



Energy Statement

Project: **107 Vale Road, Northfleet, Gravesend, Kent DA11 8DB**

Client: **Frankham Projects Ltd**

Authority: **Gravesham Borough Council**
Civic Centre, Windmill Street, Gravesend, Kent, DA12 1AU

Consultant: **Frankham Projects Ltd**
Planning and Development Consultant
Irene House, 7b Five Arches Business Park, Maidstone Road, Sidcup, Kent DA14 5AE

Prepared by: **Consult Sustainability Ltd**
55 Elmcroft Road, Orpington BR6 0HZ

Report Author: **Stuart Searle** BSc (Hons) MRICS OCDEA
T: 01689 497 852
E: stuart.searle@consultsustainability.co.uk

Date: September 2024

Reference: 24.3609/ES/01

Revision: 2

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Consult Sustainability Limited

Elm Mews 55 Elmcroft Road, Orpington, Kent BT6 0HZ
Registered in England at this [address](https://www.company-information.gov.uk/); Company No. 13524795

info@consultsustainability.co.uk 01689 497852
www.consultsustainability.co.uk





Contents

	Page
1. Executive Summary	3
2. Site Specifics.....	4
3. Planning Requirements	5
4. Energy Hierarchy	7
5. Development Proposals	8
5.1 Be Lean	8
5.2 Be Clean	10
5.3 Be Green	11
6. Carbon Emission Summary	14
7. Summary of Proposals	15
Appendices	16
Appendix A – Supporting SAP Worksheets	



1. Executive Summary

Scope	Consult Sustainability has been appointed to prepare an energy statement for the proposed development located at 107 Vale Road, Northfleet, Gravesend, Kent DA11 8DB in support of the planning application for the scheme detailed below.
Description	The development comprises the new build construction of a single four-bedroom detached house.
Author	Mr S Searle MRICS (0854781) OCDEA (Elmhurst EES/022737).
Methodology	Energy demand and CO ₂ emission figures are based on draft energy modelling undertaken using Design SAP10 software provided by Elmhurst Energy Systems Ltd. Calculations are based on the current Building Regulations (2021) applicable at the time of this report. The GLA Carbon Emission Reporting tool has been adopted to demonstrate CO ₂ emission figures at each stage of the energy hierarchy.
Planning	The development is located within the jurisdiction of Gravesham Borough Council. This statement has been prepared in accordance with the requirements of national policy and the borough council's Core Strategy, Supplementary Planning Document Design Code and Climate Change Strategy.
Proposal	Following the energy hierarchy, this development will adopt the following strategy: Be lean: use less energy and manage demand during operation by constructing to high thermal performance standards with u-values exceeding minimum Building Regulation fabric targets where technically feasible, as detailed under section 5.1 of this report. Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly: No opportunities are deemed to exist under this stage of the hierarchy as detailed under section 5.2 of this report. Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site: The proposal includes the introduction of an ASHP as detailed under section 5.3 of this report.

Summary	The development will follow the energy hierarchy and achieve: • An estimated 11% reduction in regulated CO₂ emissions through enhanced building fabric measures against the notional dwelling, as detailed under section 5.1 of this report. • No opportunities are deemed to exist under the 'Clean' stage of the energy hierarchy. • An estimated 52% reduction in regulated CO₂ emissions through the introduction of an ASHP, as detailed under section 5.3 of this report. • An overall 63% reduction in regulated CO₂ emissions against the current 2021 Building Regulations as summarised under section 6 of this report.
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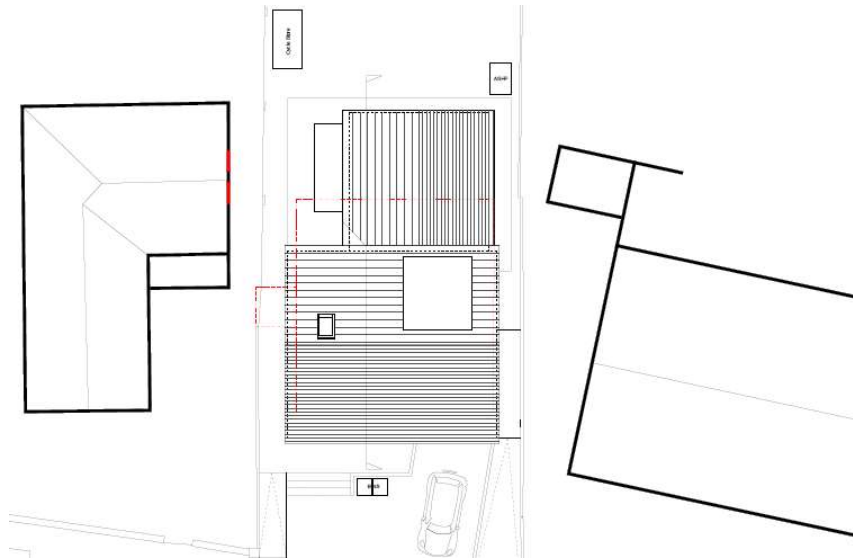
2. Site Specifics

Unit Schedule

Table 1

No.	Type	No. Beds/Persons	GIFA (m ²)	Energy Modelling Undertaken
107	Detached House	4B7P	155.40	YES

Site Plan



Plans





3. Planning Requirements

National Policy At national level, National Planning Policy Framework (2023) sets out the Governments planning policies for England, identifying how 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. The NPPF 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 planning authorities must take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures in line with the objectives and provisions of the Climate Change Act 2008.

New development should be planned for in ways that:

- a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts).
- b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development.
- c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

In determining planning applications, local planning authorities should expect new development to:

- a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.



When determining planning applications for renewable and low carbon development, local planning authorities should:

- a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Local Policy

This statement has been provided to meet the requirements of the Gravesham Borough Council's Core Strategy (adopted September 2014), Climate Change Strategy 2022-2030 and 'Design for Gravesham – Design Code' SPD, (May 2024).

5.14.42 of the Core Strategy outlines the Council will seek to reduce the overall carbon footprint of the Borough. In particular, the Council will:

- In the context of national policy on the transition to zero carbon development via amendments to Part L of the Building Regulations, require proposals for development of the Key Sites throughout the Borough and other major development elsewhere in the Gravesend Town Centre Opportunity Area to consider the potential and include proposals for low carbon and renewable energy generation, including combined heat and power. Where choosing not to do so, applicants must submit evidence which demonstrates that compliance is not technically or financially feasible or that improved fabric energy efficiency or an allowable solution results in improved carbon saving benefits;
- Support stand-alone decentralised, renewable or low carbon energy development • where it is compatible with national policies for protecting the Green Belt and where it accords with policies in this plan, in particular those relating to Development and Design Principles, Transport, Green Infrastructure, and Heritage and the Historic Environment; and
- Support other proposals which lead to a reduction in carbon footprint including • the retrofitting of existing homes and businesses, including local initiatives based on carbon off-setting via allowable solution.

In June 2019 Gravesham Borough Council passed a formal motion to declare climate emergency and committed to taking a lead in achieving Carbon Neutral status. In 2022 the Council has published its Climate Change Strategy identifying the key Climate Change action priorities for the Council and the Borough as a whole.

Priority 3 of the Council's climate change seeks to ensure climate change, energy, air quality and environmental considerations are integrated into Local Plans, policies and developments, by developing a clean growth strategic planning policy and guidance framework for Kent and Medway, to drive down emissions and mainstream climate resilience.

Applicants must demonstrate they have maximised energy efficiency of their proposals by using aspect, orientation and design elements to help reduce heating and lighting needs.

Proposals should introduce low and zero carbon decentralised energy generation infrastructure where viable. Where it is currently unviable, the introduction of infrastructure to aid future installation should be considered.

Planning Summary

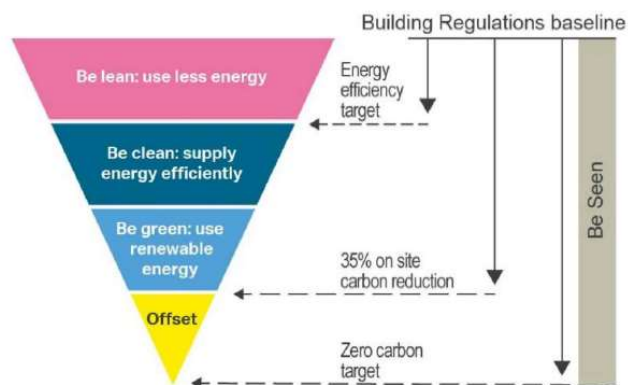
Gravesham Borough Council require new development to adopt measures to optimise energy efficiency following the energy hierarchy.

4. Energy Hierarchy

In line with best practice, development proposals should demonstrate sustainability principles by incorporating a series of measures outlined in the following energy hierarchy:

Be Lean	Use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures.
Be Clean	Exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks.
Be Green	Maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site.

Figure 1: The London Plan energy hierarchy





5. Development Proposals

5.1 Be Lean

Energy efficiency measures for the building fabric are proposed to be incorporated to reduce the energy demand and CO₂ emission of the development.

The proposals include enhancement in building fabric as outlined in Table 2 below.

Fabric Measures

Table 2	Dwellings		
	Approved Document L: Conservation of fuel and power		
Element	AD L 2021 Limiting Fabric U-Values (W/m ² K)	Proposed Fabric U-Values (W/m ² K)	% Improvement over AD L 2021
External Walls	0.26	0.18	31%
Party Walls	0.26	0.00	100%
Roofs	0.16	0.10-0.14	13-38%
Floors	0.18	0.11	39%
Windows	1.60	1.20* (G-value 0.50)	25%
Doors	1.60	1.20	25%
Air tightness	8m ³ /hr/m ²	4.0m ³ /hr/m ²	50%

*NOTE: Window U-values to be verified from BFRC, BSI or CERTASS testing data.

Air Tightness

Good site quality standards will be adhered to achieve high-performance buildings with low air permeability rates. The dwellings will not exceed 4.00m³/hr/m² at 50 Pascal's, (L1A 2021 target 8m³/hr/m² or less).

Low air permeability will be achieved through ensuring attention to detail during construction and making sure all punctures through the building envelope are adequately sealed.

The dwelling will be air tested on completion to demonstrate the actual air permeability rate.

Thermal Bridging

In addition to the enhanced building fabric standards, the development will be designed to minimise transmission of heat through thermal bridges.

Where appropriate, thermal modelling will be carried out for all junctions to assist in contributing to an improved dwelling emission rate (DER) and dwelling fabric energy efficiency (DFEE).

Table 3 below identifies the PSi values that have been targeted within the draft energy modelling.

The values below loosely represent PSi values taken from 'Recognised Construction Details' using traditional construction comprising, 150mm fully filled cavity with a thermal conductivity of 0.032W/mK plus a lightweight inner block with a thermal conductivity of 0.19W/mK.



Table 3

	Junction details	Source Type	Psi (W/mK)
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.020
External wall	E3 Sill	Independently assessed	0.030
External wall	E4 Jamb	Independently assessed	0.300
External wall	E5 Ground floor (normal)	Independently assessed	0.070
External roof	R1 Head of roof window	Independently assessed	0.240
External roof	R2 Sill of roof window	Independently assessed	0.240
External roof	R3 Jamb of roof window	Independently assessed	0.240
External roof	R11 Upstands or kerbs of rooflights	Independently assessed	0.240
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.010
External wall	E10 Eaves (insulation at ceiling level)	Independently assessed	0.070
External wall	E24 Eaves (insulation at ceiling level - inverted)	Independently assessed	0.150
External wall	E11 Eaves (insulation at rafter level)	Independently assessed	0.020
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.050
External wall	E15 Flat roof with parapet	Independently assessed	0.300
External wall	E16 Corner (normal)	Independently assessed	0.050
External wall	E17 Corner (inverted – internal area greater than external area)	Independently assessed	-0.090
External roof	R7 Flat ceiling (inverted)	Independently assessed	0.120
External roof	R9 Roof to wall (flat ceiling)	Independently assessed	0.320

Ventilation	In addition to the enhanced fabric measures, mechanical ventilation with heat recovery , (MVHR), will be provided, (Titon HRV3 Q Plus Eco assumed for calculations).
Lighting	Installing efficient low energy light fittings internally and externally can significantly reduce a building's overall lighting load subsequently lowering its annual CO ₂ emissions. To reduce the energy consumption associated with artificial lighting, energy-efficient fittings will be specified for 100% of internal and external lighting. Internal lighting will be LED type and achieve a minimum 80 lumens per circuit watt.
Heating/HW	For baseline calculations only, a notional gas boiler has been included following the notional dwelling conventions. The Be Green stage of this report outlines the actual proposed heating/HW strategy.
Controls	The dwelling will be provided time and temperature zone controls to maximise the efficiency of the heating systems.
Emitters	Underfloor heat emitters will be provided at ground floor level with radiators to upper floors, this will allow an overall lower running temperature and improved efficiency.
Use	Whilst not affecting the predicted regulated CO ₂ emissions, how people use and occupy a dwelling can significantly affect the overall energy use. Where supplied, energy efficient, 'A' rated appliances will be incorporated to reduce unregulated energy demand. Advice will also be provided to the new occupants on energy efficiency and how to reduce energy use.

Be Lean Summary

The proposal is to construct the dwellings to high thermal performance standards with u-values exceeding current minimum Building Regulation targets.

The proposed building enhancements will result in an estimated 11% reduction in regulated CO₂ emissions against 2021 Building Regulations notional dwelling.

5.2 Be Clean

In addition to the building fabric measures, consideration has been given to supplying energy efficiently.

A 'Renewable Energy for Kent' study, 'Part II: Underpinning the Vision', prepared by AECOM in 2012, identified that the site is not in a high potential area for district heating.

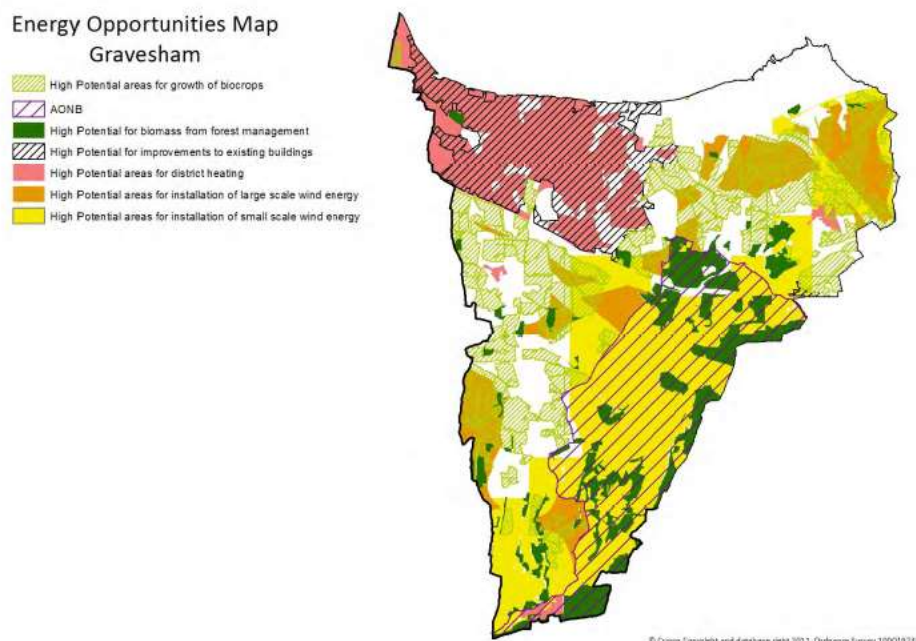


Figure 48: Energy Opportunities Map for Gravesham

Consideration has been given to connection to local existing or planned heat network to supply an efficient means of supplying heating and hot water.

No existing or planned heat networks have however been found to currently exist or planned within proximity of the proposed development site.

Consideration has also been given to the exploitation of local energy opportunities to maximise the use of locally available energy sources whilst minimising primary energy demand and carbon emissions.

Secondary heat sources should be used before renewable energy sources but can also be used in conjunction with them to minimise the carbon intensity of the heat network; these include environmental sources: air, water and ground; and waste sources: such as heat from the sewerage system, sewage treatment plants, the tube network, data centres and chiller systems.

No opportunities have been identified to exist for the exploitation of local energy opportunities.

The use of low-emission combined heat and power has also been considered however, at this scale it is not economic to install, (and where CHP is installed it tends to have lower electrical efficiencies and therefore higher carbon emissions). In addition, there would be concerns about the air quality impacts of gas-engine CHP at this scale.



Furthermore, due to the small landlord electricity demand, CHP installed to meet the base heat load would require the export of electricity to the grid. The administrative burden of managing CHP electricity sales at this small scale where energy service companies (ESCOs) are not active, and the low unit price available for small volumes of exported CHP electricity, means it is uneconomic for developers to pursue; this can lead to CHP being installed but not operated.

The use of site wide community heating is also not considered feasible and has been excluded.

Current guidance suggests that a heating strategy led by ultra-low NOx gas boilers should only be considered when it has been clearly demonstrated that all options have been investigated and ruled out or in cases where they represent interim heating solutions until a site is able to connect to an expanding or new heat network.

With the Governments current drive to move away from fossil fuels and with the increasing decarbonisation of grid electricity, gas is not proposed for use on this development.

Be Clean Summary	No district heat networks exist in proximity to the development site.
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5.3 Be Green

Renewable Energy

A reduction in carbon emissions using on-site renewable energy may be achieved through several technologies to generate heat or/and power. In determining the most suitable technology/ies consideration has been given to:

- Carbon reduction effectiveness – The estimated reduction in CO₂ emission as a result of the installation of the technology.
- Cost feasibility – The cost of installation relative to the overall cost of the development.
- Practicality – The physical practicality of installing the technology.
- Planning restrictions – Whether planning restrictions would prevent installation of the technology i.e. conservation areas, Listed buildings etc.
- Site related constraints – Whether specific site conditions would prevent the installation of a technology i.e. heavily shaded reducing efficiency of solar panels.
- Operating noise consideration – The expected level of noise associated with a technology and whether this would cause undue disturbance to occupiers or neighbouring properties.
- Ongoing maintenance – The relative expected lifetime maintenance and cost of a technology.

GSHPs

Ground Source Heat Pumps (GSHPs)	
CO₂ reduction effectiveness:	Estimated potential 60-70% reduction in CO ₂ emissions.
Cost feasibility:	High.
Practicality:	Practical for new buildings with high fabric efficiency standards and low energy demand.
Planning restrictions:	No abnormal planning restrictions.
Site related constraints:	Insufficient space exists within the development boundaries for the incorporation of sufficient horizontal 'Slinky's'. Thermogeological assessment of ground conditions plus identification of underground services would need to be established to determine the suitability for bore holes.
Operating noise:	Low.
Ongoing maintenance:	Medium - None to boreholes, annual maintenance requirement for heat pumps.
Overall Feasibility:	Not considered feasible for this development.



ASHPs

Air Source Heat Pumps (ASHPs)	
CO₂ reduction effectiveness:	Estimated potential 50-60% reduction in CO ₂ emissions.
Cost feasibility:	Medium - dependant on detailed design.
Practicality:	Practical for new buildings with high fabric efficiency standards and low energy demand.
Planning restrictions:	Consideration of externally mounted plant and operating noise. Heat pumps would need to be located externally, in proximity to the dwellings, either disguised or discreetly hidden, to reduce its visual impact.
Site related constraints:	None.
Operating noise:	Low - consideration will be required to the siting of the heat pump to ensure disturbance is not caused to the occupiers or neighbouring properties.
Ongoing maintenance:	Medium - Annual maintenance requirement for heat pumps.
Overall Feasibility:	Considered feasible for this development.

PV

Photovoltaics (PV)	
CO₂ reduction effectiveness:	Significant % reductions available, limited only by available roof area. Unlikely to reach planning CO ₂ emission targets alone.
Cost feasibility:	Low – Circa £1,500/kWp.
Practicality:	PV easy to install and can be fed to building providing a reduction in the energy demand, fuel bills and CO ₂ emissions. Space exists to the South orientated pitched roof slopes to accommodate panels.
Planning restrictions:	Consideration of externally mounted panels.
Site related constraints:	None.
Operating noise:	None.
Ongoing maintenance:	Low – Occasional cleaning of panels.
Overall Feasibility:	Considered feasible for this development.

Solar Thermal

Solar Thermal	
CO₂ reduction effectiveness:	Reduction in CO ₂ emissions limited by available roof space and demand for hot water. Estimated potential 5-10% reduction in CO ₂ emissions.
Cost feasibility:	Medium.
Practicality:	PV easy to install and can be fed to building providing a reduction in the energy demand, fuel bills and CO ₂ emissions. Space exists to the South orientated pitched roof slopes to accommodate panels.
Planning restrictions:	Consideration of externally mounted panels.
Site related constraints:	None.
Operating noise:	Negligible.
Ongoing maintenance:	Medium – Annual maintenance requirements of mechanical plant.
Overall Feasibility:	Considered feasible for this development.



Wind Turbines

Wind Turbines	
CO₂ reduction effectiveness:	Estimated potential 3-5% reduction in CO ₂ emissions
Cost feasibility:	Medium – High.
Practicality:	The standalone wind turbine would require sufficient open space on the site to locate the turbine and be far enough away from buildings to be able to work effectively. Building mounted wind turbines have not been shown to be highly effective.
Planning restrictions:	Consideration of higher impact externally mounted plant and effect on neighbouring properties.
Site related constraints:	Limitations on available roof space, wind speed and efficiency of this technology.
Operating noise:	Medium-High
Ongoing maintenance:	High – Annual maintenance of motors.
Overall Feasibility:	Not considered feasible for this development.

On consideration of the above, an ASHP is considered the most feasible solutions for providing heating and hot water to the dwellings to achieve a significant reduction in CO₂ emissions across the site.

Electricity and in particular heat pumps form the key basis of the Governments current approach to achieving zero carbon and follows the suggested path outlined in the proposed Future Homes Standard.

ASHP's can be located at ground level adjacent to each dwelling within the rear gardens to provide a low carbon source of heating and hot water.

Be Green Summary

An ASHP is considered the most feasible renewable technology for this development; a 52% reduction in regulated CO₂ emissions will be achieved against 2021 Building Regulations.



6. Carbon Emission Summary

Extract from the
GLA Carbon
Emission
Reporting tool.

Part L 2021 Performance

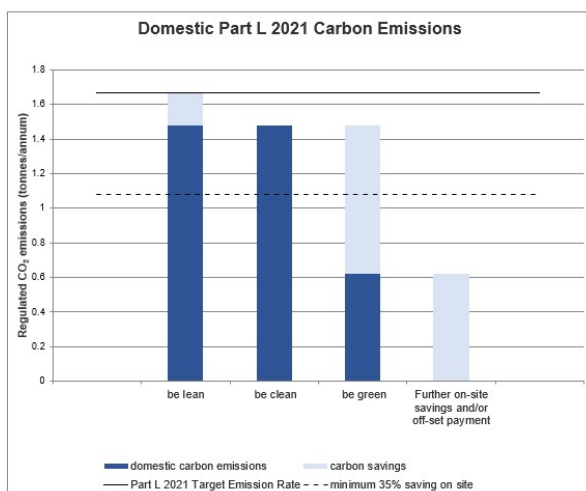
Residential

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	1.7	2.1
After energy demand reduction (be lean)	1.5	2.1
After heat network connection (be clean)	1.5	2.1
After renewable energy (be green)	0.6	2.1

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

	Regulated residential carbon dioxide savings	
	Tonnes CO ₂ per annum	(%)
Be lean: savings from energy demand reduction	0.2	11%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.9	52%
Cumulative on site savings	1.0	63%



Hierarchal Summary

The development is estimated to achieve an overall 63% reduction in regulated CO₂ emissions against the 2021 Building Regulations.



7.0 Summary of Proposals

The development will follow Gravesham Borough Council's Core Strategy.

The proposal is to construct the development to high thermal performance standards with fabric standards exceeding minimum current Building Regulation targets achieving an estimated 11% reduction in Regulated CO₂ emissions.

No district heat networks exist in proximity to the development site. Energy efficiency measures will however be introduced to supply energy more efficiently.

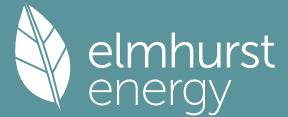
An ASHP is considered the most feasible renewable technology for the site and will provide an estimated 52% reduction in regulated CO₂ emissions against current Building Regulations.

The combined hierarchal measures will achieve a 63% reduction in site wide regulated CO₂ emissions against current 2021 Building Regulations.



Appendix A – Supporting SAP Worksheets

Full SAP Calculation Printout



Property Reference	24.3609 Vale Road			Issued on Date	06/09/2024
Assessment Reference	LEAN	Prop Type Ref			
Property	107, Vale Road, Gravesend, Kent, DA11 8DB				
SAP Rating	84 B	DER	12.41	TER	10.71
Environmental	88 B	% DER < TER			-15.87
CO ₂ Emissions (t/year)	1.66	DFEE	43.16	TFEE	45.42
Compliance Check	See BREL	% DFEE < TFEE			4.97
% DPER < TPER	-28.06	DPER	71.93	TPER	56.17
Assessor Details	Mr. Stuart Searle			Assessor ID	L603-0001
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)	
Ground floor	70.8000 (1b)	x	2.5000 (2b)	=	177.0000 (1b)	- (3b)
First floor	54.0000 (1c)	x	2.6200 (2c)	=	141.4800 (1c)	- (3c)
Second floor	30.6000 (1d)	x	1.7800 (2d)	=	54.4680 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.4000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	372.9480	(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	0 * 10 =	0.0000 (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) =	0.0000 / (5) =	0.0000 (8)	
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.2500 (18)	
Number of sides sheltered		4 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1750 (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	0.2231	0.2188	0.2144	0.1925	0.1881	0.1662	0.1662	0.1619	0.1750	0.1881	0.1969	0.2056	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												78.3000	(23c)
Effective ac	0.3316	0.3273	0.3229	0.3010	0.2966	0.2748	0.2748	0.2704	0.2835	0.2966	0.3054	0.3141	(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	
FED			3.5900	1.2000	4.3080			(26a)
Window (Uw = 1.20)			26.1200	1.1450	29.9084			(27)
RL1			1.7100	1.1450	1.9580			(27a)
RL2			0.5400	1.1450	0.6183			(27a)
Heatloss Floor 1			70.8000	0.1100	7.7880			(28a)
External Wall	195.0000	28.0000	167.0000	0.1800	30.0600			(29a)
Dormer	5.7000	1.7100	3.9900	0.1800	0.7182			(29a)
Ashlar	9.4000		9.4000	0.1800	1.6920			(29a)
Ins Ceiling	36.2000		36.2000	0.1000	3.6200			(30)
Flat	16.8000	1.7100	15.0900	0.1200	1.8108			(30)
Ins Rafter	22.0000	0.5400	21.4600	0.1400	3.0044			(30)
Total net area of external elements Aum(A, m ²)			355.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.4861			(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.6000	0.0200	0.3920
E3 Sill	17.8900	0.0300	0.5367
E4 Jamb	32.5000	0.3000	9.7500
E5 Ground floor (normal)	35.2400	0.0700	2.4668
R1 Head of roof window	0.6000	0.2400	0.1440
R2 Sill of roof window	0.6000	0.2400	0.1440
R3 Jamb of roof window	1.8000	0.2400	0.4320
R11 Upstands or kerbs of rooflights	5.5000	0.2400	1.3200
E6 Intermediate floor within a dwelling	42.3500	0.0010	0.0424
E10 Eaves (insulation at ceiling level)	9.4000	0.0700	0.6580
E24 Eaves (insulation at ceiling level - inverted)	15.7300	0.1500	2.3595
E11 Eaves (insulation at rafter level)	7.2300	0.0200	0.1446
E12 Gable (insulation at ceiling level)	4.0000	0.0500	0.2000
E15 Flat roof with parapet	17.7100	0.3000	5.3130
E16 Corner (normal)	37.2400	0.0500	1.8620
E17 Corner (inverted - internal area greater than external area)	7.9400	-0.0900	-0.7146
R7 Flat ceiling (inverted)	8.5400	0.1200	1.0248
R9 Roof to wall (flat ceiling)	5.7000	0.3200	1.8240

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

27.8991 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 113.3853 (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	40.8140	40.2756	39.7371	37.0449	36.5065	33.8143	33.8143	33.2758	34.8912	36.5065	37.5834	38.6603
Heat transfer coeff	154.1993	153.6609	153.1224	150.4302	149.8918	147.1995	147.1995	146.6611	148.2764	149.8918	150.9687	152.0455
Average = Sum(39)m / 12 =	150.2956											150.2956 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9923	0.9888	0.9853	0.9680	0.9646	0.9472	0.9472	0.9438	0.9542	0.9646	0.9715	0.9784
HLP (average)	0.9672											0.9672 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

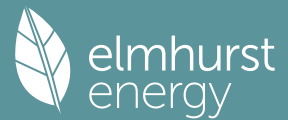
4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9423 (42)
Hot water usage for mixer showers	73.5530	72.4476	70.8369	67.7551	65.4807	62.9445	61.5028	63.1014	64.8536	67.5769	70.7249	73.2712 (42a)
Hot water usage for baths	31.7534	31.2818	30.6177	29.3933	28.4764	27.4598	26.9106	27.5701	28.2881	29.3759	30.6256	31.6461 (42b)
Hot water usage for other uses	44.7624	43.1346	41.5069	39.8792	38.2515	36.6237	36.6237	38.2515	39.8792	41.5069	43.1346	44.7624 (42c)
Average daily hot water use (litres/day)												137.9468 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	150.0687	146.8641	142.9615	137.0275	132.2086	127.0280	125.0372	128.9229	133.0209	138.4597	144.4851	149.6796 (44)
Energy content (annual)	237.6722	209.1325	219.7265	187.5838	177.9782	156.1957	151.2216	159.6335	164.0281	187.8885	205.8455	234.3620 (45)
Distribution loss (46)m = 0.15 x (45)m	35.6508	31.3699	32.9590	28.1376	26.6967	23.4294	22.6832	23.9450	24.6042	28.1833	30.8768	35.1543 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9180 (55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824 (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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2900.2342 (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	120.4023	106.9087	114.4354	102.4132	100.5541	91.9767	91.6575	94.4544	94.5809	103.8492	108.4852	119.3017 (65)

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

Metabolic gains (Table 5), Watts	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163
(66)m	167.3385	185.2676	167.3385	172.9164	167.3385	172.9164	167.3385	167.3385	172.9164	167.3385	172.9164	167.3385
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	326.3370	329.7233	321.1898	303.0230	280.0906	258.5374	244.1386	240.7522	249.2857	267.4526	290.3849	311.9381
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Pumps, fans	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930
Losses e.g. evaporation (negative values) (Table 5)	161.8311	159.0903	153.8110	142.2406	135.1533	127.7454	123.1956	126.9549	131.3624	139.5823	150.6739	160.3517
Water heating gains (Table 5)	725.6414	744.2161	712.4742	688.3149	652.7173	626.3341	601.8075	602.1805	620.6994	644.5082	684.1102	709.7632
Total internal gains	709.7632											709.7632 (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			
Northeast	15.0200				11.2829	0.5000	0.0000	0.7700	65.2459 (75)			
Southeast	2.9200				36.7938	0.5000	0.0000	0.7700	41.3636 (77)			
Southwest	7.4400				36.7938	0.5000	0.0000	0.7700	105.3923 (79)			
Northwest	0.7400				11.2829	0.5000	0.0000	0.7700	3.2145 (81)			
Northeast	1.7100				26.0000	0.5000	0.7000	1.0000	14.0049 (82)			
Northeast	0.5400				17.0692	0.5000	0.7000	1.0000	2.9035 (82)			
Solar gains	232.1246	424.4590	656.0510	935.9457	1158.4038	1197.8371	1134.9909	962.1176	752.0999	489.6020	283.3712	195.1702 (83)
Total gains	957.7660	1168.6751	1368.5251	1624.2606	1811.1211	1824.1712	1736.7984	1564.2981	1372.7994	1134.1102	967.4813	904.9334 (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	69.9852	70.2304	70.4774	71.7387	71.9964	73.3132	73.3132	73.5823	72.7807	71.9964	71.4828	70.9765
alpha	5.6657	5.6820	5.6985	5.7826	5.7998	5.8875	5.8875	5.9055	5.8520	5.7998	5.7655	5.7318
util living area	0.9977	0.9925	0.9747	0.8965	0.7230	0.5113	0.3722	0.4296	0.7061	0.9513	0.9938	0.9983 (86)
MIT	20.0826	20.2450	20.4728	20.7515	20.9012	20.9422	20.9466	20.9460	20.9181	20.6895	20.3382	20.0642 (87)
Th 2	20.0898	20.0927	20.0956	20.1101	20.1130	20.1275	20.1275	20.1305	20.1217	20.1130	20.1072	20.1014 (88)
util rest of house	0.9969	0.9901	0.9666	0.8681	0.6680	0.4439	0.2988	0.3493	0.6310	0.9313	0.9914	0.9978 (89)
MIT 2	19.0080	19.2173	19.5063	19.8514	20.0091	20.0572	20.0597	20.0625	20.0354	19.7903	19.3488	18.9938 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.2440	19.4431	19.7186	20.0492	20.2051	20.2516	20.2545	20.2566	20.2293	19.9878	19.5662	19.2290 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.2440	19.4431	19.7186	20.0492	20.2051	20.2516	20.2545	20.2566	20.2293	19.9878	19.5662	19.2290 (93)

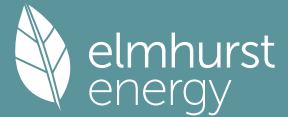
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9959	0.9878	0.9625	0.8659	0.6739	0.4536	0.3095	0.3610	0.6407	0.9278	0.9894	0.9970 (94)
Useful gains	953.8852	1154.4731	1317.1423	1406.4038	1220.5980	827.4513	537.5727	564.7259	879.6118	1052.2526	957.2258	902.2252 (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	2304.3600	2234.7047	2024.0653	1677.1733	1274.8389	831.9184	537.9468	565.6151	908.8291	1407.1584	1881.9985	2285.0858 (97)
Space heating kWh	1004.7533	725.9157	525.9507	194.9540	40.3552	0.0000	0.0000	0.0000	0.0000	264.0499	665.8363	1028.8483 (98a)
Space heating requirement - total per year (kWh/year)	4450.6633											
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	1004.7533	725.9157	525.9507	194.9540	40.3552	0.0000	0.0000	0.0000	0.0000	264.0499	665.8363	1028.8483 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4450.6633											
Space heating per m2	(98c) / (4) = 28.6400 (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 %)	88.8000 (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	1004.7533	725.9157	525.9507	194.9540	40.3552	0.0000	0.0000	0.0000	0.0000	264.0499	665.8363	1028.8483 (98)
Space heating efficiency (main heating system 1)	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000 (210)
Space heating fuel (main heating system)	1131.4789	817.4726	592.2868	219.5428	45.4450	0.0000	0.0000	0.0000	0.0000	297.3535	749.8157	1158.6129 (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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824 (64)
Efficiency of water heater	86.6156	86.2646	85.5168	83.6194	81.0272	79.8000	79.8000	79.8000	79.8000	84.2781	86.1040	79.8000 (216)
Fuel for water heating, kWh/month	334.1115	296.5848	317.4195	284.1875	283.4834	258.4558	254.3133	264.8545	268.2708	284.3074	297.1959	330.0700 (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	57.5407	51.9723	57.5407	55.6846	57.5407	55.6846	57.5407	57.5407	55.6846	57.5407	55.6846	57.5407 (231)
Lighting	45.6478	36.6204	32.9726	24.1571	18.6597	15.2451	17.0220	22.1258	28.7392	37.7074	42.5905	46.9165 (232)
Electricity generated by PVs (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 (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)	0.0000	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)	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)

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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													5012.0083	(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													3473.2545	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.3000)														
mechanical ventilation fans (SFP = 1.3000)													591.4955	(230a)
central heating pump													41.0000	(230c)
main heating flue fan													45.0000	(230e)
Total electricity for the above, kWh/year													677.4955	(231)
Electricity for lighting (calculated in Appendix L)													368.4043	(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													9531.1625	(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	5012.0083	0.2100	1052.5217	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3473.2545	0.2100	729.3834	(264)
Space and water heating			1781.9052	(265)
Pumps, fans and electric keep-hot	677.4955	0.1387	93.9770	(267)
Energy for lighting	368.4043	0.1443	53.1721	(268)
Total CO2, kg/year			1929.0543	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.4100	(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	5012.0083	1.1300	5663.5693	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3473.2545	1.1300	3924.7776	(278)
Space and water heating			9588.3469	(279)
Pumps, fans and electric keep-hot	677.4955	1.5128	1024.9152	(281)
Energy for lighting	368.4043	1.5338	565.0707	(282)
Total Primary energy kWh/year			11178.3329	(286)
Dwelling Primary energy Rate (DPER)			71.9300	(287)

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

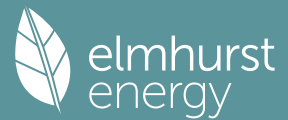
1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.8000 (1b)	x	2.5000 (2b)	=	177.0000 (1b) - (3b)	
First floor	54.0000 (1c)	x	2.6200 (2c)	=	141.4800 (1c) - (3c)	
Second floor	30.6000 (1d)	x	1.7800 (2d)	=	54.4680 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n)	155.4000				(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)... (3n) =	372.9480 (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) =	0.1073 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3573	(18)
Number of sides sheltered		4	(19)

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Shelter factor
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 0.7000 \quad (20)$$
$$(21) = (18) \times (20) = 0.2501 \quad (21)$$

	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	0.3188	0.3126	0.3063	0.2751	0.2688	0.2376	0.2376	0.2313	0.2501	0.2688	0.2813	0.2938	(22b)
Effective ac	0.5508	0.5489	0.5469	0.5378	0.5361	0.5282	0.5282	0.5268	0.5313	0.5361	0.5396	0.5432	(25)

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	
TER Semi-glazed door			3.5900	1.0000	3.5900			(26a)
TER Opening Type (Uw = 1.20)			26.1200	1.1450	29.9084			(27)
RL2			0.5400	1.5038	0.8120			(27a)
RL1			1.7100	2.0221	3.4577			(27a)
Heatloss Floor 1			70.8000	0.1300	9.2040			(28a)
External Wall	195.0000	28.0000	167.0000	0.1800	30.0600			(29a)
Dormer	5.7000	1.7100	3.9900	0.1800	0.7182			(29a)
Ashlar	9.4000		9.4000	0.1800	1.6920			(29a)
Ins Ceiling	36.2000		36.2000	0.1100	3.9820			(30)
Flat	16.8000	1.7100	15.0900	0.1100	1.6599			(30)
Ins Rafter	22.0000	0.5400	21.4600	0.1100	2.3606			(30)
Total net area of external elements Aum(A, m2)			355.9000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	87.4448		(33)

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

250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	19.6000	0.0500	0.9800
E2 Other lintels (including other steel lintels)	17.8900	0.0500	0.8945
E3 Sill	32.5000	0.0500	1.6250
E4 Jamb	35.2400	0.1600	5.6384
E5 Ground floor (normal)	0.6000	0.0800	0.0480
R1 Head of roof window	0.6000	0.0600	0.0360
R2 Sill of roof window	1.8000	0.0800	0.1440
R3 Jamb of roof window	5.5000	0.0800	0.4400
R11 Upstands or kerbs of rooflights	42.3500	0.0000	0.0000
E6 Intermediate floor within a dwelling	9.4000	0.0600	0.5640
E10 Eaves (insulation at ceiling level)	15.7300	0.2400	3.7752
E24 Eaves (insulation at ceiling level - inverted)	7.2300	0.0400	0.2892
E11 Eaves (insulation at rafter level)	4.0000	0.0600	0.2400
E12 Gable (insulation at ceiling level)	17.7100	0.5600	9.9176
E15 Flat roof with parapet	37.2400	0.0900	3.3516
E16 Corner (normal)	7.9400	-0.0900	-0.7146
E17 Corner (inverted - internal area greater than external area)	8.5400	0.0400	0.3416
R7 Flat ceiling (inverted)	5.7000	0.0400	0.2280
R9 Roof to wall (flat ceiling)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

27.7985 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 115.2433 (37)

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

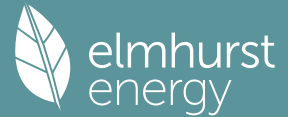
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.7925	67.5496	67.3114	66.1930	65.9837	65.0096	65.0096	64.8292	65.3848	65.9837	66.4071	66.8496	(38)
Heat transfer coeff	183.0358	182.7929	182.5548	181.4363	181.2271	180.2530	180.2530	180.0726	180.6282	181.2271	181.6504	182.0930	(39)
Average = Sum(39)m / 12 =												181.4353	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1778	1.1763	1.1747	1.1675	1.1662	1.1599	1.1599	1.1588	1.1623	1.1662	1.1689	1.1718	(40)
HLP (average)												1.1675	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9423 (42)
Hot water usage for mixer showers	73.5530	72.4476	70.8369	67.7551	65.4807	62.9445	61.5028	63.1014	64.8536	67.5769	70.7249	73.2712 (42a)
Hot water usage for baths	31.7534	31.2818	30.6177	29.3933	28.4764	27.4598	26.9106	27.5701	28.2881	29.3759	30.6256	31.6461 (42b)
Hot water usage for other uses	44.7624	43.1346	41.5069	39.8792	38.2515	36.6237	36.6237	38.2515	39.8792	41.5069	43.1346	44.7624 (42c)
Average daily hot water use (litres/day)												137.9468 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	150.0687	146.8641	142.9615	137.0275	132.2086	127.0280	125.0372	128.9229	133.0209	138.4597	144.4851	149.6796 (44)
Energy content (annual)	237.6722	209.1325	219.7265	187.5838	177.9782	156.1957	151.2216	159.6335	164.0281	187.8885	205.8455	234.3620 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2291.2682
	35.6508	31.3699	32.9590	28.1376	26.6967	23.4294	22.6832	23.9450	24.6042	28.1833	30.8768	35.1543 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9188 (55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (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	289.4188	255.8713	271.4731	237.6612	229.7248	206.2730	202.9682	211.3801	214.1054	239.6351	255.9229	286.1086 (62)
WWHRS	-33.6253	-29.7385	-31.1405	-25.7855	-24.0312	-20.5637	-19.2752	-20.4972	-21.2760	-25.0820	-28.4149	-33.0027 (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	255.7934	226.1328	240.3327	211.8756	205.6936	185.7094	183.6931	190.8829	192.8295	214.5531	227.5080	253.1060 (64)

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12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m =	2588.1099 (64)
Electric shower(s)													2588 (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 (64a)	0.0000 (64a)
Heat gains from water heating, kWh/month												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000 (64a)
	120.4233	106.9276	114.4563	102.4335	100.5750	91.9969	91.6785	94.4754	94.6012	103.8702	108.5055	119.3226 (65)	

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

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	167.3385	185.2676	167.3385	172.9164	167.3385	172.9164	167.3385	167.3385	172.9164	167.3385	172.9164	167.3385 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	326.3370	329.7233	321.1898	303.0230	280.0906	258.5374	244.1386	240.7522	249.2857	267.4526	290.3849	311.9381 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116 (69)
Pumps, fans												
	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)
Losses e.g. evaporation (negative values) (Table 5)												
	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930 (71)
Water heating gains (Table 5)												
	161.8592	159.1185	153.8392	142.2687	135.1815	127.7735	123.2237	126.9831	131.3906	139.6105	150.7021	160.3799 (72)
Total internal gains												
	725.6695	744.2443	712.5023	688.3430	652.7455	626.3623	601.8357	602.2086	620.7276	644.5364	684.1383	709.7914 (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					15.0200	11.2829		0.6300	0.7000	0.7700		51.7922 (75)				
Southeast					2.9200	36.7938		0.6300	0.7000	0.7700		32.8344 (77)				
Southwest					7.4400	36.7938		0.6300	0.7000	0.7700		83.6604 (79)				
Northwest					0.7400	11.2829		0.6300	0.7000	0.7700		2.5517 (81)				
Northeast					0.5400	17.0692		0.6300	0.7000	1.0000		3.6584 (82)				
Northeast					1.7100	26.0000		0.6300	0.7000	1.0000		17.6462 (82)				
Solar gains					192.1432	353.3114	550.1197	789.4905	979.8983	1014.1034	960.5765	812.7147	632.3633	408.7024	234.9403	161.2989 (83)
Total gains					917.8127	1097.5557	1262.6220	1477.8335	1632.6438	1640.4657	1562.4122	1414.9233	1253.0909	1053.2388	919.0786	871.0902 (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	58.9593	59.0377	59.1147	59.4791	59.5478	59.8696	59.8696	59.9295	59.7452	59.5478	59.4090	59.2646
alpha	4.9306	4.9358	4.9410	4.9653	4.9699	4.9913	4.9913	4.9953	4.9830	4.9699	4.9606	4.9510
util living area												
	0.9981	0.9952	0.9863	0.9494	0.8454	0.6623	0.4990	0.5680	0.8306	0.9747	0.9958	0.9986 (86)
MIT												
	19.5308	19.7294	20.0374	20.4552	20.7902	20.9537	20.9907	20.9830	20.8586	20.4098	19.8934	19.4957 (87)
Th 2												
	19.9378	19.9390	19.9403	19.9461	19.9471	19.9522	19.9522	19.9531	19.9502	19.9471	19.9449	19.9427 (88)
util rest of house												
	0.9975	0.9935	0.9814	0.9309	0.7937	0.5702	0.3847	0.4475	0.7549	0.9621	0.9940	0.9981 (89)
MIT 2												
	18.2233	18.4779	18.8701	19.3916	19.7717	19.9263	19.9493	19.9472	19.8524	19.3465	18.6926	18.1818 (90)
Living area fraction												
									fLA = Living area / (4) =			0.2197 (91)
MIT												
	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9908	0.9762	0.9239	0.7964	0.5888	0.4099	0.4739	0.7651	0.9561	0.9916	0.9970 (94)
Useful gains	914.3127	1087.4479	1232.6050	1365.3816	1300.2133	965.8434	640.3674	670.5487	958.6865	1007.0541	911.3195	868.5001 (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												
	2601.0381	2532.2025	2305.0426	1945.9495	1503.3614	1000.7673	644.9651	679.7301	1078.9722	1627.4319	2153.7184	2598.5496 (97)
Space heating kWh												
	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568 (98a)
Space heating requirement - total per year (kWh/year)												
												6236.0885
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												
	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
												6236.0885
Space heating per m2												
										(98c) / (4) =		40.1293 (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												
	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568 (98)
Space heating efficiency (main heating system 1)												

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Space heating fuel (main heating system)	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 efficiency (main heating system 2)	1359.6140	1051.8689	864.4567	452.8807	163.7510	0.0000	0.0000	0.0000	0.0000	500.0662	969.1520	1394.5361	(211)
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	(212)
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	(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	255.7934	226.1328	240.3327	211.8756	205.6936	185.7094	183.6931	190.8829	192.8295	214.5531	227.5080	253.1060	(64)
Efficiency of water heater (217)m	87.1360	86.9475	86.5407	85.5543	83.3794	79.8000	79.8000	79.8000	79.8000	85.7317	86.8147	79.8000	(216)
Fuel for water heating, kWh/month	293.5564	260.0798	277.7107	247.6503	246.6961	232.7185	230.1918	239.2016	241.6409	250.2610	262.0616	290.3117	(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	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	34.7696	27.8935	25.1150	18.4003	14.2129	11.6121	12.9655	16.8531	21.8905	28.7215	32.4408	35.7360	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-62.8387	-86.9039	-122.5259	-134.9711	-143.1249	-132.5991	-130.8044	-124.5591	-113.3349	-97.8860	-68.4175	-54.5143	(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)	-40.8265	-85.2141	-168.2065	-251.0326	-330.4807	-331.6601	-327.9009	-278.4190	-205.0232	-121.5003	-54.3749	-32.3488	(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												6756.3256	(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												3072.0804	(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)												280.6108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3499.4674	(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												6695.5494	(238)

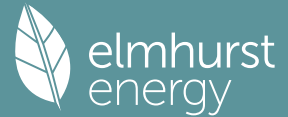
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6756.3256	0.2100	1418.8284	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3072.0804	0.2100	645.1369	(264)
Space and water heating			2063.9653	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	280.6108	0.1443	40.5008	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1272.4797	0.1350	-171.8252	
PV Unit electricity exported	-2226.9876	0.1261	-280.7663	
Total			-452.5915	(269)
Total CO2, kg/year			1663.8039	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7100	(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	6756.3256	1.1300	7634.6479	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3072.0804	1.1300	3471.4508	(278)
Space and water heating			11106.0988	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	280.6108	1.5338	430.4102	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1272.4797	1.4991	-1907.5483	
PV Unit electricity exported	-2226.9876	0.4628	-1030.6216	
Total			-2938.1698	(283)
Total Primary energy kWh/year			8728.4400	(286)
Target Primary Energy Rate (TPER)			56.1700	(287)

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Property Reference	24.3609 Vale Road				Issued on Date	06/09/2024	
Assessment Reference	GREEN			Prop Type Ref			
Property	107, Vale Road, Gravesend, Kent, DA11 8DB						
SAP Rating	80 C		DER	3.98		TER	10.71
Environmental	96 A		% DER < TER				62.84
CO ₂ Emissions (t/year)	0.55		DFEE	44.80		TFEE	45.42
Compliance Check	See BREL		% DFEE < TFEE				1.36
% DPER < TPER	25.65		DPER	41.76		TPER	56.17
Assessor Details	Mr. Stuart Searle					Assessor ID	L603-0001
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)	
Ground floor	70.8000 (1b)	x	2.5000 (2b)	=	177.0000 (1b)	- (3b)
First floor	54.0000 (1c)	x	2.6200 (2c)	=	141.4800 (1c)	- (3c)
Second floor	30.6000 (1d)	x	1.7800 (2d)	=	54.4680 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.4000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	372.9480	(5)

2. Ventilation rate

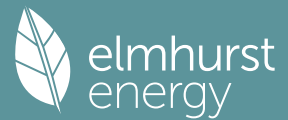
	m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (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) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.2000 (18)
Number of sides sheltered		4 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1400 (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	0.1785	0.1750	0.1715	0.1540	0.1505	0.1330	0.1330	0.1295	0.1400	0.1505	0.1575	0.1645	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												78.3000	(23c)
Effective ac	0.2870	0.2835	0.2800	0.2625	0.2590	0.2415	0.2415	0.2380	0.2485	0.2590	0.2660	0.2730	(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	
FED			3.5900	1.2000	4.3080			(26a)
Window (Uw = 1.20)			26.1200	1.1450	29.9084			(27)
RL1			1.7100	1.1450	1.9580			(27a)
RL2			0.5400	1.1450	0.6183			(27a)
Heatloss Floor 1			70.8000	0.1100	7.7880			(28a)
External Wall	195.0000	28.0000	167.0000	0.1800	30.0600			(29a)
Dormer	5.7000	1.7100	3.9900	0.1800	0.7182			(29a)
Ashlar	9.4000		9.4000	0.1800	1.6920			(29a)
Ins Ceiling	36.2000		36.2000	0.1000	3.6200			(30)
Flat	16.8000	1.7100	15.0900	0.1200	1.8108			(30)
Ins Rafter	22.0000	0.5400	21.4600	0.1400	3.0044			(30)
Total net area of external elements Aum(A, m ²)			355.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.4861			(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.6000	0.0200	0.3920
E3 Sill	17.8900	0.0300	0.5367
E4 Jamb	32.5000	0.3000	9.7500
E5 Ground floor (normal)	35.2400	0.0700	2.4668
R1 Head of roof window	0.6000	0.2400	0.1440
R2 Sill of roof window	0.6000	0.2400	0.1440
R3 Jamb of roof window	1.8000	0.2400	0.4320
R11 Upstands or kerbs of rooflights	5.5000	0.2400	1.3200
E6 Intermediate floor within a dwelling	42.3500	0.0100	0.4235
E10 Eaves (insulation at ceiling level)	9.4000	0.0700	0.6580
E24 Eaves (insulation at ceiling level - inverted)	15.7300	0.1500	2.3595
E11 Eaves (insulation at rafter level)	7.2300	0.0200	0.1446
E12 Gable (insulation at ceiling level)	4.0000	0.0500	0.2000
E15 Flat roof with parapet	17.7100	0.3000	5.3130
E16 Corner (normal)	37.2400	0.0500	1.8620
E17 Corner (inverted - internal area greater than external area)	7.9400	-0.0900	-0.7146
R7 Flat ceiling (inverted)	8.5400	0.1200	1.0248
R9 Roof to wall (flat ceiling)	5.7000	0.3200	1.8240

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

28.2803 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 113.7664 (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	35.3219	34.8912	34.4604	32.3066	31.8759	29.7221	29.7221	29.2913	30.5836	31.8759	32.7374	33.5989
Heat transfer coeff	149.0883	148.6576	148.2268	146.0731	145.6423	143.4885	143.4885	143.0578	144.3500	145.6423	146.5038	147.3653
Average = Sum(39)m / 12 =						143.4885	143.4885	143.0578	144.3500	145.6423	146.5038	147.3653

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9594	0.9566	0.9538	0.9400	0.9372	0.9233	0.9233	0.9206	0.9289	0.9372	0.9428	0.9483
HLP (average)												0.9393
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

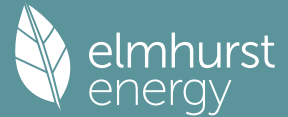
4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9423 (42)
Hot water usage for mixer showers	73.5530	72.4476	70.8369	67.7551	65.4807	62.9445	61.5028	63.1014	64.8536	67.5769	70.7249	73.2712	(42a)
Hot water usage for baths	31.7534	31.2818	30.6177	29.3933	28.4764	27.4598	26.9106	27.5701	28.2881	29.3759	30.6256	31.6461	(42b)
Hot water usage for other uses	44.7624	43.1346	41.5069	39.8792	38.2515	36.6237	36.6237	38.2515	39.8792	41.5069	43.1346	44.7624	(42c)
Average daily hot water use (litres/day)													137.9468 (43)
Daily hot water use	150.0687	146.8641	142.9615	137.0275	132.2086	127.0280	125.0372	128.9229	133.0209	138.4597	144.4851	149.6796	(44)
Energy conte	237.6722	209.1325	219.7265	187.5838	177.9782	156.1957	151.2216	159.6335	164.0281	187.8885	205.8455	234.3620	(45)
Energy content (annual)										Total = Sum(45)m =		2291.2682	
Distribution loss (46)m = 0.15 x (45)m	35.6508	31.3699	32.9590	28.1376	26.6967	23.4294	22.6832	23.9450	24.6042	28.1833	30.8768	35.1543	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9180 (55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824	(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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2900.2342	(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)
													0.0000 (64a)
Heat gains from water heating, kWh/month	120.4023	106.9087	114.4354	102.4132	100.5541	91.9767	91.6575	94.4544	94.5809	103.8492	108.4852	119.3017	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.3385	185.2676	167.3385	172.9164	167.3385	172.9164	167.3385	167.3385	172.9164	167.3385	172.9164	167.3385	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	326.3370	329.7233	321.1898	303.0230	280.0906	258.5374	244.1386	240.7522	249.2857	267.4526	290.3849	311.9381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	(69)
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	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	(71)
Water heating gains (Table 5)	161.8311	159.0903	153.8110	142.2406	135.1533	127.7454	123.1956	126.9549	131.3624	139.5823	150.6739	160.3517	(72)
Total internal gains	722.6414	741.2161	709.4742	685.3149	649.7173	626.3341	601.8075	602.1805	620.6994	641.5082	681.1102	706.7632	(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			
Northeast	15.0200				11.2829	0.4000	0.0000	0.7700	52.1967 (75)			
Southeast	2.9200				36.7938	0.4000	0.0000	0.7700	33.0909 (77)			
Southwest	7.4400				36.7938	0.4000	0.0000	0.7700	84.3138 (79)			
Northwest	0.7400				11.2829	0.4000	0.0000	0.7700	2.5716 (81)			
Northeast	1.7100				26.0000	0.4000	0.7000	1.0000	11.2039 (82)			
Northeast	0.5400				17.0692	0.4000	0.7000	1.0000	2.3228 (82)			
Solar gains	185.6997	339.5672	524.8408	748.7566	926.7231	958.2697	907.9927	769.6941	601.6800	391.6816	226.6969	156.1362 (83)
Total gains	908.3411	1080.7833	1234.3149	1434.0715	1576.4403	1584.6038	1509.8002	1371.8745	1222.3794	1033.1898	907.8071	862.8994 (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	72.3844	72.5941	72.8051	73.8786	74.0971	75.2093	75.2093	75.4357	74.7604	74.0971	73.6613	73.2307
alpha	5.8256	5.8396	5.8537	5.9252	5.9398	6.0140	6.0140	6.0290	5.9840	5.9398	5.9108	5.8820
util living area	0.9982	0.9947	0.9831	0.9285	0.7838	0.5702	0.4169	0.4767	0.7566	0.9648	0.9953	0.9987 (86)
Living	20.0983	20.2399	20.4449	20.7131	20.8837	20.9404	20.9473	20.9463	20.9097	20.6690	20.3384	20.0804
Non living	19.0504	19.2331	19.4944	19.8311	20.0172	20.0771	20.0811	20.0832	20.0511	19.7871	19.3690	19.0350
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	20.5387	20.2399	20.4449	20.7131	20.8837	20.9404	20.9473	20.9463	20.9097	20.6690	20.3384	20.2090 (87)
Th 2	20.1173	20.1196	20.1220	20.1336	20.1360	20.1477	20.1477	20.1500	20.1430	20.1360	20.1313	20.1266 (88)
util rest of house	0.9976	0.9930	0.9774	0.9065	0.7318	0.4983	0.3368	0.3902	0.6836	0.9493	0.9935	0.9982 (89)
MIT 2	19.6920	19.2331	19.4944	19.8311	20.0172	20.0771	20.0811	20.0832	20.0511	19.7871	19.3690	19.2317 (90)
Living area fraction									fLA = Living area / (4) =			0.2197 (91)
MIT	19.8780	19.4543	19.7032	20.0248	20.2075	20.2667	20.2714	20.2728	20.2397	19.9809	19.5820	19.4464 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8780	19.4543	19.7032	20.0248	20.2075	20.2667	20.2714	20.2728	20.2397	19.9809	19.5820	19.4464 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9974	0.9912	0.9740	0.9033	0.7364	0.5086	0.3485	0.4028	0.6925	0.9458	0.9919	0.9978 (94)
Useful gains	906.0057	1071.3075	1202.2624	1295.3676	1160.9365	805.8825	526.1961	552.6357	846.4758	977.2377	900.4652	860.9873 (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	2322.4951	2163.6005	1957.0732	1625.0405	1239.0577	813.1092	526.8065	554.0338	886.2709	1366.2514	1828.6580	2246.7969 (97)
Space heating kWh	1053.8681	734.0209	561.5792	237.3645	58.1221	0.0000	0.0000	0.0000	0.0000	289.4261	668.2988	1031.0423 (98a)
Space heating requirement - total per year (kWh/year)												4633.7223
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	1053.8681	734.0209	561.5792	237.3645	58.1221	0.0000	0.0000	0.0000	0.0000	289.4261	668.2988	1031.0423 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4633.7223
Space heating per m2										(98c) / (4) =		29.8180 (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 %)												274.9189 (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	1053.8681	734.0209	561.5792	237.3645	58.1221	0.0000	0.0000	0.0000	0.0000	289.4261	668.2988	1031.0423 (98)
Space heating efficiency (main heating system 1)	274.9189	274.9189	274.9189	274.9189	274.9189	0.0000	0.0000	0.0000	0.0000	274.9189	274.9189	274.9189 (210)
Space heating fuel (main heating system)	383.3379	266.9955	204.2709	86.3398	21.1416	0.0000	0.0000	0.0000	0.0000	105.2769	243.0895	375.0351 (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	289.3926	255.8477	271.4469	237.6358	229.6986	206.2477	202.9420	211.3539	214.0801	239.6089	255.8975	286.0824 (64)
Efficiency of water heater (217)m	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078	186.3078 (217)
Fuel for water heating, kWh/month	155.3303	137.3252	145.6981	127.5501	123.2898	110.7026	108.9283	113.4434	114.9066	128.6091	137.3520	153.5536 (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	50.2366	45.3750	50.2366	48.6161	50.2366	48.6161	50.2366	50.2366	48.6161	50.2366	48.6161	50.2366 (231)
Lighting	45.6478	36.6204	32.9726	24.1571	18.6597	15.2451	17.0220	22.1258	28.7392	37.7074	42.5905	46.9165 (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)												

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(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												1685.4872	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												186.3078	
Water heating fuel used												1556.6893	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.3000)													
mechanical ventilation fans (SFP = 1.3000)												591.4955	(230a)
Total electricity for the above, kWh/year												591.4955	(231)
Electricity for lighting (calculated in Appendix L)												368.4043	(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												4202.0763	(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	1685.4872	0.1565	263.7490	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1556.6893	0.1410	219.4565	(264)
Space and water heating			483.2055	(265)
Pumps, fans and electric keep-hot	591.4955	0.1387	82.0477	(267)
Energy for lighting	368.4043	0.1443	53.1721	(268)
Total CO2, kg/year			618.4253	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.9800	(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	1685.4872	1.5793	2661.8916	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1556.6893	1.5213	2368.1657	(278)
Space and water heating			5030.0573	(279)
Pumps, fans and electric keep-hot	591.4955	1.5128	894.8144	(281)
Energy for lighting	368.4043	1.5338	565.0707	(282)
Total Primary energy kWh/year			6489.9425	(286)
Dwelling Primary energy Rate (DPER)			41.7600	(287)

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

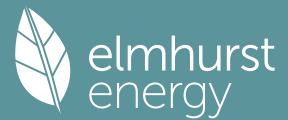
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	70.8000 (1b)	x 2.5000 (2b)	= 177.0000 (1b) - (3b)	
First floor	54.0000 (1c)	x 2.6200 (2c)	= 141.4800 (1c) - (3c)	
Second floor	30.6000 (1d)	x 1.7800 (2d)	= 54.4680 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.4000		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 372.9480 (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)	
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1073 (8)	
Pressure test	Yes	
Pressure Test Method	Blower Door	

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Measured/design AP50 5.0000 (17)
Infiltration rate 0.3573 (18)
Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7000 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2501 (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	0.3188	0.3126	0.3063	0.2751	0.2688	0.2376	0.2376	0.2313	0.2501	0.2688	0.2813	0.2938 (22b)
	0.5508	0.5489	0.5469	0.5378	0.5361	0.5282	0.5282	0.5268	0.5313	0.5361	0.5396	0.5432 (25)

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
TER Semi-glazed door			3.5900	1.0000	3.5900		(26a)
TER Opening Type (Uw = 1.20)			26.1200	1.1450	29.9084		(27)
RL2			0.5400	1.5038	0.8120		(27a)
RL1			1.7100	2.0221	3.4577		(27a)
Heatloss Floor 1			70.8000	0.1300	9.2040		(28a)
External Wall	195.0000	28.0000	167.0000	0.1800	30.0600		(29a)
Dormer	5.7000	1.7100	3.9900	0.1800	0.7182		(29a)
Ashlar	9.4000		9.4000	0.1800	1.6920		(29a)
Ins Ceiling	36.2000		36.2000	0.1100	3.9820		(30)
Flat	16.8000	1.7100	15.0900	0.1100	1.6599		(30)
Ins Rafter	22.0000	0.5400	21.4600	0.1100	2.3606		(30)
Total net area of external elements Aum(A, m2)			355.9000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 87.4448		(33)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.6000	0.0500	0.9800
E3 Sill	17.8900	0.0500	0.8945
E4 Jamb	32.5000	0.0500	1.6250
E5 Ground floor (normal)	35.2400	0.1600	5.6384
R1 Head of roof window	0.6000	0.0800	0.0480
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.8000	0.0800	0.1440
R11 Upstands or kerbs of rooflights	5.5000	0.0800	0.4400
E6 Intermediate floor within a dwelling	42.3500	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	9.4000	0.0600	0.5640
E24 Eaves (insulation at ceiling level - inverted)	15.7300	0.2400	3.7752
E11 Eaves (insulation at rafter level)	7.2300	0.0400	0.2892
E12 Gable (insulation at ceiling level)	4.0000	0.0600	0.2400
E15 Flat roof with parapet	17.7100	0.5600	9.9176
E16 Corner (normal)	37.2400	0.0900	3.3516
E17 Corner (inverted - internal area greater than external area)	7.9400	-0.0900	-0.7146
R7 Flat ceiling (inverted)	8.5400	0.0400	0.3416
R9 Roof to wall (flat ceiling)	5.7000	0.0400	0.2280

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

Point Thermal bridges

Total fabric heat loss

(36a) = 0.0000
(33) + (36) + (36a) = 115.2433 (37)

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

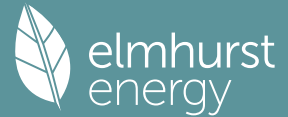
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	67.7925	67.5496	67.3114	66.1930	65.9837	65.0096	65.0096	64.8292	65.3848	65.9837	66.4071	66.8496 (38)
Average = Sum(39)m / 12 =	183.0358	182.7929	182.5548	181.4363	181.2271	180.2530	180.2530	180.0726	180.6282	181.2271	181.6504	182.0930 (39)
												181.4353

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1778	1.1763	1.1747	1.1675	1.1662	1.1599	1.1599	1.1588	1.1623	1.1662	1.1689	1.1718 (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													2.9423 (42)
Hot water usage for mixer showers	73.5530	72.4476	70.8369	67.7551	65.4807	62.9445	61.5028	63.1014	64.8536	67.5769	70.7249	73.2712 (42a)	
Hot water usage for baths	31.7534	31.2818	30.6177	29.3933	28.4764	27.4598	26.9106	27.5701	28.2881	29.3759	30.6256	31.6461 (42b)	
Hot water usage for other uses	44.7624	43.1346	41.5069	39.8792	38.2515	36.6237	36.6237	38.2515	39.8792	41.5069	43.1346	44.7624 (42c)	
Average daily hot water use (litres/day)												137.9468 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.0687	146.8641	142.9615	137.0275	132.2086	127.0280	125.0372	128.9229	133.0209	138.4597	144.4851	149.6796 (44)	
Energy content (annual)	237.6722	209.1325	219.7265	187.5838	177.9782	156.1957	151.2216	159.6335	164.0281	187.8885	205.8455	234.3620 (45)	
Distribution loss (46)m = 0.15 x (45)m	35.6508	31.3699	32.9590	28.1376	26.6967	23.4294	22.6832	23.9450	24.6042	28.1833	30.8768	35.1543 (46)	
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.9188 (55)	
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)	
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (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	289.4188	255.8713	271.4731	237.6612	229.7248	206.2730	202.9682	211.3801	214.1054	239.6351	255.9229	286.1086 (62)	
WWHRS	-33.6253	-29.7385	-31.1405	-25.7855	-24.0312	-20.5637	-19.2752	-20.4972	-21.2760	-25.0820	-28.4149	-33.0027 (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)	

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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	255.7934	226.1328	240.3327	211.8756	205.6936	185.7094	183.6931	190.8829	192.8295	214.5531	227.5080	253.1060 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2588.1099 (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	120.4233	106.9276	114.4563	102.4335	100.5750	91.9969	91.6785	94.4754	94.6012	103.8702	108.5055	119.3226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	147.1163	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.3385	185.2676	167.3385	172.9164	167.3385	172.9164	167.3385	167.3385	172.9164	167.3385	172.9164	167.3385	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	326.3370	329.7233	321.1898	303.0230	280.0906	258.5374	244.1386	240.7522	249.2857	267.4526	290.3849	311.9381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	37.7116	(69)
Pumps, fans	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)
Losses e.g. evaporation (negative values) (Table 5)	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	-117.6930	(71)
Water heating gains (Table 5)	161.8592	159.1185	153.8392	142.2687	135.1815	127.7735	123.2237	126.9831	131.3906	139.6105	150.7021	160.3799	(72)
Total internal gains	725.6695	744.2443	712.5023	688.3430	652.7455	626.3623	601.8357	602.2086	620.7276	644.5364	684.1383	709.7914	(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	15.0200	11.2829	0.6300	0.7000	0.7700	51.7922 (75)
Southeast	2.9200	36.7938	0.6300	0.7000	0.7700	32.8344 (77)
Southwest	7.4400	36.7938	0.6300	0.7000	0.7700	83.6604 (79)
Northwest	0.7400	11.2829	0.6300	0.7000	0.7700	2.5517 (81)
Northeast	0.5400	17.0692	0.6300	0.7000	1.0000	3.6584 (82)
Northeast	1.7100	26.0000	0.6300	0.7000	1.0000	17.6462 (82)

Solar gains	192.1432	353.3114	550.1197	789.4905	979.8983	1014.1034	960.5765	812.7147	632.3633	408.7024	234.9403	161.2989 (83)
Total gains	917.8127	1097.5557	1262.6220	1477.8335	1632.6438	1640.4657	1562.4122	1414.9233	1253.0909	1053.2388	919.0786	871.0902 (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	58.9593	59.0377	59.1147	59.4791	59.5478	59.8696	59.8696	59.9295	59.7452	59.5478	59.4090	59.2646
alpha	4.9306	4.9358	4.9410	4.9653	4.9699	4.9913	4.9913	4.9953	4.9830	4.9699	4.9606	4.9510
util living area	0.9981	0.9952	0.9863	0.9494	0.8454	0.6623	0.4990	0.5680	0.8306	0.9747	0.9958	0.9986 (86)
MIT	19.5308	19.7294	20.0374	20.4552	20.7902	20.9537	20.9907	20.9830	20.8586	20.4098	19.8934	19.4957 (87)
Th 2	19.9378	19.9390	19.9403	19.9461	19.9471	19.9522	19.9522	19.9531	19.9502	19.9471	19.9449	19.9427 (88)
util rest of house	0.9975	0.9935	0.9814	0.9309	0.7937	0.5702	0.3847	0.4475	0.7549	0.9621	0.9940	0.9981 (89)
MIT 2	18.2233	18.4779	18.8701	19.3916	19.7717	19.9263	19.9493	19.9472	19.8524	19.3465	18.6926	18.1818 (90)
Living area fraction	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (91)
MIT	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (92)
Temperature adjustment	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (93)
adjusted MIT	18.5105	18.7528	19.1266	19.6252	19.9955	20.1520	20.1781	20.1748	20.0734	19.5801	18.9564	18.4705 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9962	0.9908	0.9762	0.9239	0.7964	0.5888	0.4099	0.4739	0.7651	0.9561	0.9916	0.9970 (94)
Useful gains	914.3127	1087.4479	1232.6050	1365.3816	1300.2133	965.8434	640.3674	670.5487	958.6865	1007.0541	911.3195	868.5001 (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	2601.0381	2532.2025	2305.0426	1945.9495	1503.3614	1000.7673	644.9651	679.7301	1078.9722	1627.4319	2153.7184	2598.5496 (97)
Space heating kWh	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568 (98a)
Space heating requirement - total per year (kWh/year)												6236.0885
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	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6236.0885
Space heating per m2												(98c) / (4) = 40.1293 (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	

Full SAP Calculation Printout



Space heating requirement	1254.9237	970.8750	797.8935	418.0089	151.1422	0.0000	0.0000	0.0000	0.0000	461.5611	894.5273	1287.1568	(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)	1359.6140	1051.8689	864.4567	452.8807	163.7510	0.0000	0.0000	0.0000	0.0000	500.0662	969.1520	1394.5361	(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	255.7934	226.1328	240.3327	211.8756	205.6936	185.7094	183.6931	190.8829	192.8295	214.5531	227.5080	253.1060	(64)
Efficiency of water heater	87.1360	86.9475	86.5407	85.5543	83.3794	79.8000	79.8000	79.8000	79.8000	85.7317	86.8147	87.1842	(216)
Fuel for water heating, kWh/month	293.5564	260.0798	277.7107	247.6503	246.6961	232.7185	230.1918	239.2016	241.6409	250.2610	262.0616	290.3117	(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	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	34.7696	27.8935	25.1150	18.4003	14.2129	11.6121	12.9655	16.8531	21.8905	28.7215	32.4408	35.7360	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-62.8387	-86.9039	-122.5259	-134.9711	-143.1249	-132.5991	-130.8044	-124.5591	-113.3349	-97.8860	-68.4175	-54.5143	(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)	-40.8265	-85.2141	-168.2065	-251.0326	-330.4807	-331.6601	-327.9009	-278.4190	-205.0232	-121.5003	-54.3749	-32.3488	(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												6756.3256	(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												3072.0804	(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)												280.6108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3499.4674	(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												6695.5494	(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	6756.3256	0.2100	1418.8284 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3072.0804	0.2100	645.1369 (264)
Space and water heating			2063.9653 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	280.6108	0.1443	40.5008 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1272.4797	0.1350	-171.8252
PV Unit electricity exported	-2226.9876	0.1261	-280.7663
Total			-452.5915 (269)
Total CO2, kg/year			1663.8039 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7100 (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	6756.3256	1.1300	7634.6479 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3072.0804	1.1300	3471.4508 (278)
Space and water heating			11106.0988 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	280.6108	1.5338	430.4102 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1272.4797	1.4991	-1907.5483
PV Unit electricity exported	-2226.9876	0.4628	-1030.6216
Total			-2938.1698 (283)
Total Primary energy kWh/year			8728.4400 (286)
Target Primary Energy Rate (TPER)			56.1700 (287)



Consult Sustainability

www.consultsustainability.co.uk

info@consultsustainability.co.uk

01689 497 852

Elm Mews,
55 Elmcroft Road,
Orpington
BR6 0HZ