Building Services Engineering Consultants

Delivering buildings that work efficiently

Thomas Homes Ltd
Clifton Hampden Surgery

Energy Statement

ISSUED FOR PLANNING

JDP **Head Office:** **Davidson House, Forbury Square, Reading RG1 3EU**

email@jdp-ltd.co.uk **www.jdp-ltd.co.uk** **0118 972 2911**

Issue No.	01	Author	OT	Date	28/09/2023
Location	J:\J1385\7.0 Reports\J1385-ENESTRGREP.docx	Checked	AS	Date	28/09/2023

CONTENTS **PAGE NO.**

EXECUTIVE SUMMARY 2

1.0 INTRODUCTION 3

2.0 POLICY CONTEXT 5

3.0 METHODOLOGY 5

4.0 ENERGY REQUIREMENTS AND CO2 EMISSIONS APPRAISAL 7

5.0 DEMAND REDUCTION (BE LEAN) 7

6.0 HEATING INFRASTRUCTURE (BE CLEAN) 8

7.0 RENEWABLE ENERGY (BE GREEN) 9

8.0 ENERGY DEMAND ASSESSMENT 11

9.0 WATER EFFICIENCY 13

10.0 CONCLUSION 14

11.0 APPENDICES 15

REPORT AMENDMENTS

PARAGRAPH	AMENDMENT
ISSUE	

EXECUTIVE SUMMARY

JDP has been instructed by Thomas Homes Ltd. to prepare an Energy Statement in support of a Full Planning Application for the new development known as Clifton Hampden Surgery, located in Abingdon, Oxfordshire.

The development comprises the construction of a new single storey medical centre accommodating Reception lobby and waiting area, consulting rooms, treatment rooms, offices and welfare facilities including plantroom. Car parking is provided consisting of 7 bays including 2 disabled bays and covered cycle storage.

South Oxfordshire Council's Local Plan 2035 sets out their intention to implement sustainable design and renewable technology in accordance with national policy (NPPF). The development is required to meet BREEAM 'Excellent' assessment criteria with at least a 40% reduction in regulated CO2 emissions below the Building Regulations (2021) Target Emission Rate (TER).

However, the Applicant has taken the bold decision to employ an innovative net zero strategy and reduce the buildings CO2 emissions by 100%, initiating a more immediate pathway to the UK Governments 2050 climate change commitment.

The Energy Strategy follows the energy hierarchy: Be Lean, Be Clean, Be Green and the fundamental approach adopted is as follows:

a) Establish the notional energy demand using accredited thermal modelling software and methodologies.
b) Adopt passive and low energy design techniques to reduce the energy demand for the development beyond the baseline requirements.
c) Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
d) Establish the anticipated energy and carbon dioxide emission reductions for the development.

The development is categorised as commercial use and Part L Vol2:2021 (New Buildings other than Dwellings) criteria apply. The energy and carbon dioxide emission assessment has been undertaken using dynamic simulation modelling software EDSL TAS Version 9.5.6 that incorporates the SBEM calculation methodology in line with Building Regulations requirements to generate predicted annual CO_2 emission rates.

The calculations indicate the total CO2 emissions for the building equate to 2,820 kgCO2/year and by adopting passive low energy design techniques (Be Lean), utilising air source heat pump (Be Clean) and photovoltaic technology to offset otherwise grid-supplied electricity (Be Green), a total CO2 emission reduction of 3,020 kgCO_2e/year or 107% savings are achievable and the net zero target attainable in-line with increased NPPF (2021) and BREEAM expectations.

1.0 INTRODUCTION

1.1 The Application

JDP has been instructed by Thomas Homes Ltd. to prepare an Energy Statement in support of a full planning application for the new development known as Clifton Hampden Surgery located in Abingdon, Oxfordshire.

1.2 Development Description and Site Context

The development comprises the construction of a new single storey building accommodating Reception lobby and waiting area, consulting rooms, treatment rooms, offices and welfare facilities. including plantroom. Car parking is provided consisting of 7 bays including 2 disabled bays and covered cycle storage (See Figure 1 overleaf).

The building is located to the north of Abingdon Road (A415) adjacent to Clifton Hampden Village Hall, a predominantly rural area.

1.3 Aim

The aim of this Energy Strategy is to detail a robust energy demand reduction and supply strategy to enable the Development to meet the pertinent policy targets detailed within South Oxfordshire Councils planning requirements.

1.4 Approach

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

However, the Applicant has taken the bold decision to employ an innovative net zero strategy and reduce the buildings CO2 emissions by 100%, initiating a more immediate pathway to the UK Governments 2050 climate change commitment.

To demonstrate the project can achieve 100% carbon emission reduction more than the Part L of Building Regulations (2021), this Energy Strategy follows the energy hierarchy: Be Lean, Be Clean, Be Green and the fundamental approach adopted is as follows:

a) Establish the notional energy demand using accredited thermal modelling software and methodologies.
b) Adopt passive and low energy design techniques to reduce the energy demand for the development beyond the baseline requirements.
c) Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
d) Establish the anticipated energy and carbon dioxide emission reductions for the development.

The Local Plan requires that applications demonstrate how new developments will seek to reduce carbon emissions through the use of renewable technologies and meet BREEAM 'Excellent' assessment criteria.

Figure 1, Proposed Site Layout

2.0 POLICY CONTEXT

2.1 Planning Policy

Planning documents referenced for this report are as follows:

a) National Planning Policy Framework (NPPF) July 2021
b) South Oxfordshire Local Plan 2035
c) Supplementary Planning Documents (DES10)

The council's planning policy is set out in the Local Plan 2035 and key policies relating to energy consumption and CO2 emissions include the following.

2.2 DES10 – Sustainable Design and Construction

Proposals should be designed for significant carbon dioxide emissions reductions and more sustainable energy sources, through energy efficiency improvements and facilitating low and zero carbon technology also mitigating climate change impacts.

All non-residential developments to achieve BREEAM 'Excellent' as a minimum with at least a 40% reduction in regulated CO2 emissions below the Building Regulations (2021) Target Emission Rate (TER) and proposals that exceed the expectations will be strongly encouraged.

The policy recognises the Council's commitment for the district to become carbon neutral by 2030 and this will be achieved using the measures set out below:

a) A 'fabric first' approach in which all development comprising the construction of new buildings is required to reduce operational CO2 emissions below the Target Emission Rate (TER) as set out in Building Regulations, Part L2 (2021).
b) Requirement for major development comprising the construction of new buildings to reduce operational CO2 emissions using renewable energy-generating technology to be installed on site.
c) A Water Efficiency assessment has been undertaken using the methodology set out in Approved Document G (2015 with 2016 amendments).

3.0 METHODOLOGY

3.1 Definitions

The following definitions should be understood throughout this strategy:

a) Energy demand – the 'room-side' amount of energy which must be input to a space to achieve comfortable conditions. In the context of space heating, this is the amount of heat which is emitted by a radiator, or other heat delivery mechanism.
b) Energy requirement – the 'system-side' requirement for energy (fuel). In the context of a space heating system using a gas boiler, this is the amount of energy combusted (e.g., gas) to generate useful heat (i.e., the energy demand).
c) Regulated CO_2 emissions – the CO_2 emissions emitted by the combustion of fuel, or 'consumption' of electricity from the grid, associated with regulated sources (those controlled by Part L of the Building Regulations).

3.2 Limitations

The appraisals within this strategy are based on the SBEM Calculation to demonstrate compliance with Building Regulations Part L (2021) and should not be understood as a predictive assessment of likely future energy requirements or otherwise. The calculations are limited to regulated services, such as gas boilers, and not appliances plugged in by building occupants.

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

3.3 Energy Hierarchy

This strategy outlines how the Development will have a reduced impact on climate change by reducing CO_2 emissions associated with energy use in buildings. The Energy and CO_2 appraisal is based on the Energy Hierarchy approach (Be Lean, Be Clean and Be Green).

The strategic approach to the design of the Development has been to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO_2 emissions. Further reductions will be ensured through the specification of high efficiency building services to limit losses in energy supply, storage and distribution.

After the inclusion of passive design and energy efficient measures, various options have been investigated to reduce CO_2 emissions associated with energy supply.
The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application.

Calculations have been carried out in progressive improvements, reducing carbon emissions following the energy hierarchy as set out in Figure 2 (below). The dynamic simulation modelling software that incorporates the SBEM calculation methodology in line with Building Regulations is used to establish the building's energy usage, fuel consumption and CO_2 emissions before and after the associated energy efficiency measures and renewable energy technology options are applied.

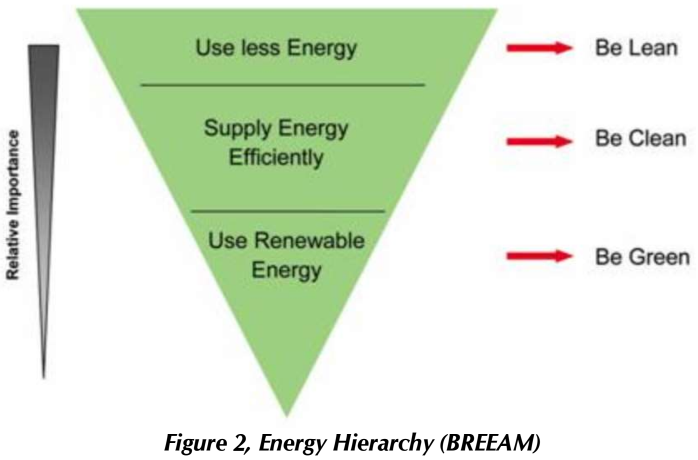


Figure 2, Energy Hierarchy (BREEAM)

4.0 ENERGY REQUIREMENTS AND CO2 EMISSIONS APPRAISAL

The following appraisal estimates the anticipated energy requirements and resultant CO_2 emissions that are likely to arise due to the Development, after the inclusion of the passive design and energy efficiency measures as previously described in this Energy Strategy.

Regulated Energy Sources

Regulated energy sources are those controlled by the Building Regulations, as follows:

a) Space Heating
b) Hot Water
c) Space Cooling
d) Lighting
e) Auxiliary Loads (pumps, fans and controls).

Unregulated Energy Sources

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

As part of this development, building users will be encouraged to reduce equipment energy use, which could be provided in the form of building user guides and tenant's fit-out guides. In general, the fit out of the Development will endeavour to include the use of A/A+ and above rated energy efficient domestic appliances in accordance with the EU Energy Efficiency Labelling Scheme. Energy efficient appliances will not only save energy but also save costs for the end users.

5.0 DEMAND REDUCTION (BE LEAN)

5.1 Passive Design Measures

Passive design measures are the most effective and robust measures for reducing CO_2 emissions as the performance of the solutions (e.g., wall insulation), is unlikely to deteriorate significantly with time or be subject to change by future property owners and therefore it is likely that the benefits of these measures will continue at a similar level for the duration of their installation.

The Development has taken a 'fabric first' approach to reducing the anticipated energy demand and CO_2 emissions.

5.2 Glazing

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

Solar gains can be beneficial in winter months as a means of avoiding the need for active heating to maintain comfortable internal temperatures. However, in summer months excessive solar gains can lead to the potential for high internal temperatures. The solar energy transmittance (g-value) of the glass has been targeted to allow solar gains in winter but control solar gains in summer. A value of no more than 70% is targeted. Maximising the amount of natural daylight available in each internal space and reducing the need for artificial light sources.

5.3 Thermal Insulation

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

The passive energy design principles that have been adopted in the current design include good thermal performance of the building's construction components. The thermal performance of the proposed fabric constructions is summarised in Table 1 (overleaf). The Part L limiting factors have been included for reference.

BUILDING ELEMENT	ELEMENT SPECIFICATION	PART L LIMITING FACTOR
Roof	0.15 W/m2·K	0.16 W/m2·K
External Walls	0.18 W/m^2·K	0.26 W/m2·K
Ground Floor	0.15 W/m2·K	0.18 W/m2·K
Windows and Rooflights	1.23 W/m2·K	1.60 W/m2·K

Table 1, Building Envelope Details

5.4 Air Permeability

Fabric air permeability is a measure of the volume (flowrate) of air that penetrates the fabric of a building, leading to ventilation heat loss and gain. High air permeability can lead to uncomfortable drafts and dramatically increase the demand for space heating in winter.

Building Regulations Part L 2021 sets a minimum standard for air permeability at 8m^3 of air per hour per square meter of envelope area, as measured at a pressure difference of 50Pa. The development will target an air permeability of 3m^3/(m^2·h) at 50Pa. achieved with enhanced (architectural) construction details particularly at junctions to improve building leakage.

5.5 Thermal Bridging

Accredited Construction Details (ACD's) will be developed to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations. Based on the ACD's, the thermal bridging is assumed with a maximum Y-value of 0.08 W/m2·K.

6.0 HEATING INFRASTRUCTURE (BE CLEAN)

6.1 Infrastructure

Infrastructure for connection to district heating schemes and on-site clean energy supply measures have been considered for the Development to further reduce regulated CO_2

emissions. The opportunity for heat networks within South Oxfordshire has not yet been fully exploited and consequently, there are no existing heat networks nearby.

6.2 On-site Technologies

The relative merits of providing a stand-alone on-site heat network served by a dedicated energy centre through a Combined Heat and Power (CHP) system has been considered. However, CHP engines typically operate on natural gas, but the wider UK Government strategy is to reduce our impact on the environment by steadily moving away from fuel combustion to produce energy.

Grid electricity has significantly decarbonised over the last several years, which is in part due to UK government policy, the deployment of renewables and retiring coal plant. With grid electricity nearly at CO_2 parity with gas and moreover as issues related to air quality rightly move higher up the agenda, the rationale for installing gas decreases further.

For Developments that require local authority and planning approval, it is unlikely that gas combustion, particularly in the form of CHP, can be shown to be viable in terms of CO_2. This is because historically the lower thermal efficiency of gas burning CHP was compensated by the high CO_2 emissions of grid supplied electricity. The electricity produced today has lower CO_2 emissions which would not even offset the CO_2 emissions from the additional gas burned to generate the same electricity from a CHP plant.

Consequently, a CHP local heat network is not proposed, and the Development is not intended to be connected to the local gas distribution network. However, gas required for cooking or resilience to power shortages in the area will be considered at detailed design stage.

7.0 RENEWABLE ENERGY (BE GREEN)

7.1 General

The final step of the energy hierarchy is to incorporate renewable energy to further reduce emissions. Renewable technologies harness energy from natural and renewable resources such as sunlight, wind, tides, and geothermal heat that is naturally replenished, to supply renewable energy or supplement grid-supplied electricity in buildings.

There are many renewable technologies available. However, not all of these are commercially viable or suitable for residential locations or appropriate for this Development in particular. The following technologies have been shortlisted in terms of cost, carbon saving, marketing and risk in support of the key early decisions to be made in the planning and design process:

a) Heat Pumps
b) Photovoltaics
c) Solar Thermal Water Heating

7.2 Heat Pumps

Heat pumps absorb heat from renewable sources such as the ambient air, the ground or bodies of water. The low-grade heat is absorbed from the renewable resource into the system (through the principles of refrigeration), where work is carried out by the system (vapour compression) to upgrade the heat to a more useable level. This heat is then transferred to the heating system via heat exchangers for space heating or domestic hot water production. The main benefit of this type of technology is the high efficiencies achieved.

Ground Source Heat Pumps

GSHPs have three common varieties:

a) Horizontal, closed-loop
b) Vertical, closed-loop
c) Vertical, open-loop.

The performance characteristics and technical requirements of each vary. Typically, vertical open-loop GSHP systems operate at the highest efficiencies and can produce the highest thermal output. Open-loop boreholes would require suitable local geology and aquifers and would require an abstraction license from the Environment Agency who would consider the impact on local water supplies and water courses. Closed loop GSHP systems are typically required to operate in balance, such that over the year, the amount of heat extracted from the ground is equivalent to the amount of heat rejected to and/or absorbed by the ground. Since the Development, will have a year-round demand for heating and hot water, there would be a large imbalance between the amount of heat extracted and heat rejected to the ground over a yearly cycle, which could lead to permafrost issues. That will render the system unusable and potentially damage nearby structures and ecology.

Impacts on ground conditions are also valid considerations for all GSHP technologies. A horizontal loop option would require a significant amount of excavation and require a large installation area. Similarly, a vertical loop will require significant ground investigations and there must be no obstructions in the ground such as buried services or underground structures.

The high capital cost and the complexities of installing a GSHP will not be a practical or economically viable solution for this Development.

Air Source Heat Pump

ASHPs have two common varieties:

a) Air to Water (used for heating, hot water and cooling systems)
b) Air to Air (limited to space conditioning only)

The seasonal efficiency of ASHP's is typically greater than that of gas-fired boilers and offer significant CO_2 savings. Generally, in buildings with a high space heating and hot water demand, space heating is the primary source of carbon dioxide emissions, and hot water is the second.

Due to the high demand for heating, the most efficient energy strategy would be to reduce the carbon emissions by specifying a higher efficiency system such as an ASHP.

7.3 Photovoltaics

Photovoltaic panels (PV) convert solar radiation (sunlight) into electricity. The cells do not need direct sunlight to work and can still generate some electricity on a cloudy day.

The output of PV panels depends on many uncontrollable variables and the annual generation is estimated using calculations based on test data for the panels and standardised local weather data which represent a typical year's conditions.

An appraisal has been undertaken of the suitability of implementing a 105m^2 PV array to reduce the CO_2 emissions by the Development using the MCS calculation methodology. Based on available roof area and solar irradiance data for London, the array with a capacity of approximately 24 kWp (comprising 66 panels) has been considered. The system could generate approximately 18,061 kWh of renewable electricity per annum, reducing CO_2 emissions by around 2.5 tonnes CO_2 per annum.

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

7.4 Solar Thermal

Solar thermal panels operate by capturing solar energy and transferring this via glycol to a thermal store to generate hot water. These systems can operate at high efficiency thus, a high energy yield can be derived from a small collector area.

Solar thermal systems are most appropriate for buildings with high year-round domestic hot water demand. Whilst a typical solar thermal system will offset some of the annual hot water demand for a building, the heat network is proposed to use electricity for the AHSP's meaning the resultant CO_2 and cost savings will be relatively low. Furthermore, due to the complex nature of a solar thermal system, the high maintenance requirement and associated access requirements, this system will not be included at this stage. However, may be subject to further consideration during the detailed design stage.

8.0 ENERGY DEMAND ASSESSMENT

8.1 General

Thermal modelling has been undertaken for the proposed development comprising a gross (internal) floor area circa 398m^2.

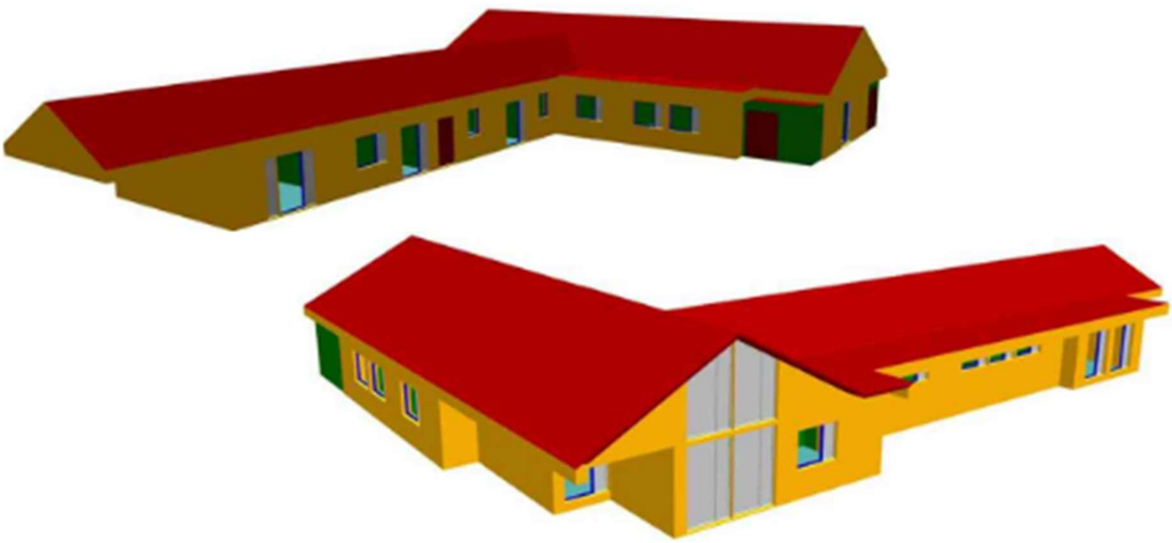


Figure 3, Thermal Model Illustrated

8.2 Notional Building

The notional building is the base line model that Building Regulations utilises to calculate the target emission rate (TER) and is determined on the assumption that any heating and hot water supply would be provided by gas boilers.

The thermal model based on the National Calculation Methodology (NCM) utilising TAS dynamic thermal modelling software has simulated options available for favourable renewable technologies (refer to section 7.0).

8.3 Actual Building

The comparison of the actual building against the notional building identifies that there is a predicted improvement in excess of 100% in terms of the Building CO_2 Emissions Rate (BER) over the notional building (TER) which is sufficient to achieve compliance with Building Regulations, Part L (2021) requirements (See Table 2 below).

	Notional Building (TER)	Actual Building (BER)
Heating & Cooling Demand (MJ/m^2)	105.12	112.97
Primary Energy (kWh/m^2)	29.89	-9.86
Total emissions (kgCO_2/m^2)	7.09	-0.49

Table 2, Predicted Energy use and associated CO_2 Emissions

The calculations indicate that the total CO_2 emissions for the building are 2,820 kg CO_2/year and 3,020 kg CO_2/ year will be offset equating to 107% savings.

Consumption figures (kWh/m^2 p.a. for non-domestic) from the Part L modelling output (BRUKL) reports have been used to estimate the CO_2 emissions for each stage of the Energy Hierarchy 'Be Lean', 'Be Clean' and 'Be Green' as follows:

	CARBON DIOXIDE EMISSIONS (Tonnes CO_2 per annum)
	REGULATED
Baseline: Part L2013 of the Building Regulations Compliant Development	2.82
Be Lean: After energy demand reduction	2.21
Be Clean: After heat network / CHP	2.21
Be Green: After renewable energy	-0.20

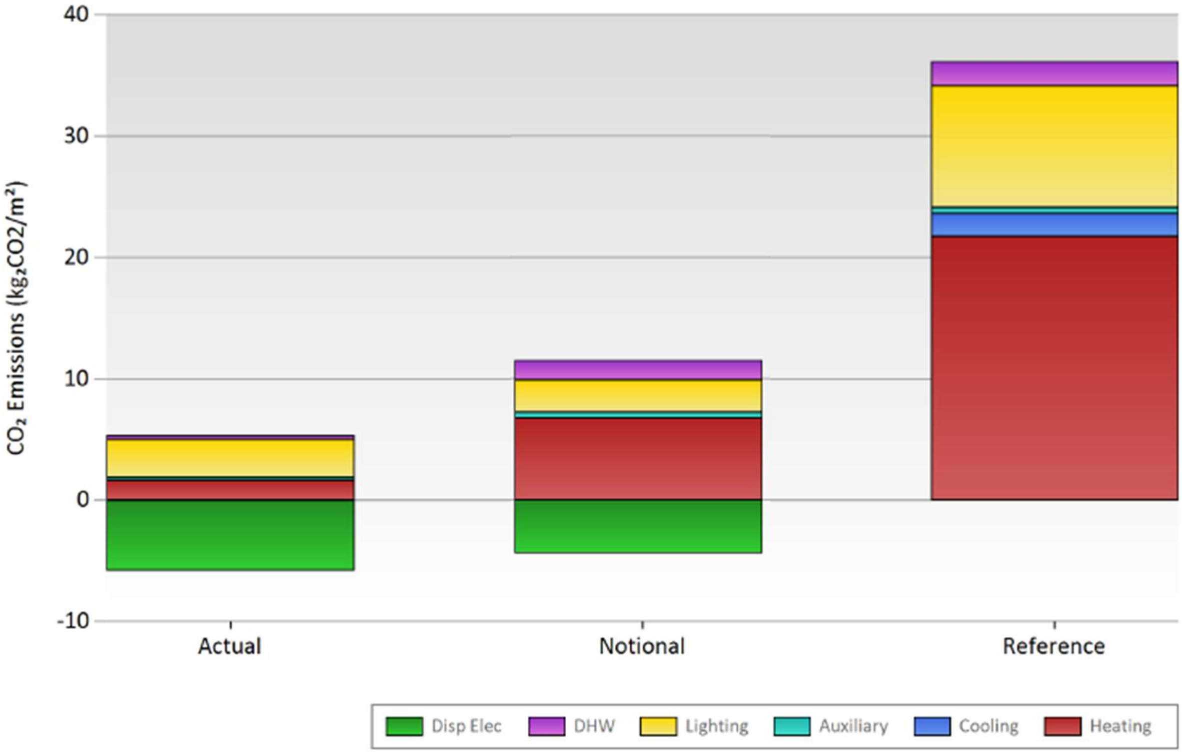
Table 3, CO_2 Emissions after each stage of the Energy Hierarchy for ASHP scheme

	REGULATED CARBON DIOXIDE SAVINGS	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction (Be Lean)	0.61	22
Savings from heat network / CHP (Be Clean)	0.00	0
Savings from renewable energy (Be Green)	2.41	85
Cumulative on-site savings	3.02	107

Table 4, CO_2 savings after each stage of the Energy Hierarchy for ASHP scheme

Tas UK Building Regulations Studio

Annual CO2 Emissions Comparison



	Actual	*Notional*	*Reference*
Heating (kg_2CO2/m^2)	1.61	6.77	21.75
Cooling (kg_2CO2/m^2)	0.00	0.00	1.93
Auxiliary (kg_2CO2/m^2)	0.23	0.49	0.49
Lighting (kg_2CO2/m^2)	3.17	2.61	9.97
DHW (kg_2CO2/m^2)	0.33	1.64	2.03
Displaced Electricity (kg_2CO2/m^2)	-5.83	-4.42	0.00
*Equipment (kg_2CO2/m^2) **	*13.70*	*13.49*	*13.84*
Total (kg_2CO2/m^2)	-0.49	7.09	36.18
Total Floor Area (m^2)	398.17	398.17	398.17

** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Figure 4, CO_2 savings for ASHP scheme illustrated

9.0 WATER EFFICIENCY

More than 20% of the UK's water is used domestically, with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water. The water efficiency measures included will ensure that the water use target of 105 litres per person per day is achieved. Water efficient devices will be fully evaluated and installed wherever possible. The specification of such devices will be considered during Stage 3 and 4 of the design process. Each will be subject to an evaluation based on technical performance, cost and market appeal and compliance with the water use regulations. The following devices will be incorporated within the Development to achieve the water efficiency requirements.

a) Water efficient taps
b) Water efficient toilets
c) Low output showers
d) Flow restrictors to manage water pressures to achieve optimum levels
e) Water meters

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

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

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

No greywater or rainwater systems are proposed due to the vulnerability of occupants to infection if poorly maintained. Therefore, calculated wholesome water consumption per person per day is 103.3 litres which is less than the maximum permitted 105 litres for internal use in accordance with the planning policy.

10.0 CONCLUSION

Generally, the most efficient energy strategy involves reducing the carbon emissions by specifying a higher efficiency system and, for the purposes of CO_2 calculations, results in air source heat pumps providing the greatest savings compared to a standard gas boiler, since the electricity produced today has a lower CO_2-value. Moreover, as issues related to air quality rightly move higher up the agenda, the rationale for installing gas-fired heating systems decreases further.

The focus of the energy (low carbon and renewable energy) strategy is on reducing greenhouse gas emissions from the proposed development. Calculations have been undertaken to demonstrate that the development can achieve a significant carbon emission reduction over that of the Part L (2021) Building Regulations as required by South Oxfordshire Council.

The calculations indicate the total CO2 emissions for the building equate to 2,820 kgCO2/year and by adopting passive low energy design techniques (Be Lean), utilising air source heat pump (Be Clean) and photovoltaic technology to offset otherwise grid-supplied electricity (Be Green), a total CO2 emission reduction of 3,020 $kgCO_2e$/ year or 107% savings are achievable and the net zero target attainable in-line with increased NPPF (2021) and BREEAM expectations.

It is important to note that the results from the calculations are based on energy consumption by regulated loads and will not reflect the actual energy use as they are based on standardised weather and occupancy profiles and do not include for unregulated energy sources. Users of the development will be encouraged to reduce their unregulated equipment energy use which could be provided in the form of building user/residents guides. In general, the fit out of the Development will endeavour to include the use of energy efficient domestic appliances rated A / A+ and above in accordance with the EU Energy Efficiency Labelling Scheme. Energy efficient appliances will not only reduce energy consumption but also reduce energy costs for the operator of the Independent Care Apartments Community.

11.0 APPENDICES

11.1 BASELINE (BRUKL) OUTPUT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Clifton Hampden - Gas Fired Boiler As designed

Date: Thu Sep 21 13:48:01 2023

Administrative information

Building Details

Address:

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.6"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.6

BRUKL compliance module version: v6.1.e.0

Certifier details

Name:

Telephone number:

Address: , ,

Foundation area [m²]: 398.17

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	7.09	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	5.56	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	29.89	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	13.07	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.18	0.18	External Wall
Floors	0.18	0.15	0.15	Exposed Floor
Pitched roofs	0.16	0.15	0.15	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.23	1.33	Window 2a
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	1.31	1.48	Window 2b
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	398	398
External area [m²]	1371	1371
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	345	353
Average U-value [W/m²K]	0.25	0.26
Alpha value* [%]	31.57	16.57

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
100	**Residential Institutions: Hospitals and Care Homes**
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	32.03	32.26
Cooling	0	0
Auxiliary	1.65	3.59
Lighting	23.03	19.25
Hot water	6.02	8.57
Equipment*	99.77	99.77
TOTAL**	**62.73**	**63.67**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	45.38	34.34
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*45.38*	*34.34*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	112.97	105.12
Primary energy [kWh_{PE}/m^2]	13.07	29.89
Total emissions [kg/m²]	5.56	7.09

11.2 AIR SOURCE HEAT PUMP (BRUKL) OUTPUT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Clifton Hampden - Heat Pump + PV

As designed

Date: Thu Sep 21 13:53:29 2023

Administrative information

Building Details

Address:

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.6"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.6

BRUKL compliance module version: v6.1.e.0

Foundation area [m^2]: 398.17

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	5.08	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	-0.49	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	54.08	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	-9.86	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.18	0.18	External Wall
Floors	0.18	0.15	0.15	Exposed Floor
Pitched roofs	0.16	0.15	0.15	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.23	1.33	Window 2a
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	1.31	1.48	Window 2b
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	398	398
External area [m²]	1371	1371
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	345	353
Average U-value [W/m²K]	0.25	0.26
Alpha value* [%]	31.57	16.57

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
100	**Residential Institutions: Hospitals and Care Homes**
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	10.43	10.51
Cooling	0	0
Auxiliary	1.65	3.59
Lighting	23.03	19.25
Hot water	2.44	2.84
Equipment*	99.77	99.77
TOTAL**	**37.56**	**36.19**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	45.38	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*45.38*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	112.97	105.12
Primary energy [kWh_{PE}/m^2]	-9.86	54.08
Total emissions [kg/m²]	-0.49	5.08