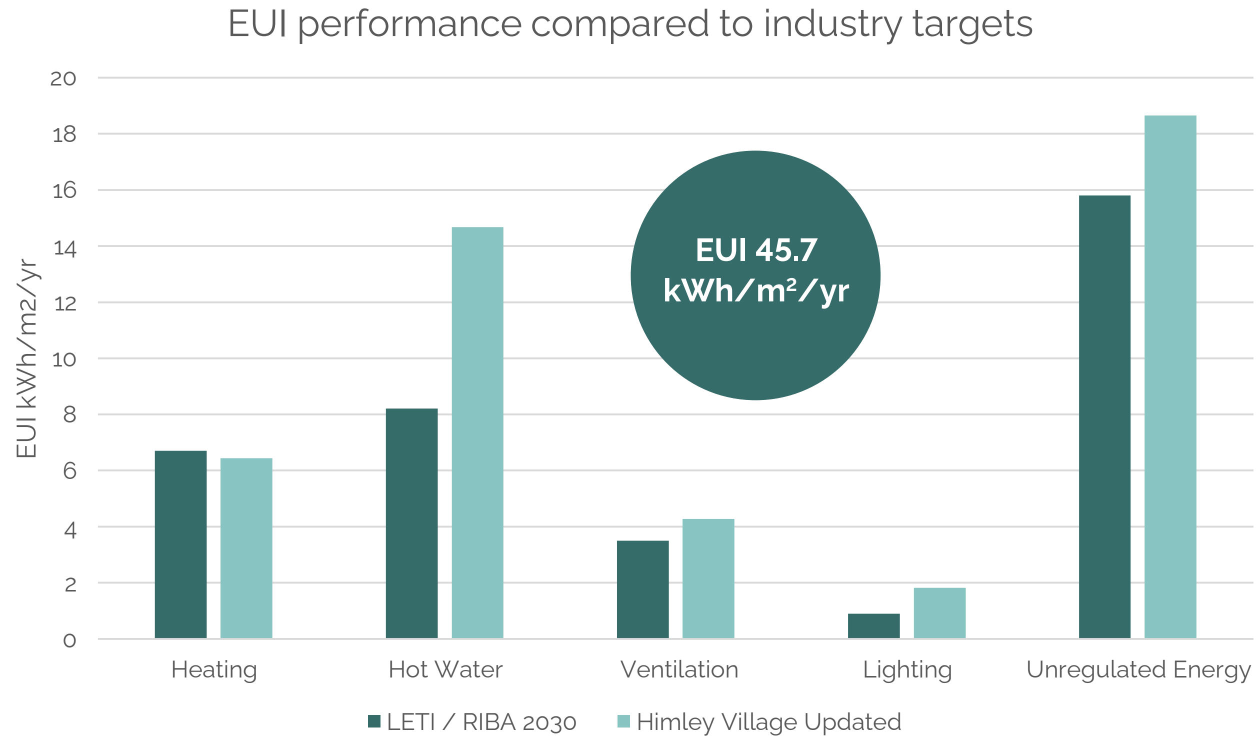


Figure 10 - Energy use intensity breakdown comparing Himley Village to LETI and RIBA 2030 targets

Conclusions

This report has provided an overview of the calculated carbon emissions for phase 2A 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.

18. 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.

18.1 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.

18.2 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 772 kWp.

19. EUI Balance

In order for the development to be truly zero carbon, the energy use for the site needs to be offset via renewable energy generation. The EUI for both the dwellings and the PV generation at the site is shown below:

EUI for Phase 2A dwellings - 45.7 kWh/m²/yr

EUI for PV - 46.9 kWh/m²/yr

The EUI for the PV is equivalent to the EUI of the dwellings, this means the renewable energy generation will match the predicted energy use resulting in a net zero carbon development.

Table 8 - 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	128,100	47,100	175,200	NA
After passive design and ASHP/GSHP	43,200	28,300	71,500	59%
After PV	0	0	0	100%

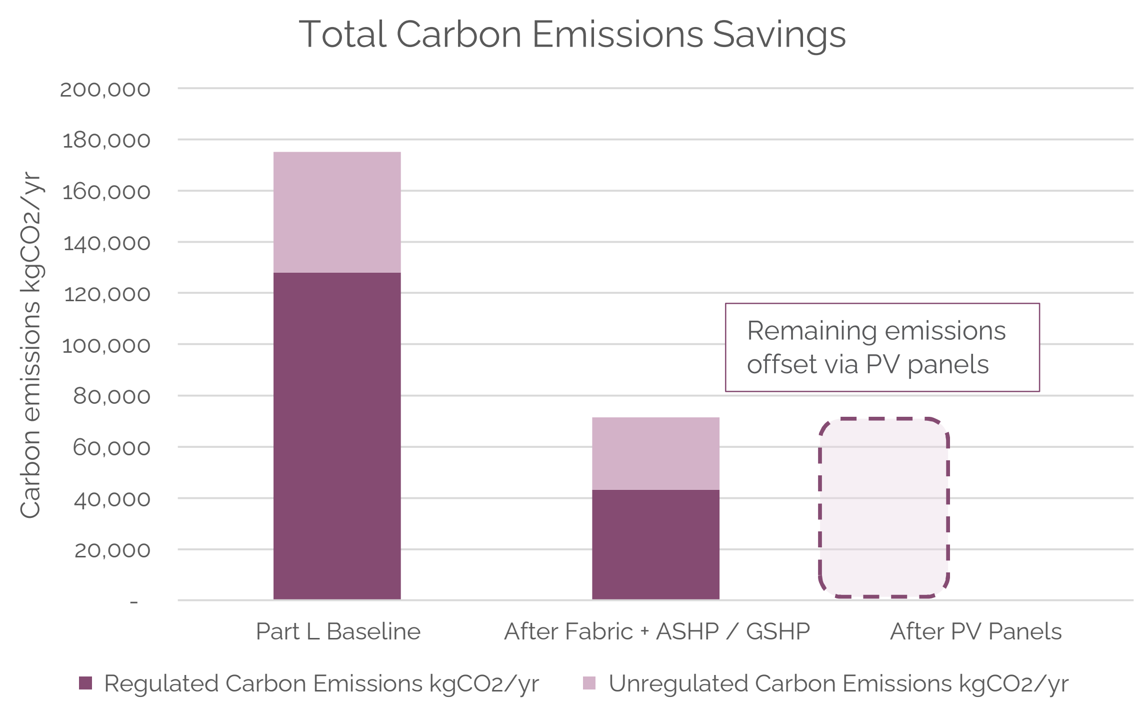


Figure 11 - Total carbon emission savings using GSHPs

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 12 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 13 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.

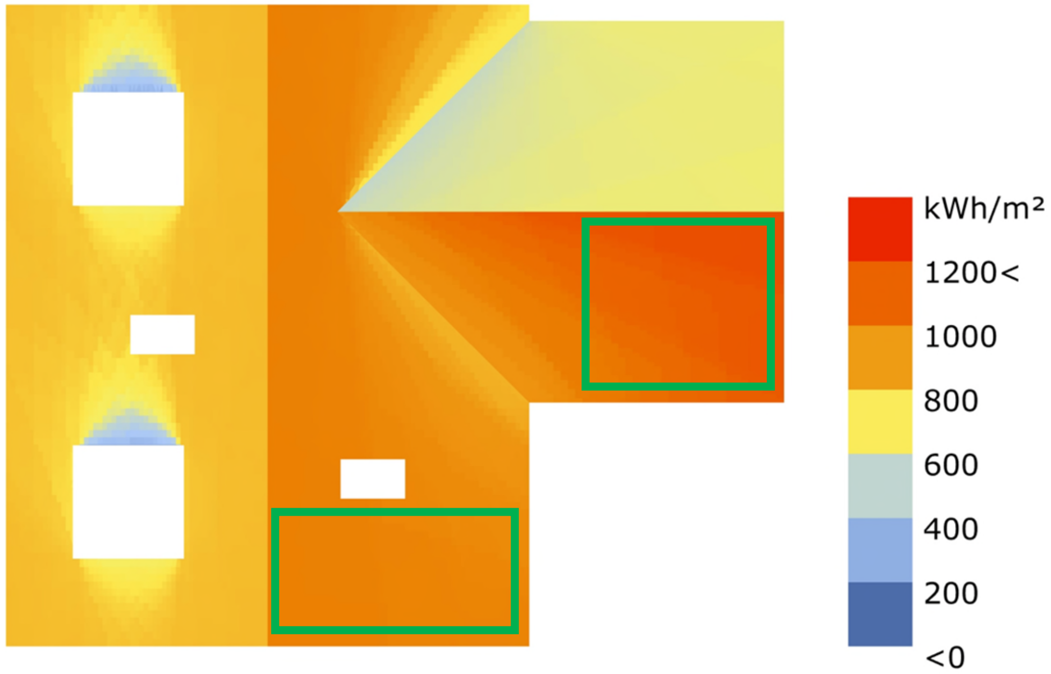


Figure 12 - Solar irradiation for Tulipwood (West-East)

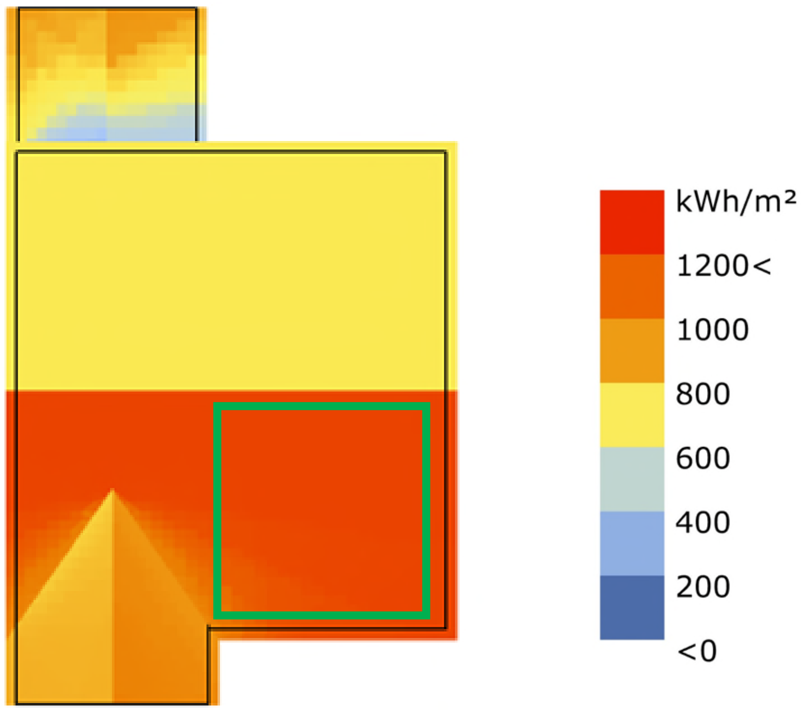


Figure 13 - Solar irradiation for Wisteria (North-South)

Appendix B Allocated PV arrays

Plot No.	House Type	Rounded South Facing Roof Available (m2)	No. PV Panels per roof	West Facing Roof Available (m2)	No. PV Panels per roof	SouthEast Facing Roof Available (m2)	No. PV Panels per roof	East Facing Roof Available (m2)	No. PV Panels per roof
1	Tulipwood	10	5	13.45	2	10.54	4		
2	Lancewood			25.35	12	20.99	9		
3	Whitebeam	4.88	2	50.14	25	37.71	18		
4	Sycamore			43.53	20	30.56	14		
5	Pine			22.81	10			24.66	12
6	Whitebeam			49.13	24			38.85	17
7	Sycamore			42.65	20			30.68	14
8	Tulipwood	14.88	7	16.38	7			29.54	14
9	Pine	22.53	10						
10	Tulipwood	12.55	5	10.52	5	10.52	4		
11	Bayberry			22.87	10	22.87	10		
12	Bayberry			22.87	10	22.87	10		
13	Bayberry			22.87	10	22.87	10		
14	Bayberry			22.87	10	22.87	10		
15	Fir			16.75	7	26.13	12		
16	Fir			16.75	7	26.13	12		
17	Bayberry			22.89	10	22.89	10		
18	Bayberry			22.89	10	22.89	10		
19	Bayberry			22.89	10	22.89	10		
20	Everglade			27.64	13	27.64	13		
21	Aspen			20.64	10	20.64	9		
22	Aspen			20.64	10	20.64	9		
23	Clover			26.29	12	26.29	12		
24	Clover			26.29	12	26.29	12		
25	Clover			26.29	12	26.29	12		
26	Everglade					27.66	13		
27	Pine	22.23	10						

Plot No.	House Type	Rounded South Facing Roof Available (m2)	No. PV Panels per roof	West Facing Roof Available (m2)	No. PV Panels per roof	SouthEast Facing Roof Available (m2)	No. PV Panels per roof	East Facing Roof Available (m2)	No. PV Panels per roof
28	Foxglove	18.14	8						
29	Foxglove	18.14	8						
30	Pine	22.75	10						
31	Everglade			27.67	13	27.67	13		
32	Aspen			20.79	10	20.79	9		
33	Aspen			20.79	10	20.79	9		
34	Clover			26.67	12	26.67	12		
35	Clover			26.67	12	26.67	12		
36	Bellflower			26.67	12	26.67	12		
37	Bellflower			26.67	12	26.67	12		
38	Everglade			27.65	13	27.65	13		
39	Fir	18.06	8						
40	Fir	18.06	8						
41	Fir	18.06	8						
42	Fir	18.06	8						
43	Daisy			25.03	12	25.03	12		
44	Clover	26.92	12						
45	Aspen			21.19	10	21.19	10		
46	Aspen			21.19	10	21.19	10		
47	Clover			26.66	12	26.66	12		
48	Clover			26.66	12	26.66	12		
49	Everglade			27.57	13	27.57	13		
50	Foxglove	17.35	8						
51	Foxglove	17.35	8						
52	Foxglove	17.35	8						
53	Foxglove	17.35	8						
54	Everglade			27.57	13	27.57	13		
55	Bellflower			21.5	10	21.5	10		
56	Bellflower			21.5	10	21.5	10		

Plot No.	House Type	Rounded South Facing Roof Available (m2)	No. PV Panels per roof	West Facing Roof Available (m2)	No. PV Panels per roof	SouthEast Facing Roof Available (m2)	No. PV Panels per roof	East Facing Roof Available (m2)	No. PV Panels per roof
57	Bellflower			21.5	10	21.5	10		
58	Bellflower			21.5	10	21.5	10		
59	Bellflower			21.5	10	21.5	10		
60	Bellflower			21.5	10	21.5	10		
61	Tulipwood	29.57	13	14.71	6	14.71	6		
62	Fir	17.29	8	2.11	1	2.11	1		
63	Fir	17.29	8	2.11	1	2.11	1		
64	Tulipwood	10.24	4	12.04	6	11.56	5		
65	Aspen			25.1	12	25.1	12		
66	Aspen			25.1	12	25.1	12		
67	Fir			25	12	16.9	7		
68	Fir			25	12	16.9	7		
69	Blackthorn			25.1	12	25.1	12		
70	Blackthorn			25.1	12	25.1	12		
71	Tulipwood	18.29	8	15.8	7	15.8	7		
72	Pine	24.63	11						
73	Tulipwood	11.23	5	11.32	5	14.46	6		
74	Foxglove			16.29	8	16.7	7		
75	Foxglove			16.29	8	16.7	7		
76	Pine			24	11	16.98	7		
77	Tulipwood	11.29	5	10.43	4	9	4		
78	Foxglove			16.29	7	16.7	7		
79	Foxglove			16.29	7	16.7	7		
80	Tulipwood	11.29	5	10.43	5	9	4		
81	Rowan	14	6					28.11	13
82	Foxglove							14	7
83	Foxglove							14	7
84	Lancewood							16	8
85	Lancewood							16	8

Plot No.	House Type	Rounded South Facing Roof Available (m2)	No. PV Panels per roof	West Facing Roof Available (m2)	No. PV Panels per roof	SouthEast Facing Roof Available (m2)	No. PV Panels per roof	East Facing Roof Available (m2)	No. PV Panels per roof
86	1 bed	68	34					33	16
87	1 bed								
88	1 bed								
89	1 bed								
90	1 bed								
91	1 bed								
92	2 bed								
93	2 bed								
94	2 bed								
95	2 bed	80	38						
96	2 bed								
97	2 bed								
98	2 bed								
99	2 bed								
100	2 bed								
101	Chestnut	25	12						
102	Bayberry							21	10
103	Bayberry							21	10
104	Bellflower							23	11
105	Bellflower							23	11
106	Bellflower							23	11
107	Bellflower							23	11
108	Daisy							27	13
109	Chestnut							26	13
110	Foxglove	14	7						
111	Foxglove	14	7						
112	Pine	21	10						
113	Rowan	27	13					12	6
114	Whitebeam							45	22

Plot No.	House Type	Rounded South Facing Roof Available (m2)	No. PV Panels per roof	West Facing Roof Available (m2)	No. PV Panels per roof	SouthEast Facing Roof Available (m2)	No. PV Panels per roof	East Facing Roof Available (m2)	No. PV Panels per roof
115	Sycamore							41	20
116	Whitebeam							45	22
117	Rowan	12	6					12	6
118	Everglade	26	13						
119	Blackthorn							25	12
120	Blackthorn							25	12
121	Blackthorn							25	12
122	Blackthorn							25	12

Parcel A (Plots 1 - 80)			
Roof Orientation	**Area (m2)**	**No. Panels**	**Total kWh p.a**
South	466	208	65,530
West	1442	662	164,188
South East	1303	588	164,228
East	124	57	14,374
Totals	3335	1515	408,321

Parcel B			
Roof Orientation	**Area (m2)**	**No. Panels**	**Total kWh p.a**
South	301	146	45,997
West	0	0	-
South East	0	0	-
East	563	273	68,842
Totals	864	419	114,839