

Sustainability & Energy Statement

Land at Dairy Cottage, Heathlands Road, Wokingham

Prepared by Ivan Ball

Bluesky Unlimited
39 Marsh Baldon
Oxfordshire
OX44 9LP

ivan@blueskyunlimited.co.uk

29th January 2024



Table of Contents

Executive Summary	3
1.0 Introduction	4
2.0 Planning policies	5
3.0 Assessment methodology	9
4.0 Proposal	9
5.0 Energy Efficiency	10
5.1 Demand Reduction (Be Lean)	10
• Passive design measures	
• Active design measures	
5.2 Establishing Baseline Carbon Dioxide Emissions (GAS)	13
• SAP calculations	
5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)	14
5.4 Summary of Calculations and Proposals for Low-carbon & Renewable Technologies	18
6.0 Climate Change Adaption and Water Resources	19
• Sustainable drainage systems (SuDs)	
• Water efficiency measures	
7.0 Materials and Waste	21
 Appendix 1: DER Worksheets for the Modelled House based on GAS Baseline	
Appendix 2: DER Worksheets for the Modelled House based on Air Source Heat Pumps	

Executive Summary

This Sustainability and Energy Statement has been prepared in support of a detailed planning application for the erection of three, 4-bedroom detached house on land at Dairy Cottage, Heathlands Road, Wokingham.

The adopted planning policy (CC05) requires a reduction in emissions of at least 10% through the installation of low-carbon and/or renewable technologies.

The three houses are broadly similar in scale and design and SAP calculations have been prepared for one of them, which is proposed as representative of all. These have been based on the detailed planning drawings and the specification set out in the report.

The fabric insulation standards and the construction specification of the homes will exceed the minimum required by the Building Regulations. Whilst various technologies are considered appropriate it is proposed to install air source heat pumps into all three houses.

All units will benefit from renewable technologies.

In order to demonstrate the reduction from the installation of air source heat pump a further set of SAP calculations have been prepared for the same modelled unit but based on the installation of gas boilers. These provide a baseline against which the air source heat pump SAP calculations can be compared and hence the reduction from renewable technologies.

The DER Worksheets for both options are attached as Appendices 1 and 2.

The carbon dioxide emissions and the reductions from the installation of air source heat pumps can be summarised as follows;

	Total Emissions	% Reduction
	kg CO ₂ per year	
Baseline (DER emissions based on gas boilers)	8,858	
Emissions after Heat pumps (renewable technologies)	1,980	77.65%

The water efficiency measures incorporated within the houses will ensure the water use is less than 105 litres per person per day (excluding 5 l/p/d for external water use) and achieves the enhanced standard required by the Building Regulations.

The proposals significantly exceed the requirements of the planning policy.

1.0 Introduction

This report has been commissioned by Hall Hunter Partnership and provides a Sustainability and Energy Statement has been prepared in support of a detailed planning application for the erection of three, 4-bedroom detached house on land at Dairy Cottage, Heathlands Road, Wokingham.

The report describes the methodology used in assessing the development and the initiatives proposed.

The houses will be designed and constructed to reduce energy demand and carbon dioxide emissions.

The objective will be to reduce the energy demand to an economic minimum by making investments in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once cost-effective structures have been designed, low-carbon and renewable technologies have been considered to provide further emissions reductions.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled “A better quality of life: A strategy for sustainable development in the UK”. This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2023

Paragraph 157 states;

“The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.”

Local Policy

Wokingham Borough Local Development Framework – Adopted Core Strategy Development Plan Document, January 2010

CP1 – Sustainable development

Planning permission will be granted for development proposals that:

- 1) Maintain or enhance the high quality of the environment;*
- 2) Minimise the emission of pollutants into the wider environment;*
- 3) Limit any adverse effects on water quality (including ground water);*
- 4) Ensure the provision of adequate drainage;*
- 5) Minimise the consumption and use of resources and provide for recycling;*
- 6) Incorporate facilities for recycling of water and waste to help reduce per capita water consumption;*
- 7) Avoid areas of best and most versatile agricultural land;*
- 8) Avoid areas where pollution (including noise) may impact upon the amenity of future occupiers;*
- 9) Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater);*
- 10) Provide attractive, functional, accessible, safe, secure and adaptable schemes;*
- 11) Demonstrate how they support opportunities for reducing the need to travel, particularly by private car in line with CP6; and*
- 12) Contribute towards the goal of reaching zero-carbon developments as soon as possible by:*
 - a) Including appropriate on-site renewable energy features; and*
 - b) Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.*

CP2 - Inclusive communities

To ensure that new development contributes to the provision of sustainable and inclusive communities (including the provision of community facilities) to meet long term needs, planning permission will be granted for proposals that address the requirements of:

- a) An ageing population, particularly in terms of housing, health and wellbeing;*
- b) Children, young people and families, including the co-ordination of services to meet their needs;*
- c) People with special needs, including those with a physical, sensory or learning disability or problems accessing services; and*
- d) The specific identified needs of minority groups in the borough, including Gypsies, Travellers and Travelling Showpeople and black and minority ethnic groups. Proposals for gypsies, travellers and travelling showpeople (including allocations in other Development Plan Documents) will demonstrate that:*

- i) *The site is located either within or close to the development limits of a settlement in policy CP9 in order to maximise the possibilities for social inclusion and sustainable patterns of living; and*
- ii) *The proposed site is not disproportionate to the scale of the existing settlement whether singly or cumulatively with any existing sites in the area.*

Wokingham Borough Development Plan – Adopted Managing Development Delivery Local Plan, February 2014

Policy CC01 – Presumption in Favour of Sustainable Development

- 1. *Planning applications that accord with the policies in the Development Plan for Wokingham Borough will be approved without delay, unless material considerations indicate otherwise.*
- 2. *Where there are no policies relevant to the application or relevant policies are out of date at the time of making the decision then the Council will grant permission unless material considerations indicate otherwise – taking into account whether:*
 - a. *Any adverse impacts of planning permission would significantly and demonstrably outweigh the benefits, when assessed against the policies in the National Planning Policy Framework (NPPF) taken as a whole; or*
 - b. *Specific policies in the National Planning Policy Framework indicate that development should be restricted.*

Policy CC04: Sustainable Design and Construction

Planning permission will only be granted for proposals that seek to deliver high quality sustainably designed and constructed developments by:

- 1. *In respect of all new homes:*
 - a) *Seeking to achieve the requirements of the full Code for Sustainable Homes Level 4;**
 - b) *Meet internal potable water consumption targets of 105 litres or less per person per day (as part of the requirement to meet full Code for Sustainable Homes Level 4).*

Policy CC05: Renewable energy and decentralised energy networks

- 1. *Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged*
- 2. *Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology where the development is for:*
 - a) *Schemes of more than 10 dwellings (gross), or*
 - b) *Non-residential proposals of more than 1,000 sq m gross floorspace.*

3. *Proposals for renewable energy and decentralised energy works, including wind turbines, must demonstrate that:*
- a) They are appropriate in scale, location and technology type;*
 - b) Are compatible with the surrounding area, including the impact of noise and odour;*
 - c) Do not have a damaging impact on the local topography and landscape;*
 - d) There is no significant impact upon heritage assets, including views important to their setting;*
 - e) In the case of wind turbines, take account of their cumulative effect and properly reflect their increasing impact on the landscape and on local amenity.*

Sustainable Design and Construction SPD, 28th May 2010 and Companion Document to the Sustainable Design and Construction Supplementary Planning Document, 28th May 2010.

These documents have been used to inform this Sustainability and Energy Statement.

3.0 Assessment Methodology

The carbon dioxide emissions from the houses have been established using agreed building specifications and the accommodation schedule set out below.

SAP calculations have been prepared for one of the houses, which is proposed as representative of all three. The results from the SAP calculations have been aggregated across the three units in order to estimate the total emissions from the site.

Emission Factors

The CO₂ emission factors, where applicable, used throughout this report have been taken from the Building Regulation Approved Document L - 2021.

	kg CO ₂ /kWh
Grid supplied and displaced electricity	0.136
Mains gas	0.210

4.0 Proposal

The proposal is for the construction of three, 4-bedroom detached houses.

The accommodation schedule in details is;

Unit Type	Number	Area
		m ²
4-Bedroom Detached house	1	249.8
4-Bedroom Detached house	1	251.2
4-Bedroom Detached house	1	263.3
		764.3

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean and Be Clean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The Proposed Site Plan shows all three houses with their primary orientations towards the northwest (front for Plots 1 & 2 and rear for Plot 3) and southeast (rear for Plots 1 & 2 and front for Plot 3).

All houses will receive direct sunlight throughout the day.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L (2021) standards and further improvements to U-values will reduce the home's heating requirements.

The strategy follows a fabric first approach and the specification proposed for the various thermal elements exceeds the limiting U-values required by the Building Regulations.

The modelling has been based upon the use of traditional cavity wall construction with external walls built with 102mm facing brick (or tile-hanging on dense concrete block), 150mm fully-filled cavities and a 100mm medium dense concrete block internally.

Ground floors will be insulated with 150mm PIR insulation and roofs (cold) with 450mm of mineral wool insulation. Sloping ceiling and dormer cheeks will be insulated with at least 150mm PIR insulation.

Other constructions will meet the targeted U-values.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m ² K	W/m ² K	
Ground Floors	0.18	0.13	28%
External Walls	0.26	0.18	31%
Roofs (lofts)	0.16	0.10	38%
Roofs (sloping)	0.16	0.15	6%
Windows	1.60	1.20	25%
External Doors	1.60	1.20	38%

'g' Value for Glazing	0.63
-----------------------	-------------

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 8 m³ of air per hour per m² of envelope area, at 50Pa. The homes will target a 38% improvement over Building Regulations and will seek to achieve a permeability of 5.0 m³/hr/m² or better.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO₂ reduction targets set out in this strategy.

The thermal details for the building will be modelled at the detailed working drawing stage but for the purposes of this assessment the thermal details formulated by the Recognised Construction Details have been used. Any details not available on the RCD website will be modelled. These will enable the building to achieve the higher energy efficiency requirements of the Building Regulations.

The following table provides the values currently used within the modelled SAP calculations.

Reference	Location	PSI Value
		W/mK
E2	Other Lintels (including other steel lintels)	0.028
E3	Sill	0.024
E4	Jamb	0.019
E5	Ground Floor (Normal)	0.046
E6	Intermediate Floor within a dwelling	0.000
E10	Eaves (Ceiling)	0.051
E12	Gable (Ceiling)	0.029
E16	Corner (normal)	0.037
E17	Corner (inverted)	-0.079

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2021 to address the possibility of overheating and poor air quality. The ventilation to Cloakrooms, En-Suites and Bathrooms will be comprised of continuous extract ventilation as per System 3 criteria. This reduces the number of external penetrations required to the building envelope.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fitting to have lamps with a minimum luminous efficacy of 80 light source lumens per circuit-watt.

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a Vaillant gas boiler installed to each unit but the proposed specification is based upon the installation of Vaillant aroTHERM air source heat pumps installed to each house.

5.2 Establishing Baseline Carbon Dioxide Emissions - GAS

The three houses are similar in scale and design and SAP calculations have been prepared for one, which are proposed as representative of all three.

The DER Worksheets are attached as Appendix 1 but the emissions can be summarised as follows:

4-Bedroom Detached house – 251.2 m ²	CO ₂ DER
	kg/yr
Space heating	2,075.11
Water heating	767.01
Electricity for pumps, fans & keep-hot	11.93
Electricity for lighting	55.63
Total	2,909.69
DER Emissions Rate (kg CO₂/yr)	11.59

Using the above results, the total site CO₂ emissions from the site for the baseline scenario (GAS) can be calculated as follows;

	Area	CO ₂ DER
	m ²	kg/yr
4-Bedroom Detached houses	764.3	8,858
Total	764.3	8,858

The baseline emissions from the site based on the installation of gas heating system to all units is calculated as **8,858 kg CO₂ per year**.

5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows. This section determines the appropriateness of each renewable technology.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Heathlands Road to be 4.7 m/s at 10m above ground level and 5.5 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station.

The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO₂ savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity. However, with the de-carbonisation of the electricity grid the benefit of CHP is negated.

CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

Whilst the houses are set in private garden areas it is unlikely there will be sufficient external ground area to sustain a horizontal collection system and the installation of ground source heat pumps is likely to require the use of a bore hole collection system to each house.

The use of ground source heat pumps with bore-hole collection systems to the houses is feasible but would be an expensive option when compared with some other technologies.

Ground source heat pumps are not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the sun's energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

It is assumed solar panels could reduce the energy demand of the hot water requirements by 50%.

Assuming panels could be installed to all three units the total reduction in emissions would be **1,167 kg CO₂ per year**, which equates to a reduction in total (DER) emissions of **13.17%**.

Whilst the installation of solar hot water heating panels would meet the requirements of the planning policy it is unlikely, they would allow the houses to achieve Building Regulation compliance using gas heating systems.

Solar hot water heating panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

Whilst the installation of photovoltaic panels to the dwellings is feasible, it is calculated that a total of **18 x 400W** panels would be required to reduce emissions by the 10% required by the planning policy.

The roofs of the houses are complex with dormer windows located on a number of roof slopes. In addition, any installation on Plot 3 would need to be located on the front elevation, which would detrimentally impact on the aesthetics of the development.

Photovoltaic panels are not proposed.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

A further set of SAP calculations have been prepared for the modelled unit modelled above but with the benefit of an air source heat pump.

The DER Worksheets for the proposed specification are attached as Appendix 2 but the emissions can be summarised as follows:

4-Bedroom Detached house – 251.2 m ²	CO ₂ DER
	kg/yr
Space heating	348.79
Water heating	244.97
Electricity for pumps, fans & keep-hot	0.00
Electricity for lighting	55.63
Total	649.39
DER Emissions Rate (kg CO₂/yr)	2.59

Using the above results, the total site CO₂ emissions from the site for the baseline scenario (GAS) can be calculated as follows;

	Area	CO ₂ DER
	m ²	kg/yr
4-Bedroom Detached houses	764.3	1,980
Total	764.3	1,980

The emissions from the site based on the installation of air source heat pumps to all houses is calculated as **1,980 kg CO₂ per year**.

The reduction in emissions as a result of the installation of air source heat pumps is therefore **6,878 kg CO₂ per year**, which equates to a reduction of **77.65%**.

5.4 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

The baseline carbon emissions based on the installation of gas heating systems are assessed as **8,858 kg CO₂ per year**.

The local planning policy requires a reduction in emissions of 10% through the installation of low-carbon and/or renewable technologies.

Various technologies are considered above and whilst wind turbines, combined heat and power, ground source heat pumps, are not considered appropriate the use of solar hot water heating, photovoltaic panels and air source heat pumps are considered feasible and appropriate (albeit the use of solar hot water heating and photovoltaic panels are not proposed).

Be Lean

The construction standards proposed include U-values, which demonstrate good practice and improve upon those required by the Building Regulations. Air tightness standards are targeted at a 50% improvement upon the minimum required by the Building Regulations.

Be Clean and Be Green

Various technologies are considered above and it is proposed to install air source heat pumps into the three houses.

As a result of these installations the total emissions from the site are assessed as **1,980 kg CO₂ per year**.

The reduction in emissions from the installation of renewable technologies is therefore 6,878 kg CO₂ per year, which equates to a reduction of 77.65%.

The proposal significantly exceeds the emissions reduction target required by the planning policy.

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

Surface Water Management

The houses have private gardens and discretely located rainwater butts could be provided to store rainwater for use with landscaping maintenance.

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 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. This is the standard required by the planning policy.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the homes:

- Water efficient taps;
- Water efficient toilets;
- Low output showers;
- Flow restrictors to manage water pressures to achieve optimum levels and
- Water meters.

Below is a typical specification, which would achieve the 110 Litres per person per day target (including five litres per person per day allowance for external water use). This is the equivalent of the 105 litres per person per day required by the planning policy.

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/3 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
Total Internal Water Consumption		102.10
External Water Use		5.00
Total Water Consumption		107.10

7.0 Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

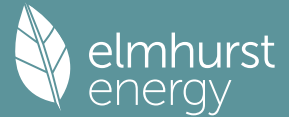
Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage;
- Efficient purchasing arrangements to minimise over ordering;
- Segregation of construction waste to maximise potential for reuse/recycling;
- Suppliers who collect and reuse/recycle packaging materials.

Appendix 1 – DER Worksheets for the Modelled House based on a GAS baseline

Full SAP Calculation Printout



Property Reference	Wokingham 4BH DET 251 - GAS				Issued on Date	01/02/2024
Assessment Reference	Wokingham 4BH DET 251 - GAS		Prop Type Ref	4BH DET 251 - GAS		
Property	Dairy Cottage, Heathlands Road, Wokingham, Berks, RG40 3AN					
SAP Rating	87 B	DER	11.59	TER	7.03	
Environmental	87 B	% DER < TER				-64.86
CO ₂ Emissions (t/year)	2.62	DFEE	33.98	TFEE	37.25	
Compliance Check	See BREL	% DFEE < TFEE				8.79
% DPER < TPER	-69.71	DPER	63.78	TPER	37.58	
Assessor Details	Mr. Ivan Ball				Assessor ID	X001-7283
Client						

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	143.6000 (1b)	x 2.4000 (2b)	= 344.6400 (1b) - (3b)
First floor	107.5000 (1c)	x 2.2900 (2c)	= 246.1750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	251.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 590.8150 (5)

2. Ventilation rate

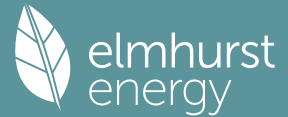
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	
Pressure test	40.0000 / (5) =	
Pressure Test Method	Yes	
Measured/design AP50	Blower Door	
Infiltration rate	4.0000 (17)	
Number of sides sheltered	0.2677 (18)	
	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	
Infiltration rate adjusted to include shelter factor	0.8500 (20)	
	(21) = (18) x (20) =	
	0.2275 (21)	

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Effective ac	0.2901	0.2844	0.2787	0.2503	0.2446	0.2162	0.2162	0.2105	0.2275	0.2446	0.2560	0.2674 (22b)
	0.5421	0.5405	0.5388	0.5313	0.5299	0.5234	0.5234	0.5222	0.5259	0.5299	0.5328	0.5357 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			32.4400	1.1450	37.1450		(27)
Opening Type 2			4.2000	1.2000	5.0400		(26a)
Heatloss Floor 1			143.6500	0.1300	18.6745		(28a)
Cavity Walls	147.9000	30.4300	117.4700	0.1800	21.1446		(29a)
Low Level Walls to FF	65.9900	6.2100	59.7800	0.1500	8.9670		(29a)
Ceiling over GF	36.1500		36.1500	0.1000	3.6150		(30)
Ceiling over FF	70.3600		70.3600	0.1000	7.0360		(30)
Sloping Ceiling	41.0300		41.0300	0.1500	6.1545		(30)
Total net area of external elements Aum(A, m ²)			505.0800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	107.7766	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E5 Ground floor (normal)				57.1300	0.0460	2.6280	
E2 Other lintels (including other steel lintels)				17.9000	0.0280	0.5012	
E3 Sill				8.7000	0.0240	0.2088	
E4 Jamb				27.3000	0.0190	0.5187	
E6 Intermediate floor within a dwelling				45.1800	0.0000	0.0000	

Full SAP Calculation Printout



E10 Eaves (insulation at ceiling level)	40.3300	0.0510	2.0568
E12 Gable (insulation at ceiling level)	4.8500	0.0290	0.1406
E16 Corner (normal)	22.2000	0.0370	0.8214
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0790	-0.7584
R1 Head of roof window	5.4000	0.0240	0.1296
R2 Sill of roof window	5.4000	0.0240	0.1296
R3 Jamb of roof window	13.5000	0.0190	0.2565
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.6329 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	114.4095 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	105.6899	105.3713	105.0589	103.5920	103.3175	102.0399	102.0399	101.8033	102.5320	103.3175	103.8728	104.4532 (38)
Average = Sum(39)m / 12 =	220.0994	219.7808	219.4684	218.0015	217.7270	216.4494	216.4494	216.2128	216.9415	217.7270	218.2823	218.8627 (39)
												218.0002
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8765	0.8753	0.8740	0.8682	0.8671	0.8620	0.8620	0.8611	0.8640	0.8671	0.8693	0.8716 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0684 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	87.2966	86.0001	84.1744	80.8081	78.2875	75.4925	73.9828	75.7957	77.7697	80.7604	84.1960	87.0015	(42b)
Hot water usage for other uses	46.0531	44.3784	42.7038	41.0291	39.3544	37.6798	37.6798	39.3544	41.0291	42.7038	44.3784	46.0531	(42c)
Average daily hot water use (litres/day)													122.8041 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	133.3497	130.3785	126.8782	121.8372	117.6419	113.1723	111.6626	115.1502	118.7988	123.4642	128.5745	133.0546	(44)
Distribution loss (46)m = 0.15 x (45)m	211.1933	185.6573	195.0070	166.7891	158.3687	139.1586	135.0462	142.5800	146.4908	167.5398	183.1779	208.3313	(45)
Water storage loss:													
Store volume	31.6790	27.8486	29.2511	25.0184	23.7553	20.8738	20.2569	21.3870	21.9736	25.1310	27.4767	31.2497	(46)
a) If manufacturer declared loss factor is known (kWh/day):													
Temperature factor from Table 2b													300.0000 (47)
Enter (49) or (54) in (55)													1.2200 (48)
Total storage loss													0.7800 (49)
If cylinder contains dedicated solar storage													0.9516 (55)
Primary loss	29.4996	26.6448	29.4996	28.5480	29.4996	28.5480	29.4996	29.4996	28.5480	29.4996	28.5480	29.4996	(56)
Combi loss	29.4996	26.6448	29.4996	28.5480	29.4996	28.5480	29.4996	29.4996	28.5480	29.4996	28.5480	29.4996	(57)
Total heat required for water heating calculated for each month	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
PV diverter	295.5505	261.8509	279.3642	248.4251	242.7259	190.2186	187.8082	195.3420	197.5508	251.8970	264.8139	292.6885	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
12Total per year (kWh/year)	295.5505	261.8509	279.3642	248.4251	242.7259	190.2186	187.8082	195.3420	197.5508	251.8970	264.8139	292.6885	(64)
Electric shower(s)													
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
	114.1079	101.3701	108.7259	97.9278	96.5437	64.2798	63.5128	66.0178	66.7178	99.5930	103.3770	113.1562	(65)

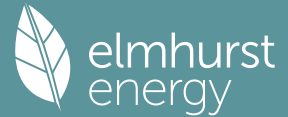
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.8553	254.4826	229.8553	237.5171	229.8553	237.5171	229.8553	229.8553	237.5171	229.8553	237.5171	229.8553 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	417.3408	421.6715	410.7583	387.5254	358.1980	330.6344	312.2202	307.8895	318.8027	342.0356	371.3630	398.9266 (68)
Pumps, fans	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344 (71)
Total internal gains	153.3708	150.8484	146.1370	136.0108	129.7630	89.2775	85.3667	88.7336	92.6636	133.8616	143.5792	152.0917 (72)
	872.5922	899.0279	858.7759	833.0787	789.8416	726.4544	696.4675	695.5037	718.0088	777.7779	824.4848	852.8990 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				1.0100	11.2829		0.6300		0.7000		0.7700		3.4827 (75)
East				1.4400	19.6403		0.6300		0.7000		0.7700		8.6433 (76)
Southeast				17.3700	36.7938		0.6300		0.7000		0.7700		195.3200 (77)
Southwest				1.0100	36.7938		0.6300		0.7000		0.7700		11.3571 (79)
Northwest				11.6100	11.2829		0.6300		0.7000		0.7700		40.0338 (81)
Solar gains	258.8369	457.5348	669.1234	899.5388	1070.5798	1090.2135	1039.7151	908.1541	748.4147	517.4011	313.0837	219.5181	(83)

Full SAP Calculation Printout



Total gains 1131.4291 1356.5627 1527.8994 1732.6175 1860.4214 1816.6679 1736.1826 1603.6578 1466.4235 1295.1790 1137.5685 1072.4171 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	79.2256	79.3404	79.4533	79.9880	80.0888	80.5616	80.5616	80.6497	80.3788	80.0888	79.8851	79.6732
alpha	6.2817	6.2894	6.2969	6.3325	6.3393	6.3708	6.3708	6.3766	6.3586	6.3393	6.3257	6.3115
util living area	0.9996	0.9985	0.9949	0.9749	0.8975	0.7253	0.5431	0.6087	0.8728	0.9874	0.9987	0.9997 (86)
MIT	20.5658	20.6065	20.6652	20.7461	20.8130	20.8461	20.8527	20.8518	20.8290	20.7421	20.6392	20.5595 (87)
Th 2	20.1875	20.1886	20.1896	20.1946	20.1956	20.1999	20.1999	20.2007	20.1982	20.1956	20.1937	20.1917 (88)
util rest of house	0.9994	0.9980	0.9930	0.9654	0.8612	0.6495	0.4473	0.5089	0.8158	0.9811	0.9982	0.9996 (89)
MIT 2	19.6561	19.7092	19.7853	19.8918	19.9712	20.0075	20.0118	20.0124	19.9919	19.8887	19.7560	19.6520 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.7924	19.8436	19.9171	20.0197	20.0973	20.1331	20.1377	20.1381	20.1172	20.0165	19.8883	19.7879 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.7924	19.8436	19.9171	20.0197	20.0973	20.1331	20.1377	20.1381	20.1172	20.0165	19.8883	19.7879 (93)

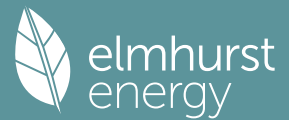
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9993	0.9977	0.9922	0.9628	0.8561	0.6427	0.4397	0.5008	0.8091	0.9793	0.9980	0.9995 (94)
Useful gains	1130.6894	1353.4965	1515.9929	1668.1978	1592.7290	1167.5373	763.4101	803.1092	1186.4306	1268.3148	1135.2608	1071.9223 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	3409.8574	3284.3123	2944.6194	2424.1181	1828.3107	1197.6392	765.7415	808.2168	1305.3889	2050.2329	2791.4531	3411.6029 (97)
Space heating kWh	1695.7009	1297.5082	1062.8981	544.2626	175.2728	0.0000	0.0000	0.0000	0.0000	581.7471	1192.4584	1740.7223 (98a)
Space heating requirement - total per year (kWh/year)												8290.5705
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	1695.7009	1297.5082	1062.8981	544.2626	175.2728	0.0000	0.0000	0.0000	0.0000	581.7471	1192.4584	1740.7223 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8290.5705
Space heating per m2												(98c) / (4) = 33.0170 (99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												83.9000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1695.7009	1297.5082	1062.8981	544.2626	175.2728	0.0000	0.0000	0.0000	0.0000	581.7471	1192.4584	1740.7223 (98)
Space heating efficiency (main heating system 1)	83.9000	83.9000	83.9000	83.9000	83.9000	0.0000	0.0000	0.0000	0.0000	83.9000	83.9000	83.9000 (210)
Space heating fuel (main heating system)	2021.0976	1546.4937	1266.8631	648.7039	208.9068	0.0000	0.0000	0.0000	0.0000	693.3815	1421.2854	2074.7584 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	295.5505	261.8509	279.3642	248.4251	242.7259	190.2186	187.8082	195.3420	197.5508	251.8970	264.8139	292.6885 (64)
Efficiency of water heater (217)m	82.4382	82.2497	81.8636	80.8687	78.4421	74.9000	74.9000	74.9000	74.9000	80.9738	82.1168	79.9000 (216)
Fuel for water heating, kWh/month	358.5118	318.3610	341.2558	307.1955	309.4330	253.9634	250.7453	260.8037	263.7528	311.0845	322.4844	354.8530 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	47.7594	38.3144	34.4978	25.2746	19.5228	15.9503	17.8094	23.1493	30.0686	39.4517	44.5606	49.0868 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												9881.4905 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.9000
Water heating fuel used												3652.4441 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												86.0000 (231)

Full SAP Calculation Printout



Electricity for lighting (calculated in Appendix L)	385.4456 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	14005.3802 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

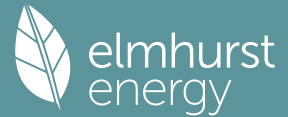
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	9881.4905	0.2100	2075.1130	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3652.4441	0.2100	767.0133	(264)
Space and water heating			2842.1263	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	385.4456	0.1443	55.6317	(268)
Total CO2, kg/year			2909.6872	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.5900	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	9881.4905	1.1300	11166.0842	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3652.4441	1.1300	4127.2619	(278)
Space and water heating			15293.3461	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	385.4456	1.5338	591.2093	(282)
Total Primary energy kWh/year			16014.6562	(286)
Dwelling Primary energy Rate (DPER)			63.7800	(287)

Appendix 2 – DER Worksheets for the Modelled House based on Air Source Heat Pumps

Full SAP Calculation Printout



Property Reference	Wokingham 4BH DET 251 - ASHP				Issued on Date	01/02/2024
Assessment Reference	Wokingham 4BH DET 251 - ASHP		Prop Type Ref	4BH DET 251 - ASHP		
Property	Dairy Cottage, Heathlands Road, Wokingham, Berks, RG40 3AN					
SAP Rating	86 B	DER	2.59	TER	7.03	
Environmental	97 A	% DER < TER				63.16
CO ₂ Emissions (t/year)	0.6	DFEE	33.98	TFEE	37.25	
Compliance Check	See BREL	% DFEE < TFEE				8.79
% DPER < TPER	28.39	DPER	26.91	TPER	37.58	
Assessor Details	Mr. Ivan Ball				Assessor ID	X001-7283
Client						

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	143.6000 (1b)	x 2.4000 (2b)	= 344.6400 (1b) - (3b)
First floor	107.5000 (1c)	x 2.2900 (2c)	= 246.1750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	251.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 590.8150 (5)

2. Ventilation rate

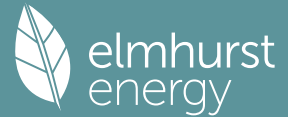
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.0677 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2677 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2901	0.2844	0.2787	0.2503	0.2446	0.2162	0.2162	0.2105	0.2275	0.2446	0.2560	0.2674 (22b)
Effective ac	0.5421	0.5405	0.5388	0.5313	0.5299	0.5234	0.5234	0.5222	0.5259	0.5299	0.5328	0.5357 (25)

3. Heat losses and heat loss parameter

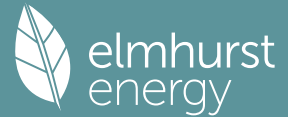
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			32.4400	1.1450	37.1450		(27)
Opening Type 2			4.2000	1.2000	5.0400		(26a)
Heatloss Floor 1			143.6500	0.1300	18.6745		(28a)
Cavity Walls	147.9000	30.4300	117.4700	0.1800	21.1446		(29a)
Low Level Walls to FF	65.9900	6.2100	59.7800	0.1500	8.9670		(29a)
Ceiling over GF	36.1500		36.1500	0.1000	3.6150		(30)
Ceiling over FF	70.3600		70.3600	0.1000	7.0360		(30)
Sloping Ceiling	41.0300		41.0300	0.1500	6.1545		(30)
Total net area of external elements Aum(A, m ²)			505.0800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	107.7766		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E5 Ground floor (normal)				57.1300	0.0460	2.6280	
E2 Other lintels (including other steel lintels)				17.9000	0.0280	0.5012	
E3 Sill				8.7000	0.0240	0.2088	
E4 Jamb				27.3000	0.0190	0.5187	
E6 Intermediate floor within a dwelling				45.1800	0.0000	0.0000	

Full SAP Calculation Printout



E10 Eaves (insulation at ceiling level)					40.3300	0.0510	2.0568					
E12 Gable (insulation at ceiling level)					4.8500	0.0290	0.1406					
E16 Corner (normal)					22.2000	0.0370	0.8214					
E17 Corner (inverted - internal area greater than external area)					9.6000	-0.0790	-0.7584					
R1 Head of roof window					5.4000	0.0240	0.1296					
R2 Sill of roof window					5.4000	0.0240	0.1296					
R3 Jamb of roof window					13.5000	0.0190	0.2565					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)											6.6329	(36)
Point Thermal bridges											0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	114.4095 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	105.6899	105.3713	105.0589	103.5920	103.3175	102.0399	102.0399	101.8033	102.5320	103.3175	103.8728	104.4532 (38)
Average = Sum(39)m / 12 =	220.0994	219.7808	219.4684	218.0015	217.7270	216.4494	216.4494	216.2128	216.9415	217.7270	218.2823	218.8627 (39)
												218.0002
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8765	0.8753	0.8740	0.8682	0.8671	0.8620	0.8620	0.8611	0.8640	0.8671	0.8693	0.8716 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
												0.8682
												31
4. Water heating energy requirements (kWh/year)												
Assumed occupancy												3.0684 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	91.8912	90.5265	88.6047	85.0612	82.4079	79.4658	77.8766	79.7850	81.8629	85.0110	88.6274	91.5805 (42b)
Hot water usage for other uses	48.4769	46.7141	44.9513	43.1885	41.4257	39.6629	39.6629	41.4257	43.1885	44.9513	46.7141	48.4769 (42c)
Average daily hot water use (litres/day)												129.2675 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	140.3681	137.2406	133.5560	128.2497	123.8336	119.1287	117.5396	121.2107	125.0514	129.9623	135.3415	140.0574 (44)
Energy content (annual)	222.3087	195.4288	205.2706	175.5675	166.7039	146.4827	142.1539	150.0842	154.2009	176.3576	192.8188	219.2961 (45)
Distribution loss (46)m = 0.15 x (45)m												2146.6736
Water storage loss:												
Store volume	33.3463	29.3143	30.7906	26.3351	25.0056	21.9724	21.3231	22.5126	23.1301	26.4536	28.9228	32.8944 (46)
a) If manufacturer declared loss factor is known (kWh/day):												300.0000 (47)
Temperature factor from Table 2b												1.2200 (48)
Enter (49) or (54) in (55)												0.7800 (49)
Total storage loss												0.9516 (55)
If cylinder contains dedicated solar storage	29.4996	26.6448	29.4996	28.5480	29.4996	28.5480	29.4996	29.4996	28.5480	29.4996	28.5480	29.4996 (56)
Primary loss	29.4996	26.6448	29.4996	28.5480	29.4996	28.5480	29.4996	29.4996	28.5480	29.4996	28.5480	29.4996 (57)
Combi loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	54.8576	53.0880	54.8576	54.8576 (59)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	306.6659	271.6224	289.6278	257.2035	251.0611	197.5427	194.9159	202.8462	205.2609	260.7148	274.4548	303.6533 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
12Total per year (kWh/year)	306.6659	271.6224	289.6278	257.2035	251.0611	197.5427	194.9159	202.8462	205.2609	260.7148	274.4548	303.6533 (64)
Electric shower(s)												3015.5692 (64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												3016 (64)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	117.8037	104.6191	112.1385	100.8466	99.3151	66.7151	65.8761	68.5129	69.2814	102.5250	106.5827	116.8020 (65)
5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180	153.4180 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.8553	254.4826	229.8553	237.5171	229.8553	237.5171	229.8553	229.8553	237.5171	229.8553	237.5171	229.8553 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	417.3408	421.6715	410.7583	387.5254	358.1980	330.6344	312.2202	307.8895	318.8027	342.0356	371.3630	398.9266 (68)
Pumps, fans	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418	38.3418 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344	-122.7344 (71)
Total internal gains	158.3384	155.6832	150.7238	140.0647	133.4881	92.6599	88.5431	92.0873	96.2241	137.8024	148.0315	156.9920 (72)
	874.5598	900.8627	860.3628	834.1326	790.5667	729.8367	699.6440	698.8574	721.5694	778.7187	825.9370	854.7993 (73)
6. Solar gains												
[Jan]												
Area												
Solar flux												
Specific data												
Specific data												
Access factor												
Gains												
North-east	1.0100				11.2829		0.6300		0.7000		0.7700	3.4827 (75)
East	1.4400				19.6403		0.6300		0.7000		0.7700	8.6433 (76)
South-east	17.3700				36.7938		0.6300		0.7000		0.7700	195.3200 (77)
South-west	1.0100				36.7938		0.6300		0.7000		0.7700	11.3571 (79)
North-west	11.6100				11.2829		0.6300		0.7000		0.7700	40.0338 (81)
Solar gains	258.8369	457.5348	669.1234	899.5388	1070.5798	1090.2135	1039.7151	908.1541	748.4147	517.4011	313.0837	219.5181 (83)

Full SAP Calculation Printout



Total gains 1133.3967 1358.3975 1529.4862 1733.6714 1861.1465 1820.0502 1739.3591 1607.0115 1469.9841 1296.1198 1139.0207 1074.3174 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	79.2256	79.3404	79.4533	79.9880	80.0888	80.5616	80.5616	80.6497	80.3788	80.0888	79.8851	79.6732
alpha	6.2817	6.2894	6.2969	6.3325	6.3393	6.3708	6.3708	6.3766	6.3586	6.3393	6.3257	6.3115
util living area	0.9996	0.9985	0.9948	0.9748	0.8973	0.7242	0.5421	0.6075	0.8718	0.9873	0.9987	0.9997 (86)
Living	20.5661	20.6067	20.6654	20.7462	20.8131	20.8462	20.8527	20.8518	20.8292	20.7422	20.6394	20.5597
Non living	19.6564	19.7095	19.7855	19.8919	19.9712	20.0076	20.0118	20.0124	19.9920	19.8889	19.7562	19.6522
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7780	20.6067	20.6654	20.7462	20.8131	20.8462	20.8527	20.8518	20.8292	20.7422	20.6394	20.6213 (87)
Th 2	20.1875	20.1886	20.1896	20.1946	20.1956	20.1999	20.1999	20.2007	20.1982	20.1956	20.1937	20.1917 (88)
util rest of house	0.9994	0.9980	0.9930	0.9653	0.8611	0.6484	0.4465	0.5079	0.8146	0.9810	0.9982	0.9996 (89)
MIT 2	19.9758	19.7095	19.7855	19.8919	19.9712	20.0076	20.0118	20.0124	19.9920	19.8889	19.7562	19.7495 (90)
Living area fraction									fLA = Living area / (4) =			0.1497 (91)
MIT	20.0959	19.8438	19.9173	20.0199	20.0973	20.1332	20.1377	20.1381	20.1174	20.0166	19.8885	19.8800 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0959	19.8438	19.9173	20.0199	20.0973	20.1332	20.1377	20.1381	20.1174	20.0166	19.8885	19.8800 (93)

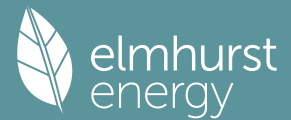
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9977	0.9922	0.9627	0.8559	0.6416	0.4389	0.4998	0.8078	0.9792	0.9980	0.9995	(94)
Useful gains	1132.7278	1355.3042	1517.5029	1669.0387	1593.0313	1167.8129	763.4349	803.1689	1187.5117	1269.1422	1136.6936	1073.8336	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3476.6670	3284.3678	2944.6659	2424.1442	1828.3204	1197.6488	765.7425	808.2191	1305.4245	2050.2584	2791.4968	3431.7688	(97)
Space heating kWh	1743.8907	1296.3307	1061.8093	543.6759	175.0551	0.0000	0.0000	0.0000	0.0000	581.1505	1191.4583	1754.3038	(98a)
Space heating requirement - total per year (kWh/year)												8347.6743	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1743.8907	1296.3307	1061.8093	543.6759	175.0551	0.0000	0.0000	0.0000	0.0000	581.1505	1191.4583	1754.3038	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8347.6743	
Space heating per m2										(98c) / (4) =		33.2444	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)	
Fraction of space heat from main system(s)												1.0000 (202)	
Efficiency of main space heating system 1 (in %)												372.6813 (206)	
Efficiency of main space heating system 2 (in %)												0.0000 (207)	
Efficiency of secondary/supplementary heating system, %												0.0000 (208)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1743.8907	1296.3307	1061.8093	543.6759	175.0551	0.0000	0.0000	0.0000	0.0000	581.1505	1191.4583	1754.3038	(98)
Space heating efficiency (main heating system 1)	372.6813	372.6813	372.6813	372.6813	372.6813	0.0000	0.0000	0.0000	0.0000	372.6813	372.6813	372.6813	(210)
Space heating fuel (main heating system)	467.9308	347.8390	284.9108	145.8823	46.9718	0.0000	0.0000	0.0000	0.0000	155.9377	319.6990	470.7249	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	306.6659	271.6224	289.6278	257.2035	251.0611	197.5427	194.9159	202.8462	205.2609	260.7148	274.4548	303.6533	(64)
Efficiency of water heater (217)m	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	174.3809	(216)
Fuel for water heating, kWh/month	175.8598	155.7638	166.0892	147.4952	143.9728	113.2823	111.7760	116.3236	117.7083	149.5088	157.3881	174.1322	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting (234a)m	47.7594	38.3144	34.4978	25.2746	19.5228	15.9503	17.8094	23.1493	30.0686	39.4517	44.5606	49.0868	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2239.8963	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												174.3809	
Water heating fuel used												1729.3002	(219)
Space cooling fuel												0.0000	(221)

Full SAP Calculation Printout



Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	385.4456 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4354.6420 (238)

----- 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2239.8963	0.1557	348.7900 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1729.3002	0.1417	244.9673 (264)
Space and water heating			593.7572 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	385.4456	0.1443	55.6317 (268)
Total CO2, kg/year			649.3890 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5900 (273)

----- 13a. Primary energy - Individual heating systems including micro-CHP -----

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2239.8963	1.5765	3531.1838 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1729.3002	1.5238	2635.1908 (278)
Space and water heating			6166.3746 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	385.4456	1.5338	591.2093 (282)
Total Primary energy kWh/year			6757.5839 (286)
Dwelling Primary energy Rate (DPER)			26.9100 (287)