

Sustainability & Energy Statement

Land to the rear of 19 Parkside Road, Reading

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Executive Summary

This Sustainability and Energy Statement has been prepared in support of an outline planning application for the construction of four dwellings following the demolition of outbuildings with access from Parkside Road and Kearsley Road on land to the rear of 19 Parkside Road, Reading.

The Statement includes an energy strategy showing how selected energy efficiency, low carbon and renewable energy measures have been considered and those, which will be incorporated into the proposals.

The four houses are assumed to be broadly similar in scale and design and therefore SAP calculations, which have been prepared for a house of a similar design and specification have been used to provide an accurate assessment of emissions from the site. The calculations are based on Part L 2021 and use the construction specification set out in the Statement.

The fabric insulation standards and the construction specification of the houses will exceed the minimum required by the Building Regulations.

It is proposed to install an air source heat pump into each house.

In addition, it is assumed that each house can sustain photovoltaic panels and the calculations are based on the installation of 6 x 400W panels being installed to each unit. The panels are assumed to be inclined at circa 45 degrees and orientated towards either the southwest or southeast.

The total site emissions and reductions can be summarised as follows;

	Emissions	% Reduction
	kg CO ₂ per year	
Baseline Emissions (TER)	6,109	
Be Green Emissions (DER) – after energy efficiency & renewables	1,496	75.51%

The residual emissions from the site are 1.496 tonnes of CO₂.

The water efficiency standards for the houses will be less than 110 litres per person per day (including 5 litres for external water use). A sample water efficiency calculator is included within the Statement.

The proposals are in compliance with the planning policy.

1.0 Introduction

This report has been commissioned by Mr R Stimpson and provides a Sustainability and Energy Statement in support of an outline planning application for the construction of four dwellings following the demolition of outbuildings with access from Parkside Road and Kearsley Road on land to the rear of 19 Parkside Road, Reading.

The Statement 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 will be 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 – December 2024

Paragraph 161 states;

‘The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks 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

The local planning policies are set out in the **Reading Borough Local Plan**, which was adopted in November 2019. Of particular relevance to the subject area of this Statement are the following policies;

CC2: Sustainable Design and Construction

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- *All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;*
- *All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;*
- *All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.*

CC3: Adaptation to Climate Change

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- *Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;*
- *Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*
- *Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and*
- *All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change.*

CC4: Decentralised Energy

- *In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.*
- *Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.*
- *Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.*

CC5: Waste Minimisation and Storage

Development should demonstrate measures to minimise the generation of waste in the construction, use and life of buildings and promote more sustainable approaches to waste management, including the reuse and recycling of construction waste and the promotion of layouts and designs that provide adequate, well-designed space to facilitate waste storage, reuse, recycling and composting.

In addition to the Local Plan the Council have published further guidance within the **Sustainable Design and Construction Supplementary Planning Document**, which was adopted in December 2019.

The SPD sets out the Councils requirement that all residential developments of 10 units or more should achieve 'zero carbon' with a preference for the reduction to be achieved on site but if it is not feasible then at least 35% should be achieved on site with the balance offset using a carbon offset payment system.

3.0 Assessment Methodology

The energy strategy uses SAP calculations that have been prepared for a house from another scheme, which is similar to those proposed in scale, design and specification.

The results have been aggregated across the four units using an indicative accommodation schedule in order to estimate the total site emissions and allow different low-carbon and renewable technologies to be tested.

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 planning application seeks outline consent and detailed design has not been completed for the unit types.

However, for the purposes for this Statement it has been assumed that the dwellings will be comprised of detached houses.

The energy strategy has been based upon the following indicative mix of accommodation:

Unit Type	Number	Area
		m ²
Detached house	1	155.9
Detached house	1	169.7
Detached house	1	177.8
Detached house	1	195.6
Totals	4	699.0

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 Design Measures

The passive design measures proposed include;

(i) 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 application is for outline consent and the arrangement of the dwellings has not yet been determined.

However, the Feasibility Layout seeks to set out the homes with either a southeast/northwest or northeast/southwest orientation and provides all homes with access to direct sunlight throughout the day.

(ii) 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.

(iii) Efficient Building Fabric

a. 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.

Exposed floors will be insulated with 150mm PIR insulation or similar.

External walls are assumed to be built with 102mm facing brickwork, 150mm fully filled cavities using Dritherm 32 insulation (or similar) and 100mm medium density blockwork internally.

Roofs will be insulated with 450mm of mineral wool insulation comprising 150mm between joists and 300mm cross laid over.

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	
Exposed Floors	0.18	0.11	39%
External Walls	0.26	0.18	31%
Roofs	0.16	0.13	19%
Windows	1.60	1.40	13%
External Doors	1.60	1.20	25%
'G' factor for Glazing		0.52	

b. 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 50% improvement over Building Regulations and will seek to achieve a permeability of 4.0 m³/hr/m² or better.

c. 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 buildings 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 buildings 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	Exposed Floor	0.046
E6	Intermediate Floor in a Dwelling	0.000
E7	Party Floor	0.036
E14	Flat Roof	0.041
E16	Corner (normal)	0.037
E17	Corner (inverted)	-0.079
E18	Party Wall	0.041

d. 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;

(i) Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fittings to have lamps with a minimum luminous efficacy of 80 light source lumens per circuit-watt. The specification for the light fittings will exceed this.

(ii) Space Heating and Hot Water

The SAP modelling has been based upon the use of a Vaillant air source heat pump to each house.

5.2 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 Parkside Road to be 4.3 m/s at 10m above ground level and 5.1 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. The use of wind turbines will also 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.

The planning policy requires community heating to be considered, which has been. The site consists of four houses. It is proposed to use heat pumps to provide space heating and hot water and whilst communal heat pump systems are becoming more available, they are intended for developments of greater number than those proposed.

A community heating system is not appropriate.

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 each house will have private garden space it is unlikely they will have sufficient area to sustain a horizontal collection system. Therefore, the installation of ground source heat pumps is likely to require a bore hole system to each unit, which will be unviable.

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%.

However, the installation of solar hot water heating panels would not enable the houses to meet the requirements of the Building Regulations without other technologies.

Solar hot water heating panels are therefore 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.

The architecture of the homes is currently unknown but photovoltaic panels are technically considered an appropriate technology and will be considered further at the detailed stage.

It is assumed each house could sustain a minimum of 6 x 400W photovoltaic panels and the SAPs calculations have been based on this quantity which are assumed to be inclined at circa 45 degrees and orientated towards the southeast or southwest.

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.

It is proposed to install air source heat pumps to all houses. The modelling has been based on the use of Vaillant air source heat pumps but other manufacturers make units with similar coefficients of performance.

5.3 Establishing Carbon Dioxide Emissions (Be Lean, Be Clean & Be green)

The following is based on the assumed accommodation schedule set out in 4.0 above.

The four houses are assumed to be broadly similar in scale and design and in order to demonstrate compliance with the policy SAP calculations, which have been prepared for a house of a similar scale, design and specification have been used in order to provide an accurate estimate of the total site emissions.

The TER and DER Worksheets for the modelling unit are attached as Appendix 1 but the emissions can be summarised as follows;

Detached 2-storey house	TER Emissions	DER Emissions
	kg CO ₂ /yr	kg CO ₂ /yr
Space heating	1,284.77	296.95
Water heating	669.71	223.12
Electricity for pumps, fans, electric keep-hot & lighting	54.86	42.93
Energy Saving/ Renewable Technologies	-537.79	-202.50
Total Emissions	1,471.55	360.50
Emissions Rate	8.74	2.14

Fabric Energy Efficiency	38.24	37.24
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Summary

Using the above results, the emissions are aggregated across the four units to calculate the total site emissions. The total emissions can be calculated as follows;

	Area	CO ₂ TER	CO ₂ DER
	m ²	kg/yr	kg/yr
Detached houses	699.0	6,109	1,496
Totals	699.0	6,109	1,496

The total emissions allowable through the Building Regulations (TER) are calculated as:

- **6,109 kg CO₂ per year**

With total actual site emissions (DER) assessed as:

- **1,496 kg CO₂ per year**

The site carbon dioxide emissions are reduced by 4,613 kg CO₂ per year as a result of the energy efficiency measures and renewable technologies, which equates to a reduction of 75.51% of the TER emissions.

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

The application seeks outline consent for the construction of four dwellings. The design and orientation of the units do not form part of the application and therefore the following analysis has to be considered in this context.

The four units are assumed to be broadly similar in design and specification and therefore SAP calculations have been used from a house proposed on another development, which is of a similar scale and design and built to a similar specification to those proposed. The results from the calculations have been aggregated across the four units to provide an assessment of the total site emissions.

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

Be Lean

The construction standards for the fabric of the buildings proposes 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. In addition, it is proposed to install energy efficiency mechanical and electrical services.

Be Clean and Be Green

As a result of the energy efficiency measures incorporated into the fabric specification of the homes and the installation of air source heat pumps and photovoltaic panels to the houses the total emissions from the site based upon the maximum permissible by the Building Regulations (TER) are calculated as **6,109 kg CO₂ per year**, with actual (DER) emissions of **1,496 kg CO₂ per year**.

The emissions are reduced by a total of **4,613 kg CO₂ per year**, which equates to a reduction of **75.51%**.

All space heating and hot water will be provided to the homes from renewable technologies.

There will be no mains gas connection to the site and therefore there will be no on-site NO_x or CO₂ emissions.

The proposal exceeds the requirements of the adopted 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

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.

However, rainwater butts will be installed to store rainwater runoff for reuse with landscape irrigation.

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 110 litres per person per day is achieved (included five litres per person per day allowance for external water use).

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 year 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.

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.

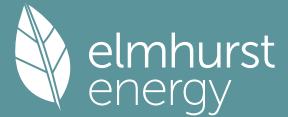
Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

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 – TER and DER Worksheets for the Modelled Unit

Full SAP Calculation Printout



Property Reference	Reading DET 169			Issued on Date	18/09/2025
Assessment Reference	Reading DET 169	Prop Type Ref	Reading DET 169		
Property	Land to the rear of 19, Parkside Road, Reading, Berkshire, RG30 2BT				
SAP Rating	90 B	DER	2.14	TER	8.74
Environmental	98 A	% DER < TER			75.51
CO ₂ Emissions (t/year)	0.29	DFEE	37.24	TFEE	38.24
Compliance Check	See BREL	% DFEE < TFEE			2.61
% DPER < TPER	53.42	DPER	21.35	TPER	45.83
Assessor Details	Mr. Ivan Ball			Assessor ID	DE88-0001
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)
Main dwelling			
Ground floor	84.1500 (1b)	x 2.4000 (2b)	= 201.9600 (1b) - (3b)
First floor	84.1500 (1c)	x 2.4000 (2c)	= 201.9600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	168.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	403.9200 (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	3 * 10 = 30.0000 (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) =	30.0000 / (5) = 0.0743 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2743 (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) = 0.2331 (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	0.2972	0.2914	0.2856	0.2564	0.2506	0.2215	0.2215	0.2156	0.2331	0.2506	0.2623	0.2739 (22b)
Effective ac	0.5442	0.5425	0.5408	0.5329	0.5314	0.5245	0.5245	0.5233	0.5272	0.5314	0.5344	0.5375 (25)

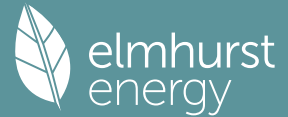
3. Heat losses and heat loss parameter

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
Main dwelling							
Windows & Glazed Doors			28.0800	1.3258	37.2273		(27)
External Doors			3.7800	1.2000	4.5360		(26a)
Ground Floor			84.1500	0.1100	9.2565		(28a)
External Wall	193.0100	31.8600	161.1500	0.1800	29.0070		(29a)
External Roof	84.1500		84.1500	0.1000	8.4150		(30)
Total net area of external elements Aum(A, m ²)			361.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.4418		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	18.5500	0.0280	0.5194
E2 Other lintels (including other steel lintels)	13.4000	0.0240	0.3216
E3 Sill	41.1000	0.0190	0.7809
E4 Jamb	40.2100	0.0460	1.8497
E5 Ground floor (normal)	28.8000	0.0370	1.0656
E16 Corner (normal)	9.6000	-0.0790	-0.7584
E17 Corner (inverted - internal area greater than external area)	40.2100	0.0000	0.0000
E6 Intermediate floor within a dwelling	24.6600	0.0510	1.2577
E10 Eaves (insulation at ceiling level)			

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E13 Gable (insulation at rafter level) 15.6000 0.0340 0.5304
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.5668 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 94.0086 (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
	72.5352	72.3066	72.0825	71.0297	70.8328	69.9159	69.9159	69.7461	70.2691	70.8328	71.2312	71.6478
Heat transfer coeff												
	166.5438	166.3152	166.0911	165.0383	164.8414	163.9245	163.9245	163.7547	164.2777	164.8414	165.2398	165.6564
Average = Sum(39)m / 12 =												165.0374
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9896	0.9882	0.9869	0.9806	0.9794	0.9740	0.9740	0.9730	0.9761	0.9794	0.9818	0.9843
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9603	(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														
	85.1987	83.9334	82.1516	78.8662	76.4061	73.6783	72.2049	73.9743	75.9008	78.8196	82.1727	84.9107	84.9107	(42b)
Hot water usage for other uses														
	44.9463	43.3119	41.6775	40.0431	38.4087	36.7743	36.7743	38.4087	40.0431	41.6775	43.3119	44.9463	44.9463	(42c)
Average daily hot water use (litres/day)													119.8530	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Daily hot water use	130.1451	127.2453	123.8291	118.9093	114.8148	110.4526	108.9792	112.3829	115.9439	120.4971	125.4846	129.8570	129.8570	(44)
Energy conte	206.1180	181.1957	190.3207	162.7809	154.5628	135.8143	131.8008	139.1536	142.9704	163.5135	178.7758	203.3247	203.3247	(45)
Energy content (annual)													1990.3312	
Distribution loss (46)m = 0.15 x (45)m														
	30.9177	27.1793	28.5481	24.4171	23.1844	20.3722	19.7701	20.8730	21.4456	24.5270	26.8164	30.4987	30.4987	(46)
Water storage loss:														
Store volume													300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6800	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													0.9072	(55)
Total storage loss														
	28.1232	25.4016	28.1232	27.2160	28.1232	27.2160	28.1232	28.1232	27.2160	28.1232	27.2160	28.1232	28.1232	(56)
If cylinder contains dedicated solar storage														
	28.1232	25.4016	28.1232	27.2160	28.1232	27.2160	28.1232	28.1232	27.2160	28.1232	27.2160	28.1232	28.1232	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	(59)
Combi loss	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	(61)
Total heat required for water heating calculated for each month														
	271.5391	240.2857	255.7419	226.0917	219.9840	199.1251	197.2220	204.5747	206.2812	228.9347	242.0866	268.7459	268.7459	(62)
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	0.0000	(63a)
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	-0.0000	(63b)
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	0.0000	(63c)
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	0.0000	(63d)
Output from w/h														
	271.5391	240.2857	255.7419	226.0917	219.9840	199.1251	197.2220	204.5747	206.2812	228.9347	242.0866	268.7459	268.7459	(64)
12Total per year (kWh/year)													2760.6126	(64)
Electric shower(s)													2761	(64)
	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	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000	(64a)
Heat gains from water heating, kWh/month														
	120.8712	107.5196	115.6186	104.7733	103.7291	95.8069	96.1607	98.6055	98.1863	106.7052	110.0916	119.9424	119.9424	(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
	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	177.3812	196.3863	177.3812	183.2939	177.3812	183.2939	177.3812	177.3812	183.2939	177.3812	183.2939	177.3812
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	339.8119	343.3381	334.4522	315.5352	291.6560	269.2128	254.2194	250.6932	259.5791	278.4961	302.3753	324.8185
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Losses e.g. evaporation (negative values) (Table 5)												
	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116
Water heating gains (Table 5)												
	162.4612	159.9994	155.4013	145.5184	139.4208	133.0652	129.2483	132.5343	136.3699	143.4209	152.9050	161.2129
Total internal gains												
	747.0587	767.1282	734.6390	711.7519	675.8623	652.9762	628.2532	628.0130	646.6472	666.7025	705.9786	730.8169

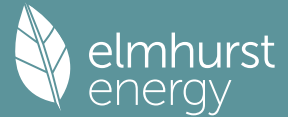
6. Solar gains

[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
Southeast	10.3800	36.7938	0.5200	0.7000	0.7700	96.3401
Southwest	5.4500	36.7938	0.5200	0.7000	0.7700	50.5832
Northwest	12.2500	11.2829	0.5200	0.7000	0.7700	34.8653
Solar gains	181.7885	321.2339	470.2871	634.2682	757.4946	772.7175
Total gains	928.8472	1088.3621	1204.9261	1346.0202	1433.3569	1425.6938

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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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	70.1767	70.2732	70.3680	70.8169	70.9015	71.2981	71.2981	71.3720	71.1448	70.9015	70.7305	70.5527	
alpha	5.6784	5.6849	5.6912	5.7211	5.7268	5.7532	5.7532	5.7581	5.7430	5.7268	5.7154	5.7035	
util living area	0.9987	0.9964	0.9902	0.9633	0.8784	0.6978	0.5221	0.5811	0.8366	0.9777	0.9967	0.9990	(86)
Living	19.7838	19.9544	20.2023	20.5397	20.8199	20.9643	20.9942	20.9897	20.9001	20.5350	20.0971	19.7529	
Non living	18.6584	18.8774	19.1939	19.6189	19.9435	20.0840	20.1031	20.1021	20.0323	19.6196	19.0645	18.6221	
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	20.3778	19.9544	20.2023	20.5397	20.8199	20.9643	20.9942	20.9897	20.9001	20.5350	20.0971	19.9273	(87)
Th 2	20.0920	20.0932	20.0943	20.0995	20.1005	20.1051	20.1051	20.1059	20.1033	20.1005	20.0985	20.0964	(88)
util rest of house	0.9982	0.9952	0.9867	0.9498	0.8363	0.6154	0.4194	0.4745	0.7689	0.9670	0.9953	0.9987	(89)
MIT 2	19.5205	18.8774	19.1939	19.6189	19.9435	20.0840	20.1031	20.1021	20.0323	19.6196	19.0645	18.8877	(90)
Living area fraction									FLA = Living area / (4) =				0.1105 (91)
MIT	19.6152	18.9964	19.3053	19.7206	20.0404	20.1812	20.2016	20.2002	20.1282	19.7208	19.1786	19.0026	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6152	18.9964	19.3053	19.7206	20.0404	20.1812	20.2016	20.2002	20.1282	19.7208	19.1786	19.0026	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9931	0.9825	0.9426	0.8330	0.6229	0.4307	0.4861	0.7711	0.9608	0.9933	0.9981	(94)
Useful gains	926.9390	1080.8849	1183.8752	1268.6917	1194.0302	888.0183	587.6787	617.0167	904.6657	989.6697	919.6390	883.3324	(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	2550.6590	2344.4524	2126.8470	1785.8177	1374.8401	914.9032	590.3894	622.2933	990.3058	1503.4840	1995.8735	2452.1514	(97)
Space heating kWh	1208.0477	849.1174	701.5710	372.3307	134.5225	0.0000	0.0000	0.0000	0.0000	382.2779	774.8888	1167.2013	(98a)
Space heating requirement - total per year (kWh/year)												5589.9573	
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	1208.0477	849.1174	701.5710	372.3307	134.5225	0.0000	0.0000	0.0000	0.0000	382.2779	774.8888	1167.2013	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5589.9573	
Space heating per m2										(98c) / (4) =		33.2142	(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 %)													293.1051 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	1208.0477	849.1174	701.5710	372.3307	134.5225	0.0000	0.0000	0.0000	0.0000	382.2779	774.8888	1167.2013	(98)
Space heating efficiency (main heating system 1)	293.1051	293.1051	293.1051	293.1051	293.1051	0.0000	0.0000	0.0000	0.0000	293.1051	293.1051	293.1051	(210)
Space heating fuel (main heating system)	412.1551	289.6972	239.3582	127.0297	45.8957	0.0000	0.0000	0.0000	0.0000	130.4235	264.3723	398.2193	(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	271.5391	240.2857	255.7419	226.0917	219.9840	199.1251	197.2220	204.5747	206.2812	228.9347	242.0866	268.7459	(64)
Efficiency of water heater	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	174.1514	(216)
Fuel for water heating, kWh/month	155.9213	137.9752	146.8503	129.8247	126.3176	114.3402	113.2474	117.4694	118.4493	131.4572	139.0093	154.3174	(219)
Space cooling fuel requirement	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	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	36.8563	29.5675	26.6223	19.5046	15.0659	12.3090	13.7436	17.8645	23.2042	30.4452	34.3878	37.8807	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-45.6723	-75.7908	-127.8762	-169.3303	-206.9056	-202.2044	-199.7775	-175.9396	-139.4390	-96.5023	-54.0866	-38.2717	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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)	-0.0106	-0.0578	-0.2432	-0.7730	-1.8019	-2.3844	-2.3638	-1.6439	-0.8545	-0.1764	-0.0253	-0.0070	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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												1907.1510	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												174.1514	
Water heating fuel used												1585.1793	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												297.4515	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1542.1382	(233)
Wind generation												0.0000	(234)

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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	2247.6436 (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	1907.1510	0.1557	296.9457 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1585.1793	0.1408	223.1191 (264)
Space and water heating			520.0648 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	297.4515	0.1443	42.9314 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1531.7964	0.1314	-201.3483
PV Unit electricity exported	-10.3418	0.1115	-1.1534
Total			-202.5017 (269)
Total CO2, kg/year			360.4946 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.1400 (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	1907.1510	1.5764	3006.4688 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1585.1793	1.5204	2410.1813 (278)
Space and water heating			5416.6501 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	297.4515	1.5338	456.2410 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1531.7964	1.4856	-2275.6625
PV Unit electricity exported	-10.3418	0.4082	-4.2216
Total			-2279.8841 (283)
Total Primary energy kWh/year			3593.0070 (286)
Dwelling Primary energy Rate (DPER)			21.3500 (287)

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

1. Overall dwelling characteristics

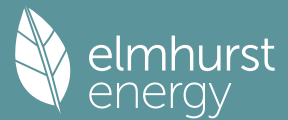
	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	84.1500 (1b)	x 2.4000 (2b)	= 201.9600 (1b) - (3b)
First floor	84.1500 (1c)	x 2.4000 (2c)	= 201.9600 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	168.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	403.9200 (5)

2. Ventilation rate

	m3 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) =	40.0000 / (5) = 0.0990 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3490 (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) = 0.2967 (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	0.3783	0.3708	0.3634	0.3263	0.3189	0.2818	0.2818	0.2744	0.2967	0.3189	0.3338	0.3486 (22b)
Effective ac	0.5715	0.5688	0.5660	0.5532	0.5509	0.5397	0.5397	0.5377	0.5440	0.5509	0.5557	0.5608 (25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Semi-glazed door			3.7800	1.0000	3.7800			(26a)
TER Opening Type			28.0800	1.1450	32.1527			(27)
Ground Floor			84.1500	0.1300	10.9395			(28a)
External Wall	193.0100	31.8600	161.1500	0.1800	29.0070			(29a)
External Roof	84.1500		84.1500	0.1100	9.2565			(30)
Total net area of external elements Aum(A, m2)			361.3100					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	85.1357		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element	18.5500	0.0500	0.9275	
E2 Other lintels (including other steel lintels)	13.4000	0.0500	0.6700	
E3 Sill	41.1000	0.0500	2.0550	
E4 Jamb	40.2100	0.1600	6.4336	
E5 Ground floor (normal)	28.8000	0.0900	2.5920	
E16 Corner (normal)	9.6000	-0.0900	-0.8640	
E17 Corner (inverted - internal area greater than external area)	40.2100	0.0000	0.0000	
E6 Intermediate floor within a dwelling	24.6600	0.0600	1.4796	
E10 Baves (insulation at ceiling level)	15.6000	0.0800	1.2480	
E13 Gable (insulation at rafter level)				14.5417 (36)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				0.0000
Point Thermal Bridges				(33a) =
Total fabric heat loss				(33) + (36) + (36a) = 99.6774 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	76.1827	75.8124	75.4495	73.7447	73.4257	71.9409	71.9409	71.6659	72.5128	73.4257	74.0709	74.7455	(38)
Heat transfer coeff	175.8601	175.4898	175.1268	173.4220	173.1031	171.6182	171.6182	171.3433	172.1902	173.1031	173.7483	174.4229	(39)
Average = Sum(39)m / 12 =													173.4205

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0449	1.0427	1.0406	1.0304	1.0285	1.0197	1.0197	1.0181	1.0231	1.0285	1.0324	1.0364	(40)
HLP (average)													1.0304
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

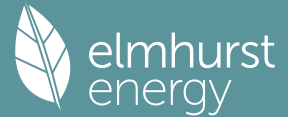
4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9603 (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	(42a)
Hot water usage for baths	85.1987	83.9334	82.1516	78.8662	76.4061	73.6783	72.2049	73.9743	75.9008	78.8196	82.1727	84.9107	(42b)
Hot water usage for other uses	44.9463	43.3119	41.6775	40.0431	38.4087	36.7743	36.7743	38.4087	40.0431	41.6775	43.3119	44.9463	(42c)
Average daily hot water use (litres/day)													119.8530 (43)
Daily hot water use	130.1451	127.2453	123.8291	118.9093	114.8148	110.4526	108.9792	112.3829	115.9439	120.4971	125.4846	129.8570	(44)
Energy conte	206.1180	181.1957	190.3207	162.7809	154.5628	135.8143	131.8008	139.1536	142.9704	163.5135	178.7758	203.3247	(45)
Energy content (annual)										Total = Sum(45)m =			1990.3312
Distribution loss (46)m = 0.15 x (45)m	30.9177	27.1793	28.5481	24.4171	23.1844	20.3722	19.7701	20.8730	21.4456	24.5270	26.8164	30.4987	(46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.1127 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.1409 (55)
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	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)
Total heat required for water heating calculated for each month	264.7468	234.1507	248.9495	219.5184	213.1916	192.5519	190.4297	197.7824	199.7080	222.1423	235.5134	261.9536	(62)
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	(63a)
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	(63b)
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	(63c)
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	(63d)
Output from w/h	264.7468	234.1507	248.9495	219.5184	213.1916	192.5519	190.4297	197.7824	199.7080	222.1423	235.5134	261.9536	(64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =			2680.6382 (64)
Electric shower(s)	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)
Heat gains from water heating, kWh/month	115.4373	102.6116	110.1847	99.5147	98.2952	90.5483	90.7268	93.1716	92.9277	101.2713	104.8330	114.5085	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	148.0146	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	177.3812	196.3863	177.3812	183.2939	177.3812	183.2939	177.3812	177.3812	183.2939	177.3812	183.2939	177.3812	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	339.8119	343.3381	334.4522	315.5352	291.6560	269.2128	254.2194	250.6932	259.5791	278.4961	302.3753	324.8185	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	37.8015	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	-118.4116	(71)
Water heating gains (Table 5)	155.1576	152.6958	148.0977	138.2148	132.1172	125.7616	121.9447	125.2307	129.0663	136.1173	145.6014	153.9093	(72)
Total internal gains	742.7551	762.8246	730.3354	707.4483	671.5587	645.6726	620.9496	620.7094	639.3436	662.3989	701.6750	726.5134	(73)

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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
Southeast					10.3800	36.7938	0.6300		0.7000	0.7700		116.7197 (77)
Southwest					5.4500	36.7938	0.6300		0.7000	0.7700		61.2835 (79)
Northwest					12.2500	11.2829	0.6300		0.7000	0.7700		42.2406 (81)
Solar gains	220.2438	389.1873	569.7709	768.4404	917.7339	936.1770	892.1375	776.9236	637.9672	440.1832	266.3564	186.8294 (83)
Total gains	962.9989	1152.0119	1300.1063	1475.8887	1589.2926	1581.8496	1513.0872	1397.6331	1277.3108	1102.5822	968.0314	913.3428 (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	66.4591	66.5993	66.7373	67.3934	67.5176	68.1017	68.1017	68.2110	67.8755	67.5176	67.2668	67.0067
alpha	5.4306	5.4400	5.4492	5.4929	5.5012	5.5401	5.5401	5.5474	5.5250	5.5012	5.4845	5.4671
util living area	0.9984	0.9955	0.9871	0.9522	0.8516	0.6634	0.4937	0.5534	0.8145	0.9728	0.9960	0.9988 (86)
MIT	19.7172	19.9095	20.1837	20.5487	20.8330	20.9680	20.9947	20.9904	20.9037	20.5260	20.0556	19.6875 (87)
Th 2	20.0461	20.0479	20.0497	20.0580	20.0596	20.0669	20.0669	20.0683	20.0641	20.0596	20.0564	20.0531 (88)
util rest of house	0.9979	0.9940	0.9826	0.9353	0.8039	0.5793	0.3919	0.4468	0.7418	0.9598	0.9944	0.9984 (89)
MIT 2	18.5394	18.7865	19.1362	19.5946	19.9180	20.0486	20.0652	20.0648	19.9977	19.5755	18.9802	18.5064 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.6696	18.9106	19.2519	19.7000	20.0191	20.1503	20.1679	20.1671	20.0978	19.6806	19.0991	18.6370 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.6696	18.9106	19.2519	19.7000	20.0191	20.1503	20.1679	20.1671	20.0978	19.6806	19.0991	18.6370 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9967	0.9913	0.9774	0.9272	0.8016	0.5872	0.4031	0.4584	0.7448	0.9529	0.9920	0.9975 (94)
Useful gains	959.8308	1142.0321	1270.7186	1368.4953	1273.9654	928.8545	609.8895	640.6598	951.2882	1050.6020	960.2601	911.0644 (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	2527.0371	2458.7133	2233.2059	1872.9627	1440.0668	952.5242	612.3233	645.4718	1032.7593	1571.8764	2084.8218	2518.1374 (97)
Space heating kWh	1166.0015	884.8098	716.0905	363.2165	123.5795	0.0000	0.0000	0.0000	0.0000	387.8281	809.6844	1195.6623 (98a)
Space heating requirement - total per year (kWh/year)	5646.8726											
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	1166.0015	884.8098	716.0905	363.2165	123.5795	0.0000	0.0000	0.0000	0.0000	387.8281	809.6844	1195.6623 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	5646.8726											
Space heating per m ²	(98c) / (4) = 33.5524 (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 %)	92.3000 (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	1166.0015	884.8098	716.0905	363.2165	123.5795	0.0000	0.0000	0.0000	0.0000	387.8281	809.6844	1195.6623 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	1263.2735	958.6238	775.8294	393.5174	133.8889	0.0000	0.0000	0.0000	0.0000	420.1821	877.2312	1295.4087 (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 requirement	264.7468	234.1507	248.9495	219.5184	213.1916	192.5519	190.4297	197.7824	199.7080	222.1423	235.5134	261.9536 (64)
Efficiency of water heater (217)m	86.9847	86.7526	86.2895	85.1811	82.8825	79.8000	79.8000	79.8000	79.8000	85.2966	86.5992	79.8000 (216)
Fuel for water heating, kWh/month	304.3602	269.9063	288.5050	257.7081	257.2215	241.2931	238.6337	247.8476	250.2606	260.4352	271.9578	300.9718 (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	36.8563	29.5675	26.6223	19.5046	15.0659	12.3090	13.7436	17.8645	23.2042	30.4452	34.3878	37.8807 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-72.1010	-98.4324	-137.0043	-148.9098	-156.2416	-144.1425	-142.1697	-136.1816	-125.1918	-109.8935	-78.0340	-62.7029 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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)	-51.1112	-106.1401	-208.5485	-309.8785	-406.6668	-407.6570	-403.0288	-342.7817	-253.1958	-150.8601	-67.9121	-40.5390 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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												6117.9551	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3189.1008	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												297.4515	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4159.3246	(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												5531.1828	(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	6117.9551	0.2100	1284.7706	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3189.1008	0.2100	669.7112	(264)
Space and water heating			1954.4817	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	297.4515	0.1443	42.9314	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1411.0050	0.1353	-190.9342	
PV Unit electricity exported	-2748.3195	0.1262	-346.8544	
Total			-537.7886	(269)
Total CO2, kg/year			1471.5539	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.7400	(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	6117.9551	1.1300	6913.2893	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3189.1008	1.1300	3603.6839	(278)
Space and water heating			10516.9732	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	297.4515	1.5338	456.2410	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1411.0050	1.5002	-2116.7229	
PV Unit electricity exported	-2748.3195	0.4633	-1273.2302	
Total			-3389.9532	(283)
Total Primary energy kWh/year			7713.3619	(286)
Target Primary Energy Rate (TPER)			45.8300	(287)